ELECTRONICS AND COMMUNICATION ENGINEERING

LIST OF NEW COURSES (2020)

S.No	Course Code	Course Name	Credits (L:T:P:C)
1.	17EC2070	Linear and Digital IC	0:0:4:2
2.	19EC2004	CAD for electronics Engineers	3:0:0:3
3.	19EC2005	Fiber Optic Communication	3:0:0:3
4.	19EC2006	Advanced Microprocessor Architecture	3:0:0:3
5.	19EC2007	Embedded System Design	3:0:0:3
6.	19EC2008	ARM Processors	3:0:0:3
7.	19EC2009	Telecommunication Switching Networks	3:0:0:3
8.	19EC2010	IoT for Communication Engineering	3:0:0:3
9.	19EC2011	High Speed Networks	3:0:0:3
10.	19EC2012	Wireless Sensor Networks	3:0:0:3
11.	19EC2013	Optoelectronics	3:0:0:3
12.	19EC2014	Basics of Satellite Communication	3:0:0:3
13.	19EC2015	Principles of Digital Image Processing	3:0:0:3
14.	19EC2016	Multimedia Compression Techniques	3:0:0:3
15.	19EC2017	Information Theory and Coding	3:0:0:3
16.	19EC2018	System Verilog for Functional Verification	3:0:0:3
17.	19EC2019	ASIC design	3:0:0:3
18.	19EC2020	Analysis and Design of Digital IC	3:0:0:3
19.	19EC2021	Low power techniques in VLSI design	3:0:0:3
20.	19EC2022	Nanoelectronics	3:0:0:3
21.	19EC2023	RF Integrated Circuit Design	3:0:0:3
22.	19EC2024	Machine Learning Techniques	3:0:0:3
23.	19EC2025	Semiconductor Device Modelling	3:0:0:3
24.	19EC2026	Micro Electro Mechanical Systems	3:0:0:3
25.	19EC2027	MATLAB programming for Engineers	3:0:0:3
26.	19EC2028	Fundamentals of Wireless Communication	3:0:0:3
27.	19EC2029	Data Science and Data analytics	3:0:0:3
28.	19EC2030	Cloud Computing	3:0:0:3
29.	19EC2031	IoT Edge Computing	3:0:0:3
30.	19EC2032	Communication Quality of Service	3:0:0:3
31.	19EC2033	Cryptography and Network security	3:0:0:3
32.	19EC2034	Fundamentals of Hardware IP protection	3:0:0:3
33.	19EC2035	Fault Tolerant architectures for hardware security	3:0:0:3
34.	19EC2036	Neural networks and Deep learning	3:0:0:3
35.	19EC2037	Real Time Operating System	3:0:0:3
36.	19EC2038	IoT based data acquisition systems and protocols	3:0:0:3
37.	19EC2039	Augmented reality	3:0:0:3
38.	19EC2040	Internet of Intelligent Things	3:0:0:3
39.	19EC2041	Cellular Mobile Computing	3:0:0:3
40.	19EC2042	Wearable and Implantable devices	3:0:0:3
41.	19EC2043	Testing of VLSI circuits	3:0:0:3
42.	19EC2044	Electromagnetic interference and Compatibility	3:0:0:3
43.	19EC2045	SoC Design	3:0:0:3
44.	19EC2046	Speech Processing	3:0:0:3
45.	19EC2047	Fundamentals of Electronics	3:0:0:3
46.	19EC2048	Communication Engineering	3:0:0:3
47.	19EC2049	MATLAB Programming	3:0:0:3
48.	19EC2050	Sensors for IoT Applications	3:0:0:3

49.	19EC2051	Microprocessor and Interfacing Techniques	3:0:0:3
50.	19EC2052	Digital System Design using HDL	3:0:0:3
51.	19EC2053	FPGA implementation of Digital Circuits	3:0:0:3
52.	19EC2054	Fundamentals of MEMS	3:0:0:3
53.	19EC2055	PCB design and Fabrication	3:0:0:3
54.	19EC2056	Electronics for Biotechnology	3:0:0:3
55.	19EC2057	Artificial Neural Networks	3:0:0:3
56.	19EC2058	Signal Processing Techniques	3:0:0:3
57.	19EC2059	Fundamentals of Satellite Communication	3:0:0:3
58.	19EC2060	Antennas for Biomedical Applications	3:0:0:3
59.	19EC2061	Embedded Systems	3:0:0:3
60.	19EC2062	Internet of Things for Mechanical systems	3:0:0:3
61.	19EC2063	Sensor Technology for Mechanical Systems	3:0:0:3
62.	20EC1001	Python Programming	2:0:0:2
63.	20EC1002	R Programming	2:0:0:2
64.	20EC1003	Programming for Problem Solving with C	3:0:0:3
65.	20EC1004	C Programming Laboratory	0:0:2:1
66.	20EC1005	Electronics For Intelligent Machines Laboratory	0:0:2:1
67.	20EC2001	Electronic Measurement Laboratory	0:0:2:1
68.	20EC2002	Electronic Devices	3:0:0:3
69.	20EC2003	Signals and Systems	2:1:0:3
70.	20EC2004	Computer Architecture	3:0:0:3
71.	20EC2005	IoT For Communication Engineering	3:0:0:3
72.	20EC2006	IoT For Communication Engineering Laboratory	0:0:2:1
73.	20EC2007	ARM Processor Laboratory	0:0:2:1
74.	20EC2008	5G Communications	3:0:0:3
75.	20EC2009	Artificial Neural Networks and Deep Learning	2:0:0:2
76.	20EC2010	VLSI for IoT Systems	3:0:0:3
77.	20EC2011	Software Defined Radio Laboratory	0:0:2:1
78.	20EC2012	Electomagnetics and Radiation Laboratory	0:0:2:1
79.	20EC2013	Fundamentals of Electrical and Electronics Laboratory	0:0:2:1
80.	20EC2014	Basic Electronics for Aerospace Engineers	3:0:0:3
81.	20EC2015	Electrical and Electronics in Civil Engineering	2:0:0:2
82.	20EC2016	Building Automation Systems Laboratory	0:0:2:1
83.	20EC2017	Media Laboratory	0:0:2:1
84.	20EC2018	Fundamentals of Printed Circuit and Arduino Board Design	3:0:0:3
85.	20EC2019	Fundamentals of Printed Circuit and Arduino Board Design Labaratory	0:0:2:1
86.	20EC3001	Digital System Design using HDL	3:0:0:3
87.	20EC3002	Low Power VLSI Design	3:0:0:3
88.	20EC3003	Analog VLSI Design	3:0:0:3
89.	20EC3004	Solar Cells and Their Applications	3:0:0:3
90.	20EC3005	VLSI Interconnects and Their Design Techniques	3:0:0:3
91.	20EC3006	VLSI Signal Processing	3:0:0:3
92.	20EC3007	Bio Mems	3:0:0:3
93.	20EC3008	ASIC Design	3:0:0:3
94.	20EC3009	Modern Radar Systems	3:0:0:3
95.	20EC3010	Advanced Software Defined Radio Lab	0:0:4:2
96.	14EC2057	Digital Image Processing	3:0:0:3

17EC2070	LINEAR AND DIGITAL IC LAB	L T P C 0 0 4 2

Co-requisite: 17EC2001 Digital Electronics
17EC2015 Linear Integrated Circuits

Course Objectives:

1. To acquire the basic knowledge of operational amplifier IC741.
2. To enable the students to design op-amp applications.
3. To get hands on experience in building combinational and sequential logic circuits.

Course Outcomes:

The Student will be able to

1. Portray the operation of basic operational amplifier.
2. Design oscillators and multivibrators for a given frequency using IC741& IC555.
3. Analyze the behavior of a filter circuit and ADC/DAC circuit using IC741
4. Prove the truth table of combinational logic circuits with the help of digital ICs.
5. Apply the design procedures to design basic sequential circuits.
6. Design and implement realtime applications of combinational and sequential circuits.

List of Experiments

1. Design of Inverting and Non-Inverting Amplifiers using IC 741
2. Astable and Monostable Multivibrator using IC 741
3. Design of RC Phase Shift Oscillator using IC 741
4. Design of Wein Bridge Oscillator using IC 741
5. Design of Filter (Low Pass/High Pass/Butterworth) using IC 741
6. Design of Analog to Digital Converter and Digital to Analog Converter using IC 741
7. Design of Astable Multivibrator using IC 555 Timer
8. Design of Schmitt Trigger using IC 555 Timer
9. Design of Full Adder and Full Subtractor
10. Design of Multiplexer and Demultiplexer
11. Design of Decoder and Encoder
12. Design of Code Converter
13. Design of Shift Registers
14. Design of BCD Counters
15. Design of Light Sensor switch circuit using LDR and IC 741

19EC2004	CAD FOR ELECTRONICS ENGINEERS	L T P C 3 0 0 3

Course Objective:

1. To provide an introduction to the fundamentals of Computer-Aided Design tools for the modelling, design, Analysis, test, and verification of digital systems, Xilinx, LabVIEW, and advanced MATLAB.
2. To design, code, and test programs that meet requirements expressed by engineers. This includes a basic Understanding of top-down design.
3. To illustrate the role of computer programming in solving engineering problems.

Course Outcomes:

The Student will be able to

1. Develop working skills with GUI in MATLAB, and Learning advanced features in MATLAB
2. Do graphical code that can solve the engineering problems – LabVIEW
3. Familiarize with XILINX tool and be able to programme in all levels of modelling.
4. Acquire basic knowledge of Python programming concepts and to equip them to write robust codes to solve complex problems.
5. Develop codes with advanced features of MATLAB tool.
6. Built Schematics using Lab VIEW for measurement, data acquisition and control.

Module 1: NI LabVIEW (8 hrs)

Introduction to LabVIEW - Modular Programming – Repetition and Loops – Arrays – Clusters - Plotting of Data – Structures - String and File I/O - Application Programme – Exercises

Module 2: VHDL Programming (8 hrs)
Introduction to VHDL - Data Types & Operators - Programming -Different Styles of Modelling - Control, Loop, decision statements - User defined functions - Logic level synthesis - Floor-planning – Routing - VHDL Programming Exercises
Module 3: Advanced Matlab – C++ Programming (8 hrs)
OOP's using MATLAB – Introduction - MATLAB Class system - Constructors in MATLAB - Inheritance in MATLAB - File Handling and Arrays in MATLAB - Sorting – Bubble sort in MATLAB - Sorting – Insertion sort in MATLAB - Searching – Binary Search Algorithm - Searching – Divide and Conquer - Matlab-C++ Programming Exercises
Module 4: Matlab Simulink (7 hrs)
Introduction to MATLAB - Arithmetic Operations in MATLAB - Functions and variable assignment - Interacting with MATLAB – Graphics - Introduction to MATLAB-Simulink - Engineer-ing applications of Simulink - Sampling using Simulink - Amplitude modulation using Simulink - Simulink Exer-cises.
Module 5: Basics of Python (7 hrs)
Variables and Simple Data Types - Introducing Lists - Working with Lists – if Statements – Arrays - Dictionaries - User Input and while Loops – Functions – Classes - Files and Exceptions - Testing Your Code
Module 6: **Project based assessment (7 hrs)**
Application design on each tool process (LabVIEW, MATLAB, XILINX and Python)
Reference Books:

1. C. F. Van Loan and K.-Y. D. Fan., "Insight Through Computing: A Matlab Introduction to Computational Science and Engineering", SIAM Publication, 2009.
2. Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, "A Guide to MATLAB, for Beginners and Experienced Users", 2001
3. Won.Y.Yang,Yong.S.Cho,Won.G.Jeon, Jeong.W.Lee,Jong.H.Paik,Jaekwon Kim, Mi-Hyun Lee, Kyu.I.Lee, Kyung.W.Park, Kyung.S.Woo," MATLAB/Simulink for Digital Communication, Hongrung Publishing, 2012
4. Samir Palnitkar, "Verilog HDL, A guide to dsign digital design and synthesis", 2007.
5. Padmanabhan, "Design through Verilog HDL", IEEE Press, Wiley interscience, 2004.
6. Jovitha Jerome, "Virtual Instrumentation using LabView", PHI Learning Eastern Edition, 2010

19EC2005	FIBER OPTIC COMMUNICATION	L T P C 3 0 0 3

Course Objectives:
1. To expose the students to the basics of signal propagation through optical fibers, fiber impairments and signal degradation factors.
2. To understand the different kinds of optical sources, detectors, modulators, amplifiers and their operation and configuration.
3. To learn the basics of optical links and networks, configurations and system design.

Course Outcomes:
The Student will be able to
1. Explain the basics of optical communication and to recognize the structures and types of optical fiber.
2. Discuss the channel impairments, and parameters of different types of optical fibers.
3. Classify the optical sources and detectors and to discuss their principles.
4. Explain the working of optical couplers, modulators, amplifiers and analyse the performance of optical amplifiers.
5. Design optical links, know the concept of WDM, and to discuss different optical components of WDM.
6. Discuss various types of optical networks and to gain knowledge about standards regarding fiber optic systems.

Module 1: Introduction to Fiber Optic Communication Systems (5 hrs)
Optical communication system evolution, General lightwave system, advantages, classification of lightwave systems, Fibers: types and refractive index profiles, mode theory of fibres: modes in SI and GI fibres.
Module 2: Wave Propagation in Optical Fiber (8 hrs)
Impairments in fibers, Dispersion: Group Velocity Dispersion, modal, wave guide and Polarization Mode Dispersion, Attenuation: absorption, bending and scattering losses, Fiber materials, fabrication of fibers, photonic crystal fiber, index guiding fiber, photonic bandgap fiber, hollow core fiber, fiber cables.
Module 3: Optical Sources & Detectors (8 hrs)
Basic concepts of optical sources, LEDs and LDs, structures, characteristics, coupling with fibres, noise in Laser diodes, Amplified Spontaneous Emission noise, effect of Laser diode noise in fibre communications.
Optical detectors, types and characteristics, structure and working of PIN and APD, noise in detectors, comparison of performance.
Module 4: Optical Couplers, Modulators & Amplifiers (8 hrs)
Input/output couplers, Coupling between wave guides, Optical modulators, Internal and external modulation techniques, Mach-Zehnder and electro-absorption modulators.
Optical amplifiers, basic concept, applications, types: Semiconductor laser amplifier, EDFA - basic theory, structure and working, Raman amplifiers, Noise characteristics and applications of amplifiers.
Module 5: Optical Communication Links (8 hrs)
Digital transmission systems, design of IMDD links, power and rise-time budgets, Coherent systems, sensitivity of a coherent receiver, comparison with IMDD systems.
The WDM concept, WDM standards, WDM components, couplers, splitters, Add/Drop multiplexers, gratings, tunable filters, system performance parameters.
Module 6: Optical Networks (8 hrs)
Introduction to optical networks - Introduction to free-space optics, Li-Fi technology and Visible Light Communication.
Radio over Fiber systems, concept, architecture, types and applications.
Standards for optical carrier transmission rates (SONET-OC standards), optical fiber cables (OM, OS), and system performance characterization (BER, OSNR, Q-factor).

Text Books:

1. Gerd Keiser, “Optical Fiber Communications”, 5th Ed., McGraw-Hill, 2013.
2. Mishra and Ugale, “Fibre Optic Communication”, Wiley, 2013.

Reference Books:

1. John M. Senior,” Optical Fiber Communications” 3rd Ed., Pearson Education, 2009.
2. Chakrabarthi, “Optical Fibre Communication” McGraw Hill, 2015.
3. Hebbar, “Optical Fibre communication” Elsevier, 2014.
4. Govind P. Agrawal, “Fiber Optic Communication Systems” 3rd Ed, Wiley, 2002.
5. Joseph C. Palais, “Fibre Optic Communications” 5th Ed., Pearson, 2013.
6. Paulo P. Monteiro and Atilio Gameiro, “Next Generation Wireless Communications using Radio over Fiber” Nathan J. Gomes Wiley, 2012.

19EC2006	ADVANCED MICROPROCESSOR ARCHITECTURE	L T P C 3 0 0 3

Course Objectives:
1. To impart knowledge in advanced microprocessors
2. To understand the concepts of parallel and multiprocessors
3. To analyze various architectures of advanced microprocessors

Course Outcomes:
The Student will be able to
1. Explain the basics of computer architecture & concepts of various pipeline architectures
2. Distinguish various parallel architectures

3. Describe high performance CISC Processor
4. Outline the significance of high performance RISC Processor
5. Analyze the reliability and performance of memory and I/O devices
6. Choose appropriate types of advanced processors for practical applications

Module 1: Essentials of Computer Design and Pipelining (8 hrs)
Fundamentals of CPU – Trends in technology, power, energy and cost, Dependability - Performance Evaluation- Instruction-Pipelining - Difficulties in Implementing Pipelines - Extending the Pipeline to Handle Multicycle Operations - Instruction Set Design and Pipelining

Module 2: Parallel Computer Models and Instruction Level Parallelism (8 hrs)
Parallel Computer Models- Multiprocessors - ILP concepts - Compiler Techniques for Exposing ILP – Dynamic Branch Prediction – Dynamic Scheduling – Multiple instruction Issue – Hardware Based Speculation – Static scheduling -Limitations of ILP.

Module 3: High Performance CISC Architecture – Pentium (7 hrs)
CPU Architecture- Bus Operations – Pipelining – Branch predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set –addressing modes

Module 4: High Performance Risc Architecture – ARM (8 hrs)
Arcon RISC Machine – Architectural Inheritance – Core & Architectures – Registers – Pipeline– ARM Organization – ARM Processor Family – Co-Processors – ARM Instruction Set- Thumb Instruction Set – Instruction Cycle Timings – The ARM Programmer's Model – ARM Development Tools

Module 5: Memory and I/O (7 hrs)
Cache Performance – Reducing Cache Miss Penalty and Miss Rate – Reducing Hit Time – Main Memory and Performance – Memory Technology - Issues in The Memory Hierarchy Design- Types of Storage Devices – Buses – RAID – Reliability, Availability and Dependability – I/O Performance Measures.

Module 6: Advanced Processor Architectures (7 hrs)
Introduction- Scalar Processors - Superscalar Processors - Vector Architecture – Symbolic Processors - VLIW Architectures - SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies– GPGPU Computing.

Text Books:

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, 6th Edition, 2017.
2. Daniel Tabak , "Advanced Microprocessors" McGraw Hill.Inc., 2012
3. James L. Antonakos, "The Pentium Microprocessor", Pearson Education , 1997.
4. Steve Furber, "ARM System –On –Chip architecture" Addision Wesley , 2000.
5. Rajiv Chopra "Advanced Computer Architecture" S.Chand Publication 2010.

Reference Books:

1. James L.Antonakos, "An Introduction to the Intel family of Microprocessors", Pearson Education 1999.
2. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", Mc Graw-Hill International Edition, 2000.
3. Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.
4. Kai Hwang, "Advanced computer architecture", McGraw Hill Education, 2nd Edition, 2010.
5. Behrooz Parhami, "Computer Architecture", Oxford University Press, 2006.

		L	T	P	C
19EC2007	**EMBEDDED SYSTEM DESIGN**	**3**	**0**	**0**	**3**

Course Objectives:

1. To understand the basic concepts of Embedded System architecture
2. To acquire knowledge in the hardware and software design of Embedded system
3. To be able to design a closed loop real time system

Course Outcomes:
The Student will be able to
1. Acquire knowledge about the embedded system architecture
2. Gain knowledge on the types of memories.
3. Design the hardware required for embedded systems
4. Develop good programming skills to develop embedded software
5. Demonstrate the OS design for embedded firmware
6. Apply the acquired knowledge to develop closed loop embedded system

Module 1: Introduction to Embedded System Design (8 hrs)
Introduction, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process: Requirements, Specifications, Hardware Software Partitioning, Architecture Design. **Embedded System Architecture:** Co-Processor & Hardware Accelerators, Processor performance Enhancement: Pipelining, Superscalar Execution, Multi Core CPUs

Module 2: Designing Embedded System Hardware-I (7 hrs)
Memory systems: Memory organization, Error detecting and correcting, memory Access times, DRAM interfaces, DRAM refresh techniques, Cache, unified versus Harvard caches, Cache coherency, Cache, Dual port and shared memory.

Module 3: **Designing Embedded System Hardware-II (8 hrs)**
I/O Devices: Watchdog Timers, Interrupt Controllers, Interfacing Protocols: SPI, I2C, CAN: Frame Formats, Wiring Topology, Reset Circuits, Interfacing RTC

Module 4: **Designing Embedded System Software –I (9 hrs)**
Application Software, System Software, Use of High-Level Languages: C, C++, Java, Programming & Integrated Development Environment tools, Emulators, Debugger, Board Support Library, Chip Support Library Analysis and Optimization: Execution Time, Energy & Power, Program Size; Embedded System Coding Standards: MISRA C 2012.

Module 5: Designing Embedded System Software –II (8 hrs)
OS based Design, Real Time Kernel, Process& Thread, Multi-threading, Synchronization, Kernel services, Case Study: RTX- ARM.

Module 6: Designing Embedded System (5 hrs)
Practical implementation of Speed control of Stepper motor or any closed loop control System for real time Application

Reference Books:

1. Introduction to Embedded Systems, Shibu K V, 2009, Tata McGraw Hill Education Private Limited, ISBN: 10: 0070678790
2. Embedded System Design, Steve Heath, 2nd Edition, 2004, Elsevier
3. Embedded Systems – A contemporary Design Tool ,James K Peckol, 2008, John Weily, ISBN: 0-444-51616-6
4. MSP430 Microcontroller Basics, John H. Davies, 2008, Newness Publishing House

19EC2008	ARM PROCESSORS	L T P C 3 0 0 3

Course Objectives:
1. To impart basic knowledge about architecture of ARM processor.
2. To get familiarized with the instruction sets in ARM processors
3. To explore the necessity of ARM processors in real time applications

Course Outcomes:
The Student will be able to
1. Summarize ARM7TDMI assembly instructions and their formats and usage.
2. Write ARM7 based assembly level programs.
3. Describe the architecture of ARM Processors.
4. Express their knowledge in cache design, virtual memory and memory protection concepts.
5. Discuss AMBA bus architecture, various HW peripherals.

6. Apply their understanding and to handle issues in using any processor software tools chain for embedded software solution development.

Module 1: ARM Introduction and Pipeline structures (8 hrs)

Types of computer Architectures-ISA's and ARM History-Embedded System Software and Hardware, stack implementation in ARM- Endianess-condition codes-Processor core VS CPU core-ARM7TDMI Interface signals-Memory Interface-Bus Cycle types-Register set-Operational Modes-Instruction Format-ARM Core Data Flow Model-ARM 3 stage Pipeline-ARM family attribute comparison-ARM 5 stage Pipeline, Pipeline Hazards, Data forwarding - a hardware solution.

Module 2: ARM7TDMI assembly instructions and modes (8 hrs)

ARM ISA and Processor Variants-Different Types of Instructions-ARM Instruction set-data processing instructions-Shift Operations-Data processing Instructions-Addressing modes-Swap Instructions-Swap Register related Instructions-Program Control Flow-Control Flow Instructions-B & BL instructions-BX instruction-Interrupts and Exceptions-Exception Handlers-Aborts-software Interrupt Instruction-Interrupt Latency-Multiply Instructions-Instruction set examples. Thumb state-Thumb Programmers model-Thumb Implementation-Thumb Applications-Thumb Instructions-Interrupt processing-Interrupt Handling schemes- Examples of Interrupt Handlers.

Module 3: Caches (7 hrs)

Memory Technologies-Need for memory Hierarchy-Hierarchical Memory Organization-Virtual Memory-Cache Memory- Mapping Functions-Cache Design-Unified or split cache-multiple level of caches-ARM cache features.

Module 4: Memory Management Unit (MMU) (7 hrs)

Processes-Memory Map-Protected Systems-ARM systems with MPU-memory Protection Unit (MPU) -Physical Vs Virtual Memory-Paging-Segmentation-MMU Advantage-virtual memory translation-Multitasking with MMU-MMU organization.

Module 5: ARM tools and Peripherals (7 hrs)

ARM Development Environment-Arm Procedure Call Standard (APCS)-Example C program-Embedded software Development-Image structure-linker inputs and outputs-memory map-AMBA Overview-Typical AMAB Based Microcontroller-AHB bus features-AHB Bus transfers-APB bus transfers-APB bridge-DMA-Peripherals- Programming Peripherals in ARM.

Module 6: Introduction to Embedded C programming (8 hrs)

Basics of C programming – Study of NXP LPC2148 ARM controllers - I/O port programming – Timer programming – Counter programming – ADC – serial communication – Interrupt programming – Linking Assembly and C programming - Case studies with examples (Temperature monitoring, Solar Intensity Tracking system)

Text Books:

1. SteveFurber, “ARM System on Chip Architecture”, Addison Wesley Professional, Second Edition, Aug 2000.
2. Andrew NSloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide, Designing and Optimizing System Software”, Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, “Design of System on a Chip: Devices and Components”, Springer FirstEdition, July 2004.
4. Jason Andrews, “Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)”, Newnes, Aug 2004.
5. Rashinkar P, Paterson and Singh L, “System on a Chip Verification – Methodologies and Techniques”, Kluwer Academic Publishers, 2001.

Reference Books:

1. ARM System Developers Guide, Designing and Optimizing System Software, by Andrew N.SLOSS, Dominic SYMES and Chris WRIGHT,ELSEVIER, 3004.
2. ARM System-on-Chip Architecture,Second Edition, by Steve Furber,PEARSON, 2013
3. Operating Systems, 5th Edition,By William Stallings
4. Manuals and Technical Documents from the ARM Inc, web site.

19EC2009	TELECOMMUNICATION SWITCHING AND NETWORKS	L T P C 3 0 0 3

Course Objectives:

1. To understand the fundamentals of a telecom switching office
2. To gain knowledge on telecommunication traffic.
3. To learn the concepts of ISDN, DSL / ADSL

Course Outcomes:

The Student will be able to

1. Summarize the concepts associated with telecommunication switching
2. Articulate the concepts associated with telecommunication system design.
3. Illustrate the types of switching in telecom
4. Assess the traffic and delay
5. Analyze various types of telephone network
6. Analyze various types of digital network

Module 1: Switching in Telecommunication Systems (8 hrs)

Evolution of Telecommunications, General principle of switching, Classification of Switching Systems, Elements of Switching System, Signalling tones, DTMF, Common Control and Direct Control, Dial management

Module 2: Electronic Space Division Switching (7 hrs)

Stored Program Control (SPC), Centralised SPC, Distributed SPC, Enhanced Services, Two-Stage Networks, Three-Stage Networks

Module 3: Time Division Switching (8 hrs)

Basic time division space switching, basic time division time switching, time multiplexed space switching, time multiplexed time switching, combination switching, three stage combination switching, N- stage combination switching.

Module 4: Traffic Engineering (7 hrs)

Network traffic load and parameters, grade of service, modelling switching systems, blocking modules & loss estimates, delay systems

Module 5: Telephone Network (7 hrs)

Network Subscriber Loop Systems, Switching Hierarchy & Routing, Transmission Plan, Numbering Plan, National Schemes, International numbering

Module 6: Digital Network (8 hrs)

Network synchronization, signalling, digital signalling common channel signalling system, SS7 signalling FDDI. ISDN and its motivation, Network and Protocol Architecture, Transmission Channels, Internetworking, BISDN. DSL technology, Cable Modem, SONET

Text Book:

1. Viswanathan. T., "Telecommunication Switching System and Networks", Prentice Hall of India Ltd., reprint 2015.

Reference Books:

1. B.A. Forouzan, "Data Communications & Networking", TMH, 2001
2. Bellamy, "Digital Telephony", John Wiley, 3rd Edition, 2003.
3. R.A.Thomson, "Telephone Switching Systems", Artech House Publishers, 2000.
4. W. Stalling, "Data and Computer Communications" Prentice Hall, .2007
5. T.N.Saadawi, M.H.Ammar, A.E.Hakeem, "Fundamentals of Telecommunication Networks", Wiley Interscience, 1994.
6. W.D. Reeve, "Subscriber Loop Signaling and Transmission Hand book", IEEE Press (Telecomm Handbook Series), 1995

19EC2010	INTERNET OF THINGS FOR COMMUNICATION ENGINEERING	L T P C 3 0 0 3

Course Objectives:

1. To provide in depth knowledge in the basics, architecture and layering analysis of various protocols in IoT

2. To comprehend on the various networks and development platforms in IoT
3. To provide the various IoT applications

Course Outcomes:

The Student will be able to

1. Understand the basics of IoT, networks and communication.
2. Realize the importance of sensors and understand the sensor mechanism.
3. Possess the required knowledge and expertise in IoT architecture, layering concepts and analysis of various protocols in IoT.
4. Understand the various networks and development platforms in IoT
5. Develop knowledge to overcome the challenges in IoT application platforms.
6. Familiarize the various IoT applications.

Module 1: Introduction (7 hrs)

IoT Architecture: History of IoT, Layers of IoT, M2M – Machine to Machine, Web of Things, Data transfer referred with OSI Model, IP Addressing, Data transfer & Network Topologies.

Module 2: IoT Components (7 hrs)

Basic function and architecture of a sensor - Sensor body, sensor mechanism, sensor calibration, sensor maintenance, cost and pricing structure, legacy and modern sensor network. IoT – processing, communication, powering, networking, standards and cloud interface

Module 3: IoT Performance and Communication (7 hrs)

Performance analysis – architecture, engineering, hardware performance, and hardware challenges. The Layering concepts. IoT Communication Pattern. IoT protocol Architecture. Messaging Protocols.

Module 4: Technologies for IoT (8 hrs)

The IoT Networking Core Technologies. Processors for IoT. WSN - wireless sensor networks. Cloud computing. Big data analytics. Embedded systems. Security protocols & architecture. Communication protocols. Web services. Mobile internet. Semantic search engines

Module 5: Challenges in IoT (8 hrs)

Design challenges, Development challenges, Security challenges – identity and access management. Prevention of attacks and network security.

Module 6: Applications (8 hrs)

Applications: IoT applications – Remote Monitoring & Sensing, Remote Controlling, IoT in home security, industries, IoT electronic equipments.

Reference Books:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers 2013.
2. Jean-Philippe Vasseur, Adam Dunkels , “Interconnecting Smart Objects with IP: The Next Internet”, Morgan Kuffmann Publishers, 2010.
3. Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning, “The Internet of Things: From RFID to the Next-Generation Pervasive Networked”, 2008.
4. Vijay Madisetti , Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 2014.
5. Adrian McEwen , Hakim Cassimally , “Designing the Internet of Things”, Wiley, 2013.
6. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice”, Wiley 2010.

19EC2011	HIGH SPEED NETWORKS	L T P C 3 0 0 3

Course Objectives:

1. To gain knowledge on ATM and Frame relay.
2. To acquire knowledge on the developments in High Speed Networks.
3. To understand and analyze the techniques involved to support real-time traffic and congestion control.

Course Outcomes:

The Student will be able to

1. Summarize on ATM and Frame Relay

2. Understand the importance of queueing in network
3. Discover the significance of TCP congestion control
4. Relate performance of various ATM traffic.
5. Explain the features of integrated and differentiated Services
6. Examine the protocols used for QoS support.

Module 1: High Speed Networks (8 hrs)

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL – PNNI protocol – PNNI Routing Hierarchy. High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fiber Channel – Wireless LANs: applications, requirements – Architecture of 802.11

Module 2: Congestion and Traffic Management (7 hrs)

Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

Module 3: TCP Congestion Control (7 hrs)

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO back off – KARN's Algorithm – Window Management – Performance of TCP over ATM.

Module 4: ATM Congestion Control (7 hrs)

Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Framework, Traffic Control – ABR traffic Management – ABR rate Control, RM cell formats, ABR Capacity allocations – GFR traffic management.

Module 5: Integrated and Differentiated Services (8 hrs)

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ – Random Early Detection, Differentiated Services

Module 6: Protocols for QoS Support (8 hrs)

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, and Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

Text Books:

1. William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2002.
2. Warland, Pravin Varaiya, "High Performance Communication Networks", Second Edition, Jean Harcourt Asia Pvt. Ltd., 2001.

Reference Books:

1. IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN Architecture", CISCO Press, Volume 1 & 2, 2012.
2. Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.
3. William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM", Pearson Education, Fourth edition, 2001.

19EC2012	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Course Objective:

1. To impart the basic concepts of Sensor Networks
2. To explore the overview of communication Protocols of wireless sensor networks
3. To introduce the principles of tracking techniques, sensor database and energy management

Course Outcomes:

The Student will be able to

1. Understand the concepts of sensor network architecture
2. Categorize the different types of protocols
3. Acquire knowledge in IEEE 802.15.4 standards for Wireless Sensor Networks
4. Understand different tracking techniques
5. Express the functions of sensor database

6. Analyze the energy management in WSN

Module 1: Architecture of Wireless Sensor Networks (6 hrs)

Introduction, Difference between sensor networks and traditional networks, Technical challenges in WSN, sensor node architecture, Individual components of sensor node. Functional architecture of sensor network

Module 2: Sensor Networks Protocols (8 hrs)

Time synchronization protocols, Transport Layer protocols, Network layer protocols, Data link protocols, Medium Access Control, Requirements and design constraints of MAC for WSN, SMAC protocol, IEEE 802.15.4 standard, Zigbee.

Module 3: Tracking Technologies (9 hrs)

Tracking scenario, Problem formulation, Sensing model, Fundamentals-ToA, TDoA, and AoA, Positioning by signal strength, Positioning and location tracking algorithms, Trilateration, Multilateration, Pattern matching, Nearest neighbour algorithms, location tracking, Network based tracking

Module 4: Sensor Network Database (8 hrs)

Sensor Network Data Base challenges**,** querying the physical environment**,** High level database organization**,** Data aggregation types**,** Packet level aggregation**,** Total aggregation**,** Geographic aggregation**,** Selection of best aggregation points

Module 5: Power Management (8 hrs)

Dynamic power Management: Idle power management, Active power management, Design challenges in energy efficient medium access control, IEEE 802.11-operation, power saving mode, Merits-drawbacks-implications in WSN, Blue tooth – Operation, Overview of Node level energy management

Module 6: Application (6 hrs)

Security architecture –EDGE network- Cell based WSNs, Privacy local of location, applications of wireless sensor networks in health monitoring and agriculture.

Text Book:

1. Mohammad Ilyas and ImadMahgoub, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems” CRC Press, 2009.

Reference Books:

1. Shuang-Hua Yang, “Wireless Sensor Networks: Principles, Design and Applications”, Springer-Verlag London, 2014.
2. Förster, Anna, Introduction to wireless sensor networks, Wiley-IEEE Press;John Wiley & Sons, 2016.
3. Pratyay Kuila, Prasanta K. Jana, “Clustering and Routing Algorithms for Wireless Sensor Networks: Energy Efficiency Approaches”, Chapman and Hall/CRC, 2018.
4. Feng Zhao, Leonidas J. Guibas, “Wireless Sensor Networks: An Information Processing Approach” Morgan Kaufmann Publishers, 2004.
5. Michel Banatre, Pedro Jose Marron, AnibalOllero and Adam Wolisz, “Cooperating Embedded Systems and Wireless Sensor Networks”, ISTE Ltd, 2008.

19EC2013	OPTOELECTRONICS	L T P C 3 0 0 3

Course Objective:

1. To design and understand various types of display devices.
2. To design optoelectronic detection devices, modulators and other networking components for optical communication.
3. To design optoelectronic integrated circuits and to understand various applications of optoelectronic integrated circuits in the field of electronic/optical communication.

Course Outcomes:

The Student will be able to

1. Understand the nature of light and to analyse various semiconductor physics and semiconductor junction characteristics.
2. Explore electronic displays with its working principle & characteristics.

3. Discuss optical detection devices and its types.
4. Explain optical modulation and optical modulation devices.
5. Investigate various optical networking components and their applications.
6. Develop various applications of optoelectronics integrated circuits.

Module 1: Introduction to Physics of Light (7 hrs)
Wave Nature of Light, Polarization, Interference, Diffraction, Light Source, Review of Quantum Mechanical Concept, Review of Solid-State Physics, Review of Semiconductor Physics and Semiconductor Junctions.

Module 2: Lasers and Display Devices (8 hrs)
Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, Laser Applications.

Module 3: Optical Detection Devices (8 hrs)
Photo Detector, Thermal Detector, Photo Devices, Photo Conductors, Photodiodes, PIN, APD, Modulated Barrier Photodiode, Schottky Barrier Photodiode, Wavelength Selective Detection, Micro Cavity Photodiodes, Detector Performance, Solar Cells.

Module 4: Optical Modulation and Devices (7 hrs)
Introduction, Analog and Digital Modulation, Electro-optic Modulators, Magneto-optic Devices, Acousto-optic Devices, Optical Switching and Logic Devices.

Module 5: Optical Networking Components (8 hrs)
Introduction, Directional Couplers, Multiplexers, Attenuators, Isolators, Circulators, Tunable Filters, Fixed Filters, Add/Drop Multiplexers, Optical Cross Connects, Wavelength Convertors, Optical Bistable Devices.

Module 6: Introduction to Optical-Electronics Integrated Circuits (7 hrs)
Introduction, Hybrid and Monolithic Integration, Applications of Opto-electronic Integrated Circuits, Integrated Transmitters and Receivers, Guided Wave Devices, Introduction to Heterogeneous ICs.

Text Books:

1. Pallab Bhattacharya, “Semiconductor Opto Electronic Devices”, 2nd Ed., Pearson Education Ltd., 2017.
2. Jasprit Singh, “Semiconductor Optoelectronics: Physics and Technology”, McGraw Hill, 2019.

Reference Books:

1. Piprek, Semiconductor Optoelectronic Devices, Academic Press, 2008.
2. J. Willson and J. Haukes, “Opto Electronics – An Introduction”, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.
3. Yariv, “Photonics Optical Electronics in modern communication”, 6th Ed., Oxford University Press, 2006.
4. John M. Senior, “Optical Fiber Communications: Principles and Practice”, 3rd Ed., Pearson Education Ltd., 2009.
5. Djafar K. Mynbaev and Lowell L. Scheiner, “Fiber optic communication Technology”, Pearson Education, 2001.
6. Xun Li, Optoelectronic Devices Design Modelling and Simulation, Cambridge University Press, 2009

19EC2014	BASICS OF SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives:
1. To understand the basic elements of satellite communication systems.
2. To understand the modulation techniques for satellite communication.
3. To understand launch systems and analyze their effect on satellite and payload design.

Course Outcomes:
The Student will be able to
1. Understand the satellite orbits, elements of satellite and operation of satellite communication.

2. Interpret the concepts of space segment, propulsion, payload, and TTC.
3. Analyze the design requirements and the performance of earth station.
4. Develop the multiplexing techniques, modulation techniques, and multiple access techniques for satellite communication.
5. Illustrate the concepts of link design, rain fading and link availability and perform interference calculations.
6. Design various satellite applications.

Module 1: Elements of Satellite Communication (8 hrs)
Kepler's laws and equations of motion - Newtons's law, Orbital parameters, Orbital description and Orbital mechanics of LEO, MEO and GEO, launching satellites in to orbits, Range to satellite, Satellite – description of different Communication subsystems, Bandwidth allocation.

Module 2: Space Segment (7 hrs)
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, Communication payload and supporting subsystems, Telemetry, Tracking and command-Transponders- Antenna Subsystem.

Module 3: Earth Station (7 hrs)
Earth Station Transmitters, Receivers-antenna types – Gain and radiated power – Poynting loss – Noise temperature – G/T ratio – High power amplifiers – Redundancy configurations – Carrier & power combining – Low noise amplifiers.

Module 4: Transmission, Multiplexing, Modulation, Multiple Access and Coding (8 hrs)
Different modulation and multiplexing schemes, Multiple Access Techniques – Frequency Division Multiple Access (FDMA) Intermodulation. Time Division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple Access (CDMA), Spread spectrum transmission and reception.

Module 5: Satellite Link Design (7 hrs)
Basic link analysis, Interference analysis, Adjacent channel and inter symbol Interference-Rain induced attenuation and interference, Ionospheric characteristics, Satellite link design -Link Design with and without frequency reuse.

Module 6: Applications and Services (8 hrs)
Very small aperture terminal (VSAT) networks – Technologies & configurations – Mobile satellite (MSAT) networks – Low orbital satellites – COMSAT- Domestic satellite systems - the INSAT System-International systems - INTELSAT / INMARSAT

Text Books:
1. D. Roddy, "Satellite Communication", (4/e), McGraw- Hill, 2009.
2. B.N. Agrawal, "Design of Geosynchrons Spacecraft", Prentice- Hall,1986.

Reference Books:
1. T. Pratt, C.W. Bostain and J.E. Allnutt, "Satellite Communication", 2nd Edition, Wiley 2002.
2. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Bostan London, 1997.
3. Tri T. Ha, "Digital Satellite Communication", 2nd edition, 1990.
4. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.

19EC2015	PRINCIPLES OF DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives:
1. Learn digital image fundamentals.
2. Understand the image enhancement and restoration techniques.
3. Explore image segmentation methods

Course Outcomes:
The Student will be able to
1. Grasp the basics of digital image acquisition and processing system
2. Select methods for enhancing an image

3. Estimate and restore the degraded images
4. Detect object shapes using morphological operators
5. Segment the object of interest and provide suitable representation and description
6. Analyze the image processing methods

Module 1: Image Processing Fundamentals (8 hrs)
Application areas of digital image processing, Elements of digital image processing system, Vidicon and Digital Camera working principles, - Elements of visual perception, Image sampling and Quantization, Basic relationship between pixels, Basics of color image processing.

Module 2: Image Enhancement (8 hrs)
Basic Gray Level Transformations, Histogram Processing, Spatial filtering, Two Dimensional Discrete Fourier Transform and its properties, Frequency domain filters, Homomorphic filtering, Application to medical field.

Module 3: Image Restoration (8 hrs)
Image restoration/degradation process model, Noise models, Linear, Position-Invariant degradations, Estimating the degradation function, Inverse filtering, Wiener filtering, Constrained least square filtering, Geometric transformations, Astronomical applications.

Module 4: Image Morphology (7 hrs)
Dilation and erosion, Opening and closing, Hit-or-Miss Transformation, Morphological algorithms, Extension to gray scale images, Application to pattern recognition.

Module 5: **Image Segmentation (7 hrs)**
Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-based segmentation, Watershed segmentation, Use of motion in segmentation, Object detection applications.

Module 6: **Representation & Description (7 hrs)**
Representation, Boundary descriptors, Regional descriptors, Principal components for description, image coding and classification applications.

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Prentice Hall, Third Edition, 2008.
2. Wilhem Burgar, Mark James Burge, “Principles of Digital Image Processing: Fundamental Techniques”, Springer-Verilag London, 2009

Reference Books:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, Inc., 2002
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, Second Edition, Gatesmark Publishing, 2009.
4. Alan C. Bovik, “Handbook of image and video processing”, Elsevier Academic press, 2005
5. William K. Pratt, “Digital Image Processing”, Wiley, 2001

19EC2016	MULTIMEDIA COMPRESSION TECHNIQUES	L T P C 3 0 0 3

Course Objective:
1. To understand the characterization of speech and image waveforms
2. To learn about the various compression techniques for text data, audio, image and video signals
3. To know about the speech and video coding standards

Course Outcomes:
The Student will be able to
1. Recall the basic concepts of multimedia data
2. Demonstrate knowledge about the principles of various coding techniques
3. Assess lossy and lossless compression systems
4. Choose suitable compression algorithm for signal processing
5. Analyze the performance of various compression algorithms
6. Apply the appropriate coding technique for real time applications

Module 1: Introduction (7 hrs)
Introduction to Multimedia Systems and Processing , Special features of Multimedia – Graphics and Image Data Representations -Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications - Need for Compression
Module 2: Text Compression (8 hrs)
Compaction techniques – Huffmann coding – Arithmetic coding – Shannon Fano– LZW family algorithms
Module 3: Audio Compression (7 hrs)
μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic subband coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio.
Module 4: Image Compression (8 hrs)
Transform Coding – JPEG Standard – Subband coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG.
Module 5: Video Coding Standards (8 hrs)
MPEG-1 Standard, MPEG-2 Standard, MPEG-4 Standard, H.261, H.263 Standards, H.264 standard, Motion estimation and Motion compensation.
Module 6: Applications (7 hrs)
Role of compression in Natural Language Processing (NLP), Satellite image compression, Compression techniques for object tracking in digital videos and speech signal compression.
Text Books:
1. Khalid Sayood, "Introduction to Data Compression", Morgan Kauffman Harcourt India, 5th Edition, 2017.
2. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering - Fundamentals, Al-gorithms & Standards", CRC press, 2003.

Reference Books:
1. David Salomon, "Data Compression – The Complete Reference", Springer Verlag, 4th Edition, 2007.
2. Peter Symes, "Digital Video Compression", McGraw Hill, 2004.
3. Mark S.Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, 2003.
4. Lain E.G. Richardson, "H.264 and MPEG-4 Video Compression", Wiley, 2003.
5. Nicolas Moreau, "Tools for Signal Compression: Applications to Speech and Audio Coding", Wiley, 2011.

19EC2017	INFORMATION THEORY AND CODING	L T P C 3 0 0 3

Course Objectives:
1. To learn the basics of information theory
2. To calculate channel capacity and other measures
3. To understand the source coding techniques for text, audio and speech

Course Outcomes:
The Student will be able to
1. Understand the basic concepts of probability and random variables
2. Understand the basics of information theory
3. Gain knowledge to calculate channel capacity and other measures
4. Compare the source coding techniques for text, audio and speech
5. Analyze the different error control techniques
6. Calculate the coding rate and error probabilities.

Module 1: Probability and random variables (8 hrs)
Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Module 2: Information Theory (8 hrs)
Introduction – Information, Entropy, Information rate, classification of codes, Kraft McMillam inequality, Source coding theorem, Shannon Fano coding, Huffman coding – algorithm, tree construction, Efficiency – Joint and Conditional Entropies, Mutual information and its properities – Discrete Memory less channels – BSC, BEC, Channel capacity – Shannon limit
Module 3: Source Coding: Text, Audio and Speech (8 hrs)
Introduction to text coding, Adaptive Huffman coding, Arith- metic coding, LZW algorithm - Introduction to Audio coding, Perceptual coding, Masking techniques, Psychoacous- tic model, MPEG audio layers I, II, III – Dolby AC3 – Introduction to Speech Coding, Channel vocoder, Linear Predictive Coding.
Module 4: Error Control Coding: Block Codes (7 hrs)
Introduction to error control coding – Definition and Principles – Hamming weight, Hamming distance, minimum distance decoding – Single parity codes, hamming codes, repetition codes – Linear block codes – Cyclic codes – Syndrome calculation – Encoder and decoder – CRC
Module 5: Error Control Coding: Convolutional Codes (7 hrs)
Introduction to Convolutional codes – Code tree – Trellis codes – State diagram – Encoding and decoding – Sequential search – Viterbi algorithm
Module 6: Application of error control coding (7 hrs)
Introduction to Turbo coding, LDPC codes, Application of convolution codes to noisy channels (AWGN)
Reference Books:

1. Andre Neubauer, Jurgen Freudenberger, Volker Kuhn, "Coding theory: Algorithms, Architectures and Applications" John Wiley & Sons Ltd, Reprint 2012.
2. Robert. H. Morelos- Zaragoza, "The Art of Error Correcting Coding", Second Edition, John Wiley & Sons Ltd, Reprint 2013.
3. R. Avudaiammal, "Information Coding Techniques", 2nd Edition, Tata McGraw Hill Education Pvt. Ltd., 2010.
4. R Bose, "Information Theory, Coding and Cryptography", TMH 2007
5. Fred Halsall, "Multidedia Communications: Applications, Networks, Protocols and Standards", Perason Education Asia, 2002
6. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
7. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007
8. Amitabha Bhattacharya, "Digital Communication", TMH 2006

19EC2018	SYSTEM VERILOG FOR FUNCTIONAL VERIFICATION	L	T	P	C
		3	0	0	3

Course Objectives:
1. To make the students understand the need of Verilog programming for functional verification
2. To enable the students to get familiarized with system Verilog programming
3. To make the students understand the concepts of test bench.

Course Outcomes:
The Student will be able to
1. Understand concept of Verilog programming in Functional Verification
2. Illustrate the concepts of System Verilog
3. Analyse different classes in System Verilog
4. Code in System Verilog using constraints and randomization
5. Interpret coverage methods and interprocess synchronisation
6. Comprehend test bench concepts in System Verilog

Module 1: Verilog for Functional Verification (7 hrs)
Verilog Logic values, Data types, Constants, Parameters, Test bench, Delays in assignment statements, Types of Timing controls, Port connections/ Mapping, Blocking and non-blocking assignments, Synthesizable and non- synthesizable constructs.

Module 2: System Verilog Concepts (7 hrs)
Introduction to System verilog, Features, Data types, Arrays, Procedural statements, Scheduler, Program control, Processes, Task and Functions.
Module 3: Classes in System Verilog (7 hrs)
Classes, Constructs, Static property and methods, Types of copy, Parameterized class, Inheritance, Virtual methods, Polymorphism, Encapsulation, Virtual classes.
Module 4: Constraints and Randomization (8 hrs)
Stimulation Generation methodologies, Constraint blocks- inside operator, Weighted distributive, Implication and if else, Iterative, in-line, Soft, Unique, Bi-directional constraints, Randomization-Randomize, Random sequence.
Module 5: Interprocess Synchronisation and Coverage (8 hrs)
Mailboxes, Semaphores, Event, Program block, Interface, Modport and Clocking block, Virtual Interface, Functional coverage- Cover group, Cover points, Cross, Coverage methods, options.
Module 6: System Verilog Test Bench Components (8 hrs)
System Verilog Test Bench Architecture- Transactional level modelling, Generator, Driver, Monitor, Coverage, Scoreboard, Checker.
Reference Books:

1. Samir Palnitkar, "Verilog HDL A Guide to Digital Design and Synthesis" Prentice Hall, PTR, 2nd Edition 2003.
2. Spear, Chris, Tumbush, "SystemVerilog for Verification A Guide to Learning the Testbench Language Features", Greg, 2012.
3. SystemVerilog Golden Reference Guide - Updated Dec 2012 Supporting SystemVerilog IEEE Standard 1800™-2012

19EC2019	ASIC DESIGN	L T P C 3 0 0 3

Course Objectives:
1. To understand the types of ASIC s and design flow.
2. To acquire knowledge on programmable ASICs and programmable ASIC logic cells.
3. To study the concepts of programmable ASIC interconnect and programmable ASIC design software and to develop algorithms for physical design ASICs.

Course Outcomes:
The Student will be able to
1. Define the types of ASICs, combinational and sequential logic cells, concepts of design rules and logical effort.
2. Describe the programmable ASICs and programmable ASIC logic cells.
3. Demonstrate programmable ASIC interconnect and programmable ASIC design software.
4. Illustrate the goals and objectives of partitioning, floorplanning and placement.
5. Develop algorithms for various types of routing and explain the concepts of circuit extraction and DRC.
6. Develop the HDL logic synthesis skills.

Module 1: Fundamental to ASICs- CMOS Logic (8 hrs)
Types of ASICs – Design flow – CMOS transistors, CMOS design rules – Combinational logic cell – Sequential logic cell –Logical effort.
Modele 2: Programmable ASICs– Programmable ASIC Logic Cells and Programmable ASIC I/O block (7 hrs)
Anti-fuse – static RAM – EPROM and EEPROM technology – Actel ACT – Xilinx LCA –Altera FLEX –Xilinx I/O blocks.
Module 3: Programmable ASIC Interconnect– Programmable ASIC Design- Software and Low Level Design Entry (8 hrs)
Actel ACT –Xilinx LCA – Xilinx EPLD – Altera MAX 5000 and 7000 – Altera MAX 9000 – Altera FLEX – Half gate ASIC –Schematic entry –EDIF– CFI design representation.

Module 4: Partitioning – Floor Planning– Placement (8 hrs)
Partitioning methods – Floor planning – Floorplanning Goals and Objectives- Floorplanning Tools- Channel Definition- I/O and Power Planning - Placement Goals and Objectives- Placement Algorithms- Iterative Placement Improvement.
Module 5: Routing (7 hrs)
Global routing – Detailed routing – Special routing – Circuit extraction – DRC
Module 6: Logic synthesis (7 hrs)
Comparator/Mux, Viterbi decoder, Memory synthesis, Multiplier.
Text Books:

1. M.J.S.Smith, “Application Specific Integrated Circuits”, Addison Wesley Professional, 2008.
2. Himanshu Bhatnagar, “Advanced ASIC Chip Synthesis: Using Synopsys Design Compiler”, 2nd Edition, Kluwer Academic, 2001

Reference Books:

1. Wayne Wolf, “FPGA-Based System Design”, Prentice Hall PTR, 2004.
2. Weng Fook Lee, “Verilog Coding for Logic Synthesis” John Wiley & Sons, Inc., 2003.
3. Razak Hossain, “High Performance ASIC Design: Using Synthesizable Domino Logic in an ASIC Flow” Cambridge University Press; 1st edition 2008.
4. Chinnery, David, Keutzer, Kurt, “Closing the Gap Between ASIC & Custom Tools and Techniques for High-Performance ASIC Design” Springer US 2002.

19EC2020	ANALYSIS AND DESIGN OF DIGITAL IC	L T P C 3 0 0 3

Course Objective:

1. To learn about the basic concepts of MOS transistor.
2. To learn the concept of designing CMOS inverter and analysing its static and dynamic behaviour.
3. To illustrate the concept of designing combinational and sequential circuits using different logic styles and its timing issues.

Course Outcomes:
The Student will be able to

1. Understand the basic concepts of MOS transistor.
2. Illustrate different second order effects in MOS transistor.
3. Analyse static and dynamic behaviour of CMOS inverter
4. Design combinational logic circuits in CMOS.
5. Interpret different logic style to design sequential logic circuits and its optimisation.
6. Comprehend the significance of timing issues in logic circuit design.

Module 1: MOS Transistor (8 hrs)
Physical structure of MOS transistor – threshold voltage – body effect – dc equations – second order effects – MOSFET regions of operation – MOS as switch - MOS Models – Interconnect parameters – capacitance – resistance – inductance – Electrical wire model: ideal wire – lumped model – RC model – transmission line – switching characteristics : Analytical delay model – empirical delay model - case study: study of technology development in MOS.
Module 2: CMOS Inverter (7 hrs)
Static CMOS inverter – DC Characteristics – combinational logic gate implementation – CMOS gate transistor sizing –Static behavior: switching threshold – noise margin – Dynamic behavior: computing capacitance – propagation delay - power dissipation – case study: Technology scaling and its impact on inverter metrics.
Module 3: Combinational Logic Circuits in CMOS (8 hrs)
Static CMOS logic Design : complementary CMOS – Ratioed logic – pass transistor logic – CPL – transmission gate logic – Dynamic CMOS logic design : Basic principles – speed and power dissipation - signal integrity issues – Cascading dynamic gates - domino logic – np CMOS logic – NORA logic.
Module 4: Sequential Logic Circuits in CMOS (7 hrs)
Introduction – timing metrics for sequential circuits – classification of memory elements – static and dynamic latches and registers – C^2MOS approach – TSPCR.

Module 5: Sequential Circuits Optimization (8 hrs)
Pipelining: latch versus register based pipelines – NORA CMOS logic style for pipelined structures. Non-bistable Sequential Circuits – Schmitt Trigger – Monostable and Astable circuits.
Module 6: Timing Issues in Digital Circuits (7 hrs)
Timing Classification of Digital Systems – Synchronous Design timing basics – clock skew – clock jitter – Synchronizers and Arbiters – Clock Synthesis and Synchronization using PLL.
Reference Books:

1. Jan.M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education, 2nd Edition 2003.
2. Neil H E West and Kamran Eshranghian, "Principles of CMOS VLSI Design: A System Perspective", Addison Wesley, 2nd edition, 2002.
3. Charles H.Roth, "Fundamentals of Logic Design", 6th edition, Thomson Learning, 2013.
4. Kang, Leblebigi "CMOS Digital IC Circuit Analysis & Design", McGraw Hill, 2003.
5. A.Pucknell, Kamran Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India, 2007.

19EC2021	LOW POWER TECHNIQUES IN VLSI DESIGN	L T P C 3 0 0 3

Course Objectives:
1. To understand basic principles of low power concepts.
2. To acquire knowledge on circuit and logic level power reduction techniques
3. To design low power flip-flops and SRAM devices.

Course Outcomes:
The Student will be able to
1. Describe the simulation based power analysis.
2. Apply the various low power reduction techniques at circuit level and logic level.
3. Demonstrate the various special techniques at architecture and system techniques.
4. Design of low power latches & flip-flops.
5. Design low power SRAM chips.
6. Apply the of energy recovery concepts to design low power circuits.

Module 1: Simulation Power Analysis (8 hrs)
Need for Low Power VLSI Chips- Charging and Discharging Capacitance- Short Circuit Current- Leakage Current- Static Current- Basic Principles of Low Power Design- Gate Level Logic Simulation.
Module 2: Circuit and Logic Level Power Estimation (8 hrs)
Transistor and Gate Sizing- Equivalent Pin Ordering- Network Reconstructing and Reorganization- Gate Reorganization- Signal Gating - Logic Encoding- State Machine Encoding- Pre-Computation Logic.
Module 3: Special Techniques for Architecture and System Level Power Estimation (8 hrs)
Power Reduction in Clock Networks- CMOS Floating Node- Low Power Bus- Delay Balancing. Power and Performance Management- Switching Activity Reduction- Parallel Architecture- Flow Graph Transformation.
Module 4: Low Power Latches and FLIP FLOPS (7 hrs)
Need for Low Power Latches and Flip Flops- Evolution of Latches and Flip Flops- Quality Measures for Latches and Flip Flops.
Module 5: SRAM Architectures (7 hrs)
MOS Static RAM- Memory Cell- Banked SRAM- Reducing Voltage Swing on Bit Lines- Reducing Power in the Write Driver and Sense Amplifier Circuits.
Module 6: Adiabatic Logic Circuits (7 hrs)
Adiabatic Charging- Adiabatic Amplification -Adiabatic Logic Gates- Pulsed Power Supply- Stepwise Charging Circuits- Partially Adiabatic Circuits.
Text Books:

1. Gary Yeap, "Practical Low Power Digital VLSI Design", Springer; 1998 edition (2012).
2. Kaushik Roy, Sharat Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley & Sons Inc., 2009.

Reference Books:

1. Anantha Chadrasekaran and Robert Broderson, “Low Power CMOS Design”, Standard Publishers, 2000.
2. Kiat, Seng Yeo, Samir S.Rofail, Wang, Ling Goh, “CMOS/BiCMOS ULSI Low Voltage, Low Power”, Pearson Education India; First Edition, 2011.
3. Pal Ajit, “Low-Power VLSI Circuits and Systems” Springer India 2015.
4. Nianxiong Nick Tan, Dongmei Li, Zhihua Wang, “Ultra-Low Power Integrated Circuit Design Circuits, Systems, and Applications” Springer New York 2014.

19EC2022	NANO ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objective:

1. To understand the fundamentals of Nanoelectronics.
2. To design nano electronic devices
3. To understand the fabrication techniques and applications of Nanodevices.

Course Outcomes:

The Student will be able to

1. Demonstrate the basic concepts of nanotechnology and the processes involved in making nano components and material
2. Use the fundamental concepts of nano-electronics.
3. Explore various structure and operation of various MOS nano devices
4. Compare Tunneing devices and SET transistors in nano regim.
5. Investigate the emerging nanodevices and its applications.
6. Choose various fabrication methods of nano-devices

Module 1: Overview of technology scaling (6 hrs)

Introduction to nanoelectronics, basic CMOS process flow, MOS scaling theory, issues in scaling MOS transistors: short channel effects, requirements for non-classical MOS transistor.

Module 2: Fundamentals of nanoelectronics (6 hrs)

Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

Module 3: Non-classical FETs (8 hrs)

Nano-scale MOSFETs, FinFETs, and Vertical MOSFETs. Transport in nano-scale devices, velocity saturation, ballistic transport, injection velocity, velocity overshoot, I-V characteristics.

Module 4: Synthesis of nanomaterials (8 hrs)

Nano materials: preparation plasma arcing, chemical vapour deposition, Sol-gels, electro deposition, ball milling, applications of nano materials.

Module 5: Emerging nanoelectronic devices (9 hrs)

Introduction to Tunneling Diode, Resonant Tunneling Diode, Coulomb blockade, Single electron transistors and applications. Carbon nanotube-band structure and transport, CNTFETs and I-V characteristics, Nano-composite materials, 2D Semiconductors, Graphene and atomistics device simulation

Module 6: Fabrication and measurement techniques (8 hrs)

Nanofabrication – Crystal Growth techniques, Diffusion, Oxidation, Dip pen lithography – Thin Flim Deposition and Etching, Self assembled Inorganic/Organic layers.

Text Books:

1. Karl Goser, Jan Dienstuhl and others “Nanoelectronics and Nanosystems” From Transistor to Molecular & Quantum Devices, Springer, 2004
2. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
3. Robert Puers , Livio Baldi , Marcel Van de Voorde , Sebastiaan E. van Nooten, Nanoelectronics: Materials, Devices, Applications, 2 Volumes, Wiley 2017.

Reference Books:

1. Rainer Waser "Nano Electronics and Information Technology" 3rd Edition, Wiley-VCH, 2012 2. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.
2. Plummer, Deal, Griffin " Silicon VLSI Technology", Pearson Education India 2009 ,.
3. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003
4. Jessamyn A Fairfield "Nanoelectronics", from IOP science, March 2018.
5. Razali Ismail, Sohail Anwar and other "Advanced Nanoelectronics " 2018 edition.
6. Muhammad 7. Mustafa Hussain "Advanced Nanoelectronics " by WILEY.VCH - 2018

19EC2023	RF INTEGRATED CIRCUIT DESIGN	L	T	P	C
		3	0	0	3

Course Objective:

1. Analyze transmission-line circuits at RF frequencies
2. Use the Smith chart for solving impedance matching problems
3. To study the basics and design process of power amplifiers.

Course Outcomes:

The Student will be able to

1. Acquire basic knowledge of general RF circuits, components and systems.
2. Summarize the transmission line model theory
3. Utilize the smith Chart in RF subsystem design.
4. Design passive RF filters.
5. Analyze the characteristics of biasing and matching networks
6. Design RF power amplifiers using biasing and matching networks

Module 1: Introduction (2 hrs)

RF Behavior of Passive Components, Chip components and Circuit board considerations: Chip resistors, chip capacitors, surface mounted inductors, and RF circuit manufacturing process.

Module 2:Transmission Line Analysis (7 hrs)

Example of Transmission Lines, Equivalent Circuit Representation, Circuit Parameters for a Parallel-Plate Transmission Line, Summary of Different Transmission Line Configurations, General Transmission Line Equations, Microstrip Transmission Lines, Terminated Lossless Transmission Line-Special Termination Conditions. Introduction to ADS / NI AWR (Simple Examples)

Module 3: Network Parameter Measurements (10 hrs)

The Smith Chart (From Reflection Coefficient to Load Impedance, Impedance Transformation, Admittance Transformation, Parallel Series Connection), Single-and Multi-port Networks (Interconnecting networks, Network properties and Applications, Scattering Parameters), Design and Analysis of multi-port network using Simulation- Introduction to ADS / NI AWR (Simple Examples).

Module 4: RF Filter Design (10 hrs)

Filter types and parameters, Low pass filter, High pass filter, Bandpass and Band stop filter, Insertion Loss. Special Filter Realizations: Butterworth type filter, Chebyshev type filters, Denormalization of standard low pass design. Examples of Microstrip Filter Design. Coupled Filters: Odd and Even Mode Excitation, Bandpass Filter Design, Cascading bandpass filter elements, Design examples- ADS / NI AWR (Simple Examples) - Vector Network Analyzer and Simple Calibration Approach

Module 5: Matching and Biasing Networks (8 hrs)

Impedance Matching Using Discrete components-Microstrip Line Matching Networks-Amplifier classes of operation and Biasing networks- ADS / NI AWR (Simple Examples)

Module 6: RF Amplifier (8 hrs)

Active RF Components (RF Field Effect Transistors, MOSFETs, HEMTs), Biasing and Setting Operating Points, Power Flow of RF Active and Passive Devices, Stability considerations-Constant Gain-Noise Figure circles- constant VSWR circles, One-Stage RF Amplifier Design –MMIC technology- ADS / NI AWR (Simple Examples).

Text Books:

1. R. Ludwig, G. Bogdanov, "RF Circuit Design: Theory and Practice", 2nd edition, Prentice Hall, 2009
2. Razavi, "RF Microelectronics", Pearson publishers, 2nd Edition, 2013

Reference Books:

1. D.M. Pozar, "Microwave Engineering", Addison-Wesley, Reading, MA, 4th edition, 2013
2. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", Author House, 2009.
3. Richard Chi –His Li, "RF Circuit Design", Wiley Sons, 2009
4. Joseph Carr, "Secrets of RF Circuit Design", McGraw Hil, 3rd Edition 2004
5. G. Gonzales, "Microwave Transistor Amplifiers: Analysis and Design", 2nd edition, Prentice Hall, 1996.
6. Chris Bowick, "RF Circuit Design", Newnes publishers, 1982

19EC2024	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the concepts of machine learning algorithms
2. To understand the performance and limitations of various machine learning algorithms
3. To get familiarized with the use of neural networks in pattern recognition

Course Outcomes:

The Student will be able to

1. Understand the techniques, mathematical concepts of machine learning
2. Select the appropriate machine learning algorithm to solve real time problems.
3. Compare the data and efficiently execute the algorithm to solve the problem
4. Analyze and compare the results of different machine learning algorithms
5. Comprehend the statistical techniques to analyze the results
6. Acquire knowledge about the artificial neural networks.

Module 1: Introduction to machine learning (8 hrs)

Application of machine learning - types of learning- supervised, unsupervised, reinforcement, classification learning, representations.

Module 2: Learning Algorithms (7 hrs)

Hypothesis space, inductive bias, under fitting and over fitting, evaluation of learning algorithm, cross validation, limitations.

Module 3: Regression (8 hrs)

Linear regression and decision tree, LMS algorithm, Delta rule, Entropy, information gain, splitting rule, model selection. Logistic regression.

Module 4: Support Vector Machine (7 hrs)

Introduction to support vector machine, Dual, maximum margin with noise, non-linear SVM and kernel function, SMO algorithm.

Module 5: Artificial Neural Networks (8 hrs)

Neural Networks, perceptron, multilayer network, Hopfield neural network, Kohonen neural network.

Module 6: Applications (7 hrs)

Applications-machine learning for pattern recognition-biometrics-natural language processing.

Text Books:

1. Ethem Alpaydin, "Introduction to machine learning", MI T Press, 2010.
2. Robert Schalkoff, "Pattern Recognition-Statistical, Structural and Neural Approaches", John Wiley & sons,Inc, New York, 2005.

Reference Books:

1. David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012
2. Duda, R. O, Hart, P. E., and Stork, D. G, "Pattern Classification", 2nd edition, John Wiley & Sons, NewYork,2001.

3. Tou and Gonzales, “Pattern Recognition Principles”, Wesley Publication Company, London, 1974.

19EC2025	SEMICONDUCTOR DEVICE MODELING	L T P C 3 0 0 3

Course Objectives:

1. To Know about the physics of Electrostatics
2. To know about the physics behind semiconductor devices
3. To know about the practical applications of Semiconductor Devices

Course Outcomes:

The Student will be able to

1. Formulate new mathematical models for
2. Learn the physics behind the semiconductor devices
3. Deep understanding of PN Junction theory, heterojunctions and Contacts in the devices.
4. Explore the BJT, MOSFET and other semiconductor devices from semiconductor device perspective.
5. Understand short channel effect and leakage mechanism in MOSFET devices.
6. Advantages and applications of various SPICE models in the MOS devices.

Module 1: Semiconductor Physics and Materials (8 hrs)

Semiconductor Materials and Structures- Band Structures – Electron-Hole Statistics – Carrier Mobility and Conductivity– Carrier Diffusion, Generation/Recombination – Avalanche Multiplication – Hall Effect, P-N Junction Theory – Built-In Potential – Current-Voltage Relation In P-N Junction – Diffusion Capacitance – Diode Equivalent Circuit – Breakdown Voltage – Transient Behavior -Metal-Semiconductor Junctions – Schottky Diode and Ohmic Contact Hetero- Junctions

Module 2: Bipolar Junction Transistors (9 hrs)

BJT Current- Voltage Relation – Current Gain – Band Gap Narrowing – Auger Recombination – Early Effect – Punch-Through In BJT – Breakdown Voltage In BJT – Small Signal Equivalent Circuit – Cut-Off Frequency – Switching Behavior – HBT.

Module 3: Semi-Classical Bulk Transport Models (7 hrs)

Basic Ebers-Moll Model – Basic Gummel-Poon Model – Model Derivation – Moll-Ross Equation – High Injection Effect – Knee Current – Early Effect – Base Widening Effects.

Module 4: MOSFET Characteristics (7 hrs)

Basic Concepts Of MOSFET – Capacitance- Voltage Characteristics – Threshold Voltage of MOS Capacitor – Flat-Band Voltage – Current-Voltage Relation of Long Channel MOSFETS – Drain Conductance – Transconductance – Drain Current Saturation – Body Effect

Module 5: MOSFET Structures (7 hrs)

Drift- Diffusion Model – Sub-Threshold Conduction, Slope And Mobility Models in MOSFETS – Temperature Effect – Equivalent Circuit of MOSFETS- Tailoring of MOSFET Parameters – Charge Sharing Model – Narrow Width Effect – Hot Carrier Effects. LDD MOSFET – VMOS, MESFET – MODFET.

Module 6: MOSFET Model: Equations, Boundary conditions and Approximations (7 hrs)

Level-1 model of MOSFET Level-2 model of MOSFET: Mobility modeling, Sub-threshold current-Channel length modulation- Short channel effect- Velocity saturation- Narrow width Effect- Gate capacitance- Junction capacitances – Level-3 model of MOSFET: Slope discontinuity Gate capacitances, BSIM model.

Text Book:

1. S.M. Sze, K. N. Kwok, “Physics of Semiconductor Devices”, 3rd Edition, John Wiley & Sons, 2008.

Reference Books:

1. S. M. Sze, “Semiconductor Devices: Pioneering Papers”, World Scientific Publishing Company, 2004.
2. D. P. Foty, “MOSFET Modeling with SPICE, Principles and Practices”, Prentice Hall PTR, 1997.

3. H. C. deGraff and F. M. Klaassen, “Compact Transistor Modeling for Circuit Design”, Springer-Verlog Wein, New York, 1990
4. E. Getreu, “Modeling the Bipolar Transistor”, Elsevier Scientific Publishing Company, 1978
5. Ben G. Streetman, Sanjay Banerjee, “Solid State Electronic Devices”, Pearson Prentice Hall, 2006
6. B. Bhattacharyya, “Compact MOSFET Models for VLSI Design”, March 2009, Wiley-IEEE Press

19EC2026	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives:
1. To understand the basic concepts of MEMS devices and materials for MEMS devices;
2. To impart knowledge about the fabrication processes in MEMS Design;
3. To know the essentials of SMART devices and its applications.

Course Outcomes:
The Student will be able to
1. Acquire knowledge on the basic concepts of MEMS Design;
2. Understand the mechanics behind MEMS devices;
3. Demonstrate on the rudiments of Micro fabrication techniques;
4. Develop MEMS structures based on various Micromachining techniques;
5. Design and model Smart devices;
6. Apply smart materials to intelligent systems.

Module 1: Introduction to MEMS and Characteristics of MEMS Materials (7 hrs)
Historical Background of MEMS – Typical MEMS products – Evolution of MEMS – Market Survey. MEMS materials: Silicon Compounds- Silicon Piezoresistors- Gallium Arsenide-Quartz-Piezoelectric crystals-Polymers.

Module 2: Mechanics of Solids in MEMS/NEMS (7 hrs)
Deformation Strains and Stresses – Residual Stress and Stress Gradients – Hookes’s law - Poisson effect - Linear Thermal Expansion - Bending Modeling of coupled Electrostatic Microsystems (Case study).

Module 3: Micro System Fabrication Processes ((8 hrs) hrs)
Photolithography- Ion Implantation- Diffusion- Oxidation- CVD – PVD - MBE- Chemical Etching (DRIE Process).

Module 4: Micromachining (7 hrs)
Basic surface micro machining processes –Problems in surface Micromachining – LIGA process (Case Study).

Module 5: Smart Sensors and Smart Actuators (8 hrs)
MEMS Switches – Circuit model and electromagnetic modeling of MEMS switches - Sensors and actuators based on HBLS materials – Application of ferroelectric materials in energy harvesters (Case Study) – NEMS.

Module 6: Smart Materials and Intelligent Systems (8 hrs)
Modelling mechanical and electrical systems –SMA – Piezoelectric - Electrostrictive materials – Magnetostrictive materials – patterning of piezo, pyro and ferroelectric polymers - Case studies on PVDF, Terfenol D, NiTiNOL.

Text Books:
1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, “Micro and Smart Systems”, Wiley India, 2012.
2. M. Madou, “Fundamentals of Microfabrication”, CRC Press, 2002.

Reference Books:
1. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering” (Vol. 8). CRC press, (2005).
2. M.H. Bao, “Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes”, Elsevier, New York, 2000.

3. Varadan, V.K., Vinoy, K.J. and Jose, K.J., “RF MEMS and their Applications”, John Wiley & Sons. 2002.
4. R.C Smith, “Smart Materials Systems: Model Development”, SoC Industrial and Appl. And Math., Philadeliphia, 2005.
5. JasPrit Singh, “Smart Electronic Materials: Fundamentals and Applications”, Cambridge University Press, 2006.

19EC2027	MATLAB PROGRAMMING FOR ENGINEERS	L T P C 3 0 0 3

Course Objectives:
1. To enable the students to understand the fundamentals and programming knowledge in MATLAB
2. To provide the deeper understanding of the tools and processes that enable students to use MATLAB for the engineering problems.
3. To assist the students with computational tools to design their own analysis and interpretation strategies when facing different engineering applications.

Course Outcomes:
The Student will be able to
1. Understand the process of converting computational problems into a series of simple steps.
2. Develop programs in the MATLAB language for engineering applications.
3. Analyze numerical data and perform input and output operations on it.
4. Illustrate the concept of toolboxes for practical applications
5. Summarize the concepts of various data visualization techniques.
6. Design Graphical User Interfaces for practical applications

Module 1: Introduction to MATLAB (8 hrs)
Advantages of MATLAB – MATLAB Environment – Using MATLAB as a Scratch Pad –Variables and Arrays – Multidimensional Arrays – Scalar and Array Operations – Hierarchy of Operations – Built-in MATLAB Functions – Branching Statements and Program Design– Loops and Vectorization – User Defined Functions – Introduction to Plotting – Examples – Errors – Debugging MATLAB Programs.

Module 2: Input and Output Functions (8 hrs)
Input / Output Functions: Text, Audio, Image and Video Read Functions – Load and Save –MATLAB File Processing – File Opening and Closing – Comparing Formatted and Binary I/O Functions – File Positioning and Status Functions – The text scan Function – Function uimport.

Module 3: Programs of Matrices and Polynomials (8 hrs)
Vectors and Matrices – Mathematical Operations with Matrices – Polynomial Evaluation – Rots of a Polynomial – Mathematical Operations with Polynomial – Formulation of Polynomial Equation – Differentiation and Integration – Polynomial Curve Fitting – Evaluation of Polynomials with Matrix Arguments – Ordinary Differential Equation Solvers – Symbolic Mathematics.

Module 4: Data Visualization (7 hrs)
Data Visualization and Statistics – 2D Graphics: Plot and fplot COMMAND– Plotting Multiple Graphs in the Same Plot –Formatting a Plot. Logarithmic Axes – Error Bars – Special Graphics – Histograms – Putting Multiple Plots on the Same Page – Multiple Figure Windows – 3D Graphics: Line Plots – Mesh and Surface Plots – Examples of MATLAB Application.

Module 5: Graphical User Interface (7 hrs)
Introduction to Graphical User Interfaces in MATLAB – Designing GUI interfaces using MATLAB’s GUIDE interface – MATLAB Handle graphics primitives – Cell-array – Structure of a Callback Subfunction – Get/Set Interface –Object Properties – Graphical User Interface Components – Additional Containers:Panels and Button Groups – Dialog Boxes – Menus – Creating Efficient GUI

Module 6: Applications using MATLAB Toolboxes (7 hrs)
Control System toolbox, Neural Networks tool box, Signal/image processing tool box, optimization toolbox.

Text Books:

1. Stephen J Chapman, “MATLAB programming for engineers”, 5th Edition, Cengage Learning, 2015.
2. Amos Gilat, “MATLAB: An Introduction With Applications", John Wiley & Sons, 2009.

Reference Books:

1. R.K.Bansal, A.K.Goe, M.K.Sharma, "MATLAB and Its Applications in Engineering", Pearson Education India, 2009.
2. Edward B. Magrab, “An Engineer's Guide to MATLAB: With Applications from Mechanical, Aerospace, Electrical, Civil, and Biological Systems Engineering",3rd Edition, Prentice Hall, 2011.
3. Rudra Pratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 2010.
4. D. M. Etter, "Introduction to MATLAB for Engineers and Scientists", Prentice Hall, 1996.
5. William J. Palm III, "Introduction to MATLAB for Engineers", 3rd Edition, McGraw-Hill, 2005.

19EC2028	FUNDAMENTALS OF WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the concepts of wireless communication.
2. To make the students to know about the various propagation methods and Channel models.
3. To enhance the understanding of various transceivers and its multiple access schemes.

Course Outcome:

The Student will be able to

1. Explain the concepts of wireless communication.
2. Interpret the various propagation methods and channel models.
3. Identify various transceivers and its multiple access schemes.
4. Model multichannel response
5. Develop design of wireless system
6. Analyze wireless channel capacity

Module 1: Review of Wireless Systems (8 hrs)

History of Wireless Systems-Wireless Vision- Technical Issues-Current Wireless Systems-Cellular Telephone systems-Cordless Phones-Wireless LAN-Wide Area WDS-Broadband Wireless Access-Paging Systems-Satellite Networks-Low Cost-Low power Radio-Bluetooth-Zigbee-Ultraband Radio.

Module 2: Wireless Spectrum (8 hrs)

Wireless Spectrum: Methods of Allocation-Spectrum Allocation of Wireless System-Cellular System Fundamentals: Frequency Reuse-Channel Assignment strategies-Handoff Strategies-Interference and system Capacity-Interference and Capacity-Improving Coverage and Capacity in Cellular system.

Module 3: Path Loss and Shadowing (8 hrs)

Path Loss and Shadowing: Radiowave propagation-transmit and Receive signal Model-Free Space path loss-Ray Tracing: Two ray Model-Simplified Path loss Model-Shadow Fading-Combined path loss and shadowing-Outage Probability under path loss and shadowing.

Module 4: Statistical Multipath Channel (7 hrs)

Statistical Multipath Channel Models: Time varying channel impulse response-Narrow band Fading Models: Level Crossing Rate –Average Fade Duration.

Module 5: Wideband Fading Models (7 hrs)

Wideband Fading Models: Power Delay Profile-Coherence Bandwidth-Doppler Spectrum –Coherence Time-Capacity of Wireless Channel: Capacity of AWGN Channel-Capacity of Frequency Selective Fading Channels.

Module 6: Signal Encoding and Multi Carrier Modulation (7 hrs)

Digital Signal encoding techniques, multi carrier modulation, orthogonal frequency division multiplexing, orthogonal frequency division multiple access

Text Book:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2007.

Reference Books:

1. William C Y Lee, "Mobile Communication Engineering, Theory and Applications", Second Edition, McGraw Hill International Editions, 1998.
2. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia, New Delhi, Second Edition, 2002.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Prentice Hall, 2003.
4. Vijay K. Garg, "Wireless Communications and Networking", Elsevier-Morgan Kaufmann Publishers, Reprint 2013.

19EC2029	DATA SCIENCE AND DATA ANALYTICS	L T P C 3 0 0 3

Course Objectives:

1. Understand the statistics and machine learning concepts that are vital for data science
2. Learn to statistically analyze a dataset
3. Critically evaluate data visualization based on their design and use for communicating stories from data

Course Outcomes:

The Student will be able to

1. Understand the key concepts in data science, its applications and the toolkit used by data scientists;
2. Realize how data is collected, managed and stored for data science;
3. Apply various machine learning techniques in real-world applications
4. Implement data collection and management
5. Apply visualization tools for data visualization
6. Possess the required knowledge and expertise to become a proficient data scientist

Module 1: Introduction to Data Analytics (7 hrs)

Introduction, Terminology, data science process, data science toolkit, Types of data, Introduction to Python, Data Analysis in Excel, Analytics Problem Solving, Exploratory Data Analysis, Example applications.

Module 2: Data collection management and Statistics (7 hrs)

Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Advanced SQL using multiple data sources, Statistics and Hypothesis Testing, Inferential Statistics, Big Data Storage and Processing Framework, Hadoob.

Module 3: Data analysis (8 hrs)

Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.

Module 4: Data visualization (8 hrs)

Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings, Data Visualization in Python-Superset or in Microsoft Power BI

Module 5: Computing and Applications (8 hrs)

Using Python for Data Science - Using Open Source R for Data Science - Using SQL in Data Science - Software Applications for Data Science. Applications of Data Science, Technologies for visualization like Data Visualization in Microsoft Power BI.

Module 6: Trends and Technologies (7 hrs)

Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods used in data science, NYC Parking Case Study: Apache Spark

Text Books:

1. Cathy O'Neil and Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly, 2014. ISBN: 978-1-449-35865-5
2. Davy Cielen. Arno D.B Meysman, Mohamed Ali, "Introducing Data Science", Dreamtech Press, 2016. ISBN: 978-93-5119-937-3

Reference Books:

1. Joel Grus, Data Science from Scratch, O'Reilly, 2015, ISBN: 978-1-491-90142-7
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman, Mining of Massive Datasets. v2.1,
3. Cambridge University Press, 2014. ISBN : 9781139924801
4. John W. Foreman, Using Data Science to Transform Information into Insight – Data Smart, Wiley, 2014. ISBN: 978-81-265-4614-5
5. https://github.com/maximrohit/SPARK-R-SQL-NYC-PArking-Ticket-Analysis

19EC2030	CLOUD COMPUTING	L T P C 3 0 0 3

Course Objectives:

1. Understand the concepts of virtualization and its application in cloud
2. Learn an overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
3. Develop real world design constraints

Course Outcomes:

The Student will be able to

1. Infer the concept of virtualization in the cloud computing
2. Use the concepts of cloud storage, cloud networks and its management
3. Identify security aspects of each cloud model
4. Develop a risk-management strategy for moving to the Cloud
5. Infer the advantages of Cloud Services.
6. Learn about optimization of cloud storage.

Module 1: Virtualization (8 hrs)

Virtualization, Hypervisors, Types of hypervisors. Virtualization techniques - para virtualization - full virtualization, - hardware assisted virtualization - hybrid virtualization, what is virtual machine, server virtualization models, server virtualization platforms Architecture - KVM - Citrix Xen Server - Microsoft Hyper-V - VMware ESx, physical to virtual conversion - VMWare converter - Microfocus Platespin - Microsoft conversion tools - Case Study Open Source p2v conversion tools.

Module 2: Cloud Computing (8 hrs)

Overview of Cloud Computing, Characteristics of Cloud, Benefits, limitations, Cloud Deployment Models, Cloud service models-Infrastructure as a service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), Anything as a Service (XaaS). OpenStack Private Cloud Architecture, Deployment models, Basic Services - Keystone - Glance - Nova - Cinder - Swift - Horizon, Case Study OpenStack optional services.

Module 3: Security Issues in Cloud Computing (8 hrs)

Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security.

Module 4: Security and Access Management in the Cloud (7 hrs)

Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS, Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management.

Module 5: Cloud of Things (7 hrs)

Cloud computing-Grid/SOA and Cloud Computing-Cloud Middleware-NIST's SPI Architecture and Cloud Standards-Cloud Providers and Systems-Internet of Things and Cloud Computing-Mobile Cloud Computing-MAI versus XaaS-Cloud of Things Architecture.

Module 6: Deployment Models of Cloud in IoT (7 hrs)
Deployment models of Cloud computing in IoT-Implications of Cloud Computing in view of Deployment-Issues for Deployment and Optimization, MS Azure, Amazon interfaces-Convergence of Cloud and IoT-Data Security Reliability-Resource Provisioning-Service Level Agreement-Quality of Service-Privacy and Device Integration.

Text Book:
1. Pradeep Tomar, Gurjit Kaur," Examining Cloud Computing Technologies Through the Internet of Things (Advances in Wireless Technologies and Telecommunication)", IGI Global, 2018, 1st Edition, ISBN-13: 978-1522534457, ISBN-10: 1522534458.

Reference Books:
1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", 2009, McGraw-Hill Osborne Media, ASIN: B00ME3OQP6
2. John W. Rittinghouse, James F. Ransome, "Cloud Computing Implementation, Management, and Security", First Edition, 2009, CRC Press, ISBN-13: 978-1439806807
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", 2013, CRC press, ISBN 978-1-4398-9299-2.
4. Raghuram Yeluri, "Building the Infrastructure for Cloud Security-A Solutions View", Apress Open, 2014, ISBN-13: 978-1430261452.
5. John Rhoton, "Cloud Computing Explained: Implementation Handbook for Enterprises", Publication, 2009, ISBN: 0956355609

19EC2031	IoT EDGE COMPUTING	L T P C 3 0 0 3

Course Objectives:
1. To understand the fundamentals of IoT and Edge Computing Devices
2. To develop IoT architecture and protocols.
3. To implement the IoT based systems.

Course Outcomes:
The Student will be able to
1. Infer the structure of IoT systems
2. Critically evaluate cloud services and edge computing.
3. Implement software using standard open-source cloud and edge computing software for data analytics.
4. Identify security issues of edge devices
5. Develop and execute a project related to data analytics and edge computing
6. Apply edge computing techniques for various applications

Module 1: Introduction (8 hrs)
Organisation and primary components of IoT systems, Structure of IoT systems, IoT backend modules, IoT gateways, IoT edge devices, Edge Computing and Fog Computing, Information Data Management: Handling and Security, Compliance, Audit

Module 2: Cloud Computing (7 hrs)
Cloud Computing, Cloud databases, Cloud computing analytics pipeline Coordination of Cloud Services, Usage of Private/public cloud, Hybrid cloud, connected car

Module 3: Edge architectures and protocols (8 hrs)
Edge Computing, Security and Performance, Load Balance, Streaming data: Collection and Sharing of data, Edge Computing authentication, Edge Architectures, Sensors and actuators for IoT systems, Algorithms, BAN/WSN Architectures and Characteristics for Sensor Networks and IoT Devices, Communication protocols and protocol stacks for the edge device, Edge servers, data security and manipulation, 3GPP (LTE-M, NB-IOT, EC_GSM, 5G & IoT), LPWAN, LORA, SIGFOX

Module 4: Hardware security and issues (7 hrs)
Hardware security for edge devices, Design issues for the IoT edge, Interoperability and reliability issues, Identity and access management, Implementing Security control, data plan, SDN, Dynamic QoS, Data generated from device, Life cycle of Edge device.

Module 5: Building IoT with RASPBERRY PI & ARDUINO (8 hrs)
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.
Module 6: Applications (7 hrs)
Edge Computing Applications, Case Study using Apache Edgent, Connected air craft, Health care, Connected car, Media Streaming Services : Edge Server, data security, Data content delivery, Home Security, heart beat technology – Monitoring and data compliance.
Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach‖", Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things Key applications and Protocols", Wiley, 2012
4. Hanes David,Salgueiro Gonzalo, Grossetete Patrick, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things", 2017, edition 1st, Henry Jerome 9386873743-13:978-ISBN, Pearson Education
5. Harry Fairhead, "Raspberry Pi Iot in C", 1st edition, 2016, I/O Press, ISBN-13: 978-1871962468.
6. Kimmo Karvinen ,Tero Karvinen, "Getting Started with Sensors", 1st edition 2014, O′Reilly, ISBN-13: 978-1449367084

19EC2032	COMMUNICATION QUALITY OF SERVICE	L	T	P	C
		3	0	0	3

Course Objectives:
1. To develop understanding of some fundamental techniques used to model communication networks.
2. Analyze the various advanced networks.
3. Design and simulate innovative networks and topologies.

Course Outcomes:
The Student will be able to
1. Illustrate the flow control and congestion control in Transmission control protocol.
2. Distinguish best effort service and QoS.
3. Explain Quality of Service mechanisms in networking.
4. Demonstrate the challenges in packet classification and scheduling algorithm.
5. Develop QoS framework for wireless IP networks.
6. Formulate IP/ATM integration

Module 1: Overview of Internet (7 hrs)
Evolution of network, Internet, overview of ATM, overview of IP based wireless communication, TCP/IP - Congestion and Flow Control, TCP for high bandwidth delay networks, Fairness issues in TCP.
Module 2: Real Time Communications over Internet (8 hrs)
Current state of Internet, QOS, architectures for resource allocation – IETF solutions, Integrated Services Model (IntServ), architecture, reference model, Characterization of Traffic - Linearly Bounded Arrival Process (LBAP), Leaky bucket, token bucket algorithm, QOS parameters, RSVP.
Module 3: Packet Scheduling (7 hrs)
Basic requirements, Design choices, approaches, GPS, WFQ, WFQ variants and Rate proportional algorithms. Active Queue Management – Goals, RED, WRED.
Module 4: IP address lookup-challenges (8 hrs)
Flow Identification – Hashing based schemes, Packet classification, Classification algorithms – Caching approach, IP lookup problem & longest prefix matching, Grid of Tries approach, Cross producting algorithm and controlled prefix expansion algorithms.

Module 5: Admission control and differentiated services (8 hrs)
Admission control functions, Measurement based admission control – Exponential averaging, Time window approach, Differentiated Services in Internet (DiffServ), DiffServ architecture and framework, Service & forwarding treatment, PHBs, DS field, Traffic classification & conditioning, Dual token bucket algorithm, IntServ over DiffServ.
Module 6: IP switching and MPLS (7 hrs)
QoS in ATM, Service classes, Overview of IP over ATM, IP switch, Label switching, MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.
Reference Books:

1. Zheng Wang, "Internet QoS: Architectures and Mechanisms for Quality of Service", Morgan Kaufman, 2001.
2. Sanjay Jha, Mahbub Hassan, "Engineering Internet QoS", Artech House Publishers, 2002.
3. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach", Morgan Kaufman Publishers, 2004.
4. George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005.

19EC2033	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

Course Objectives:
The main objectives of the course are
1. To provide a conceptual understanding of security issues and challenges
2. To impart knowledge on classical and modern encryption standards and algorithms
3. To provide an insight on network security applications

Course Outcomes:
The Student will be able to
1. List and describe the various security risks and mechanisms for handling them
2. Understand the mathematical concepts involved in cryptography
3. Classify symmetric and asymmetric ciphers
4. Handle data integrity using hash functions and fulfil message authentication requirements
5. Describe key management and user authentication techniques
6. Apply algorithms to handle network security issues

Module 1: Introduction to Cryptography (67 hrs)
OSI Security Architecture, Security Attacks, Services and Mechanisms, Model for Network Security, Simple Cryptosystems – Shift Cipher, Substitution Cipher, Permutation Cipher, Steganography, Block Cryptography.
Module 2: Modular Arithmetic (7 hrs)
Groups, Rings, Fields, Finite Fields of the Form GF(p) and GF(2n), Testing for Primality, Chinese Remainder Theorem, Fermat's and Euler's Theorem, Discrete Logarithms, Shannon's Theory
Module 3: Symmetric and Asymmetric Ciphers (8 hrs)
Data Encryption Standard, Advanced Encryption Standard, Triple DES, RC4, Principles of Public Key Cryptography, RSA Algorithm, Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Cryptography
Module 4: Cryptographic Data Integrity (8 hrs)
Applications of Hash Functions, Hash functions based on Cipher Block Chaining, Secure Hash Algorithm (SHA), Whirlpool, HMAC, CMAC, Message Authentication Requirements and Functions, Digital Signal Schemes and Algorithms
Module 5: Key Management and User Authentication (8 hrs)
Key Distribution using Symmetric and Asymmetric Encryption, Distribution of Public Keys, X.509, Remote User Authentication, Kerberos
Module 6: Network Security Applications (8 hrs)
Email Architecture and Security, PGP, S/MIME, IP Security Overview, IP Security Architecture, Encapsulating Security Payload, Web Security Considerations, SSL and TLS, Secure Electronic Transaction, Wireless LAN Security Standards, Intrusion Detection, Firewalls

Text Books:

1. William Stallings, "Cryptography and Network Security – Principles and Practices", Seventh Edition, Pearson, 2017.
2. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw Hill, 2008.

Reference Books:

1. Douglas R Stinson and Maura B Paterson, "Cryptography – Theory and Practice", Fourth Edition, Chapman & Hall/CRC, 2018.
2. Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003.
3. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000.
4. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2002.

19EC2034	FUNDAMENTALS OF HARDWARE IP PROTECTION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To demonstrate DRM concept in SoC platform.
2. To design on-chip locks by modifying circuit under data protection schemes.
3. To know the techniques and challenges of Hardware Obfuscation in hardware application for the Detection of Hardware Trojan.

Course Outcomes:

The Student will be able to

1. Manage hardware digital rights (DRM).
2. Modify a design to make it lockable.
3. Change the circuit harder to reverse-engineer.
4. Identify IP identification embedded in a digital device.
5. Hamper IP piracy and technological espionage
6. Make a novel partial hardware for reverse engineering methodology

Module 1: Introduction (8 hrs)

Smart Lock DRM IP Principle - State of the Art : PUF Principles, Fingerprint and IP Protection - DRM Flow - DRM Integration in SoC.

Module 2: On-Chip Locks (7 hrs)

Features Usable as Locking Means - Practical Transformation into On-Chip Locks - Implementation on FPGA and Results

Module 3: IP Protection Methods (8 hrs)

A Formal Foundation for Logic Protection Schemes - Proposed Graph Analysis-Based Logic Locking Scheme - Implementation Results - Evaluation - Security Analysis - Architecture of a Complete Design Data Protection Scheme

Module 4: Side Channel Analysis (7 hrs)

Introduction - FSM Watermarking Verification Scheme Using Power Consumption Analysis - Electromagnetic Communication of IP Data

Module 5: Hardware Obfuscation (8 hrs)

Layout-Level Obfuscation - Camouflage Gates - Obfuscating the Connectivity - Further Obfuscation Techniques - Reverse-Engineering Camouflage Gates - Netlist-Level - Netlist Reverse-Engineering Techniques - Control Flow Obfuscation - Combined Data and Control Flow Obfuscation - Reconfiguration Obfuscation

Module 6: Hardware Trojan (7 hrs)

Integrated Circuits, Malicious Hardware Modifications and Base of Retro-Engineering - Accessing Information by Microscopy Means - Proposal of a Novel HT Detection Methodology - Methodology Advantages - The Three Different Detection Scenarios - Applying the Methodology to a Real Detection Case

Text Book:

1. Lilian bossuet, Lionel Torres, "Fundamentals of Hardware IP Protection", Springer International Publishing AG 2017.

Reference Books:

1. M. Tehranipoor, C.Wang (eds.), “Introduction to Hardware Security and Trust” (Springer, 2012). ISBN 978-1-4419-8079-3.
2. Forte, Domenic, Bhunia, Swarup, Tehranipoor, Mark M. (Eds.) “Hardware Protection through Obfuscation”, Springer International Publishing 2017,
3. Swarup Bhunia, Mark M. Tehranipoor, “The Hardware Trojan War, Attacks, Myths, and Defenses” (Springer, 2018). Online ISBN 978-3-319-68511-3.

19EC2035	FAULT TOLERANT ARCHITECTURES FOR HARDWARE SECURITY	L T P C 3 0 0 3

Course Objectives:

1. To make the students understand the concept of fault model and fault attacks
2. To enable the students to get familiarized coverage of countermeasure techniques and fault tolerant architectures
3. To make the students understand how the fault tolerance can be combined with side channel security to achieve protection against implementation-based attacks.

Course Outcomes:

The Student will be able to

1. Apply different Fault analysis
2. Understand Different fault attacks
3. Use the Side channel fault analysis
4. Build the Faults injection techniques
5. Get knowledge about fault tolerance
6. Relate Counter measures

Module 1: Introduction- Fault attacks and fault models (7 hrs)

Differential Fault Analysis (DFA), Fault Sensitivity Analysis, Differential fault Intensity Analysis (DFIA), Safe Error Attacks (SEA) and Differential Behavior Analysis (DBA) Fault Injection Techniques :– Semi – invasive and Non –invasive Methodologies- Spike Attacks, Glitch Attacks Optical / Laser Attacks, Electromagnetic Attacks

Module 2: Classical fault attacks on public and Symmetric Key cryptosystems (8 hrs)

The Seminal fault attack on RSA, Differential Fault Analysis(DFA)of Block ciphers- The Basic principle of DFA, Permanent and Transient faults, Fault models for DFA, DFA on a Generic SPN Block Cipher, Differential fault analysis of AES,Differential fault analysis of AES-128 Using Multiple Byte Faults, Differential fault analysis of the AES-128 Key Schedule

Module 3: Side channel Fault analysis Techniques (8 hrs)

Fault sensitivity Analysis of block ciphers- General Attack Principle,Formal Attack Procedure, Advantages of FSA over DFA , Differential Fault Intensity Analysis of Block Ciphers-The Fault Model for DFIA, The General Attack Methodology, Overview of the PRESENT Block Cipher, DFA on PRESENT, The Combined SCA and DFA of PRESENT, The Key Recovery Process,

Module 4: Fault Injection and Analysis (7 hrs)

Laser based fault Injection Techniques- The Physics of Laser Fault Injection, Device Decapsulation, A Case Study of Laser-Based Fault Attackson the ChaCha Family of Stream Ciphers.

Module 5: Advanced Fault Attacks in Software Automation of fault Analysis (8 hrs)

What Is Rowhammer? Dynamic Random Access Memory(DRAM) Combining Timing Analysis and Rowhammer Experimental Validation for Inducing Bit Flipson Secret, Possible Countermeasures, Algebraic Cryptanalysis, Polynomial Systems of Equations over Finite Fields, Generation of S-Box Polynomials, MQ to CNF Conversion,Algebraic Fault Analysis.

Module 6: Classical Countermeasures Against Differential Fault Analysis (7 hrs)

Spatial Redundancy, Temporal Redundancy , Information Redundancy: Code-Based Detection Techniques, Hybrid Redundancy, Fault Bias Versus Classical Redundancy, Biased Fault Attack on Redundant AES-128, Countering Fault Collision: Transformation of the Fault Space, Application of Fault Space Transformationon AES-128 The First Infective Countermeasure for AES

Reference Books:

1. Sikhar patranabis, Debdeep Mukhopadhyay, “Fault Tolerant Architectures for Cryptography and Hardware Security”, 2018, Springer, Singapore Publishers
2. P. K. Lala, “Fault Tolerant and Fault Testable Hardware Design”, Prentice-Hall,1985.
3. SwarupBhunia, Mark Tehranipoor, “A Hands-on Learning Approach”, 1st Edition, Kindle Edition
4. Stallings,W, "Cryptography and Network security", Principles and Practice, 3rdEdition, Prentice Hall, 2002.

19EC2036	NEUTRAL	L T P C
		3 0 0 3

Course Objective:

1. To impart knowledge on the fundamentals of neural networks
2. To get familiarized with the different architectures involved in neural networks
3. To identify the appropriate neural/deep network for practical applications.

Course Outcomes:

The Student will be able to

1. Compare and comprehend the functioning of human brain and ANN.
2. Gain an understanding about training methodologies of neural networks
3. Summarize the pros and cons of different single layer ANN.
4. Apply artificial neural networks for solving engineering problems
5. Outline the basic concepts and applications of deep learning
6. Make use of different Deep networks for real time applications.

Module 1: Introduction to Neural Networks (8 hrs)

Humans and Computers - Organization of the Brain - Biological Neuron, Biological and Artificial Neuron Models – Characteristics of ANN - McCulloch-Pitts Model – Historical Developments – Potential Applications of ANN.

Module 2: Essentials of Artificial Neural Networks (7 hrs)

Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, nsupervised, Reinforcement) - Learning Rules.

Module 3: Single Layer Feed Forward Neural Networks (8 hrs)

Introduction- Perceptron Models: Discrete, Continuous and Multi-Category- Training Algorithms: Discrete and Continuous Perceptron Networks - Limitations of the Perceptron Model. Architecture of Hopfield Network.

Module 4: Multilayer Feed forward Neural Networks (8 hrs)

Generalized Delta Rule, Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Learning Difficulties and Improvements

Module 5: Introduction to Deep learning (7 hrs)

History of Deep Learning, Real time applications, Gradient Descent, Momentum based GD, Eigenvalues and eigenvectors, Eigenvalue Decomposition.

Module 6: Deep learning networks (7 hrs)

Convolutional Neural Networks LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Guided back propagation.

Text Book:

1. Laurene Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Fourth edition, Pearson Education India, 2006.

Reference Books:

1. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.
2. Mohamad Hasoun, “Fundamentals of artificial neural networks”, MIT Press, 2003

3. Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville. http://www.deeplearningbook.org.
4. Michael Nielson, "Neural Networks and Deep Learning", "http://static.latexstudio.net/article/2018/0912/neuralnetworksanddeeplearning.pdf"

19EC2037	REAL TIME OPERATING SYSTEM	L T P C 3 0 0 3

Course Objectives:
1. To understand functional differences between real time and real time operating systems.
2. To Examine and evaluate the hardware functionality required by embedded systems to achieve real time operations.
3. To demonstrate the concept of real time programming using tasks, gain knowledge and skills necessary to design and develop embedded applications using real time operating systems.

Course Outcomes:
The Student will be able to
1. Understand the fundamental concepts of real-time system and real-time operating system.
2. Analyze given requirements, design hardware & software for real time systems.
3. Apply modern engineering tools for real time firmware development & performance analysis.
4. Verify the specifications of various real time operating systems used for meeting timing constraints of given problem.
5. Apply their understanding to develop and implement device drivers
6. Apply their understanding in handling in handling real time problems through some case studies.

Module 1: Introduction (8 hrs)
Overview, Architecture Real Time Systems, Real Time Services, Real Time Standards,Hard Real time and Soft Real-time, Differences between General Purpose OS & RTOS **System Resources:** Resource Analysis, Real Time Service Utility, Cyclic Executives **Basics of RTOS:** Kernel Features, Real-time Kernels: Polled Loops System, Co- routines, Interrupt-driven System, Multi-rate System; Processes, Threads, Tasks, States, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi-tasking

Module 2: Processing (8 hrs)
Scheduling Classes, Scheduler Concepts, Pre-emptive Fixed Priority Policy, Feasibility, Rate Monotonic LUB, Necessary & Sufficient Feasibility, Dead Line Monotonic, Dynamic Priority Policies **I/O Resources:** WCET, Intermediate I/O, Execution Efficiency **Memory:** Physical Hierarchy, Cache, Memory Planning, Memory shadowing – I/O Buffering

Module 3: RTOS Services (8 hrs)
Task Creation, Inter Task Communication: Pipes, Message Queues, Mail Box, Memory Mapped Objects; Critical Section, Shared Data Problem, Synchronization: Signals, Semaphores Mutex; Remote Procedure and Sockets, Real Time Memory Management: Process Stack Management, Dynamic Allocation Memory Technologies-Need for memory Hierarchy-Memory allocation strategy-Hierarchical Memory Organization-Virtual Memory-Cache Memory- Mapping Functions-Cache Design-Unified or split cache-multiple level of caches-ARM cache features

Module 4: Real Time Kernel & Timer Services (7 hrs)
Converting a normal Linux kernel to real time kernel, Xenomai basics. Overview of Open source RTOS for Embedded systems (Free RTOS/ ChibiosRT) and application development. Real Time Clocks & System Clocks, Programmable Interval Timers, Timer Interrupt Service Routine, Soft-timer Handling, Soft Timers elated Task**Synchronization Issues:** Resource Classification, Racing, Deadlock – Deadlock Avoidance – Deadlock Prevention – Deadlock detection – Producer Consumer problem, Live lock, Starvation, Priority Inversion, Priority Ceiling & Inheritance. POSIX standards, RTOS Issues – Selecting a Real-Time Operating System.Basic design using RTOS.

Module 5: VXWORKS / RTOS Zephyr (7 hrs)
VxWorks/ RTOS Scheduling and Task Management – Realtime scheduling, Task Creation, Intertask Communication, Pipes, Semaphore, Message Queue, Signals, Sockets, Interrupts I/O Systems –

General Architecture, Device Driver Studies, Driver Module explanation, Implementation of Device Driver for a peripheral.

Module 6: Case Study (7 hrs)

Software Development and Tools: Simulators, debuggers, cross compilers, in circuit emulators for the microcontrollers. Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board (Beagle Bone Black, Rpi or similar), Porting an Embedded OS/ RTOS to a target board. Testing a real-time application on the board

Reference Books:

1. Sam Siewert, "Real-Time Embedded Systems and Components", Cengage Learning India Edition 2007, ISBN: 9788131502532
2. Krishna CM and Kang Singh G, "Real time systems", 2003, Tata McGraw Hill, ISBN: 0-07-114243-64
3. Qing Li and Carolyn Yao, "Real-Time Concepts for Embedded Systems", 2003 CMP Books, ISBN:1578201241
4. Jane W. S. Liu, "Real Time Systems", Prentice Hall, 2000 ISBN:0130996513
5. Jean J Labrosse, "Micro C/OS-II, The Real Time Kernel", CMP Books, 2011
6. VxWorks: Programmer's Guide 5.4, Windriver, 1999.

19EC2038	IOT BASED DATA ACQUISITION SYSTEMS AND PROTOCOLS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basic concepts of IoT network architecture.
2. To acquire Knowledge in sensors for data acquisition.
3. To explore the potential areas utilizing IoT networked real time systems.

Course Outcomes:

The Student will be able to

1. Acquire knowledge about the various network architectures of IoT
2. Understand the basic concepts of sensors and actuators
3. Gain knowledge in various network protocols
4. Gain knowledge in data acquisition methods and instruments
5. Articulate the various applications of IoT networked systems
6. Apply the acquired knowledge to develop an IoT networked application

Module 1: Introduction to IoT (7 hrs)

IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack, Everything as a Service (XaaS), IOT Analytics and M2M.

Module 2: **Engineering IoT Networks (8 hrs)**

Smart Objects: The "Things" in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Wireless Sensor Networks, Connecting Smart Objects, Communications Criteria, Range, Frequency Bands, Power Consumption, Constrained- Node Networks, Data Rate and Throughput, Latency and Determinism, Overhead and Payload

Module 3: **IoT Access Technologies (7 hrs)**

IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, IEEE 802.11ah, Physical Layer, MAC Layer, Topology, Security, LoRaWAN, LTE-M, NB-IoT

Module 4: **IP as the IoT Network Layer (8 hrs)**

The Need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, IoT Application Transport Methods, SCADA, SCADA Transport over LLNs with MAP-T, IoT Application Layer Protocols

Module 5: **Data Acquisition (8 hrs)**

Introduction to data acquisition, Analog Interfacing Connecting signal to board, Analog Input/output techniques digital I/O, counters, NI-DAQmx tasks. DAQ Hardware configuration: Introduction, Measurement and Automation Explorer, DAQ Assistants, Analysis Assistants. Interfacing Instruments:

GPIB and RS232 Introduction, RS232 Vs. GPIB, Handshaking, GPIB Interfacing, RS232C/RS485 Interfacing, and VISA

Module 6: **Case Studies and Real-World Applications (7 hrs)**

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT

References Books:

1. Hanes David,Salgueiro Gonzalo, Grossetete Patrick, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things:, 2017, edition 1st, Henry Jerome 9386873743-13:978-ISBN ,Pearson Education
2. Harry Fairhead "Raspberry Pi IoT in C", , 1st edition, 2016, I/O Press;, ISBN-13: 978-1871962468
3. Arsheep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach", 1st edition, 2015, Orient Blackswan Private Limited - New Delhi, ISBN-13: 978-8173719547
4. Kimmo Karvinen ,Tero Karvinen, "Getting Started with Sensors", 1st edition 2014, O′Reilly, ISBN-13: 978-1449367084

		L	T	P	C
19EC2039	**AUGMENTED REALITY**	**3**	**0**	**0**	**3**

Course Objectives:

1. To establish and cultivate a board and comprehensive understanding of the rapidly evolving and commercially viable field of computer vision.
2. To make students know the basic concept and framework of augmented reality.
3. To know the mixed reality for multimodal user interaction and perception in virtual reality.

Course Outcomes:

The Student will be able to

1. Compare the difference between augmented reality and virtual reality.
2. Articulate the 3D model in virtual environment.
3. Illustrate the visual modelling in both marker and marker-less AR.
4. Categorize the different interactive techniques in AR and VR.
5. Apply in various application of digital entertainment.
6. Explore AR and VR model in software tools.

Module 1: Introduction to Augmented Reality (7 hrs)

Introduction to augmented reality, System structure of AR, Key technology in AR, General solution for calculating geometric and illumination consistency in the augmented environment, opportunities for augmented reality.

Module 2: Types of Augmented Reality (7 hrs)

Different types of augmented reality, How AR works, Augmented reality methods – Marker and Marker-less AR, AR display technology, Interaction in AR applications, User interface and Uses of AR

Module 3: Virtual Environment and 3D User Interface (8 hrs)

The historical development of VR, Scientific landmarks computer graphics, Real-time computer graphics, Flight environment, Virtual environments, Requirement for VR, Visual displays, Auditory displays, Haptic displays, Desktop input devices, 3D Mice, Special purpose input devices, Direct human input, Home – Brewed input devices, Choosing input and output devices for 3D user interface.

Module 4: Camera Tracking and 3D Rendering for Immersive Environment (8 hrs)

Inside-Out camera tracking, Full-Body tracking, Rendering architecture, Distributed VR architecture, Augmenting the sense of presence, Identify in immersive environments, agency and interactivity, Physical computing, User performance studies.

Module 5: Sound in Immersive Environment (8 hrs)

Evolution of sound systems – From mono to stereo to surround, Object based sound, Ambisonics, HRTF, Sound design basics – Sound as information, Earcons, Impact of sound in objects and actions, Natural versus Real sound.

Module 6: Development Tools and Its Application (7 hrs)
Frameworks of software development in VR, Modelling tools for VR, X3D standards, Vega, MultiGen, Virtools, Unity 3D, Vuforia.

Text Books:

1. Guangran LIU. "Virtual Reality Technology", Tsinghua Press, Jan. 2011.
2. Burdea, G. C. and P. Coffet. "Virtual Reality Technology", Second Edition. Wiley-IEEE Press, 2006/ 2003.

Reference Books

1. Fei GAO. "Design and Development of Virtual Reality Application System", Tsinghua Press, March 2012.
2. Erin Pangilinan, Steve Lukas, and Vasanth Mohan, "Creating Augmented & Virtual Realities: Theory and Practice for Next-Generation Spatial Computing", O`Reily Media Publisher, 2019.
3. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
4. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
5. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
6. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
7. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
8. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002.

19EC2040	INTERNET OF INTELLIGENT THINGS	L	T	P	C
		3	0	0	3

Course Objectives:

1. The students understand the concepts of Internet of Intelligent Things.
2. The students to get familiarized with the applications of neural networks and computing connected to intelligent machines.
3. The students to choose appropriate technologies for implementing various prototypes

Course Outcomes:
The Student will be able to

1. Understand the concepts of intelligent things
2. Articulate the structure of Neural Networks in IoT
3. Understand the need of FOG computing services
4. Design and build IoT systems using Raspberry Pi
5. Be able to demonstrate various prototypes
6. Examine various real time applications and case studies

Module 1: Intelligent Things (7 hrs)
Introduction, IOT Challenges, Artificial Intelligence for Intelligent Sensing, Social Networks and IIOT, Pervasive Intelligent Robots, Intelligent Large-Scale Sensing, Natural Language Processing and Automatic Speech Recognition.

Module 2: Neural Networks (8 hrs)
ANN for IoT Health Care, CNN- GCNN and FCNN, Deep Learning Basics, Deep Neural Networks, Deep Neural Processing Units, Feedforward DNN Accelerator, Applications of DNN.

Module 3: Fog Computing (7 hrs)
Fog Computing Basics, Fog Computing Services, Fog Computing Architecture, Self-Aware Fog Computing, Health Monitoring, Patient Safety Monitoring, Intelligence Surveillance.

Module 4: Building IoT with Raspberry PI & ARDUINO (8 hrs)
Building IOT with RASPERRY PI- IoT Systems - Logical Design – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi - Other IoT Platforms - Arduino.
Module 5: Prototypes (8 hrs)
Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT, Smart Networked Cities, Smart Residences, Smart Individual Transportation, Intelligent Hospitals.
Module 6: Applications and Case Study (7 hrs)
Body Area Networks, Brain Computer Interface, BCI Classes and Applications, Smart Stick for Blind Peoples, Smart Home Assistive System, Intelligent Face Recognition.
Text Books:
1. Fatos Xhafa, Nik Bessis, "Inter-Cooperative Collective Intelligence: Techniques and Applications", Edited by, Springer, 2014.
2. Amir M. Rahmani, Pasi Liljeberg, Jürgo-Sören Preden, Axel Jantsch, "Fog computing in the Internet of Things: Intelligence at the Edge", Springer, 2018.
3. Dac-Nhuong Le, Chung Van Le, Jolanda G. Tromp, Gia Nhu Nguyen, "Emerging Technologies for Health and Medicine", John Wiley and Sons Limited, 2018.

Reference Books:
1. Betty Prince, David Prince, "Memories for the Intelligent Internet of Things", John Wiley and Sons Limited, 2018.
2. Fadi Al-Turjman, "Artificial Intelligence in IoT", Springer, 2019.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.

19EC2041	CELLULAR MOBILE COMPUTING	L	T	P	C
		3	0	0	3

Course Objectives:
1. Understand the Cellular concept, Frequency reuse, Hand-off strategies, Co-channel and Non-Co-channel interference
2. Apply wireless and mobile cellular communication system techniques over stochastic fading channel
3. Define Mobile Computing, types of mobility and acquire solid knowledge on cellular networks and mobile computing

Course Outcomes:
The Student will be able to
1. Understand impairments due to multi path fading channel,
2. Apply fundamental techniques to overcome the different fading effects, Co-channel and Non-Co-channel interference
3. Familiar with cell coverage for signal and traffic, diversity techniques and mobile antennas.
4. Analyze advanced data communicating methods and networking protocols for wireless and mobile environments
5. Utilize and employ application frameworks for developing mobile applications including under disconnected and weakly connected environment
6. Critically analyze security issues of mobile and wireless computing systems

Module 1: Fundamentals of Cellular Radio System Design (7 hrs)
Concept of Frequency Reuse, Co-Channel Interference, Co-Channel Interference Reduction Factor, Desired C/I From a Normal Case in a Omni Directional Antenna System, System Capacity, Trunking

and Grade of Service, Improving Coverage and Capacity in Cellular Systems- Cell Splitting, Sectoring, Microcell Zone Concept.

Module 2: Co-Channel and Non-Co-Channel Interference (7 hrs)

Co-Channel Interference: Measurement of Real Time Co-Channel Interference, Design of Antenna System, Antenna Parameters and Their Effects, Diversity Techniques-Space Diversity, Polarization Diversity, Frequency Diversity, Time Diversity.

Non-Co-Channel Interference: Adjacent Channel Interference, Near End Far End Interference, Cross Talk, Effects on Coverage and Interference by Power Decrease, Antenna Height Decrease, Effects of Cell Site Components.

Module 3: **Introduction to Cellular Mobile Radio Systems (7 hrs)**

Limitations of Conventional Mobile Telephone Systems, Basic Cellular Mobile System, First, Second, Third, Fourth and fifth Generation Cellular Wireless Systems

Module 4: **Mobility of Bits and Bytes, Mobile fundamentals and channels (9 hrs)**

Wireless-The Beginning, Mobile Computing, Dialogue Control, Networks, Middleware and Gateways, Application and Services (Contents), Developing Mobile Computing Applications, Security in Mobile Computing Standards-why is it Necessary? Multiple access techniques like Frequency division multiple access (FDMA) ,Time division multiple access (TDMA), Code division multiple access (CDMA) ,Space division multiple access (SDMA) .

Module 5: **Uniqueness of Mobile Radio Environment (7 hrs)**

Fading -Time Dispersion Parameters, Path-loss, slow-fading, fast-fading, delay spread and Coherence Bandwidth, Doppler Spread and Coherence Time, flat fading and frequency selective fading ,The power budget design of mobile radio channels.

Module 6: Global System for Mobile Communications (8 hrs)

GSM Architecture, GSM Entities ,Call Routing in GSM, PLMN Interfaces, GSM Addresses and Identifiers , Network Aspects in GSM , GSM Frequency Allocation, Authentication and Security, Mobile Computing over SMS, Short Message (SMS) , Value Added Services through, MS, Accessing the SMS Bearer, GPRS and packet Architecture GPRS Network Architecture, GPRS Network Operations, Data Services in GPRS , Application for GPRS, Limitation of GPRS, Billing and Charging in GPRS, WAP , MMS , GPRS Applications, Spread – Spectrum Technology, Is – 95.

Text Books:

1. W.C.Y. Lee, “Mobile Cellular Telecommunications” Mc Graw Hill, 2nd Edn., 1989.
2. Theodore. S. Rapport, “Wireless Communications”, Pearson Education, 2nd Edn., 2002.

Reference Books:

1. Raj Kamal, “Mobile Computing”, Oxford University Press, Second edition, 2012.
2. Mazliza Othman, “Principles of Mobile Computing & Communications”, SPD publications.
3. Gordon L. Stuber, “Principles of Mobile Communications”, Springer International, 2nd Edn., 2001.
4. Simon Haykin, Michael Moher, “Modern Wireless Communications”, Pearson Education, 2005.

19EC2042	WEARABLE AND IMPLANTABLE DEVICES	L	T	P	C
		3	0	0	3

Course Objectives:

1. To make the students to get familiarized with various wearable and implantable devices
2. To enable the students to understand various fabrication techniques
3. To make the students understand the requirements of practical design and optimal performance

Course Outcomes:

The Student will be able to

1. Experiment with wearable and implantable devices
2. Build antenna structures for Body Area Networks
3. Explain various fabrication techniques
4. Design intelligent based devices

5. Assess the its functional architecture and organization
6. Design the device for a given application

Module 1: Fundamental concepts (6 hrs)
Biomedical Engineering design, Clinical problems and engineering approaches, Technical considerations of wearable technologies, Wearable computers, minimally invasive devices and techniques, Health and Fitness wearables, Bionics, Promise and perils of wearable systems,Security and privacy risks.

Module 2: Antennas for Body Area Networks (5 hrs)
Wearable antennas, Flexible antenna designs, Metamaterial and AMC based antenna structures, Organic Paper based antennas, Flexible Optically transparent antennas, Diversity antennas, Conformal antennas, GPS aided VHF Animal Collar antenna, Textile based rectennas, Biodegradable antennas Parametric analysis.

Module 3: Fabrication and Measurement Techniques (7 hrs)
Material selection, Parameter Characterization, Impedance matching strategy, Printing technologies, Meshed antenna, Transparent and conductive oxides, Smart skins-flexible chemical sensing components, Nano wires.

Module 4: IoT TriggeredBody Area Networks (10 hrs)
Intelligent wearable device, Biosensors and IoT in smart health care applications: challenges and opportunities, Secure data aggregation framework, Wearing sensors inside and outside of the human body for the early detection of diseases.

Module 5: Implant Architecture and Organization (9 hrs)
External parts of implantable devices, Internal structure layout, Data Telemetry unit, Central Processing unit, Memory storage, Analog Front end, Neural simulation and charge balancing approaches.

Module 6: Application (8 hrs)
Case studies on design of wearable and implantable antennas - Smart ambulance traffic management system, power efficient health monitoring system for the aging population.

Reference Books:

1. Andrés D. Lantada, "Handbook on Advanced Design and Manufacturing Technologies for Biomedical Devices". Springer London 2013.
2. "Management Association, Information Resources. Wearable Technologies: Concepts, Methodologies, Tools, and Applications" (3 Volumes). IGI Global, 2018. 1-1571. Web. 23 Oct. 2019. doi:10.4018/978-1-5225-5484-4.
3. Haider Khaleel, "Innovation in Wearable and Flexible Antennas, WIT Transactions on State-of-the-art in Science and Engineering, 2015, ISBN: 978-1-84564-986-9.
4. Nilanjan Dey, Amira S. Ashour, Simon James Fong, Chintan Bhatt, "Wearable and Implantable Medical Devices: Applications and Challenges", Academic Press, 06-Sep-2019.
5. Edward Sazonov, "Wearable Sensors: Fundamentals, Implementation and Applications", Elsevier, 14-Aug-2014 - Technology & Engineering.
6. Vinod Kumar Khanna, "Implantable Medical Electronics: Prosthetics, Drug Delivery, and Health Monitoring", Springer, 10-Dec-2015 - Technology & Engineering.

19EC2043	TESTING OF VLSI CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To make the students to understand the testing methods in combinational and sequential circuits.
2. To enable the students to get familiarized with various fault simulation techniques.
3. To make the students to understand the difference between DFT and BIST

Course Outcomes:
The Student will be able to

1. Gain basic knowledge in VLSI testing
2. Particular testing method for a Device under Test (DUT)
3. Categorize various fault simulation techniques
4. Illustrate the Design for Testability (DFT) concepts

5. Articulate Scan Based Design concepts
6. Demonstrate the various BIST architectures

Module 1: Faults in Digital Circuits (7 hrs)
Role of Testing-Digital and Analog VLSI Testing-Failures and Faults-Modelling of faults-Stuck-at-faults-Bridging faults-Stuck open faults

Module 2: Test Generation Algorithms (7 hrs)
Test Generation algorithms for combinational logic circuits-One-Dimensional Path Sensitization-Boolean Difference-D-Algorithm-Path Oriented Decision Making (PODEM)-Test Generation algorithms for sequential circuits: State Table Verification

Module 3: Fault Simulation Techniques (7 hrs)
Simulation for Digital Verification-Algorithms for Fault Simulation-Serial Fault Simulation-Parallel Fault Simulation-Deductive Fault Simulation- Concurrent Fault Simulation

Module 4: Design for Testability (8 hrs)
Key Testability Concepts-Ad Hoc Design for Testability Techniques: Test Points-Initialization-Scan-in-Scan-out Design-Signature Analysis

Module 5: Scan Based Design (8 hrs)
Generic Scan based Design: Full Serial Integrated Scan-Isolated Serial Scan-Classical Scan Design: Level Sensitive Scan Design (LSSD)-LSSD Gate Overhead-Boundary Scan Standards

Module 6: Built-in Self-Test(BIST) Architectures (8 hrs)
BIST Concepts-Test-pattern Generation for BIST-Exhaustive Testing-Pseudorandom Testing-Constant Weight Counter-Combined LFSR/SR-Combined LFSR/XOR Gates-Condensed LFSR

Text Books:

1. Vishwani D. Agarwal “Essential of Electronic testing for digital, memory and mixed signal circuits”, Springer, 2013.
2. Abramovici. M, Breuer. M.A. and Friedman.A.D, "Digital Systems Testing and Testable Design", Jaico Publishing House; First edition, 2001.

Reference Books:

1. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Englewood Cliffs, 1998.
2. Parag.K.Lala, “Digital circuit testing and testability”, Academic press, 1997.

19EC2044	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basics of EMI and EMC
2. To gain knowledge on the coupling mechanism and mitigation techniques
3. To impart insight about the current EMC standards, various measurement techniques and EMC design of PCB

Course Outcomes:

The Student will be able to

1. Find solution to EMI and EMC Sources,
2. Assess EMI problems in PCB level / Subsystem,
3. Plan and develop the system level design,
4. Measure emission immunity level from different systems,
5. Apply to couple with the prescribed EMC standards,
6. Test the EMI with different standards

Module 1: EMI and EMC Concepts (8 hrs)
Introduction to EMI and EMC, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Radiation hazards to humans, EMC Testing categories, EMC Engineering Application.

Module 2: Coupling Principles (7 hrs)
Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling.

Module 3: Mitigation Techniques (8 hrs)
Working principle of Shielding and Murphy‟s Law, shielding effectiveness, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Filter types and operation, Transient protection.

Module 4: Standards and Regulation (8 hrs)
Need for Standards, Civilian standards - FCC, CISPR, Military standards - MIL STD 461D/462.Instruments /Systems, EMI Shielded Chamber, TEM Cell, Sensors/Injectors/Couplers, Test beds for ESD and EFT, Military Test Method and Procedures.

Module 5: Test Methods and Instrumentation (7 hrs)
TEM cell for immunity test, Shielded chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, MIL -STD test methods, Civilian STD test methods.

Module 6: EMC Design of PCBs (7 hrs)
PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

Text Books:

1. Clayton R. Paul, "Introduction to Electromagnetic Compatibility", Wiley, Second Edition, 2010.
2. V Prasad Kodali, "Engineering Electromagnetic Compatibility", Wiley India Pvt Ltd; Second edition, 2010.

Reference Books:

1. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009
2. Daryl Gerke and William Kimmel, "EDN‟s Designer‟s Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002
3. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.

19EC2045	**SoC DESIGN**	**L T P C** **3 0 0 3**

Course Objectives:

1. To provide an introduction to the SoC Design.
2. To provide theoretical and practical aspects of SoC design.
3. To understand the memory design concepts in processors.
4. To understand interconnect architectures for SoC and NoC.

Course Outcomes:
The Student will be able to

1. Understand the basic concepts of SoC System Architecture.
2. Understand the concepts of choosing the processor for the SoC Design.
3. Design processors keeping area, power and speed as constraints.
4. Analyze memories using reconfigurable architectures.
5. Develop interconnect architectures for SoC and NoC.
6. Analyze reconfigurable architectures for real time applications.

Module 1: Introduction to System on Chip (7 hrs)
System Architecture - Components of the System - Hardware and Software - Processor Architectures An Approach for SoC Design - System Architecture and Complexity.

Module 2: Chip Basics (7 hrs)
Introduction - Cycle Time - Die Area and Cost - Power - Area–Time–Power Trade-offs in Processor Design - Reliability – Configurability.

Module 3: Processors (8 hrs)
Introduction - Processor Selection for SoC - Basic Concepts in Processor Architecture - Basic Concepts in Processor Microarchitecture - Basic Elements in Instruction Handling - Branches: Reducing the cost of branches - Robust Processors - Very Long Instruction Word (VLIW) Processors.

Module 4: Memory Design (8 hrs)
Introduction - Scratchpads and Cache Memory - Cache Organization - Cache Data - Write Policies - Multilevel Caches - On-Die and Off-Die Memory Systems - Simple DRAM and the Memory Array.
Module 5: Interconnect (7 hrs)
Overview of Interconnect Architectures – Bus Basic Architecture - SoC Standard Buses - NOC with Switch Interconnects and Examples - Layered Architecture and Network Interface Unit.
Module 6: Application Studies (7 hrs)
A SOC Controller for Digital Still Camera- 3 –D Graphics Processor**.**
Text Book:
1. Micheal J Flynn and Wayne Luk, ”Computer System Design: System-on-Chip,” Wiley, First Edition, 2011.

Reference Books:
1. Sudeep Pasricha and NikilDutt, “On-Chip Communication Architectures: System on Chip Interconnect”, Morgan Kaufmann, 2008.
2. Michael Keating, Pierre Bricaud, “Reuse Methodology manual for System on chip designs”, Kluwer academic Publishers, 2nd edition-2008.
3. Youn-Long Steve Lin**,** “Essential Issues in SoC Design Designing Complex Systems-on-Chip”, Springer, 2006
4. Hoi-Jun Yoo, Kangmin Leeand Jun Kyong Kim, “Low-Power NoC for High-Performance SoC Design”, CRC Press, 2008
5. S.Pasricha and N.Dutt, “Chip Communication Architectures System on Chip Interconnect”, Elsevier, 2008

19EC2046	SPEECH PROCESSING	L T P C 3 0 0 3

Course Objective:
1. To introduce speech production mechanism and associated time and frequency parameters
2. To introduce the computation of short time Fourier transform and linear prediction based parametric estimation
3. To understand different speech modeling procedures

Course Outcomes:
The Student will be able to
1. Model speech production system and describe the fundamentals of speech.
2. Extract features from speech in time-domain
3. Extract features from speech in frequency-domain
4. Model speech signals using statistical modelling methods
5. Develop speech synthesis and recognition systems
6. Develop speaker and language identification system

Module 1: Introduction to Digital Speech Processing (8 hrs)
Speech Production and Classification of Speech Sounds, Source-System Model, Auditory Perception of Speech, Phonemes, Allophones, Co-articulation
Module 2: Speech Signal Analysis in Time Domain (7 hrs)
Speech Signal Analysis, Segmental, Sub-Segmental and Suprasegmental Levels, Average Magnitude, Zero Crossing Rate, Short Time Auto Correlation Function, Silence Discrimination Using ZCR and Energy, Pitch Period Estimation Using Auto Correlation Function.
Module 3: Speech Signal Analysis in Frequency Domain (8 hrs)
Short Time Fourier Analysis, Filter Bank Analysis, Formant Extraction, Pitch Extraction, Homomorphic Speech Analysis, Cepstral Analysis of Speech, Formant and Pitch Estimation. Linear Predictive Analysis of Speech, Autocorrelation Method, Covariance Method, Solution of LPC Equations, Durbin’sRecursive Algorithm, Application of LPC Parameters, Pitch Detection Using LPC Parameters, Formant Analysis.
Module 4: Machine Learning For Speech Processing (7 hrs)
Introduction to machine learning, k means clustering, Gaussian Mixture Model(GMM), Hidden Markov Model(HMM), Artificial Neural Networks: CNN,RNN

Module 5: Speech Processing Applications I (7 hrs)
Text-to-Speech Synthesis – Basic Principles, Unit Selection and Statistical Parametric Synthesis, Prosody Modification, Voice Transformation, Automatic Speech Recognition (ASR) – HMM and DNN-Based Methods, Towards Super-Human Speech Recognition

Module 6: Speech Processing Applications II (8 hrs)
Speaker Recognition – Text-Dependent and Text-Independent, Principles of Spoken Language Identification, Natural Language Understanding, Fundamentals of Speech Enhancement, Current Trends and Future Scope of Speech Processing

Text Books:

1. R. Rabiner and Schaffer, "Digital Processing of Speech signals Pearson Education", 2004.
2. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Pearson Education, 2003.
3. Christopher M Bishop, "Pattern Recognition and Machine Learning", Springer-Verlag, 2006.
4. Jacob Benesty, M. Mohan Sondhi, Yiteng Huang, "Springer Handbook of Speech Processing", Springer-Verlag, 2007.

Reference Books:

1. Thomas F Quatieri, "Discrete-Time Speech Signal Processing Principles and Practice", Pearson Education, 2004.
2. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing and Perception of Speech and Music", Wiley- India Edition, 2006.
3. Nilanjan Dey, "Intelligent Speech Signal Processing", First Edition, Academia Press, 2019.
4. Israel Cohen, Jacob Benesty, Sharon Gannot, "Speech Processing in Modern Communication", Springer Berlin Heidelberg, 2010.
5. Uday Kamath, John Liu, Jimmy Whitaker, "Deep Learning for NLP and Speech Recognition", Springer, 2019.
6. Paul Hill, "Audio and Speech Processing with MATLAB", First Edition, CRC Press, 2018.
7. Douglas O'Shaughnessy, "Speech Communications: Human and Machine", Wiley-India, 2012.

19EC2047	FUNDAMENTALS OF ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn about various electronic components, its applications and circuit design.
2. To understand the basic digital system and microprocessor.
3. To impart the basic knowledge on recent advancements in sensors and communication system.

Course Outcomes:

The Student will be able to

1. Understand the design concepts of electron device architecture
2. Select the op-amp ICs based on their characteristics
3. Comprehend the digital system design
4. Explain the architecture of Microprocessor
5. Choose suitable transducers and sensors for the applications
6. Acquire knowledge of recent advancements of communication systems

Module 1: Introduction to Semiconductors and electron device architectures (7 hrs)
P type Semiconductor – N type Semiconductor – Diodes - PN Junction, Zener, LED– BJT Configurations, FET - JFET, MOSFET, UJT.

Module 2: Operational Amplifiers (7 hrs)
Op-Amp – Applications – Inverting amplifier, Non-Inverting amplifier, Adder, Subtractor, Differentiator, Integrator – Fabrication steps of Integrated Circuits.

Module 3: Digital System (7 hrs)
Combinational circuit – Design of Half Adder, Full Adder, Decoder, Encoder – Sequential circuit – Flip-Flops – Latches – Memory – Types of Memory.

Module 4: Microprocessor (8 hrs)
8086 Configuration – architecture - Instruction set – programming - memory and I/O interfacing – Introduction to Embedded systems.
Module 5: Transducers and Sensors (8 hrs)
Active and Passive Transducers – Resistive, Capacitive, Inductive, piezoelectric - Pressure sensors – bellows, diaphragm, Digital Transducer – shaft encoder, optical encoder - Hall effect transducer, vibration sensors – seismic transducer, chemical sensor – PH sensor.
Module 6: Communications System (8 hrs)
General block diagram of communication system, Need for Antenna - Modulation - Demodulation techniques -AM Transmitter – FM transmitter, Radio Receiver - Satellite communication.
Reference Books:

1. Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill Education (India) Private Limited, New Delhi, 2014
2. V. K. Mehta, R. Mehta, "Principles of Electrical Engineering and Electronics", S. Chand & Company Ltd., New Delhi, 2015.
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
4. Thomas Floyd, "Digital Fundamentals", Prentice Hall, 10th Edition, 2011.
5. A.K.Sawney, "A course in Electrical and Electronics Measurements and instrumentation", Dhanpat Rai &amp, 19th Edition, 2011.
6. Jochen Schiller, "Mobile Communications", Pearson Education Asia Ltd., Second edition, 2016.
7. Douglas V Hall, "Microprocessors and Interfacing" Tata McGraw Hill Education Private Limited, 2nd Edition 2005

19EC2048	COMMUNICATION ENGINEERING	L T P C 3 0 0 3

Course Objectives:
1. To learn the basic principles, concepts and types of communication systems.
2. To understand the various multiplexing schemes and networking
3. To gain knowledge in cell phone and wireless technologies.

Course Outcomes:
The Student will be able to
1. Understand the basic concepts of communication system.
2. Acquire knowledge on different modulation techniques.
3. Understand various multiplexing and demultiplexing techniques
4. Analyze networking and internet technologies
5. Develop the ability to compare and contrast the strengths and weaknesses of various cell phone technologies.
6. Acquire knowledge on various wireless technologies.

Module 1: Introduction to Communication (8 hrs)
Introduction, significance of human communication-Communication systems-types of electronic communication –Modulation and multiplexing- The Electromagnetic spectrum- Bandwidth-Spectrum management and standards
Module 2: Modulation Fundamentals (8 hrs)
AM concepts- Modulation index -AM power- Classification of radio emissions- Basic principles of Frequency modulation, Principles of phase modulation- side bands- Narrow band FM and wide band FM
Module 3: Multiplexing and Demultiplexing (8 hrs)
Multiplexing principles-frequency division multiplexing-time division multiplexing- telemetry-FM Stereo broadcasting- pulse code modulation- PCM multiplexer and demultiplexer- Digital carrier system- Duplexing.

Module 4: Introduction to Networking and Local Area Networks (7 hrs)
network fundamentals-LAN hardware- Ethernet LAN- Token ring LAN- Internet technologies-Internet application- internet transmission system- storage area networks- internet security
Module 5: Cell Phone Technologies (7 hrs)
Telephones- telephone systems- Internet telephony- cellular telephone systems- the advanced mobile phone system- digital cell phone system
Module 6: Wireless Technologies (7 hrs)
Wireless LAN-PAN and Bluetooth-ZigBee- WiMAX- Infrared Wireless-Radio frequency identification and near field communications- Ultrawideband wireless.
Reference Books:

1. Louis E. Frenzel, "Principles of Electronic Communication Systems", Mc Graw Hill, 4th Edition, 2015.
2. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", Pearson Education, Arizona, 5th Edition 2012.
3. William Schweber, "Electronic Communication Systems - A Complete Course", Prentice Hall International, New Jersey, 4th Edition, 2002.
4. Kennedy G, "Electronic Communication Systems", Tata McGraw-Hill Education India Private Limited, New Delhi, 4th Edition, 2011.
5. Simon Haykins, "Communication Systems", John Wiley & Sons, New Jersey, 4th Edition, 2011.
6. Taub and Schilling, "Principles of Communication Systems", Tata McGraw-Hill Education India Private Limited, 4th Edition, 2015.

		L	T	P	C
19EC2049	**MATLAB PROGRAMMING**	**3**	**0**	**0**	**3**

Course Objectives:
1. To enable the students to understand the fundamentals and programming knowledge in MATLAB
2. To provide the deeper understanding of the tools and processes that enable students to use MATLAB for the engineering problems
3. To assist the students with computational tools to design their own analysis and interpretation strategies when facing different engineering applications.

Course Outcomes:
The Student will be able to
1. Understand the process of converting computational problems into a series of simple steps.
2. Develop programs in the MATLAB language for engineering applications.
3. Analyze numerical data and perform input and output operations on it.
4. Illustrate the concept of toolboxes for practical applications
5. Summarize the concepts of various data visualization techniques.
6. Design Graphical User Interfaces for practical applications

Module 1: Introduction to MATLAB (8 hrs)
Advantages of MATLAB – MATLAB Environment – Using MATLAB as a Scratch Pad –Variables and Arrays – Multidimensional Arrays – Scalar and Array Operations – Hierarchy of Operations – Built-in MATLAB Functions – Branching Statements and Program Design– Loops and Vectorization – User Defined Functions – Introduction to Plotting – Examples – Errors – Debugging MATLAB Programs.
Module 2: Input and Output Functions (7 hrs)
Input / Output Functions: Text, Audio, Image and Video Read Functions – Load and Save –MATLAB File Processing – File Opening and Closing – Comparing Formatted and Binary I/O Functions.
Module 3: Programs of Matrices and Polynomials (8 hrs)
Vectors and Matrices – Mathematical Operations with Matrices – Polynomial Evaluation – Rots of a Polynomial – Mathematical Operations with Polynomial – Formulation of Polynomial Equation –

Differentiation and Integration –Evaluation of Polynomials with Matrix Arguments – Ordinary Differential Equation Solvers – Symbolic Mathematics.

Module 4: Data Visualization (7 hrs)

Data Visualization and Statistics – 2D Graphics: Plot and fplot COMMAND– Plotting Multiple Graphs in the Same Plot –Formatting a Plot. Logarithmic Axes – Error Bars – Special Graphics – Histograms – Putting Multiple Plots on the Same Page – Multiple Figure Windows – 3D Graphics: Line Plots – Mesh and Surface Plots – Examples of MATLAB Application.

Module 5: Graphical User Interface (7 hrs)

Introduction to Graphical User Interfaces in MATLAB – Designing GUI interfaces using MATLAB's GUIDE interface – MATLAB Handle graphics primitives – Cell-array – Structure of a Callback Subfunction – Get/Set Interface –Object Properties – Graphical User Interface Components – Additional Containers:Panels and Button Groups – Dialog Boxes – Menus – Creating Efficient GUI

Module 6: Applications using MATLAB Toolboxes (8 hrs)

Control System toolbox, Neural Networks tool box, Signal/image processing tool box, optimization toolbox.

Reference Books:

1. Stephen J Chapman, "MATLAB programming for engineers", 5th Edition, Cengage Learning, 2015.
2. Amos Gilat,"MATLAB: An Introduction With Applications", John Wiley & Sons, 2009.
3. R.K.Bansal, A.K.Goe, M.K.Sharma, "MATLAB and Its Applications in Engineering", Pearson Education India, 2009.
4. Edward B. Magrab,"An Engineer's Guide to MATLAB: With Applications from Mechanical, Aerospace, Electrical, Civil, and Biological Systems Engineering",3rd Edition, Prentice Hall, 2011.
5. Rudra Pratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 2010.
6. D. M. Etter, "Introduction to MATLAB for Engineers and Scientists", Prentice Hall, 1996.
7. William J. Palm III, "Introduction to MATLAB for Engineers", 3 rd Edition, McGraw-Hill, 2005.

19EC2050	SENSORS FOR IOT APPLICATIONS	L T P C 3 0 0 3

Course Objectives:

1. To understand the basic theories behind IoT and sensors.
2. To describe the wireless sensor network and security issues in IoT.
3. To analyze applications of IoT and sensors in real life situations.

Course Outcomes:

The Student will be able to

1. Understand the characteristics of IOT systems.
2. Describe the security issues in IoT.
3. Relate the various basic ideas behind sensors with respect to IOT.
4. Choose appropriate sensors for measuring various parameters.
5. Demonstrate the wireless sensor network in the aspects of IOT.
6. Appraise sensors used in IOT for real life situations.

Module 1: Introduction to IoT (8 hrs)

Defining IoT, Characteristics of IoT, Physical design of IoT, Architecture of IoT, Logical design of IoT, IoT enabling technologies, Difference between IoT and Machine to Machine, Body Area Network, IoT in HVAC

Module 2: Security in IoT (8 hrs)

IoT attacks and Countermeasures, Common IoT attack types, Security Architecture in Internet of Things, Security Requirements in IoT, Data privacy and trust, Access Restriction and control, Ownership management, Data Audit, Device software update.

Module 3: Introduction to Sensors (8 hrs)
Sensors-Working principles, Selection of Sensors for practical applications, Equivalent circuit of Sensors and Modelling of Sensors, Importance and Adoption of Smart Sensors, Architecture of Smart Sensors: Important components and their features, Thread modelling, static/dynamic vulnerability and assessment.
Module 4: Sensors used in IoT (7 hrs)
Temperature Sensors, Proximity Sensors, Pressure Sensors, Water Quality Sensor, Chemical Sensor, Gas Sensor, Smoke Sensor, IR sensor, Level Sensor, Image Sensor, Motion Detection Sensor, Accelerometer Sensor, Gyroscope Sensor, Humidity Sensor.
Module 5: Wireless Sensor Networks (7 hrs)
Basic components of a sensor node-Constraints on sensor node, Wireless sensor deployment and node discovery, data aggregation and dissemination, Event aware topology management in WSN.
Module 6: Case Studies illustrating IoT systems (7 hrs)
Weather monitoring system, Air Pollution Monitoring system, Home Automation, Smart Parking, Smart Grid, Smart Irrigation, Forest fire detection, Health and Fitness Monitoring, Smart Payments, IoT Printer.
Text Books:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-On Approach" University Press, 2014.
2. David Boswarthick, Omar Elloumi and Olivier Hersent, "M2M Communications: A Systems Approach", John Wiley & Sons Ltd., Publications, 2012.
3. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, USA,2016.
4. John Vetelino, Aravind Reghu, "Introduction to Sensors", CRC Press, 2011.

Reference Books:

1. D. Patranabis, "Sensors and Transducers", 2nd edition, PHI pvt., Ltd., 2005.
2. Waltenegus Durgie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", John Wiley & Sons Ltd., Publications, 2010.
3. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", John Wiley & Sons Ltd., UK, 2014.
4. Dieter Uckelmann, Mark Harrison and Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.
5. Olivier Hersent, David Boswarthick and OmarElloumi, "The Internet of Things: Key Applications and Protocols", Wiley & Sons Ltd., UK, 2012.

19EC2051	MICROPROCESSORS AND INTERFACING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives:
1. To gain knowledge about the architecture and programming concepts of 8085 and 8086 Microprocessors.
2. To understand the concepts on memory and peripheral interfacing chips.
3. To design microprocessor based systems.

Course Outcomes:
The Student will be able to
1. Analyse the functional building block of 8085 microprocessor
2. Describe the architecture of 8086 microprocessor and minimum /maximum modes of operation.
3. Develop 8085 and 8086 assembly language programs for the given applications
4. Apply the interrupts, memory, and I/O interfacing concepts for any microprocessor design.
5. Make use of the peripheral interfacing chips for microprocessor based applications
6. Develop Microprocessor based systems for various applications

Module 1: 8085 Microprocessors (8 hrs)
Functional Building Block of 8085 microprocessor –Timing and control signals – Timing Diagram – Addressing modes – Instruction set–- Assembly language programs-Memory interfacing- I/O interfacing.
Module 2: 8086 Microprocessors (8 hrs)
Architecture of 8086 microprocessor – memory segmentation – Physical Address formation – Addressing modes in 8086 – Instruction set – Assembly language programming – Minimum mode and maximum mode.
Module 3: Microprocessor Interfacing Chips (8 hrs)
8253 programmable interval timer- 8251A Programmable communication interface - 8259A Programmable interrupt controller -8257 DMA controller
Module 4: Peripheral Interfacing Chips (8 hrs)
8255 Programmable Peripheral interface - 8279 Programmable Keyboard/display interface- 8295 Programmable printer controller – 8275 programmable CRT display controller.
Module 5: Interrupts Interfacing (6 hrs)
Interrupt Mechanism- Types and Priority- Interrupt Vector Table- Interrupt Instructions- Enabling and Disabling of Interrupts-Hardware Interrupts-Software Interrupts
Module 6: Applications (7 hrs)
LCD and Keyboard Interface- ADC, DAC and Sensor Interface-Stepper motor-DC motor-Microprocessor based System design.
Text Books:

1. Ramesh.S.Gaonkar "Microprocessor Architecture, Programming & Applications With 8085/8080a" Penram International Publishing; 6th edition, 2013
2. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", Tata McGraw Hill, 3rd Edition, 2012.

Reference Books:

1. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2nd Edition, 2014.
2. Yu.Cheng Liu & Glenn A Gibson," Microcomputer System, 8086/8088 Family, Architecture, Programming and Design", 2nd Edition, PHI, 2007.
3. Rafiquzzaman.M. "Microprocessor Theory and Applications-Intel and Motorola", PHI, Revised Edition, 2007.
4. A.K. Ray, K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", Tata McGrawHill, 3rd Edition, 2017.

		L	T	P	C
19EC2052	**DIGITAL SYSTEM DESIGN USING HDL**	**3**	**0**	**0**	**3**

Course Objectives:
1. To make the students to understand the advanced digital system concepts.
2. To make the students to understand the need for Verilog HDL programming
3. To enable the students to get familiarized with the FPGA implementation

Course Outcomes:
The Student will be able to
1. Understand the basic concepts in combinational logic design
2. Design sequential circuit design
3. Understand the basic concepts in Verilog HDL
4. Understand the various levels of modeling
5. Design and simulate combinational and sequential circuits using Verilog HDL
6. Implement combinational and sequential circuits in FPGA

Module 1: Basic concepts and Combinational Circuit Design (8 hrs)
Binary code–Simplification of logic functions using Karnaugh Map-Logic gates –Implementation of Combinational logic functions – Half adder-Full adder -Encoders & Decoders – Multiplexers & Demultiplexers – Comparator

Module 2: Sequential Circuit Design (8 hrs)
Flip-Flops-Characteristic table-Excitation table- Mealy machine - Moore machine –Design of Counters: Up-Down Counter-Shift registers: Serial-in-Serial Out (SISO)-Parallel-in-Parallel Out (PIPO)
Module 3: Introduction to Verilog (8 hrs)
Design methodology – Modules – Ports – Basic concepts – Operators – Number specification – Data types – Gate delays – Operator types
Module 4: Peripheral Interfacing Chips (7 hrs)
Dataflow Modeling-Behavioral Modeling: Conditional statements –IF statements-CASE Statements-Gate level Modeling- Switch Modeling: MOS Switches-CMOS Switches
Module 5: Design & Simulation of Digital Logic (7 hrs)
Design of Combinational Circuits: Half Adder-Full Adder –Multiplexer-De-Multiplexer-Encoder-Decoder-Comparator-Flip-flops-Counter
Module 6: Implementation in FPGA (7 hrs)
Implementation of Combinational Circuits & Sequential circuits in FPGA: Adder-Multiplexer-Encoder- Flip-flops-Counter
Text Books:
1. MorrisMano, "Digital logic and computer Design", Pearson Education India; Ist edition 2016.
2. Charles. H. Roth, Jr, "Digital System Design using VHDL", Cengage; 2nd edition 2012.
3. Samir Palnitkar, "Verilog HDL", Pearson Publication", 2nd Edition. 2003.

Reference Books:
1. Mano,Cilettti, "Digital Design: With an Introduction to Verilog HDL, Pearson Education India; 5th edition,2013.
2. Jain R.P, "Modern Digital Electronics", McGraw Hill Education; 4th edition 2009.
3. Floyd T.L., "Digital Fundamentals ", Pearson Education; Eleventh edition, 2017.

19EC2053	FPGA IMPLEMENTATION OF DIGITAL CIRCUITS	L	T	P	C
		3	0	0	3

Course Objectives:
1. To make the students understand the concept Digital circuit design
2. To enable the students to get familiarized Verilog HDL coding
3. To make the students understand how to do FPGA implementation

Course Outcomes:
The Student will be able to
1. Get recall the concepts of logic gates
2. Design Combinational circuits and sequential circuits
3. Get familiarize with Verilog HDL
4. Design Combinational and sequential circuits using Verilog HDL
5. Make knowledge about FPGA and PLD
6. Implement circuit on FPGA

Module 1: **Minimization Techniques and Logic gates (8 hrs)**
Logic Gates: NAND–NOR implementations. Boolean postulates and laws –Boolean expression Minimization of Boolean expressions – Minterm –Maxterm - SOP – POS – Karnaugh map Minimization -Binary Codes - Gray Code – BCD Code –- Multi level gate implementations - Multi output gate implementations -
Module 2: Design of combinational circuits and synchronous sequential circuits (8 hrs)
Combinational circuit design procedure: Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder – Multiplexer -Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.
Latches, Flipflops Characteristic table and equation-excitation table, Design of Moore model and mealy model circuit
Module 3: Verilog HDL (7 hrs)
Design Methodology – Module – Ports – Basic concepts – Operators – Number specification – Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multiway

branches - Loops - Switch – Modeling elements – Implementation of Basic circuit using Dataflow & Behavioral Modeling

Module 4: Application of Verilog HDL (7 hrs)

Component Assignments – Switch level modeling – Applications of all dataflow, behavioral and Structural modeling– FSM Implementation – Test Benches.

Module 5: Programmable Logic Device Circuits (8 hrs)

Programmable Logic Devices-Programmable Logic Element (PLE), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Basic concepts, Programming Tech-niques, PROM realization, Structure of standard PLD, Design of combinational and sequential circuits using PLD's. Xilinx 3000 series and 4000 series

Module 6: FPGA implementation (7 hrs)

FPGA implementation of combinational circuit, Implementation of Circuits on Zybo board

Reference Books:

1. Samir Palnitkar, "Verilog HDL", Pearson Publication", II Edition. 2003.
2. M.D. Ciletti, "Advanced Digital Design with the VERILOG HDL" PHI, 2008.
3. MorrisMano,"Digital logic and computer Design", 3rd edition Prentice Hall of India, 2002.
4. M.J.S.Smith, "Application Specific Integrated Circuits", Pearson Education Asia, 2006.
5. S.D. Brown R.J. Francis, J.Rox, Z.G. Urumesic, "Field Programmable Gate Arrays", Kluwer Academic Publishers, 2007.

19EC2054	FUNDAMENTALS OF MEMS	L T P C 3 0 0 3

Course Outcomes:

1. To understand the basic concepts of MEMS devices and materials for MEMS devices;
2. To impart knowledge about the fabrication processes in MEMS Design;
3. To know the essentials of SMART devices and its applications.

Course Outcomes:

The Student will be able to

1. Acquire knowledge on the basic concepts of MEMS Design;
2. Understand the mechanics behind MEMS devices;
3. Demonstrate on the rudiments of Micro fabrication techniques;
4. Develop MEMS structures based on various Micromachining techniques;
5. Design and model Smart devices;
6. Apply smart materials to intelligent systems.

Module 1: Introduction to MEMS and Characteristics of MEMS Materials (8 hrs)

Historical Background of MEMS – Typical MEMS products – Evolution of MEMS – Market Survey – MEMS materials: Silicon Compounds- Silicon Piezoresistors- Gallium Arsenide-Quartz-Piezoelectric crystals.

Module 2: Mechanics of Solids in MEMS/NEMS (7 hrs)

Deformation Strains and Stresses – Residual Stress and Stress Gradients – Hookes's law - Poisson effect - Linear Thermal Expansion - Bending Modeling of coupled Electrostatic Microsystems (Case study).

Module 3: Micro System Fabrication Processes (7 hrs)

Photolithography- Ion Implantation- Diffusion- Oxidation- CVD – PVD - MBE- Chemical Etching (DRIE Process).

Module 4: Micromachining (7 hrs)

Basic surface micro machining processes –Problems in surface Micromachining – LIGA process (Case Study).

Module 5: Smart Sensors and Smart Actuators (8 hrs)

MEMS Switches – Sensors and actuators based on HBLS materials – Application of ferroelectric materials in energy harvesters (Case Study) – NEMS.

Module 6: Smart Materials and Intelligent Systems (8 hrs) Modelling mechanical and electrical systems –SMA – Piezoelectric - Electrostrictive materials – Magnetostrictive materials – patterning of piezo, pyro and ferroelectric polymers - Case studies on PVDF, Terfenol D, NiTiNOL.

Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, "Micro and Smart Systems", Wiley India, 2012.
2. S. E.Lyshevski, "Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering" (Vol. 8). CRC press, (2005).
3. M. Madou, "Fundamentals of Microfabrication", CRC Press, 2002.
4. M.H. Bao, "Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes", Elsevier, New York, 2000.
5. Varadan, V.K., Vinoy, K.J. and Jose, K.J., "RF MEMS and their Applications", John Wiley & Sons. 2002.
6. R.C Smith, "Smart Materials Systems: Model Development", SoC Industrial and Appl. And Math., Philadeliphia, 2005.
7. JasPrit Singh, "Smart Electronic Materials: Fundamentals and Applications", Cambridge University Press, 2006.

19EC2055	PCB DESIGN AND FABRICATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the concept of PCB design to meet the requirement of Electronic Product development standards.
2. To use various Electronic Design Automation tools (EDA) for PCB Design and Product Design.
3. To understand the essentials of IPC standards and PCB design for EMI /EMC.

Course Outcomes:

The Student will be able to

1. Choose active and passive components from datasheet for meeting the given product specification
2. Apply design rules of PCB design in different type of applications like RF and Power Electronics circuits.
3. Design printed circuit board for electronic circuits using EDA tools
4. Fabricate cost effective printed circuit boards.
5. Handle different electromagnetic Interference problems occurring in PCBs and sub systems and to overcome these issues by applying design rules.
6. Create own project hardware by PCB design, Fabrication and testing.

Module 1: Introduction to PCB designing concepts (7 hrs)

Introduction & Brief History-What is PCB-Difference between PWB and PCB-Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer)-PCB Materials. Introduction to Electronic design Automation (EDA)-Introduction to Cadence Allegro – OrCAD PCB -Proteus - Eagle

Module 2: Electronic Components (6 hrs)

Introduction and their categories-Types of Components-Active Components –Passive Components – Component Package Types-Through Hole –Packages-Axial lead-Radial Lead-Single Inline Package(SIP)-Dual Inline Package(DIP)-Transistor Outline(TO)-Pin Grid Array(PGA)-Through Hole Packages-Metal Electrode Face(MELF)-Leadless Chip Carrier(LCC)-Small Outline Integrated Circuit(SOIC)-Quad Flat Pack(QPF) and Thin QFP (TQFP)-Ball Grid Array(BGA)-Plastic Leaded Chip Carrier(PLCC)-Datasheets Exploration

Module 3: Introduction to EDA Tools (8 hrs)

Introduction to PCB Design using OrCAD tool-Introduction to PCB Design using PROTEUS tool-Introduction to Cadence Allegro –Simple PCB Design demonstration-PCB Track Size Calculation Formula. Study of IPC Standards -IPC Standard for Schematic Design-IPC Standard for PCB Design-IPC Standard for PCB Materials-IPC Standard for Documentation and PCB Fabrication

Module 4: Introduction printed circuit board production (8 hrs)

Photo printing, film-master production, film emulsion, stability, reprographic camera, basic process for double sided PCBs photo resists, wet film, dry film, Screen printing process Plating, immersion plating, Electroless-plating, Electro-plating, tinning, relative performance and quality control, Etching machines, Etchants and its comparative study. Solders alloys, corrosive and non-corrosive fluxes, soldering techniques, Mechanical operations.

Module 5: PCB design for EMI/EMC (8 hrs)

Component placement, Subsystem/PCB Placement in an enclosure, filtering circuit placement, decoupling and bypassing, Electronic discharge protection, Introduction to Integrated Circuit Packaging and footprints

Module 6: PCB Design Practice (8 hrs)

PCB Designing of Basic and Analog Electronic Circuits-PCB Designing of Power Supplies-PCB Designing of Different Sensor modules-PCB Designing of Electronics Projects-PCB Designing of Embedded Projects Post Designing & PCB Fabrication Process -Printing the Design-Etching-Drilling-Interconnecting and Packaging electronic Circuits (IPC) Standards-Gerber Generation-Soldering and De-soldering - Component Mounting-PCB and Hardware Testing.

Text Book:

1. R. S. Khandpur, "Printed circuit board design, fabrication assembly and testing", Tata Mc Graw Hill 2005
2. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", 2nd edition, John Wiley & Sons.

Reference Books:

1. W Bosshart, "Printed Circuit Boards -Design & Technology", 1st edition, Tata McGraw Hill
2. DE.J. McCormic, "Human factors in engineering design", McGraw Hill 19764.PCB Design Guidelines For Reduced EMI; Application note ZZA009 http://www.ti.com
3. R. S. Khandpur, "Printed circuit board design, fabrication assembly and testing", Tata Mc Graw Hill 2005
4. Christopher T. Robertson, "Printed Circuit Board Designer's Reference: Basics", Prentice Hall Professional, 2004

19EC2056	**ELECTRONICS FOR BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To impart the basic knowledge about various components of bioinstruments.
2. To understand the fundamentals of sensors and protocols of IoT techniques.
3. To get the knowledge about the basic concept of AI, Microcontroller and python programming.

Course Outcomes:

The Student will be able to

1. Understand the basic principles of passive components and transducers.
2. Apply engineering mathematical concepts in electron devices and bioinstruments.
3. Analyze and design the concepts in various types of sensors.
4. Employ appropriate and understanding the concepts in Internet of things.
5. Choose suitable applications for AI.
6. Acquire knowledge of basic concepts of Microcontroller and Python programs.

Module 1: Introduction to Passive components (7 hrs)

Resistors – Types of resistors – colour coding, Capacitors – Types of capacitors, Inductors – Types of inductors. Covalent bond – N type & P type semiconductor – conduction in semiconductor-Transducers-Active-passive-Resistive-Loading effect.

Module 2: Electronic Devices (7 hrs)

PN diode –Application: Half wave rectifier, Zener diode - Application: Zener Voltage Regulator-Bipolar Junction Transistor – Thermocouple-LVDT-Strain gauge.

Module 3: Sensors (7 hrs)

Data acquisition-ADC/DAC-Sensor characteristics-Transfer function-Physical principles of sensing-Piezoelectric Effect-Pyroelectric Effect-Hall Effect-Pressure Sensors-Chemical Sensors-Humidity and Moisture Sensors-Temperature Sensors-Light Sensors-Photodiode-Tactile Sensors-Real time application.

Module 4: Internet of Things (8 hrs)
IoT Sensors-/Actuators-Wireless Sensor Networks-IoT architecture-IoT Protocols-IoT Data security-Edge computing-Cloud interface- IoT Interface Techniques-Real time Application.
Module 5: Artificial Intelligence (8 hrs)
Introduction- Neural Networks-Perceptron- Learning Rule-Single layer Network-Multilayer Network— Fuzzy logic basics -Real time application.
Module 6: Microcontroller (8 hrs)
Stepper motor-Bionic arm-Python programming-Wireless Standards-Zigbee-Bluetooth-Wifi-Real Time application
Text Books:
1. Muthusubramanian R, Salivahanan S, “Basic Electrical Electronics & Computer Engineering, “Tata Mc.Graw Hill, 2010.
2. Laurence Fausett, “Fundamentals of Neural Networks, Architecture, Algorithm and Applications”, Prentice-Hall, Inc, 2004.
3. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, Mc.Graw Hill International Editions, 1997.
4. Clarence W.de Silva, “Sensor systems: Fundamentals and applications”, 2016 Edition, CRC Press, ISBN: 9781498716246
5. Fraden, Jacob, “Handbook of modern sensors”, Springer Verlag, Springer-2010

Reference Books:
1. Hanes David,Salgueiro Gonzalo, Grossetete Patrick, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things”, 2017, edition 1st, Henry Jerome 9386873743-13:978-ISBN, Pearson Education
2. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things Key applications and Protocols‖”, Wiley, 2012
3. Muhammed Ali Mazidi, “The 8051 microcontroller and embedded systems using assembly and c” 2nd edition, Kindle edition.
4. Harsh Bhasin, “Python for Beginners”, New Age International Publishers; First edition (1 January 2018).
5. A.K.Sawney, “A course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai &Co, 19th Edition, 2011.
6. D.V.S Murthy, “Transducers and Instrumentation”, 2nd Edition 2008, PHI Publication, ISBN: 978-81-203-3569-1.

19EC2057	ARTIFICIAL NEURAL NETWORKS	L	T	P	C
		3	0	0	3

Course Objectives:
1. To impart knowledge on the fundamentals of neural networks
2. To gain an understanding about training methodologies of neural networks
3. To get familiarized with the different architectures involved in neural networks

Course Outcomes:
The Student will be able to
1. Summarize the pros and cons of different artificial neural networks.
2. Discuss the principles of training methodologies of neural networks.
3. Develop novel artificial neural networks.
4. Formulate neural networks based expert systems.
5. Analyze the single layer and multi-layer neural networks.
6. Apply artificial neural networks for solving engineering problems.

Module 1: Introduction to Neural Networks (8 hrs)
Humans and Computers - Organization of the Brain - Biological Neuron, Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN.

Module 2: Essentials of Artificial Neural Networks (8 hrs)
Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules.
Module 3: Single Layer Feed Forward Neural Networks (8 hrs)
Introduction- Perceptron Models: Discrete, Continuous and Multi-Category- Training Algorithms: Discrete and Continuous Perceptron Networks - Limitations of the Perceptron Model.
Module 4: Multilayer Feed forward Neural Networks (7 hrs)
Generalized Delta Rule, Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Learning Difficulties and Improvements.
Module 5: Associative Memories (7 hrs)
Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function.
Module 6: Architecture of Hopfield Network (7 hrs)
Discrete and Continuous versions - Storage and Recall Algorithm - Stability Analysis. Neural network applications: Process identification, control, fault diagnosis.
Reference Books:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Fourth edition, Pearson Education India, 2006.
2. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.
3. J.S.R.Jang, C.T. Sun and E.Mizutani, "NeuroFuzzy and Soft Computing", PHI / Pearson Education, Third edition, 2004.
4. Mohamad Hasoun, "Fundamentals of artificial neural networks", MIT Press, 2015.

19EC2058	SIGNAL PROCESSING TECHNIQUES	L T P C 3 0 0 3

Course Objectives:
1. Choose the transforms based on the application.
2. To analyze biomedical signals
3. Design and implement filtering solutions for applications

Course Outcomes:
The Student will be able to
1. Analyze the relations among time and Fourier domain representation of signals and systems
2. Describe the characteristics of biomedical signals and the need for their analysis.
3. Apply filtering, spectral estimation for processing biomedical signals.
4. Explore the applications of wavelets and wavelet packets in transient analysis, biomedical signal processing, speech, audio, signal denoising.
5. Apply filter banks in Signal Processing applications
6. Design and develop optimum adaptive filtering solutions for real life applications

Module 1: Introduction (9 hrs)
Fourier analysis of discrete-time signals : Discrete Fourier series, Discrete time Fourier transform and Discrete Fourier transform (DFT) – DFT of complex sinusoids; DFT of real sinusoids - Properties of the transforms; Interpreting the DFT and approximation of Fourier transform through DFT - Fast algorithms for DFT computation: The Raddix-2 DIT and DIF FFT algorithms, Computation of inverse DFT using FFT algorithms
Module 2: Fourier Transforms (9 hrs)
Analysis of simple periodic signals and complex sounds; Analyze a sound using the DFT. Generating sinusoids and implementing the DFT. Computation of spectrogram of sound. Analysis of sound using them STFT equation; analysis window: FFT size and hop size; time-frequency compromise; inverse STFT. Non-stationary signal analysis using STFT.

Module 3: Biomedical Signal Processing (8 hrs)
Nature of biomedical signals - Examples of biomedical signals and the underlying physiological processes. Random processes, stationarity and ergodicity, noise. Signal characteristics: autocorrelation, crosscorrelation, covariance, power spectral density,cross-spectral density, coherence Filtering biomedical signals: FIR and IIR filters, ensemble averaging, frequency domain filtering. trend removal, artifact removal, noise reduction. Event detection: correlation, matched filtering, coherence.
Module 4: Wavelets (8 hrs)
Nonstationary signal analysis: time-frequency methods,wavelets-Applications of Wavelets and Wavelet Packets in Signal Processing - Detection of signal changes - analysis and classification of audio signals - Wavelet based signal de-noising and energy compaction.
Module 5: Multirate Signal Processing (6 hrs)
Decimation, Interpolation, Sampling rate conversion by a rational factor. Time domain and frequency domain analysis; Aliasing and imaging, Interpolator and decimator design.
Module 6: Adaptive Filters (5 hrs)
Adaptive filtering- Need for adaptation – Classification- Method of Steepest Descent – Least mean Square adaptive filters – Convergence and stability- Least Squares and Recursive Least Squares- Kalman filtering- Applications of adaptive filters
Text Books:
1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", 4th Edition, Pearson India, 2007.
2. Rangayyan R.M., "Biomedical Signal Analysis : A Case Study Approach", Wiley – IEEE Press, 2001

Reference Books:
1. J.C. Goswami and A.K. Chan, "Fundamentals of Wavelets: Theory, Algorithms and Applications", 2nd Ed, WILEY, 2011
2. Sanjit K. Mitra, "Digital Signal Processing: A Computer based Approach", Special Indian Edition,McGraw Hill, 2013.
3. Simon Haykin, "Adaptive Filter Theory", 5 Ed, Pearson Education, 2014

		L	T	P	C
19EC2059	**FUNDAMENTALS OF SATELLITE COMMUNICATION**	**3**	**0**	**0**	**3**

Course Objectives:
1. To understand the basic elements of satellite communication systems.
2. To understand the modulation techniques for satellite communication.
3. To understand launch systems and analyze their effect on satellite and payload design.

Course Outcomes:
The Student will be able to
1. Understand the satellite orbits, elements of satellite and operation of satellite communication.
2. Interpret the concepts of space segment, propulsion, payload, and TTC.
3. Analyze the design requirements and the performance of earth station.
4. Develop the multiplexing techniques, modulation techniques, and multiple access techniques for satellite communication.
5. Illustrate the concepts of link design, rain fading and link availability and perform interference calculations.
6. Design various satellite applications.

Module 1: Elements of Satellite Communication (8 hrs)
Kepler's laws and equations of motion- Newtons's law, Orbital parameters, Orbital description and Orbital mechanics of LEO, MEO and GSO, launching satellites in to orbits, Range to satellite, Satellite – description of different Communication subsystems, Bandwidth allocation.
Module 2: Space Segment (8 hrs)
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem.

Module 3: Earth Station (7 hrs)
Earth Station Transmitters, Receivers-antenna types – Gain and radiated power – Poynting loss – Noise temperature – G/T ratio – High power amplifiers – Redundancy configurations – Carrier & power combining – Low noise amplifiers.
Module 4: Transmission, Multiplexing, Modulation, Multiple Access and Coding (8 hrs)
Different modulation and multiplexing schemes, Multiple Access Techniques – Frequency division multiple access (FDMA) Intermodulation. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception.
Module 5: Satellite Link Design (7 hrs)
Basic link analysis, Interference analysis, Adjacent channel and inter symbol Interference-Rain induced attenuation and interference, Ionospheric characteristics, Satellite link design -Link Design with and without frequency reuse.
Module 6: Applications and Services (7 hrs)
Very small aperture terminal (VSAT) networks – Technologies & configurations – Mobile satellite (MSAT) networks – Low orbital satellites – space craft system design- Domestic satellite systems-the INSAT System-International systems-INTELSAT / INMARSAT.
Reference Books:

1. D. Roddy, “Satellite Communication “, (4/e), McGraw- Hill, 2009.
2. B.N. Agrawal, “Design of Geosynchrons Spacecraft”, Prentice- Hall, 1986.
3. T. Pratt, C.W. Bostain and J.E. Allnutt, “Satellite Communication”, 2nd Edition, Wiley 2002.
4. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan London, 1997.
5. Tri T. Ha, “Digital Satellite Communication”, 2nd edition, 1990.
6. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.

19EC2060	ANTENNAS FOR BIOMEDICAL APPLICATIONS	L	T	P	C
		3	0	0	3

Course Objectives:
1. Get clear idea about implant design and its parameters and solution
2. Understand the in depth and quantitative view of medical sensors and its characteristics
3. Apply the tools to design and development of antennas for the medical applications

Course Outcomes:
The Student will be able to
1. Understand the key concepts about implant design
2. Asses implant design and its parameters
3. Articulate the concepts about blood interfacing implants
4. Infer the applications of implants in medical field
5. Asses about medical sensors
6. Design various implantable antenna for Medical applications

Module 1: Principles of Implant Design (7 hrs)
Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the deceased organ and its replacement, Tissue Engineering, scaffolds, cells and regulators, criteria for materials selection, Case study of organ regeneration.
Module 2: Implant Design Parameters and Its Solution (8 hrs)
Biocompatibility, local and systemic effects of implants, Design specifications for tissue bonding and module matching, Degradation of devices, natural and synthetic polymers, corrosion, wear and tear, Implants for Bone, Devices for nerve regeneration.
Module 3: Blood Interfacing Implants (7 hrs)
Neural and Neuromuscular implants, heart valve implants, heart and lung assist devices, artificial heart, cardiac pacemakers, artificial kidney- dialysis membrane and artificial blood.

Module 4: Implantable Medical Devices and Organs (8 hrs)
Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.
Module 5: Classification of Medical Sensors (8 hrs)
Sensors for Pressure Measurement, Sensors for Motion and Force Measurement, Sensors for Flow Measurement, Temperature Measurement, Sensors for speed, torque, vibration, smart sensors, design of interface system.
Module 6: Software Tools (7 hrs)
Introduction to microstrip patch antenna, design of implantable antennas for biomedical applications using FEKO
Text Books:
1. Tatsuo Togawa; Toshiyo Tamura; P. Ake Oberg, "Biomedical Sensors and Instruments", CRC Press,UK 2011.
2. Life: Healthcare Settings (Smart Sensors, Measurement and Instrumentation), CRC Press, 2017.

Reference Books
1. Octavian Adrian Postolache and Subhas Chandra Mukhopadhyay, "Sensors for Everyday
2. Gabor Harsanyi, "Sensors In Biomedical Applications: Fundamentals, Technology & Applications", CRC Press, USA, 2000.
3. J D Bronzino, "Biomedical Engineering handbook" Volume II, (CRC Press / IEEE Press), 2000.
4. R S Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 2003.Joon B Park, Biomaterials – An Introduction, Plenum press, New York, 1992.
5. Yannas, I. V, "Tissue and Organ Regeneration in Adults", New York, NY: Springer, 2001. ISBN:9780387952147.
6. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, "Clinical Engineering", CRC Press, 1st edition,2010.
7. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design" McGraw- Hill, 2003

19EC2061	EMBEDDED SYSTEMS	L T P C 3 0 0 3

Course Objectives:
1. To understand the basic concepts of Embedded System architecture.
2. To acquire knowledge in the hardware and software design of Embedded system.
3. To be able to design a closed loop real time system.

Course Outcomes:
The Student will be able to
1. Acquire knowledge about the embedded system architecture
2. Gain knowledge on the types of memories.
3. Design the hardware required for embedded systems
4. Develop good programming skills to develop embedded software
5. Demonstrate the OS design for embedded firmware
6. Apply the acquired knowledge to develop closed loop embedded system

Module 1: Introduction to Embedded System Design (8 hrs)
Introduction, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Architecture Design. **Embedded System Architecture:** Co-Processor & Hardware Accelerators, Processor performance Enhancement: Pipelining, Superscalar Execution, Multi Core CPUs
Module 2: Designing Embedded System Hardware-I (7 hrs)
Memory systems: Memory organization, Error detecting and correcting, memory Access times, DRAM interfaces, Cache, unified versus Harvard caches, Cache coherency, Cache, Dual port and shared memory.

Module 3: Designing Embedded System Hardware-II (8 hrs)
I/O Devices: Watchdog Timers, Interrupt Controllers, Interfacing Protocols: SPI, I2C, CAN: Frame Formats, Wiring Topology, Reset Circuits.
Module 4: Designing Embedded System Software –I (9 hrs)
Application Software, System Software, Use of High-Level Languages: C, C++, Java, Programming & Integrated Development Environment tools, Emulators, Debugger, Board Support Library, Chip Support Library Analysis and Optimization: Execution Time, Energy & Power, Program Size; Embedded System Coding Standards: MISRA C 2012.
Module 5: Designing Embedded System Software –II (8 hrs)
OS based Design, Real Time Kernel, Process& Thread, Multi-threading, Synchronization, Kernel services, Case Study: RTX- ARM.
Module 6: Designing Embedded System (5 hrs)
Practical implementation of Speed control of Stepper motor or any closed loop control System for real time Application
Reference Books:

1. Shibu K V, "Introduction to Embedded Systems", 2009, Tata McGraw Hill Education Private Limited, ISBN: 10: 0070678790
2. Steve Heath, "Embedded System Design", 2nd Edition, 2004, Elsevier
3. James K Peckol, "Embedded Systems – A contemporary Design Tool", 2008, John Weily, ISBN: 0-444-51616-6
4. John H. Davies, "MSP430 Microcontroller Basics", 2008, Newness Publishing House
5. Rajkamal, "Embedded Systems Architecture, Programming & Design", Mc. GrawHill 2017.

19EC2062	INTERNET OF THINGS FOR MECHANICAL SYSTEMS	L T P C 3 0 0 3

Course Objectives:
1. To make the students understand the requirements of Industrial automation standards
2. To enable the students to get familiarized with the concepts of IoT connecting the mechanical systems
3. To make the students apply IoT concepts in mechanical systems

Course Outcomes:
The Student will be able to
1. Interpret the Essentials of IoT for Modern Engineers
2. Examine the importance of Smart and Digital Factories
3. Make use of IoT in Manufacturing Process and Applications
4. Model IoT for Cyber-Physical Systems, Virtual Reality and Data Analytics
5. Interpret the IoT Challenges in Mechanical Systems
6. Apply IoT concepts in various applications

Module 1: Essentials of IoT for Modern Engineers (8 hrs)
The IoT revolution, The smart product mechanical engineer, Consumer IoT, Industrial IoT, Sensor, Analysis, Connectivity, Exchange. Data characteristics, The IoT process, Product components, External sources, Data Visualization, Closed loop design, Performance metrics, statistical data, Future design, Edge/Cloud computing.
Module 2: Smart and Digital Factories (7 hrs)
Big data, Predictive Analytics, Virtualized Processes, Modelling and Simulation, High-performance computing, Robotics, Code Halo Thinking, 3D Printing, Informed Manufacturing, Additive Manufacturing
Module 3: IoT in Manufacturing Process and Applications (8 hrs)
Supply Chain Management, Operating Efficiency, Predictive Maintenance, Inventory Optimization, Intelligent Supply, Maturity Scale for Smart Manufactured Products.
Intelligent Product Enhancements, Dynamic Response to Market Demands, Waste Reduction, Product Safety.

Module 4: IoT Model for Cyber-Physical Systems (7 hrs)
Industry 4.0, IIOT, Smart factories, Cyber Physical production Systems, synchronized planning, COBOTS, Digital Threads, Augmented and Virtual Reality, sensing and control, security, system design, Data analytics

Module 5: IoT Challenges in Mechanical Systems (8 hrs)
Resource Constraints, Appropriate Information Models, Standardization of Device Models, Bridging to the Cloud, Security, AI/Autonomy, Cyber Security.

Module 6: Industrial IoT Application Cases (7 hrs)
Robotics Remote Service, Electrical Vehicle Charging, Container Ship Trim Optimization, Condition Monitoring for Industrial Drives, Digital TWINS.

Reference Books:

1. William Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, 2017.
2. "Internet of Things", Copyright 2016 by Tutorials Point (I) Pvt. Ltd.
3. Heiko Koziolek "IoT Challenges for Smart Manufacturing", Senior Principal Scientist, ABB Corporate Research Germany
4. "The Essentials of IoT for Modern Engineers", 2016 Autodesk, Inc.
5. "IoT and Smart Manufacturing", Stephen EzellVice President, Global Innovation Policy Information Technology and Innovation Foundation
6. Gurdip Singh, "Cyber-Physical Systems and IoT Research Challenges", National Science Foundation
7. "From Mechatronic Components to Industrial Automation Things: An IoT Model for Cyber-Physical Manufacturing Systems", Journal of Software Engineering and Applications

19EC2063	SENSOR TECHNOLOGY FOR MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objective:
1. To make the students understand the sensor requirements for machines
2. To enable the students familiarize with the working principles of sensors
3. To make the students use appropriate sensor systems for building intelligent machines

Course Outcomes:
The Student will be able to
1. Get familiarized with the types of sensors and transducers
2. Understand the working of sensors used in machines
3. Apply the knowledge of sensors in building intelligent sensing systems
4. Examine the performance of support systems in machines
5. Validate sensors to build viable systems with minimal resources
6. Create interfacing circuitry for embedding sensors into machines

Module 1: Sensor Fundamentals (6 hrs)
Sensors, Signals, and Systems, Sensor Classification, Units of measurements, Sensor Characteristics, Types of sensors used in IoT applications, Transducers.

Module 2: Interfacing Circuits and processing (6 hrs)
Characteristics of interface circuits, Amplifiers, Excitation circuits, Analog to digital converters, direct digitization and processing, bridge circuits, data transmission, noise in sensors and circuits.

Module 3: Sensors and Transducers 1 (7 hrs)
PIR Motion detectors, Inductive and Magnetic sensors, Optical Sensors, Accelerometer, Gyroscopes, Pressure sensors, Pneumatic sensors.

Module 4: Sensors and Transducers 2 (7 hrs)
Flow sensors, Acoustic sensors, Humidity and moisture sensors, Light detectors, Radiation detectors, Temperature sensors, ChemFET.

Module 5: Sensors for Intelligent Building and household appliances (10 hrs)
Requirements of sensor systems in intelligent building, principles of smoke sensing, flame sensing, gas sensing, CO_2 and VOC sensors. Sensor systems for safety and health, Sensor systems for Heating,

Ventilation and Air conditioning and Comfort, Water level sensors, Detergent dispensing, Detecting drum positions in washing machines, Detecting water flow, Reed sensors for stove applications

Module 6: Sensors for Automotive Technology (9 hrs)

Force and torque sensors, Wheel-speed sensors, Rain Sensors, Tire-pressure sensors, Digital cruise control, Airbag system, Radar warning system.

Text Books:

1. O Gassmann, H. Meixner, J. W. G. J. Hesse, and W. Gopel, "Sensors in Intelligent Buildings: Sensor Applications", Wiley-VCH, 2001.
2. Fraden, Jacob, "Handbook of Modern sensors", Springer-2010
3. Guido Tschulena, Andreas Lahrman, "Sensors in Household Appliances: Sensor Applications", Wiley-VCH, 2003.
4. J. Marek, H.P. Trah, Y. Suzuki, I. Yokomori, "Sensors for Automotive Applications: Sensor Applications", Wiley-VCH, 2003.

Reference Book:

1. William Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, 2017.
2. Simon Laflamme, Filippo Ubertini, Jian Li, "Smart Sensors for Structural Health Monitoring", Mdpi AG Publisher, 2019.

Course code	PYTHON PROGRAMMING	L	T	P	C
20EC1001		2	0	0	2

Course Objectives:

Impart knowledge on

1. To understand the need for high level programming and I/O.
2. To apply visualization using python programming language.
3. To develop skills to solve real time problems.

Course Outcomes:

The student will be able to

1. Understand the basics of programming using python.
2. Write and execute python programs
3. Understand the concepts of using math library
4. Adopt different techniques using functions in the program.
5. Formulate algorithms and write programs using modules, packages and strings
6. Apply python for real time application using object oriented approach.

Module: 1	INTRODUCTION TO PROGRAMMING	5 Hours

Programming for everybody, Hardware overview, python as a language, Features of python, Syntax, Install and run the Python interpreter, using python to write basic programs, printing statement, instruction execution.

Module: 2	DATA TYPES, VARIABLES AND EXPRESSIONS	5 Hours

Data types, manipulations, operations, slicing, loops and conditionals, variable declaration, expressions, control structures, assignment statement, Definite loops, loop constructs.

Module: 3	COMPUTING WITH NUMBERS AND STRINGS	5 Hours

Numeric datatypes, using math library, handling large numbers, type conversion, string datatype, simple string processing, Input/output as string manipulation.

Module: 4	FUNCTIONS	5 Hours

Functions, Overview, Functions and parameters, building functions, Returning a result from a function, Scopes in Python, Tuples and dictionaries.

Module: 5	MODULES, PACKAGES, STRING	5 Hours
Using modules, packages, errors, Characters and strings, Python's nature of strings, string methods, sample programs, visualization of data.		
Module: 6	**OBJECT-ORIENTED APPROACH**	**5 Hours**
Basic concepts of object programming, from procedural to object approach, properties, methods, Inheritance, processing files, working with real files: Case study on real time application.		
	Total Lectures	**30 Hours**

Text Books	
1.	Kenneth A. Lambert, Martin Osborne, “Fundamentals of Python: First Programs, CengageLearning”, second edition, 2018, ISBN 13:978-1337560092.
2.	Michal Jaworski, TarekZiade, “Expert Python Programming”, Packt Publishing, SecondRevised edition, 2016, ISBN-13: 978-1785886850
Reference Books	
1.	Zed A. Shaw, “Learn Python the Hard Way”, Addison-Wesley, Third Edition, 2014, ISBN-13:978-0-321-88491-6.
2.	Dave Kuhlman, “A Python Book: Beginning Python, Advanced Python, and PythonExercises”, 2013, ISBN: 9780984221233
3.	Paul Barry, “Head First Python 2e”, O′Reilly, 2nd Revised edition, 2016, ISBN-13: 978-1491919538
4.	Greg L. Turnquist, Bhaskar N. Das, “Python Testing Cookbook:Easy solutions to test yourPython projects using test-driven development and Selenium”, 2nd Edition,2018, ISBN:1787281507, 9781787281509
5.	Charles Dierbach, “Introduction to Computer Science Using Python: A Computational Problem- Solving Focus”, Wiley India Pvt. Ltd, June 2015, ISBN-10: 8126556013.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	R PROGRAMMING	L	T	P	C
20EC1002		2	0	0	2

Course Objectives:

Impart knowledge on

1. To understand the need for data analysis and graphics.
2. To describe generic programming concepts implemented in high level language.
3. To solve practical issues in statistical computing, image processing.

Course Outcomes:

The student will be able to

1. Understand the basics of programming using R.
2. Create and execute R programs
3. Understand the concepts of file processing
4. Adopt different techniques for using functions in the program.
5. Formulate algorithms and programs using basic objects and methods
6. Analyze existing data of real world problems in business, medical fields etc

Module: 1	INTRODUCTION	5 Hours
Introduction, overview and history of R, Installation, writing code, console, data types, arithmetic and logical operators, interfacing, sub setting lists and matrices, the art of data science, nuts and bolts of R.		
Module: 2	**BASIC OBJECTS**	**5 Hours**

Vector, matrix, array, Data frame creating, selection of frame elements, sorting, sorting data frames, creating lists, creating a named list, selecting elements from a list, creating new list.		
Module: 3	**PROGRAMMING USING R**	**5 Hours**
Control structures and loops, IF, ELSE, ELSE IF statements in R, FOR loop, WHILE loop, simple R functions- apply(), lapply(), sapply(), tapply() with Examples, scoping rules, coding standards, programming exercises.		
Module: 4	**FILES AND STRINGS**	**5 Hours**
Reading text files, excel files and CSV files, writing into files, Strings, regular expressions, Diagnosing the errors, practical R exercises with real time datasets-weather dataset, wine dataset		
Module: 5	**BASIC OBJECTS**	**5 Hours**
Vector, matrix, array, Data frame creating, selection of frame elements, sorting, sorting data frames, creating lists, creating a named list, selecting elements from a list, creating new list, visualizing data, charts and graphs - boxplot, scatter plot.		
Module: 6	**GRAPHICS IN R**	**5 Hours**
The function plot and allied functions, use of color, aspect ratio, plotting expressions and symbols, identification and location on the figure region, plot methods for objects, lattice graphics. Application: Image processing and case studies on real time problems.		
	Total Lectures	**30 Hours**

Text Books	
1.	Hothorn, Torsten, and Brian S. Everitt. A handbook of statistical analyses using R. CRC press, 2014. ISBN-13: 1-584-88539-4.
2.	John Maindonald and John Braun. Data Analysis and Graphics Using R-an example-based approach. Cambridge University Press, Cambridge, Third edition, 2010. ISBN 978-0-521-76293-9.
Reference Books	
1.	Phil Spector. Data Manipulation with R. Springer, New York, 2008. ISBN 978-0-387-74730-9.
2.	Alain F. Zuur, Elena N. Ieno, and Erik Meesters. A Beginner's Guide to R. Use R. Springer, 2009. ISBN: 978-0-387-93836-3.
3.	Benjamin M. Bolker. Ecological Models and Data in R. Princeton University Press, 2008. ISBN 978-0-691-12522-0.
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**PROGRAMMING FOR PROBLEM SOLVING WITH C**	**L**	**T**	**P**	**C**
20EC1003		2	0	0	2

Course Objectives:

The student will be able to

1. To understand the need for software programming languages.
2. To apply coding techniques and function based modularization.
3. To develop skills to solve real time computational problems

Course Outcomes:

The student will be able to

1. Understand the basics of computer and software development process.
2. Understand the basics of programming skills using C language

3. Apply innovative ideas for the problem using arrays and strings. 4. Adopt different techniques for using functions in the program. 5. Formulate algorithms and programs using arrays, pointers and structures 6. Create a new application software to solve real world problems.		
Module: 1	**INTRODUCTION TO PROGRAMMING**	**5 Hours**
Introduction to digital computers, Introduction to hackerrank, Idea of algorithms, Flowchart and Pseudocode, Hardware vs software, Introduction to programming, Software development life cycle, Structured programming, Types of programming languages software and compilers.		
Module: 2	**OPERATORS AND EXPRESSIONS**	**5 Hours**
Data types, Constants, Variables, Declarations, Expressions, Statements, Operators in C, arithmetic and relational expressions, Logical operators, branching statements, Implementation of loops, Sum and difference of two numbers using hackerrank.		
Module: 3	**ARRAYS AND STRINGS**	**5 Hours**
Introduction, programming using arrays, processing an array, 1D Arrays using hackerrank, Multidimensional arrays, Strings, defining a string, Initialization of strings, Reading and writing a string, Introduction to recursion.		
Module: 4	**FUNCTIONS**	**5 Hours**
Functions, Overview, defining a function, accessing a function, Function prototypes, passing arguments to a function, Problem solving using functions in hackerrank.		
Module: 5	**POINTERS**	**5 Hours**
Fundamentals, Pointer declarations, use of pointer in function, Pointers and one-dimensional arrays		
Module: 6	**STRUCTURES**	**5 Hours**
Fundamentals, defining a structure, Processing a structure, Array of structures, Pointer in structures.		
	Total Lectures	**30 Hours**

Text Books	
1.	Byron Gottfried, “Schaum's Outline of Programming with C”, 3rd edition, 2016, McGraw Hill Education (India), ISBN: 9780070145900
2.	Balagurusamy, E “Programming in ANSI C”, 7th edition, McGraw Higher Ed, 2016, ISBN:9789339219666
3.	HackerRank skills and knowledge: Refer the link: (https://www.hackerrank.com/skills-verification/problem_solving_basic) and (https://www.hackerrank.com/domains/c)
Reference Books	
1.	YashavantKanetkar, “Let Us C”, 15th edition, 2016, Bpb Publications, ISBN:9788183331630
2.	Herbert Schildit, “The Complete Reference C”, 4th edition, 2017, McGraw Hill Education(India),2017, ISBN:978007041183
3.	Beulah ChristalinLatha, Anuja Beatrice, CarolinJeeva& Anita Sofia, Fundamentals ofComputing and Programming, 1st edition, Pearson, 2018.
4.	Sumitabha Das, “Computer Fundamentals and C Programming”, 18th edition, 2018, McGraw Hill Education (India), ISBN:9789387886070
5.	Stephen G. Kochan, “Programming in C”, 4 th edition, 2015, ISBN: 9789332554665. David Griffiths, “Head First C”, 1st edition, 2012, O'Reilly Media, ISBN:978-1449399917

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	C PROGRAMMING LABORATORY	L	T	P	C
20EC1004		0	0	2	1

Course Objective:

Impart knowledge on
1. To understand the need for computational problem-solving using programming languages.
2. Frame the basic programming to design the program.
3. Develop applications to solve real time problems.

Course Outcome:

The student will be able to
1. Formulate the programs for simple problems
2. Define the concepts using logical and arithmetic expressions
3. Identify and correct logical errors encountered at run time
4. Create iterative programs using control statements.
5. Represent data in arrays, strings and structures and manipulate them through a program.
6. Declare pointers of different types and use them in user defined datatypes.

List of Experiments

1.	Implementation of Basic programs using C language
2.	Simple computational problems using arithmetic operators and logical expressions
3.	Program Implementation using control statements and loops using hackerrank
4.	Problem solving using arrays using hackerrank
5.	Implementation and manipulation of strings using hackerrank
6.	Find Square Root, numerical differentiation, numerical integration using functions.
7.	Problem solving using pointers
8.	Implementation of user defined datatypes using structures.
Total Lectures	**30 Hours**

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	ELECTRONICS FOR INTELLIGENT MACHINES LABORATORY	L	T	P	C
20EC1005		0	0	2	1

Course Objective:

Impart knowledge on
1. To make the students get familiarized with a development tool
2. To enable the students to understand the means to interface I/O devices to a processor board
3. To enable the students to develop an embedded system

Course Outcome:

The student will be able to
1. To identify a basic development platform and tool
2. To identify the software requirements for an intelligent machine
3. To classify the sensors for various applications
4. To be able to apply programming to interface I/O devices
5. To be able to apply programming to interface sensor
6. To be able to send data to the cloud

List of Experiments

1.	Program to interface I/O devices using development board
2.	Password based led control using development board
3.	Program to interface temperature sensor using development board

4.	Program to interface Humidity sensor using development board
5.	Serial Interface using development board
6.	An application program integrating sensors and I/O devices with development board
7.	Program to send data to cloud
8.	Program to send real time data to cloud
Total Lectures	**30 Hours**
Recommended by Board of Studies	
Approved by Academic Council	

Course code	**ELECTRONIC MEASUREMENT LABORATORY**	**L**	**T**	**P**	**C**
20EC2001		0	0	2	1

Course Objective:

Impart knowledge on

1. To develop the Construction of AC and DC Bridge Circuits
2. To enable the students to learn Signal Conditioning Circuits for measurement systems
3. To understand the fundamental concepts of data acquisition systems

Course Outcome:

The student will be able to

1. Analyze and validate DC and AC bridges
2. Perform Signal acquisition in LabVIEW
3. Design Signal Conditioning Circuits for Sensor Data Acquisition
4. Demonstrate the use of different types of analyzers
5. Determine the characteristics of ADC
6. Interpret the concepts of computerized data acquisition

List of Experiments

1.	Calibration of Ammeter and Voltmeter
2.	Measurement of Capacitance using Schering's Bridge
3.	Measurement of Inductance using Maxwell's Bridge
4.	Measurement of Strain using Wheatstone Bridge
5.	Measurement of Signal Parameters using LABVIEW
6.	Measurement of Temperature using LABVIEW
7.	Measurement of the speed of a DC motor using LABVIEW
8.	Measurement of Frequency spectrum of AM and FM signal using Spectrum Analyzer
9.	Measurement of S-parameters of two-port networks using vector Network Analyzer
10.	Effect of ADC Resolution, Range and Sampling rate on signal acquisition
Total Lectures	**30 Hours**
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**ELECTRONIC DEVICES**	**L**	**T**	**P**	**C**
20EC2002		3	0	0	3

Course Objectives:

The student will be able to

1. To understand the mechanisms of current flow in semi-conductors.
2. To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
3. To design practical circuits and to analyse various components.

Course Outcomes:

The student will be able to

1. Demonstrate the flow of charge carriers in semiconductor and interpret the VI relations.

2. Understand the physical and functional properties of diode.
3. Compare the properties of different configurations of bipolar junction transistors.
4. Apply the semiconductor concepts to construct MOS devices.
5. Categorize the special semiconductor devices based on their applications.
6. Infer the knowledge of power devices and display devices

Module: 1	**SEMICONDUCTOR IN EQUILIBRIUM**	**8 Hours**
Energy band diagram of semiconductor-Charge carriers in semiconductors- Extrinsic semiconductor-Charge neutrality-Position of Fermi energy level-Carrier transport phenomena-Carrier generation and recombination-Poisson and Continuity equation -Hall effect.		
Module: 2	**THEORY OF PN DIODES**	**7 Hours**
PN junctions: Basic structure- Applied bias- Current components –Quantitative theory of PN junction diode, Diffusion Capacitance and Transition Capacitance.		
Module: 3	**THEORY OF JUNCTION TRANSISTORS**	**8 Hours**
Bipolar transistor action- working of NPN and PNP transistor-Transistor current components: Emitter injection efficiency, Base transport factor, Collector efficiency, Large signal current gain-Static characteristics of transistor: CB, CE and CC -Ebers Moll model.		
Module: 4	**THEORY OF JFET AND MOSFET**	**7 Hours**
Junction FET operation - Static characteristics - Enhancement MOSFET- Depletion MOSFET - Comparison of JFET and MOSFET- MOS Capacitor: Construction-VI characteristics-UJT		
Module: 5	**SPECIAL SEMICONDUCTOR DEVICES (QUALITATIVE TREATMENT ONLY)**	**8 Hours**
Zener diode -Tunnel diode - Schottky barrier diode- Metal Semiconductor Junction-Avalanche photo diode, LASER diode, MESFET, UJT.		
Module: 6	**POWER DEVICES AND DISPLAY DEVICES**	**7 Hours**
SCR, DIAC, TRIAC, LED, Photo diode, Photo transistor, Solar cell, solid state memories.		
	Total Lectures	**45 Hours**

Text Books

1.	Donald A. Neamen, “ Semiconductor physics and Devices “,Tata McGraw Hill, 4th Edition, 2012.
2.	Jacob Millman & Halkias,"Electronic Devices & Circuits",Tata McGraw Hill, 4th Edition, 2015.

Reference Books

1.	Malvino A P, “Electronic Principles”, McGraw Hill International, 8th Edition 2016.
2.	David.A.Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2010.
3.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Edition, Pearson Education, 2015

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
20EC2003		2	1	0	3

Course Objectives:

Impart knowledge on

<table>
<tr><td colspan="3">1. To explain the basic properties of signal & systems and the various methods of classification
2. To introduce Fourier Series, Fourier transform, Laplace Transform and their properties
3. To paraphrase Z transform and their properties</td></tr>
<tr><td colspan="3">Course Outcomes:</td></tr>
<tr><td colspan="3">The student will be able to
1. Analyze different types of signals for mathematical modelling
2. Realize the system properties to build basic model
3. Represent continuous time system using fourier series and fourier transform
4. Investigate the sampling process and Laplace Transform
5. Signify discrete time system using fourier series and fourier transform
6. Familiarize the frequency analysis of discrete time system using Z transform</td></tr>
<tr><td>Module: 1</td><td>CLASSIFICATION OF SIGNALS</td><td>7 Hours</td></tr>
<tr><td colspan="3">Continuous Time (CT) signals – CT signal operations – Discrete Time (DT) signals – Representation of DT signals by impulses – DT signal operations – CT and DT systems and discrete amplitude signals.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Module: 2</td><td>CLASSIFICATION OF SYSTEM</td><td>8 Hours</td></tr>
<tr><td colspan="3">Linear Time Invariant(LTI)-Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behavior with aperiodic convergent inputs-System properties-Characterization of causality and stability of linear shift-invariant systems.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Module: 3</td><td>FOURIER ANALYSIS OF CT SIGNALS AND SYSTEMS</td><td>8 Hours</td></tr>
<tr><td colspan="3">Fourier series representation of periodic signals – Properties – Harmonic analysis of LTI systems – Convergence of Fourier series – Representation of a periodic signals by Continuous Time Fourier Transform (CTFT) – Properties – Frequency response of systems characterised by Differential Equations – Power and Energy Spectral Density – Parseval’s Relation.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Module: 4</td><td>DISCRETISATION OF CT SIGNALS</td><td>8 Hours</td></tr>
<tr><td colspan="3">Representation of CT signals by samples – Sampling Theorem – Sampling Methods– Effect of under sampling – Aliasing Error –- The Laplace Transform-properties- region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Module: 5</td><td>FOURIER ANALYSIS OF DT SIGNALS AND SYSTEMS</td><td>7 Hours</td></tr>
<tr><td colspan="3">Discrete Time Fourier series representation of DT periodic signals – Properties – Representation of DT aperiodic signals by Discrete Time Fourier Transform (DTFT) – Properties – Frequency response of systems characterised by Difference Equations – Power and Energy Spectral Density concepts related to DT signals – Parseval’s Relation.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Module: 6</td><td>TRANSFORM OPERATIONS OF DT SIGNALS AND SYSTEMS</td><td>7 Hours</td></tr>
<tr><td colspan="3">Z transform and its properties – Inverse Z transform – Solution of Difference equations –Z Transform</td></tr>
<tr><td colspan="2" align="right">Total Lectures</td><td>45 Hours</td></tr>
<tr><td colspan="3">Text Books</td></tr>
<tr><td>1.</td><td colspan="2">Allan V. Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, Indian Reprint, 2009.</td></tr>
<tr><td>2.</td><td colspan="2">Simon Haykin and Barry Van Veen, “Signals & Systems”, John Wiley and Sons Inc., 2005</td></tr>
<tr><td colspan="3">Reference Books</td></tr>
<tr><td>1.</td><td colspan="2">B. P. Lathi, “Principles of Linear Systems and Signals”, Oxford, Second Edition, 2009.</td></tr>
</table>

2.	Samir S Solimon and Srinath M.D., "Continuous and Discrete Signals and Systems", II Edition, PHI, 2003.
3.	Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, 2002.
4.	P.Ramakrishna Rao, "Signals and Systems" , Tata Mc Graw Hill Publications, 2008.
5.	John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**COMPUTER ARCHITECTURE**	**L**	**T**	**P**	**C**
20EC2004		3	0	0	3

Course Objectives:

Impart knowledge on

1. To impart basic concepts computer architecture
2. To study the basic concepts of microprocessor 16 bit (8086).
3. To introduce interfacing devices, programmable peripheral devices and applications

Course Outcomes:

The student will be able to

1. Illustrate the basics of computer organization.
2. Outline the architecture of 8086 microprocessor
3. Implement micro operations and micro programming concepts.
4. Formulate Memory hierarchy
5. Demonstrate the concepts of I/O devices
6. Outline the importance of pipelining

Module: 1	**REGISTER TRANSFER AND MICRO OPERATIONS**	**7 Hours**

Basic Structure of Computers: Register Transfer -Bus and Memory Transfers - Arithmetic Microoperations - Logic Micro operations -Shift Micro operations - Arithmetic Logic Shift Unit.

Module: 2	**BASIC COMPUTER ORGANIZATION**	**8 Hours**

Instruction Codes –Indirect address- Computer Registers – Common bus system-Computer Instructions –Instruction set -Timing and Control - Instruction Cycle-Register reference Instructions-Memory reference instructions

Module: 3	**PROGRAMMING THE BASIC COMPUTER**	**8 Hours**

Subroutines - Input–Output Programming-Control Memory - Address Sequencing - Microprogram –General register organization-Program Control

Module: 4	**MEMORY AND PIPELINING**	**8 Hours**

Memory hierarchy – Main memory – Cache basics- Parallel Processing - Pipelining 9-Arithmetic Pipeline - Instruction Pipeline - RISC Pipeline - Vector Processing

Module: 5	**8086 MICROPROCESSOR**	**7 Hours**

Architecture – Signals - Memory Organization – addressing modes - Minimum Mode & Maximum Mode.

Module: 6	**I/O INTERFACING TECHNIQUES**	**7 Hours**

Parallel Peripheral interface (8255) – Serial communication interface (8251) –Timer and counter Interface (8254)		
	Total Lectures	**45 Hours**

Text Books

1.	M.Morris Mano, “Computer System Architecture” Third Edition, Pearson – 2013
2.	V.CarlHamacher, Zvonko G. Varanesic and Safat G. Zaky, “Computer Organisation“, VI edition, Mc Graw-Hill Inc, 2012.
3.	William Stallings “Computer Organization and Architecture”, Seventh Edition, Pearson Education, 2006.
4.	Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, Second Edition, Pearson Education, 2005

Reference Books

1.	Govindarajalu, “Computer Architecture and Organization, Design Principles and Applications”, first edition, Tata Mc Graw Hill, New Delhi, 2005.
2.	John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata Mc Graw Hill, 1998.
3.	David A. Patterson and John L. Hennessey, “Computer Organization and Design“, Fifth edition, Morgan Kauffman/ Elsevier, 2014.
4.	DoughlasV.Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,201
5.	Ramesh.S.Goankar “Microprocessor Architecture, Programming &Applications with 8085” –Penram International, Fifth Edition, 1999

Recommended by Board of Studies	
Approved by Academic Council	12^{th} September 2020

Course code	**IOT FOR COMMUNICATION ENGINEERING**	**L**	**T**	**P**	**C**
20EC2005		3	0	0	3

Course Objectives:

Impart knowledge on

1. To understand IoT, components, architecture and networks
2. To Examine the cloud topologies, network security and prevention
3. To demonstrate the Internet of things with real time applications

Course Outcomes:

The student will be able to

1. Understand the fundamental concepts of IoT, architecture and communication pattern.
2. Analyse the various sensors/actuators and the various IoT protocols.
3. Analyse WSN architecture, node behaviour and interoperability issues.
4. Analyse the various network security issues and its prevention.
5. Apply their understanding and to apply the IoT principles in real time applications.

Module: 1	**INTRODUCTION**	**8 Hours**

IoT – Terminology – characteristics – market share – Evolution of connected devices – IoT vs M2M – IoTvsWoT – Connectivity terminologies- IoT network components – functionalities – service oriented architecture – Implementation with an example- Core IoT technologies – Energy harvesting - IoT stack vs Web stack – communication patterns with applications. IPv4 format and IPv6 format – IPv4 vs IPv6.

Module: 2	**DATA ACQUISITION/ACTUATION AND IOT PROTOCOLS**	**8 Hours**

Data acquisition and actuation - sensors - classification and examples - Analog/Digital – scalar/vector – errors – resolution -Standard and protocols - Network layer protocols – Identification protocols - Discovery protocols – Data protocols – communication/transport protocols – IEEE 802.15.4 –

ZigBee – Bluetooth – LoRaWAN- 6LoWPAN – RPL – NFC - RFID – MQTT – CoAP – XMPP – AMQP -		
Module: 3	**IOT WIRELESS SENSOR NETWORKS AND INTEROPERABILITY**	**8 Hours**
WSN – communication –challenges and constraints – Sensor Node architecture of WSN- IM Node architecture – Object/intruder detection by nodes and their cooperation- Node behaviour - Software defined networking – Network function virtualization – WSN applications – Interoperability in IoT-current challenges – types – issues – device identification – syntactic – semantic – solution – universal middleware bridge (UMB)		
Module: 4	**NETWORK SECURITY ISSUES AND PREVENTION**	**8 Hours**
Network security – types of attacks –perception layer –blocking of brute force attack – clone node-Impersonation of the user to access the account –routing attack – Denial of service – node privacy leak - recent attacks – Mirai – stuxnet- chain reaction - Prevention of attacks –Physical and hardware security - cryptography		
Module: 5	**CLOUD AND FOG TOPOLOGIES**	**8 Hours**
Cloud services model – NaaS – SaaS – PaaS – IaaS – Public – Private – Hybrid cloud – Open stack cloud architecture – keystone – Glance – Nova compute – swift – neutron – cinder – horizon constraints of cloud architectures – Fog computing – Fog topologies – fog computing vs edge computing vs cloud computing		
Module: 6	**IOT APPLICATIONS**	**5 Hours**
Case studies – home automation – smart parking – weather monitoring system – smart irrigation		
	Total Lectures	**45 Hours**

Reference Books

1.	Dr. OvidiuVermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers 2013.
2.	Vijay Madisetti ,ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 2014.
3.	Adrian McEwen , Hakim Cassimally , “Designing the Internet of Things”, Wiley, 2013.
4.	WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice”, Wiley 2010.
5.	Behorouz A. Foruzan, “ Data communication and Networking”, Tata McGraw-Hill,2004
6.	Anuradha, J._ Tripathy, B. K, “Internet of things (IoT) _ technologies, applications, challenges and solutions”, CRC Press_Taylor& Francis, 2018.
7.	Perry Lea, “Internet of Things for Architects_ Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security”, Packt , 2018.
8.	Raj, Pethuru_ Raman, Anupama C, “The Internet of things _ enabling technologies, platforms, and use cases”, Auerbach Publications, Taylor & Francis, 2017.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	IOT FOR COMMUNICATION ENGINEERING LABORATORY	L	T	P	C
20EC2006		0	0	2	1

Course Objective:

Impart knowledge on

1. To understand the IoT Cloud platforms and to monitor and control data remotely

2. To demonstrate Long range IoT communication protocols (LoRa) 3. To Configure and work with python programming for remote monitoring and control of IoT devices	
Course Outcome:	
The student will be able to 1. Interface IoT devices and access Cloud platforms 2. Program and work with long range IoT communication protocols such as LoRa 3. Formulate mini projects using python programming by interfacing various sensors and network and application protocols	
List of Experiments	
1.	Configuring ESP8266 and introduction to Cloud platforms
2.	a) Monitoring sensor data from cloud platforms b) Controlling actuator data from cloud platforms
3.	Gateway configuration for LoRa communication and application server a) Data monitoring between end node and application server using LoRa communication and MQTT/HTTP b) Device control between end node and application server using LoRa communication and MQTT/HTTP
4.	Raspberry pi platform setup and GPIO configuration
5.	Displaying measured information and controlling actuator on cloud platforms
6.	Event triggering notifications through CoAP communication
Total Lectures	**30 Hours**
Recommended by Board of Studies	
Approved by Academic Council	12^{th} September 2020

Course code	ARM PROCESSOR LABORATORY	L	T	P	C
20EC2007		0	0	2	1

Course Objective:

Impart knowledge on

1. To impart knowledge on various programming environment.
2. To inculcate programming skills
3. To inspire them to design solutions in embedded for human problems

Course Outcome:

The student will be able to

1. To explore new launch pads and continue to work on
2. To develop programming skills on Embedded
3. To design a product with timer concept.
4. To identify the working of sensors and actuators
5. To apply his/her knowledge in product development
6. To enrich his/her knowledge for life-long learning and in developing projects

List of Experiments

1.	Installation and overview of Code composer Studio, Energia, Mbed Programming environment
2.	Interfacing and programming GPIO ports in C using MSP432 (blinking LEDs , push buttons)
3.	Interrupt programming examples through GPIOs and timer in MSP432
4.	PWM generation using Timer on MSP432 GPIO
5.	Relay controlled bulb using STM32
6.	LED and temperature sensor interfacing with STM32
7.	LCD and LDR interfacing with STM32

8.	Microphone and Speaker interfacing with STM32	
9.	Interfacing accelerometer and Bluetooth with STM32	
10	Design Of A Simple Alarm System Using Touch Sensor(any project)	
	Total Lectures	**30 Hours**
Recommended by Board of Studies		
Approved by Academic Council	12th September 2020	

Course code	5G COMMUNICATIONS	L	T	P	C
20EC2008		3	0	0	3

Course Objectives:

Impart knowledge on

1. To learn the latest in the 4G evolution to 5G, 5G use cases and coexistence of 4G & 5G.
2. To provide a sound understanding of RF front end for 5G and 5G New Radio Waveforms.
3. To expose the students to the key technologies of 5G standard, components of 5G network along with 5G applications.

Course Outcomes:

The student will be able to

1. Describe the key part of the evolution to 5G, requirements of 5G, building blocks of 5G and 5G spectrum.
2. Explain the Millimeter Wave Communications and massive MIMO.
3. Discuss the 5G Radio Access Technologies and Modulation Techniques.
4. Outline the significance New Radio Air Interface and wireless propagation channel models
5. Analyze the multi-point transmission and network coding in 5G.
6. Acquire basic knowledge on 5G applications like Machine-type communications.

Module: 1	**INTRODUCTION AND ROADMAP TO 5G**	**7 Hours**

Historical trend and evolution of LTE technology to beyond 4G – An Overview of 5G requirements – Key building blocks of 5G – 5G use cases – Regulations for 5G – Spectrum Analysis and Sharing for 5G – The 5G Architecture – IoT: relation to 5G

Module: 2	**RF FRONT END FOR 5G**	**8 Hours**

Millimeter Wave Communications: Hardware technologies for mmW systems – Architecture and Mobility – Massive MIMO: Resource allocation and transceiver algorithms for massive MIMO – Fundamentals of baseband and RF implementations in massive MIMO – Beamforming.

Module: 3	**5G NEW RADIO WAVEFORMS**	**8 Hours**

Modulation Techniques: Orthogonal frequency division multiplexing (OFDM) – generalized frequency division multiplexing (GFDM) – filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), 5G Radio Access Technologies: Design principles – Multi-carrier with filtering – Non-Orthogonal Multiple Access (NOMA) – Radio access for dense deployments – Radio Access for V2X Communication – Radio access for massive machine – type communication.

Module: 4	**5G NEW RADIO AIR INTERFACE AND CHANNEL MODELS**	**7 Hours**

5G New Radio Air Interface: Numerology – Frames – Slots and Resource blocks – Frequency raster – Antenna ports. 5G wireless propagation channel models: Modelling requirements and scenarios – The METIS channel models

Module: 5	**NETWORKING IN 5G**	**7 Hours**

Coordinated multi-point transmission in 5G: Joint Transmission CoMP enablers – Distributed cooperative transmission – JT CoMP with advanced receivers. Relaying and network coding in 5G: Multi-flow wireless backhauling – Buffer aided relaying.

Module: 6	**EVALUATION OF 5G AND 5G APPLICATIONS**	**8 Hours**
Machine-type communications: Fundamental techniques for MTC – Massive MTC – Ultra-reliable low-latency MTC – Device-to-device (D2D) communications – Multi-hop D2D communications – Multi-operator D2D communication. Simulation methodology: Evaluation methodology – New challenges in the 5G modelling.		
	Total Lectures	**45 Hours**

Text Books	
1.	Wei Xiang, KanZheng, Xuemin (Sherman) Shen, - "5G Mobile Communications", Springer, 2017.
2.	AfifOsseiran, Jose F. Monserrat and Patrick Marsch, - "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
3.	Jonathan rodriguez, - "Fundamentals of 5G mobile networks", John Wiley & Sons, Ltd, 2015.
Reference Books	
1.	Martin Sauter "From GSM from GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", John Wiley & Sons, Ltd, 2017
2.	Amitabha Ghosh and RapeepatRatasuk "Essentials of LTE and LTE-A", Cambridge University Press, 2011.
3.	Dahlman E, Parkvall S, Skold J, "5G NR: the next generation wireless access technology", Academic Press, 2 0 1 8
4.	Athanasios G. Kanatas, Konstantina S. Nikita, PanagiotisMathiopoulos, "New Directions in Wireless Communication Systems from Mobile to 5G", CRC Press, 2018.
5.	T S Rappaport, R W Heath, R C Daniels, J N Murdock, "Millimeter Wave Wireless Communications", Prentice Hall Communications, 2015.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**ARTIFICIAL NEURAL NETWORKS AND DEEP LEARNING**	**L**	**T**	**P**	**C**
20EC2009		2	0	0	2

Course Objectives:

Impart knowledge on

1. To impart knowledge on the fundamentals of neural networks
2. To get familiarized with the different architectures involved in neural networks
3. To identify the appropriate neural/deep network for practical applications.

Course Outcomes:

The student will be able to

1. Compare and comprehend the functioning of human brain and ANN.
2. Gain an understanding about training methodologies of neural networks
3. Summarize the pros and cons of different single layer ANN.
4. Apply artificial neural networks for solving engineering problems
5. Outline the basic concepts and applications of deep learning
6. Make use of different Deep networks for real time applications.

Module: 1	**INTRODUCTION TO NEURAL NETWORKS**	**4 Hours**
Humans and Computers - Organization of the Brain - Biological Neuron, Artificial Neuron Models – Characteristics of ANN - McCulloch-Pitts Model – Potential Applications of ANN.		
Module: 2	**ESSENTIALS OF ARTIFICIAL NEURAL NETWORKS**	**4 Hours**

Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, nsupervised, Reinforcement) - Learning Rules.		
Module: 3	**SINGLE LAYER FEED FORWARD NEURAL NETWORKS**	**5 Hours**
Introduction- Perceptron Models: Discrete, Continuous and Multi-Category- Training Algorithms: Discrete and Continuous Perceptron Networks - Limitations of the Perceptron Model. Architecture of Hopfield Network		
Module: 4	**MULTILAYER FEED FORWARD NEURAL NETWORKS**	**5 Hours**
Generalized Delta Rule, Backpropagation (BP) Architecture - Summary of Backpropagation training Algorithm - Learning Difficulties and Improvements		
Module: 5	**INTRODUCTION TO DEEP LEARNING**	**6 Hours**
History of Deep Learning, Deep Feed forward neural network, Gradient Descent, Momentum based GD, Eigenvalues and eigenvectors.		
Module: 6	**DEEP LEARNING NETWORKS**	**6 Hours**
Convolutional Neural Networks, Auto Encoders, Deep Belief networks, Practical Applications		
	Total Lectures	**30 Hours**

Text Books	
1.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, MIT Press, 1st edition, 2016.
2.	LaureneFausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Fourth edition, Pearson Education India, 2006.
Reference Books	
1.	Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005
2.	MohamadHasoun, “Fundamentals of artificial neural networks”, MIT Press, 2003
3.	Michael Nielson, “Neural Networks and Deep Learning”, “http://static.latexstudio.net/article/2018/0912/neuralnetworksanddeeplearning.pdf

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**VLSI FOR IOT SYSTEMS**	**L**	**T**	**P**	**C**
20EC2010		3	0	0	3

Course Objectives:

Pre-requisites

1. Basic concepts in digital circuit design
2. Exposure to CMOS IC Design
3. Familiar with FPGA Architecture and Design flow

Course Objectives:

1. To impart knowledge on changing needs of electronic system design and IC design for IoT based applications
2. To get familiarized with thecircuit and system design techniques for the emerging applications of IoT.
3. To identify the appropriate sensor and compute components of IoT framework

Course Outcomes:

The student will be able to 1. Gain an understanding on IoT Framework 2. Compare and comprehend the features of IoT based systems 3. Summarize the use of IC technology for IoT. 4. Apply IC technology for designing IoT devices. 5. Outline the basic concepts of electronic system design for IoT 6. Make use of Guidelines and prevailing standards to design systems for IoT.		
Module: 1	**INTRODUCTION**	**8 Hours**
Concept of connected world – Need, Legacy systems for connected world – features and limitations,Dawn of IoT – IoT era in comparison with contemporary world, Key features of IoT architecture, Merits and Demerits of IoT technology, Applications driven by IoT technology – examples.		
Module: 2	**COMPONENTS OF IOT**	**10 Hours**
Review of classic embedded system architecture, Basic building blocks of an IoT system – Artificial Intelligence, Connectivity, Sensors and Computing nodes. Sensors used in IoT systems – Characteristics and requirements, Types of sensors for IoT systems, Compute nodes of IoT, Connectivity technologies in IoT – Software in IoT systems - features and properties.		
Module: 3	**IC TECHNOLOGY FOR IOT**	**8 Hours**
SoC architecture for IoT Devices– Application Processors, Microcontrollers, Smart Analog; Memory architecture for IoT – Non Volatile Memories (NVM), Embedded Non-Volatile Memories, Anti-Fuse One Time Programmable (OTP) memories.		
Module: 4	**POWER MANAGEMENT UNITS (PMUS) IN IC'S**	**6 Hours**
Power Management-Low Drop Out Regulators, DC-to-DC Converters, Voltage References, Power Management Units (PMUs) in IC's and Systems, Role of Field Programmability in IoT systems.		
Module: 5	**ELECTRONIC SYSTEM DESIGN FOR IOT**	**6 Hours**
Electronic System Design for IoT – Requirements, Computing blocks in IoT systems – MCU's, DSPs and FPGA's, System Power Supply Design for IoT systems, Mixed Signal challenges in hardware systems, Form Factor.		
Module: 6	**GUIDELINES AND PREVAILING STANDARDS**	**7 Hours**
Guidelines and prevailing standards,Component models&System Design-Feasibility and challenges, System Level Integration, Operating conditions of IoT devices and impact on Electronic System Design; Hardware Security issues, EMI/EMC, SI/PI and Reliability Analysis in IoT systems		
	Total Lectures	**45 Hours**

Text Books	
1.	-
Reference Books	
1.	Alioto, "Enabling the Internet of Things- From Integrated Circuits to Integrated Systems", Springer Publications, First Edition, 2017.
2.	Pieter Harpe, Kofi A. A. Makinwa, Andrea Baschirotto, "Hybrid ADCs, Smart Sensors for the IoT, and Sub-1V & Advanced Node Analog Circuit Design", Springer International Publishing AG, 2017.
3.	OrCAD, "P-spice Technology for Internet of Things" - http://www.pspice.com/solution/pspice-technology-internet-things
4.	Jim Lipman, Sidense Corp." NVM memory: A Critical Design Consideration for IoT Applications"- https://www.design-reuse.com/articles/32614/nvm-memory-iot-applications.html
5.	ApekMulay, " Sustaining Moore's Law: Uncertainty Leading to a Certainty of IoT Revolution" Morgan and Claypool Publishers, 2015.

6.	Rashid Khan, KajariGhoshdastidar, AjithVasudevan, “Learning IoT with Particle Photon and Electron”, Packt Publishing Limited (Verlag), 2016.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	SOFTWARE DEFINED RADIO LABORATORY	L	T	P	C
20EC2011		0	0	2	1

Course Objective:

Impart knowledge on

1. To impart introductory learning experiments in communication systems through NI LabVIEW programming essentials and USRP hardware
2. To describe the concepts of analog and digital modulation techniques through software defined radio platform
3. To realize the qualitative parameters such as eye diagram and bit error rate in communication system.

Course Outcome:

The student will be able to

1. Use USRP hardware to capture RF signals from the environment for specific applications.
2. Understand the essentials of image rejection in communication systems
3. Comprehend analog and digital modulation techniques
4. Independently handle the USRP hardware for software defined radio applications
5. Build a variety of analog and digital communications systems comprising of a complete transmitter and receiver using LabVIEW Communications and NI USRP software defined radios.
6. With the knowledge built up through this course students will be able to identify common modulation schemes, diagnose impairments and use simple tools such as the Eye Diagram and Bit Error Rate to determine the quality of a communication system

List of Experiments (any 6)

1.	Introduction to USRP
2.	Amplitude Modulation
3.	Frequency division multiplexing
4.	Image Rejection
5.	Double Sideband Suppressed Carrier
6.	Frequency Modulation
7.	Amplitude Shift Keying
8.	Frequency Shift Keying
9.	Binary Phase Shift Keying
10.	The Eye diagram
11.	Equalization
12.	Quadrature phase shift keying
Total Lectures	**30 Hours**

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	ELECTROMAGNETICS AND RADIATION LABORATORY	L	T	P	C
20EC2012		0	0	2	1

Course Objective:

Impart knowledge on

1. To give an overall significance of Engineering Electromagnetics
2. To demonstrate impedance matching in transmission line

3. To give an overall description of electromagnetic radiation and antenna design
Course Outcome:
The student will be able to 1. Define electromagnetic parameters using transmission line 2. Assess the electromagnetic characteristics using software tools 3. Design matching circuits using electromagnetic software tools 4. Implement antenna design for different specifications 5. Demonstrate antenna testing using MIC kits 6. Configure radiation pattern of different antenna structures

List of Experiments		
1.	Measurement of parameters of Transmission Line.	
2.	Design and simulation of superheterodyne receiver	
3.	Design a lumped-element matching network to match 100Ω load to 50 Ω using Electromagnetic Software tool	
4.	Design and simulate a Microstrip planar transmission line with Characteristic Impedance Z0.	
5.	Design and testing of a dipole antenna	
6.	Testing of Horn antenna	
7.	Design of Microstrip antenna (Rectangular Patch)	
8.	Testing of Microstrip antenna using MIC kits	
	Total Lectures	**30 Hours**

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS LABORATORY	L	T	P	C
20EC2013		0	0	2	1

Course Objective:
Impart knowledge on 1. To impart practical knowledge on basics of Electrical Engineering 2. To impart practical knowledge on basics of Electronics Engineering 3. To impart knowledge on selection of electrical and electronics components
Course Outcome:
The student will be able to 1. Test the electronic components 2. Study and use of electric equipments 3. Identify control circuits of electrical equipments 4. Utilize the knowledge gained in microcontrollers to design projects 5. Develop a motor control with processor and controller 6. Demonstrates simple applications based on sensors

List of Experiments		
1.	Test and Verification of active and passive components.	
2.	Voltage regulator in battery and charger.	
3.	Signal generation and Measurement.	
4.	Aircraft tilt position identification using Arduino controller	
5.	Aircraft orientation identification using Microcontroller.	
6.	Temperature and Humidity measurement using Electronic sensor in an Aircraft.	
	Total Lectures	**30 Hours**

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	BASIC ELECTRONICS FOR AEROSPACE ENGINEERS	L	T	P	C
20EC2014		3	0	0	3

Course Objectives:

To impart knowledge on

1. To learn about various electronic components and its applications.
2. To understand the functioning of electrical systems and electric motors used in various fields.
3. To impart the basic knowledge on recent advancements in sensors, instrumentation technology and communication engineering.

Course Outcomes:

The student will be able to

1. Recognize importance and judicious use of electronic components in everyday life
2. Identify the types of electrical machines used for various applications.
3. Understand and apply the concept of electronics to design simple circuits.
4. Understand and relate various digital circuits
5. Understand the various sensing and instrumentation applications.
6. Identify the various generations of wireless communications.

Module: 1	INTRODUCTION TO ELECTRONIC COMPONENTS	7 Hours

Evolution and impact of electronics in industry and society, Resistors, Capacitors: Electrolytic, Inductors and Transformers: types and specifications, Batteries and Chargers: UAV.

Module: 2	ELECTRICAL MOTORS	7 Hours

Construction and Working of Generator, Electrical Motor: DC and AC, Special Motor: Brushless DC Motor, Applications: Home appliances -Fan, Laptop, Refrigerators,Electricity in Transportation: Electric Train, Electric Car, Electric bike.

Module: 3	INTRODUCTION TO ANALOG ELECTRONICS	7 Hours

Overview of Semiconductors, PN junction diode-Rectifier, Zener diode-Voltage regulator, BJT – Construction and Characteristics, Measuring Instruments: Digital Multi meters, Function generator, DSO.

Module: 4	INTRODUCTION TO DIGITAL SYSTEMS	8 Hours

Logic Gates, block diagram of combinational circuits, Block diagram of sequential circuits, Block diagram of Micro Controller, Introduction to Arduino Microcontroller –IDE-Hardware configuration-Design flow.

Module: 5	INTELLIGENT SENSING FOR AUTOMATION	8 Hours

Types of Sensors with applications: Altitude and Pressure measurement in Aircrafts ,Gyro and accelerometers in Space crafts, Electronic sensors in Air craft: Pressure,Temperature,Altimeters and Air speed indicators.

Module: 6	MODERN WIRELESS COMMUNICATIONS	8 Hours

General block diagram of communication system, wireless transmission, Cellular Mobile Communication: Reuse, handoff, 1G, 2G, 3G, 4G and Beyond: Comparison, Satellite system for global mobile communication.

	Total Lectures	45 Hours

Text Books

1. -

Reference Books

1. H Robbins, W.C. Miller, “Circuit Analysis: Theory and Practice”, Fifth Edition, Delmar. Cengage Learning, New York, 2013.

2.	Robert B, Northrop, "Introduction to Instrumentation and Measurements", CRC press, Taylor and Francis group, Second Edition 2011
3.	J Larminie J, Lowry, "Electric Vehicle Technology Explained", John Wiley, & Sons, New York 2013
4.	Haitham Abu-Rub, Mariusz Malinowski, Kamal Al- Haddad, "Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons Limited, Sussex, 2014.
5.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
6.	Thomas Floyd, "Digital Fundamentals", Prentice Hall, 10th Edition, 2011.
7.	Tony Givargis Frank Vahid, "Embedded System Design: A Unified Hardware / Software Introduction", Wiley, 2006.
8.	Jochen Schiller, "Mobile Communications", Pearson Education Asia Ltd., Second edition,

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	ELECTRICAL AND ELECTRONICS IN CIVIL ENGINEERING	L	T	P	C
20EC2015		2	0	0	2

Course Objective:

To impart knowledge on

1. To understand the functioning of electrical systems, home power supply and electric motors used in various fields.
2. To learn about various electronic components, its applications and circuit design.
3. To impart the basic knowledge on recent advancements in sensors, instrumentation technology and communication engineering

Course Outcome:

The student will be able to

1. Recognize importance and judicious use of energy systems in everyday life
2. Identify the types of electrical machines used for various applications.
3. Understand and apply the concept of electronics to design simple circuits.
4. Understand and relate various digital circuits.
5. Understand the various sensing and instrumentation applications
6. Identify the various generations of wireless communications

Module: 1	**ELECTRICAL ENGINEERING**	**8 Hours**

Concept of current, voltage, power and energy, Conventional Power Plants, Non-conventional Sources, photovoltaic technology. Home Power Supply: Single phase, Three phase, Domestic Wiring, Energy Meter (Digital/Smart), Electricity Tariff, Star Rating for Electrical Appliances, Fluorescent lamp, CFL, LED. Batteries and Chargers, Home UPS, Stabilizers. Heating application Electric heaters. Electrical Safety.

Module: 2	**ELECTRICAL MOTORS**	**6 Hours**

Electrical Motors: Construction and Working of Generator, Electrical Motor: DC and AC, Applications: Home appliances -Fan, Laptop, Refrigerators,Electricity in Transportation: Electric Train, Electric Car, Electric bike, Agriculture (Water pump).

Module: 3	**INTRODUCTION TO ANALOG ELECTRONICS**	**7 Hours**

Evolution and impact of electronics in industry and society, Resistors and Capacitors: types and specifications, Inductors and Transformers: types and specifications, Diodes, Transistors, Electro Mechanical components: relays and switches.

Module: 4	**INTRODUCTION TO DIGITAL SYSTEMS**	**9 Hours**

Logic Gates, block diagram of combinational circuits, Block diagram of sequential circuits, Block diagram of Micro Controller, Introduction to Arduino Microcontroller –IDE-Hardware configuration-Design flow. Logic Gates, block diagram of combinational circuits, Block diagram of sequential circuits, Flip-flop definition and types, memory classification, Block diagram of Micro Controller, Introduction to Arduino Microcontroller –IDE-Hardware configuration-Design flow.		
Module: 5	**INSTRUMENTATION TECHNOLOGY & IOT APPLICATIONS**	**9 Hours**
Types of Sensors with applications: Overhead tank water level indicator, Biosensors, Biomedical Instruments: ultrasound scanner, Agricultural Instruments: Soil moisture measurement, Ground water level monitoring, Automated control of lights, fans, electronic appliances, Automatic fire detector, Automated variation control of lights and Air Conditioning.		
Module: 6	**MODERN WIRELESS COMMUNICATIONS**	**6 Hours**
General block diagram of communication system, wireless transmission, Cellular Mobile Communication: Reuse, handoff, 1G, 2G, 3G, 4G and Beyond: Comparison, Satellite system for global mobile communication.		
	Total Lectures	**45 Hours**

Text Books	
1.	-
Reference Books	
1.	H Robbins, W.C. Miller, “Circuit Analysis: Theory and Practice”, Fifth Edition, Delmar. Cengage Learning, New York, 2013.
2.	Robert B, Northrop, “Introduction to Instrumentation and Measurements”, CRC press, Taylor and Francis group, Second Edition 2011
3.	J Larminie J, Lowry, “Electric Vehicle Technology Explained”, John Wiley, & Sons, New York 2013
4.	Haitham Abu-Rub, Mariusz Malinowski, Kamal Al- Haddad, “Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons Limited, Sussex, 2014.
5.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
6.	Thomas Floyd, “Digital Fundamentals”, Prentice Hall, 10th Edition, 2011.
7.	Tony Givargis Frank Vahid, “Embedded System Design: A Unified Hardware / Software Introduction”, Wiley, 2006.
8.	Jochen Schiller, “Mobile Communications”, Pearson Education Asia Ltd., Second edition,

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	BUILDING AUTOMATION SYSTEMS LABORATORY	L	T	P	C
20EC2016		0	0	2	1

Course Objective:

Impart knowledge on

1. To impart practical knowledge on basics of Electrical Engineering
2. To impart practical knowledge on basics of Electronics Engineering
3. To impart knowledge on selection of electrical and electronics components

Course Outcome:

The student will be able to

1. Test the electrical components
2. Study and use of electric equipments
3. Perform domestic wiring
4. Utilize the knowledge gained in microcontrollers to design projects
5. Identify control circuits of electrical equipments

6. Demonstrates simple applications based on sensors and IoT systems	
List of Experiments	
1.	Domestic wiring with earthing
2.	Test the working of different types of switches, relays, connectors and cables
3.	Study of control circuit of Home inverters
4.	Components and design of solar inverters
5.	Automatic control of motor on/off control based on water level of tank
6.	Automatic control of lights and fans in the house
7.	Automatic control of electronic appliances in home from mobile
8.	Automatic fire detector and switching on of firefighting gadgets
9.	Control of lights in a room based on natural lightening
10.	Control of AC in a room based on weather conditions
Total Lectures	**30 Hours**
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	MEDIA LABORATORY	L	T	P	C
20EC2017		0	0	2	1

Course Objective:

Impart knowledge on

1. To discuss the need for Media in daily life such as making a presentation, editing photos, working with audio, etc.
2. To illustrate how to meet the simple graphical and media needs.
3. To evaluate the degree of creativity in achieving the desired design work.

Course Outcome:

The student will be able to

1. Students will design a logo for a given purpose/theme or company
2. Students will learn to construct a design for book/magazines cover pages
3. Students will learn to do backgrounds, banners for their website.
4. Organize the hierarchy of software used for various media needs.
5. Display creative templates for media
6. Visualize and demonstrate an idea and express it.

Software Required:

Adobe Photoshop, Adobe InDesign, Adobe After Effects, Adobe Illustrator, Audacity

List of Experiments

1.	Techniques of Image making
2.	Elements of Visual Design
3.	Typography/ Text Based Design
4.	Fundamentals of Shape and Colour
5.	Fundamentals of Composition
6.	Introduction to Image Editing
7.	Audio capturing and Editing
8.	Video Editing
9.	Motion Graphics
10.	Compositing Text for Books and Magazines
Total Lectures	**30 Hours**
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	FUNDAMENTALS OF PRINTED CIRCUIT AND ARDUINO BOARD DESIGN	L	T	P	C
20EC2018		3	0	0	3

Course Objective:

To impart knowledge on

1. To learn about various electronic components and its applications.
2. To understand the need for PCB Design and steps involved in PCB Design and Fabrication process.
3. To acquire knowledge about embedded systems and the use of Arduino microcontroller.

Course Outcome:

1. The student will be able to
2. Recognize the importance of electro mechanical systems in everyday life.
3. Understand the properties of semiconductor devices.
4. Understand and relate various digital concepts and circuits.
5. Acquire the knowledge about the packages of Electronic components, types of PCBs and history of PCBs
6. Understand the design and programming of Arduino boards.
7. Acquire the knowledge and skills to implement various smart systems application.

Module: 1	ELECTRO-MECHANICAL SYSTEMS	9 Hours

Conventional Power Plants - Hydro and thermal power plants, Electrical power consumption rate and losses in Power Plants under different loads, Energy Meters, Electricity Tariff, Home UPS, Basic Concepts of Motor and Generator, Electro mechanical components (Relay, Switch, Circuit Breakers, Solenoid).

Module: 2	ANALOG ELECTRONICS	9 Hours

Evolution and Impact of Electronics in industries and in society, Familiarization of Resistors, Capacitors, Inductors, Semiconductor Theory: Formation of N type and P Type Semiconductor, PN Junction diode: Structure, Principle of operation and Characteristics, Photo Diode, LED, BJT – Construction and Operation.

Module: 3	DIGITAL SYSTEMS	6 Hours

Logic Gates, block diagram of combinational circuits, Block diagram of sequential circuits, Flip Flops, Transducers: Sensors and Actuators, Evolution and Classification of microprocessor and microcontroller, Block diagram of microcontroller.

Module: 4	PCB CONCEPT AND DESIGN	8 Hours

PCB, Types of PCB, PCB Materials, Introduction to EDA, Component Package Types, Development Tools, General Rules and Parameters. Schematic Entry, Net listing, Layout Designing, Prototype Designing, PCB Making and Assembling of Components, Fault Finding Methods.

Module: 5	IOT AND ARDUINO	8 Hours

Introduction to Embedded Systems and Internet of Things, Block Diagram of Arduino, Hardware and Software Configuration for Arduino, IDE, Basic Arduino Programming and Design flow.

Module: 6	APPLICATIONS	5 Hours

Robotic Arm Control, Obstacles Avoidance and Line Follower robots. Automatic door control, Traffic Light Control.

	Total Lectures	45 Hours

Text Books

1.	-

Reference Books

1.	A. H Robbins, W.C. Miller, “Circuit Analysis: Theory and Practice”, Fifth Edition, Delmar. Cengage Learning, New York, 2013.

2.	Robert B, Northrop, “Introduction to Instrumentation and Measurements”, CRC press, Taylor and Francis group, Second Edition 2011
3.	Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
4.	Thomas Floyd, “Digital Fundamentals”, Prentice Hall, 10th Edition, 2011.
5.	Tony Givargis, Frank Vahid, “Embedded System Design: A Unified Hardware / Software Introduction”, Wiley, 2006.
6.	Walter C Bosshart, “Printed Circuits Boards”, Tata Mcgraw Hill Publishing Company Limited, 1984
7.	Raghbir Singh Khandpur, “Printed Circuit Boards: Design, Fabrication and Testing”, Tata Mcgraw Hill Publishing Company Limited, 2006..

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**FUNDAMENTALS OF PRINTED CIRCUIT AND ARDUINO BOARD DESIGN LABORATORY**	**L**	**T**	**P**	**C**
20EC2019		0	0	2	1

Course Objective:

Impart knowledge on

1. To impart practical knowledge on basics of Electronics Engineering
2. To learn PSIM tool
3. To familiarize with PCB design and interfacing using Arduino board

Course Outcome:

The student will be able to

1. Get familiarized with the PSIM tool
2. Design and simulate electronic circuits using PSIM
3. Emulate Printed Circuit Boards (PCB) for electronic circuits
4. Gain knowledge in electronic circuits design
5. Apply programming to interface LED and Switch
6. Demonstrate simple applications based on embedded and IoT system.

List of Experiments

1.	Simulation of PN Junction Diode using PSIM
2.	Simulation of Multiplexer using PSIM
3.	PCB Schematic of Diode Circuits
4.	PCB Schematic of Bipolar Junction Transistor
5.	Interfacing LED and Switch using Arduino Microcontroller
6.	Sensor based motor and lighting control
Total Lectures	**30 Hours**

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**DIGITAL SYSTEM DESIGN USING HDL**	**L**	**T**	**P**	**C**
20EC3001		3	0	0	3

Course Objective:

To impart knowledge on

1. To understand the design procedureof the digital circuits.
2. To learn the circuit design using VHDL and Verilog HDL
3. To get familiar with implementation using PLDs.

Course Outcome:

On successful completion of the subject, students can be able to

1. Design Digital circuits

2. Construct ASM chart and Design Circuits using PLDs
3. Develop Combinational and sequential circuits using VHDL statements.
4. Build Combinational and sequential circuits using in Verilog HDL statements.
5. Create Test bench ,VHDL packages and sub programs in VHDL.
6. Illustrate the switch level design of Digital circuitsin Verilog HDL

Module: 1	**DIGITAL DESIGN**	**5 Hours**
Design of combinational circuits - Adders, subtractors -multiplexers, demultiplexer decoders, encoders,code converters parity generators, magnitude comparators - Design of static hazard free and dynamic hazard free logic circuits - Mealy machine, Moore machine - Design of synchronous sequential logic circuits		
Module: 2	**DESIGN OF ASYNCHRONOUS CIRCUITS AND DESIGN WITH PLDS**	**6 Hours**
Design of asynchronous sequential circuit - Static,dynamic , essential Hazards, glitches and clock skew.Design of combinational circuits,sequential circuits using PLDs-ASM Chart.		
Module: 3	**VHDL DATA FLOW AND BEHAVIORAL MODELLING**	**9 Hours**
VHDL Overview – FPGA Design flow Process -Software tools- Xilinx Tool Flow –Libraries- Basic Terminology- Entity Declaration- Architecture Body- Data objects-Data types-Operators- Data flow modelling, Concurrent signal assignment statement, conditional signal assignment statement, Selected signal assignment statement, Delta delay, Inertial Delay Model, Transport Delay Model, Block statement-Behavioral modelling, Process Statement,Variable Assignment Statement,Signal Assignment Statement, Wait Statement, If Statement, Case Statement, Null Statement, Loop Statement, Exit Statement, Next Statement, Assertion Statement, Multiple process.		
Module: 4	**VHDL STRUCTURAL MODELLING AND PACKAGES**	**9 Hours**
Structuralmodelling ,Component Declaration, Component Instantiation- Attributes- Generics- Test benches- Subprograms, function and procedure- Packages and libraries, Package declaration, Package body and Design libraries. Design of Combinational and sequential circuit using VHDL.		
Module: 5	**VERILOG HDL BASICS AND GATE LEVEL MODELING**	**8 Hours**
Design Methodology – Module – Ports – Basicconcepts – Operators – Number specification-Data types – Operator types – Gate level modelling, Gate types, Gate delays- Data flow modelling, Continuous assignment, Delays.		
Module: 6	**VERILOG HDL BEHAVIORAL MODELING AND SWITCH LEVEL MODELING**	**8 Hours**
Behavioral modelling, Initial statement, always statement, Procedural assignment, Timing controls, Conditional statements – Multiway branches - Loops – Switch level modelling –Switch level Modeling elements-CMOSNAND, NOR and NOT, MUX . Design of Combinational and sequential circuit using Verilog HDL.		
	Total Lectures	**45 Hours**

Text Books	
1.	-
Reference Books	
1.	J. Bhaskar, “A VHDL Primer”, PHI Learning, III Edition, 2009.
2.	Bhasker, “A Verilog HDL Primer”, Star Galaxy Publishing, 2010
3.	Samir Palnitkar, “Verilog HDL”, Pearson Education, 2004.
4.	Morris Mano, “Digital Logic & Computer Design ”, Pearson Education, India First edition ,2016.
5.	Palmer, J.E., Perlman, D.E., "Introduction to Digital Systems", Tata McGraw Hill, New Delhi, Reprint 1996

6.	Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", PrenticeHall International, Inc., New Jersey, 1995.
7.	Charles H. Roth, Jr and Lizy Kurian John's Digital Systems Design Using VHDLCengage Learning 2nd edition 2012.
8.	Douglas L. Perry, "VHDL Programming by Example", Tata McGraw Hill, 4th Edition,2017.
9.	Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Pearson Education; Second edition , 2017.
10.	Stephen Brown, "Fundamentals of Digital Logic Design with VHDL", Tata Mcgraw-Hill Publishing Company Limited, McGraw Hill Education; 3 edition ,2017.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	LOW POWER VLSI DESIGN	L	T	P	C
20EC3002		3	0	0	3

Course Objective:

To impart knowledge on

1. To expose the students to the basic principles of low power design.
2. To make the students to acquire knowledge on circuit ,logic ,architecture and system level power reduction techniques
3. To make the students to understand low power clock networks, bus , SRAM and adiabatic circuits .

Course Outcome:

On successful completion of the subject, students can be able to

1. Understand the various sources of power dissipation.
2. Acquire the knowledge on simulation power analysis and Probabilistic power analysis Techniques.
3. Learn the various low power reduction techniques at circuit and logic level.
4. Analyze the various low power techniques at Architecture and system level.
5. Design low power clock Networks, bus and low power SRAM circuits.
6. Design various adiabatic logic circuits

Module: 1	**SOURCES OF POWER DISSIPATION**	**7 Hours**

Need for Low Power VLSI Chips- Charging and Discharging of Capacitance- Short Circuit Current- Leakage Current- Static Current- Basic Principles of Low Power Design.

Module: 2	**SIMULATION POWER ANALYSIS AND PROBABILISTIC POWER ANALYSIS**	**7 Hours**

Gate Level Logic Simulation- Architectural Level Analysis- Data Correlation Analysis in DSP Systems- Random Logic Signals - Probability and frequency - Probabilistic Power Analysis Techniques.

Module: 3	**CIRCUIT AND LOGIC LEVEL LOW POWER TECHNIQUES**	**8 Hours**

Transistor and Gate Sizing- Equivalent Pin Ordering- Network Reconstructing and Reorganization- Special Latches and Flip-flops -Gate Reorganization- Signal Gating - Logic Encoding- State Machine Encoding- Pre-Computation Logic

Module: 4	**ARCHITECTURE AND SYSTEM LEVEL POWER ESTIMATION**	**7 Hours**

Power and Performance Management- Switching Activity Reduction- Parallel Architecture- Flow Graph Transformation –low power arithmetic components

Module: 5	**SPECIAL LOW POWER TECHNIQUES AND LOW POWER SRAM CIRCUITS**	**8 Hours**
Power Reduction in Clock Networks- CMOS Floating Node- Low Power Bus- Delay Balancing. MOS Static RAM- Memory Cell- Banked SRAM- Reducing Voltage Swing on Bit Lines- Reducing Power in the Write Driver and Sense Amplifier Circuits.		
Module: 6	**ADIABATIC LOGIC CIRCUITS**	**8 Hours**
Adiabatic Charging-Adiabatic Amplification-Adiabatic Logic Gates-Pulsed Power Supply-Stepwise Charging Circuits-Partially Adiabatic Circuits.		
	Total Lectures	**45 Hours**

Text Books	
1.	-
Reference Books	
1.	Gary Yeap, "Practical Low Power Digital VLSI Design", Springer; 1998 edition (2012).
2.	Kaushik Roy, Sharatprasad, "Low Power CMOS VLSI Circuit Design", John Wiley & Sons Inc., 2009.
3.	AnanthaChadrasekaran and Robert Broderson, "Low Power CMOS Design", Standard Publishers, 2000.
4.	Kiat,Seng Yeo, Samir S.Rofail, Wang,LingGoh, "CMOS/BiCMOSULSI Low Voltage, Low Power", Pearson Education India; First Edition edition ,2011.
5.	Ajit Pal, "Low-Power VLSI Circuits and Systems", Springer India 2015

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**ANALOG VLSI DESIGN**	**L**	**T**	**P**	**C**
20EC3003		3	0	0	3

Course Objectives:

Impart knowledge on

1. To develop a fundamental Computing in the concepts of device modeling.
2. To know the essentials of analog systems including ADC and DAC.
3. To impart the knowledge of circuit design and modeling and compute in CMOS amplifiers, Oscillators and Comparators.

Course Outcomes:

The student will be able to

7. compute the characteristics of MOS transistors and analyze the circuit characteristics through device modeling
8. utilize the analog design concepts in data converters
9. illustrate different types of switched capacitor circuits
10. perform analysis in CMOS amplifiers
11. perform analysis in Oscillators
12. design and develop various comparators and illustrate the performance of analog circuits using EDA tools.

Module: 1	**DESIGN PROCESS FOR ANALOG INTEGRATED CIRCUITS**	**7 Hours**
Design process for analog Integrated circuits-Approach to Device Modeling: MOS Models-dc MOSFET Model-Bipolar Models-dc BJT Model-Small Signal BJT Model-High Frequency BJT Model-Noise and mismatch.		
Module: 2	**ANALOG SYSTEMS**	**7 Hours**
Analog Signal Processing-Digital-to-Analog Converters-Current Scaling D/A Converters-Voltage Scaling D/A Converters-Charge Scaling D/A Converters-Serial D/A Converter-Analog-to-Digital		

Converters-Serial A/D Converters-Successive Approximation A/D Converters-Parallel A/D Converters.		
Module: 3	**SWITCHED -CAPACITOR CIRCUITS**	**9 Hours**
Switched Capacitor Circuits-Resistor Emulation-Design of a Parallel switched capacitor resistor emulation-Design of series parallel capacitor resistor emulation- Sampling Switches: MOSFETs as Switches-Switched-Capacitor Amplifiers-Unity-Gain Sampler/Buffer-Noninverting Amplifier-Switched Capacitor Integrator-Switched Capacitor Common Mode Feedback.		
Module: 4	**CMOS AMPLIFIERS**	**9 Hours**
CMOS differential amplifier using a current mirror load- Current source load differential amplifier-Design of CMOS Differential amplifier with a current mirror load- Current Amplifiers: Single-ended input current amplifier-Differential-input current amplifier- High-Gain Amplifier Architectures: VCCS circuit-CCCS Circuit-CCVS Circuit-Power amplifiers fundamentals Classes: Class A PAs, Class AB PAs, Class B PAs, Class C Pas		
Module: 5	**OSCILLATORS**	**7 Hours**
Ring Oscillators: Two-pole feedback system-Two-pole feedback system with additional signal information-LC Oscillators-Voltage Controlled Oscillators: Tuning in Ring Oscillators -Tuning in LC Oscillators		
Module: 6	**COMPARATORS**	**6 Hours**
Basic CMOS Comparator design: Pre amplification-Decision circuit-output buffer-clocked comparators-Two-stage, Open-loop Comparator		
	Total Lectures	**45 Hours**

Text Books

1.	--

Reference Books

1.	Philip E. Allen, Douglas R. Halberg, “CMOSAnalog Circuit Design”, Oxford University Press; Third edition ,2013.
2.	Randall L.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques for Analog and Digital Circuits”, McGraw Hill International Co, 1990.
3.	BehzadRazavi, “Design of AnalogCMOS Integrated Circuits McGraw Hill Education; Second edition,2017
4.	Hector Solar Ruiz,RocBerenguer Perez, “Linear CMOSRF Power Amplifiers: A Complete Design Workflow”,Springer,2013.
5.	YannisTsividis, “Mixed Analog – Digital VLSI Device and Technology” World scientific publishing Co. Pvt. Ltd., 2002

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**SOLAR CELLS AND THEIR APPLICATIONS**	**L**	**T**	**P**	**C**
20EC3004		3	0	0	3

Course Objectives:

Impart knowledge on

1. To impart basic concepts of Solar cells
2. To impart the knowledge of different types of solar cells
3. To understand the design concepts of solar cells for space applications

Course Outcomes:

The student will be able to

1. Demonstrate the basics of solar cells

2. Estimate and analyse the performance characteristics of solar cells 3. Evaluate the characteristics of different silicon solar cells 4. Assess the performance of Cadmium Telluride Thin Film Solar Cells 5. Analyze the performance of Dye Sensitized Solar Cell and Polymer Organic Thin-Film Solar cells 6. Demonstrate knowledge of solar cells for space applications		
Module: 1	**SOLAR CELL FUNDAMENTALS**	**7 Hours**
Photovoltaic effect - Principle of direct solar energy conversion into electricity in a solar cell. Semiconductor properties, energy levels, basic equations. Solar cell, p-n junction, structure		
Module: 2	**PV MODULE PERFORMANCE AND MICROCRYSTALLINE SILICON SOLAR CELL TECHNOLOGIES**	**8 Hours**
I-V characteristics of a PV module, maximum power point, cell efficiency, fill factor, effect of irradiation and temperature. Microcrystalline Silicon: Material Fabrication and Characterization- Microcrystalline Silicon Solar Cells.		
Module: 3	**AMORPHOUS SILICON SOLAR CELL TECHNOLOGIES**	**7 Hours**
Hydrogenated Amorphous Silicon-Deposition of Hydrogenated Amorphous Silicon- Amorphous Silicon Solar Cells- Performance and Fabrication of Hydrogenated Amorphous Silicon Based Modules- Applications.		
Module: 4	**CADMIUM TELLURIDE THIN FILM SOLAR CELLS**	**8 Hours**
Materials and Cell Concepts for Cadmium Telluride Based Solar Cells- Research Areas and Trends in Cadmium Telluride Solar Cells- Fabrication of Cadmium Telluride Cells and Modules- Advanced Characterization and Modeling of Cadmium Telluride Solar Cells		
Module: 5	**DYE SENSITIZED SOLAR CELL ANDPOLYMER ORGANIC THIN-FILM SOLAR CELLS**	**7 Hours**
Photovoltaic Performance of the Dye Sensitized Solar Cell- Solid State Dye Sensitized Solar Cells- Bulk Heterojunction Solar Cells- Charge Carrier Mobility and Recombination - Polymer Organic Thin-Film solar cells		
Module: 6	**SOLAR CELL DESIGN FOR SPACE APPLICATIONS**	**8 Hours**
Material Requirements for Solar Cells Used in Space- Performance Parameters for Solar Cells in Space- Impact of Space Radiation on Solar Cell Performance- Effects of Operating Temperature on Open-Circuit Voltage- Multijunction Solar Cells for Space Applications- Solar Array Design for Space Applications.		
	Total Lectures	**45 Hours**

Text Books

1.	--

Reference Books

1.	Chetan Singh Solanki., “Solar Photovoltaic: Fundamentals, Technologies and Application”, PHI Learning Pvt., Ltd., 2011.
2.	Jha .A.R, “Solar Cell Technology and Applications”, CRC Press, 2010.
3.	JefPoortmans and Vladimir Arkhipov, “Thin Film Solar Cells Fabrication, Characterization and Applications”, John Wiley & Sons Ltd, 2006.
4.	John R. Balfour, Michael L. Shaw, SharlaveJarosek., “Introduction to Photovoltaics”, Jones & Bartlett Publishers, Burlington, 2011.
5.	Luque .A. L and Andreev .V.M, “Concentrator Photovoltaic”, Springer, 2007.
6.	Partain .L.D, FraasL.M., “Solar Cells and Their Applications”, 2nd ed., Wiley, 2010.
7.	Sukhatme .S.P, Nayak .J.K, “Solar Energy”, Tata McGraw Hill Education Private Limited, New Delhi, 2010.

8.	Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice- Hall, 2008.
9.	Nelson J, “The Physics of Solar Cells”, Imperial College Press, 2003.
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**VLSI INTERCONNECTS AND THEIR DESIGN TECHNIQUES**	**L**	**T**	**P**	**C**
20EC3005		3	0	0	3

Course Objectives:

Impart knowledge on

1. To enable the students to gain knowledge on VLSI Interconnects.
2. To make the students to get an insight on Transmission line parameters of VLSI interconnects.
3. To give exposure to the novel solutions on interconnects.

Course Outcomes:

The student will be able to

1. Basic knowledge on VLSI Interconnects.
2. Exposure to Transmission line parameters of VLSI interconnects.
3. Knowledge on Interconnection delays
4. understanding on cross talk analysis
5. Exposure to novel solutions on Interconnects
6. Exposure to Carbon Nanotube interconnect applications

Module: 1	**PRELIMINARY CONCEPTS OF VLSI INTERCONNECTS**	**9 Hours**

Interconnects for VLSI applications-copper interconnections –method of images- method of moments even and odd capacitances- transmission line equations- Miller’s theorem- Resistive interconnects asladder network- Propagation modes in micro strip interconnects- slow wave propagations Propagationdelay.

Module: 2	**PARASITIC RESISTANCES, CAPACITANCE AND INDUCTANCES**	**8 Hours**

Parasitic resistances, capacitances and inductances- approximate formulas for inductances- green’sfunction method: using method of images and Fourier integral approach- network Analog method-Inductance extraction using fast Henry- copper interconnections for resistance modeling

Module: 3	**INTERCONNECTION DELAYS**	**10 Hours**

Metal insulator semiconductor micro strip line- transmission line analysis for single level interconnections- transmission line analysis for parallel multilevel interconnections- analysis of crossing interconnections- parallel interconnection models for micro strip line- modeling of lossy parallel and crossing interconnects- high frequency losses in micro strip line- Expressions for interconnection delays- Active interconnects.

Module: 4	**CROSS TALK ANALYSIS**	**7 Hours**

Lumped capacitance approximation- coupled multi conductor MIS micro strip line model for single level interconnects- frequency domain level for single level interconnects- transmission line level analysis of parallel multi level interconnections.

Module: 5	**NOVEL SOLUTIONS FOR PROBLEMS IN INTERCONNECTS**	**5 Hours**

Overview of Carbon Nanotube Interconnects – Modeling and Characterization.

Module: 6	**CARBON NANOTUBE INTERCONNECT APPLICATIONS**	**6 Hours**

Carbon Nanotubes for Horizontal On-Chip Interconnects -Carbon Nanotubes as Vertical Interconnects for 3D Integrated Circuits.		
	Total Lectures	**45 Hours**

Text Books	
1.	--
Reference Books	
1.	H B Bakog Lu, Circuits, "Interconnections and packaging for VLSI", Addison WesleyPublishing company, 1990
2.	J A Davis, J D Meindl, "Interconnect technology and design for Gigascale integration",Kluwer academic publishers,2003
3.	Nurmi J, Tenhumen H, Isoaho J, Jantsch A, "Interconnect Centric design for advanced SOC and NOC", Springer.
4.	C K Cheng, J Lillis, S Lin, N Chang, "Interconnect analysis and synthesis", Wiley Interscience,2000.
5.	Hall S H, G W Hall and J McCall, High speed digital system designA Handbook of Interconnect Theory and Design Practices 1st Edition, Wiley Inter-science, 2000.
6.	Askok K Goel, "High speed VLSI interconnections", Wiley interscience, second edition,2007.
7.	Todri-Sanial, Aida, Dijon, Jean, Maffucci, Antonio, "Carbon Nanotubes for Interconnects Process, Design and Applications", Springer 2017

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**VLSI SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
20EC3006		3	0	0	3

Course Objectives:

Impart knowledge on
1. To understand the various VLSI architectures for digital signal processing.
2. To know the techniques of critical path and algorithmic strength reduction in the filter structures.
3. To enable students to design VLSI system with high speed and low power.
4. To encourage students to develop a working knowledge of the central ideas of implementation of DSP algorithm with optimized hardware.

Course Outcomes:

The student will be able to
1. Understand the overview of DSP concepts and design architectures for DSP algorithms.
2. Gain exposure to retiming, folding and unfolding concepts.
3. Improve the overall performance of DSP system through various transformation and optimization techniques.
4. Gain Knowledge on pipelining and parallel processing on FIR and IIR systems to achieve high speed and low power.
5. Optimize design in terms of computation complexity and speed.
6. Understand clock based issues and design asynchronous and wave pipelined systems

Module: 1	**INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS**	**6 Hours**
An overview of DSP concepts, Pipelining of FIR filters. Parallel processing of FIR filters. Pipelining and parallel processing for low power, Combining Pipelining and Parallel Processing.		
Module: 2	**RETIMING, FOLDING AND UNFOLDING**	**6 Hours**
Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application.		

Module: 3	**ALGORITHMIC STRENGTH REDUCTION IN FILTERS AND TRANSFORMS**	**7 Hours**
2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd- Even merge-sort architecture, parallel rank-order filters.		
Module: 4	**FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS**	**9 Hours**
Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm, Pipelined and parallelrecursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.		
Module: 5	**N BIT-LEVEL ARITHMETIC ARCHITECTURES**	**9 Hours**
Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple andcarry-save multipliers, Design of Lyon’s bit-serial multipliers using Horner’s rule, bit-serial FIR filter,CSD representation, CSD multiplication using Horner’s rule for precision improvement, Distributed Arithmetic fundamentals and FIR filters.		
Module: 6	**NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING**	**8 Hours**
Numerical strength reduction – subexpression elimination, multiple constant multiplication, iterative matching.synchronous pipelining and clocking styles, clock skew in edge-triggered single phaseclocking, two-phase clocking, wave pipelining, Asynchronous pipelining, bundled data versus dual rail protocol.		
	Total Lectures	**45 Hours**

Text Books	
1.	K.K.Parhi, “VLSI Digital Signal Processing Systems: Design and Implementation”, John-Wiley, 2010.
Reference Books	
1.	U. Meyer -Baese, “Digital Signal Processing with FPGAs”, Springer, 2014
2.	Wayne Burleson, KonstantinosKonstantinides, Teresa H. Meng, “VLSI Signal Processing”, IEEE signal processing society, 1996
3.	Richard J. Higgins, “Digital signal processing in VLSI”, Prentice Hall Books, 1991.
4.	Sun Yuan Kung, Harper J. Whitehouse, “VLSI and modern signal processing”, Prentice-Hall, 1985
5.	Magdy A. Bayoumi, “VLSI Design Methodologies for Digital Signal Processing”, Springer 2012
6.	Earl E. Swartzlander, “VLSI signal processing systems”, Springer Netherlands, 1986
7.	Recent literature in Optimizations of Digital Signal Processing Structures for VLSI

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**BIO MEMS**	**L**	**T**	**P**	**C**
20EC3007		3	0	0	3
Course Objectives:					
Impart knowledge on 1. To train the students in the design aspects of Bio MEMS devices and Systems. 2. To make the students aware of applications in various medical applications. 3. To expose the students to the emerging Bio-MEMStechnology .					
Course Outcomes:					

The student will be able to 1. Understand the MEMS applications in Bio Medical Engineering 2. Gain knowledge on the Micro fluidic Principles and its applications. 3. Gain knowledge in the applications of Sensors in Health Engineering. 4. Understand the principles of Micro Actuators and Drug Delivery system 5. Learn the principles and applications of Micro Total Analysis 6. Explore the emerging Bio-MEMS technology		
Module: 1	**SILICON MICRO FABRICATION-SOFT FABRICATION TECHNIQUES**	**8 Hours**
The driving force behind Biomedical Applications – Biocompatibility - Reliability Considerations-Regularity Considerations – Organizations - Education of Bio MEMS-Silicon Micro fabrication-Soft Fabrication techniques.		
Module: 2	**MICRO FLUIDIC PRINCIPLES**	**7 Hours**
Introduction-Transport Processes- Electro kinetic Phenomena-Micro valves –Micro mixers- Micro pumps.		
Module: 3	**SENSOR PRINCIPLES AND MICRO SENSORS**	**8 Hours**
Introduction-Fabrication-Basic Sensors-Optical fibers- Piezo electricity and SAW devices-Electrochemical detection-Applications in Medicine.		
Module: 4	**MICRO ACTUATORS AND DRUG DELIVERY**	**7 Hours**
Introduction-Activation Methods-Micro actuators for Micro fluidics-equivalent circuit representation-Drug Delivery.		
Module: 5	**MICRO TOTAL ANALYSIS**	**8 Hours**
Lab on Chip-Capillary Electrophoresis Arrays-cell, molecule and Particle Handling-Surface Modification-Microsphere-Cell based Bioassay Systems.		
Module: 6	**EMERGING BIO MEMS TECHNOLOGY**	**7 Hours**
Detection and Measurement Methods -Packaging, Power, Data and RF Safety-Biocompatibility, Standards		
	Total Lectures	**45 Hours**

Text Books	
1.	Steven S. Saliterman, “Fundamentals of Bio MEMS and Medical Micro devices”, Wiley Inter science, 2006.
Reference Books	
1.	Albert Folch , “Introduction to Bio MEMS”, CRC Press, 2012
2.	Gerald A. Urban, “Bio MEMS”, Springer, 2006
3.	Wanjunwang, steven A. Soper, “Bio MEMS”, 1st Edition, CRC Press, 2006.
4.	M. J. Madou, “Fundamental of Micro fabrication”, 2nd Edition, CRC Press, 2002.
5.	G.T. A. Kovacs, “Micro machined Transducers Sourcebook”, 1st Edition, McGraw Hill, 1998.
6.	Recent literature in Bio MEMS.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**ASIC DESIGN**	**L**	**T**	**P**	**C**
20EC3008		3	0	0	3
Course Objectives:					
Impart knowledge on					

1. To prepare the student to be an entry-level industrial standard ASIC or FPGA designer. 2. To provide the Knowledge on programmable ASICs. 3. To give exposure to ASIC physical design. 4. To give an understanding of high performance algorithms implementation.		
Course Outcomes:		
The student will be able to 1. Explain ASIC types, design tool flow and programmable technologies. 2. Describe the issues involved in ASIC logic cells and I/O cells design. 3. Gain Knowledge about programmable ASIC Interconnects. 4. Analyse the issues in ASIC partitioning and floorplanning. 5. Explain the algorithms used for ASIC placements and routing. 6. Synthesize high performance algorithms available for ASICs.		
Module: 1	**INTRODUCTION TO ASICS& PROGRAMMABLE ASICS**	**7 Hours**
Types of ASICs - Design flow –Design and Layout Rules -Programming Technologies: Antifuse–Static RAM – EPROM and EEPROM technology.		
Module: 2	**PROGRAMMABLE ASIC LOGIC CELLS & I/O CELLS**	**8 Hours**
Programmable ASIC cells for Actel ACT and Xilinx LCA - Altera FLEX-Altera MAX- DC & AC inputs and outputs- Clock and Power inputs-Xilinx I/O block.		
Module: 3	**PROGRAMMABLE ASIC INTERCONNECT**	**7 Hours**
ACTEL ACT- Xilinx LCA - Xilinx EPLD- Altera MAX 5000 and 7000 - Altera MAX 9000-Spartan and Virtex (latest version).		
Module: 4	**ASIC PHYSICAL DESIGN ISSUES**	**8 Hours**
System partition Partitioning - Partitioning methods – Interconnect delay models and measurement ofdelay - Floor planning methods.		
Module: 5	**PLACEMENT METHODS AND ROUTING**	**7 Hours**
Placement Goals and objectives – Placement methods- Global routing methods - Detailed routing methods.		
Module: 6	**HIGH PERFORMANCE ALGORITHMS FOR ASICS/ SOCS**	**8 Hours**
Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC, Digital camera.		
	Total Lectures	**45 Hours**

Text Books	
1.	M.J.S. Smith, “Application Specific Integrated Circuits”, Pearson, 2003
2.	H.Gerez, “Algorithms for VLSI Design Automation”, John Wiley, 1999.
Reference Books	
1.	J.M.Rabaey, A. Chandrakasan, and B.Nikolic, “Digital Integrated Circuit Design Perspective” 2 nd Edition, PHI 2003.
2.	HimanshuBhatnagar,”Advanced ASICChip Synthesis” Kluwer Academic Publishers, second edition, 2002.
3.	VaibbhavTaraate, “Advanced HDL Synthesis and SoC prototyping: RTL design using Verilog” Springer, First edition, 2019.
4.	Hoi-Jun Yoo, Kangmin Lee and Jun Kyong Kim, “Low-Power NoC for High-Performance SoC Design”, CRC Press, 2008.
5.	SudeepPasricha and NikilDutt, “On Chip Communication Architectures System on Chip Interconnect”, Elsevier, 2008.

Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	MODERN RADAR SYSTEMS	L	T	P	C
20EC3009		3	0	0	3

Course Objectives:

Impart knowledge on

1. To discuss the radar range equations and different types of radar
2. To introduce the radar signal detection methods and its parameters
3. To impart the concepts of pulse compression techniques and imaging radar

Course Outcomes:

The student will be able to

1. Illustrate the operation principles of radar systems.
2. Apply the radar equation to describe the performance of various types of radar systems.
3. Analyse the performance of simple tracking radar systems
4. Estimate the probabilities of detection and false alarm, pulse repetition frequency, transmit power, received power, observation time, range, range resolution and other radar system parameters.
5. Solve radar signal detection problems.
6. Conduct data collection and interpretation using imaging radar for specific applications

Module: 1	RADAR FUNDAMENTALS	8 Hours

Electromagnetic Waves & properties- applications of radar, radar frequencies-radar block diagram, Radar Coordinates, Radar equation for hard targets and the SNR-radar cross section of targets, Radar Resolution Elements swerling target models, pulse repetition frequency, Duty Ratio, Pulse Compression, Coding, Detection of signals in noise and Radar signals

Module: 2	CW AND FMCW RADARS	7 Hours

Doppler Effect-CW Radar --FMCW Radar—Application-Airborne Doppler Navigation-Multi-CW Radar, Pulse Doppler radar

Module: 3	MTI RADAR AND TRACKING RADAR	8 Hours

Doppler processing, Delay Line Cancellers, Multiple or staggered, pulse repetition frequencies, Range gated Doppler filters-Example of MTI Radar Processor, Non coherent MTI, MTI from a moving platform, Tracking with Radar-Sequential lobing-conical scan, Monopulse Tracking Radar-target-reflection characteristics and Angular accuracy, Comparison of trackers-Radar Tracking algorithms, Extended-Kalman Filter

Module: 4	DETECTION THEORY OF RADAR SIGNALS	7 Hours

Matched Filters, Detection strategies for multiple measurements-optimal detection-statistical models for noise and target RCS in radar, Threshold detection of radar signals, constant false alarm rate detectors-CFAR detectors-Cell averaging CFAR-Robust CFAR-Adaptive CFAR

Module: 5	PULSE COMPRESSION AND IMAGING RADAR	8 Hours

Range resolution, straddle loss, pulse compression waveforms-Gain-LFM waveform, Ambiguity function, phase coded waveforms, Bi-phase codes, poly-phase codes, Imaging Radar: Synthetic Aperture Radar, Imaging considerations-Resolution relationships and sampling-Data collection-Image formation-Image phenomenology

Module: 6	ADVANCEMENTS IN RADAR APPLICATIONS	7 Hours

Automotive mmWave Radar-Ground penetrating Radar- Police Radar-Human detection radar-Radar Tomography and Radar based Microwave Imaging- Emerging and Modern Applications of Radar Principles

Total Lectures	**45 Hours**

Text Books

1.	--
Reference Books	
1.	M.I. Skolnik , Introduction to Radar Systems, McGraw Hill Higher Education, 3rd Edition, 2001
2.	Mark A. Richards, James A. Scheer, William A. Holm, Principles of Modern Radar: Basic Principles, Scitech publishing, 1st Edition, 2010
3.	Bassem R Mahafza, Radar systems, analysis and design using MATLAB, Chapman & Hall/CRC press, 1st Edition, 2000
4.	H. Meikle, Modern Radar systems, Artech House, 2nd Edition, 2008
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

Course code	**ADVANCED SOFTWARE DEFINED RADIO LABORATORY**	**L**	**T**	**P**	**C**
20EC3010		0	0	4	2

Course Objective:

Impart knowledge on

1. To introduce the NI LabVIEW programming essentials and NI USRP software defined radio hardware for wireless communication
2. To explore the physical layer requirements in communication system
3. To perform OFDM modulation and channel coding scheme in software defined radio environment

Course Outcome:

The student will be able to

1. Independently conduct software defined radio experiment using NI USRP hardware
2. Perform baseband processing for given spefications
3. Construct a robust OFDM downlink channel including transmitter and receiver design. This will stand them in perfect place to further explore wireless standards such as LTE and IEE 802.11 that make heavy use of OFDM in their physical layer (PHY).
4. Design communication algorithms that can combat the real world challenges faced wireless channels including carrier frequency offset (CFO) and synchronisation.

List of Experiments

1.	Lab 1 : Part 1 : Introduction to NI LabVIEW
2.	Lab 1 : Part 2 : Introduction to NI RF Hardware
3.	Lab 2 : Part 1 : Modulation and Detection
4.	Lab 2 : Part 2 : Pulse shaping and matched filtering
5.	Lab 3 : Synchronization
6.	Lab 4 : Channel Estimation and equalization
7.	Lab 5 : Frame Detection and Frequency offset correction
8.	Lab 6 : OFDM Modulation and Frequency Domain Equalization
9.	Lab 7 : Synchronization in OFDM Systems
10.	Lab 8 : Channel coding in OFDM Systems
Total Lectures	**48 Hours**
Recommended by Board of Studies	
Approved by Academic Council	12th September 2020

14EC2057	DIGITAL IMAGE PROCESSING	L 3	T 0	P 0	C 3

Course Objective

1. To introduce the fundamentals of digital image processing
2. To study the techniques for improving the quality of spoilt images and segmenting image components
3. To deal with the compression of images to save storage space

Course Outcome

At the end of the course student will be able to

1. Illustrate the operation principles of radar systems.
2. Apply the radar equation to describe the performance of various types of radar systems.
3. Analyse the performance of simple tracking radar systems

Course Contents

Review of image processing, 2D transforms - DFT, DCT, KLT-Basic gray level transformation, Histogram processing, Enhancement using arithmetic/logic operations, Smoothing and Sharpening - spatial and frequency domain filters, Homomorphic filtering, Color transformations-Image Degradation/Restoration model, Noise probability density functions, Mean and order statistics filters, Linear, position-invariant degradations, Estimating the degradation function, Inverse, Wiener and Constrained Least Squares filtering, Geometric transformations.- Morphological operators, Morphological algorithms, Edge detection, Edge linking and boundary detection, Thresholding–global and adaptive, Region based segmentation, Watershed segmentation, Use of motion in segmentation

Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education Inc., Second Edition, 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education Inc., 2002.
3. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing using MATLAB, 2 Edition", Tata McGraw Hill, 2010.
5. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill, 2009.
6. S.Sridhar, "Digital Image processing" Oxford University Press, 2011

ELECTRONICS AND

COMMUNICATION ENGINEERING

LIST OF NEW COURSES

Sl. No.	Course Code	Name of the Course	Credits (L:T:P:C)
1	17EC2070	Linear and Digital IC Lab	0:0:2:2
2	19EC1001	Fundamentals of Electrical and Electronics Engineering	3:1:0:4
3	19EC1002	Fundamentals of Electrical and Electronics Engineering Laboratory	0:0:2:1
4	19EC1003	Basic Principles of Electrical and Electronics Engineering	3:0:0:3
5	19EC2001	Electronics For Intelligent Machines	2:0:0:2
6	19EC2002	Electronics For Intelligent Machines Laboratory	0:0:3:1.5
7	19EC2003	Microwave and Optical Communication Laboratory	0:0:2:1
8	19EC3001	HDL Laboratory	0:0:4:2
9	19EC3002	Digital Circuit Design and Verification Laboratory using CADENCE Tool	0:0:4:2

17EC2070 LINEAR AND DIGITAL IC LAB

Credits 0:0:2
Co-requisite: 17EC2001 Digital Electronics
17EC2015 Linear Integrated Circuits

Course Objectives:

- To acquire the basic knowledge of operational amplifier IC741.
- To enable the students to design op-amp applications.
- To get hands on experience in building combinational and sequential logic circuits.

Course Outcomes:
After completion of the course, students will be able to

- Portray the operation of basic operational amplifier.
- Design oscillators and multivibrators for a given frequency using IC741& IC555.
- Analyze the behavior of a filter circuit and ADC/DAC circuit using IC741
- Prove the truth table of combinational logic circuits with the help of digital ICs.
- Apply the design procedures to design basic sequential circuits.
- Design and implement realtime applications of combinational and sequential circuits.

List of Experiments

1. Design of Inverting and Non-Inverting Amplifiers using IC 741
2. Astable and Monostable Multivibrator using IC 741
3. Design of RC Phase Shift Oscillator using IC 741
4. Design of Wein Bridge Oscillator using IC 741
5. Design of Filter (Low Pass/High Pass/Butterworth) using IC 741
6. Design of Analog to Digital Converter and Digital to Analog Converter using IC 741
7. Design of Astable Multivibrator using IC 555 Timer
8. Design of Schmitt Trigger using IC 555 Timer
9. Design of Full Adder and Full Subtractor
10. Design of Multiplexer and Demultiplexer
11. Design of Decoder and Encoder
12. Design of Code Converter
13. Design of Shift Registers
14. Design of BCD Counters
15. Design of Light Sensor switch circuit using LDR and IC 741

19EC1001	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	1	0	4

Course Objectives:

1. To understand the functioning of electrical systems, home power supply and electric motors used in various fields.
2. To learn about various electronic components, its applications and circuit design.
3. To impart the basic knowledge on recent advancements in sensors, instrumentation technology and communication engineering

Course Outcome:

At the end of the course, the student will be able to

1. Recognize importance and judicious use of energy systems in everyday life
2. Identify the types of electrical machines used for various applications.
3. Understand and apply the concept of electronics to design simple circuits.
4. Understand and relate various digital circuits.
5. Understand the various sensing and instrumentation applications
6. Identify the various generations of wireless communications

Module 1: Electrical Engineering: Concept of current, voltage, power and energy, Conventional Power Plants, Non-conventional Sources, photovoltaic technology. Home Power Supply: Domestic Wiring, Energy Meter (Digital/Smart), Electricity Tariff, Star Rating for Electrical Appliances, Fluorescent lamp, CFL, LED. Batteries & Chargers, Home UPS, Stabilizers. Heating application Electric heaters. Electrical Safety.

Module 2: Electrical Motors: Construction and Working of Electrical Motor, Types & Applications of Motors: Home appliances (Fan, Laptop, Hair dryer, Mixer, Refrigerators), Machine Tools (Lathe, CNC machines), Agriculture (Water pump), Textile industry, Medical (Motorized catheters, Implanted blood pumps), Nano motors, motors in Robots. Electricity in Transportation: Electric Train, Electric Car, Electric bike, Solar Powered Airplane, Personal Flying Cars

Module 3: Introduction to Analog Electronics: Evolution and impact of electronics in industry and society, Resistors and Capacitors: types and specifications, Inductors and Transformers: types and specifications, Electro Mechanical components: relays and switches, Semiconductors, PN junction diode, Zener diode, LED, photo diode, Transistor: types, operations, Transistor as amplifier, Transistor as switch.

Module 4: Introduction to Digital systems: Logic Gates, block diagram of combinational circuits, Half adder, block diagram of ALU, block diagram of sequential circuits, Flip-flop definition and types, memory classification, block diagram of processor, Introduction to Embedded systems.

Module 5: Instrumentation Technology & IOT applications: Types of Sensors with applications: Overhead tank water level indicator, Biosensors, Altitude and Pressure measurement in Aircrafts Gyro and accelerometers in Space crafts, Biomedical Instruments: ultrasound scanner, Agricultural Instruments: Soil moisture measurement, Ground water level monitoring, Automatic irrigation system, Food Processing (Case study with sensor application)

Module 6: Modern wireless communications: General block diagram of communication system, Simplified reference model, wireless transmission, Cellular Mobile Communication: Reuse, handoff, 1G, 2G, 3G, 4G and Beyond: Comparison, Satellite system for global mobile communication

Reference Books:

1. A. H Robbins, W.C. Miller, “Circuit Analysis: Theory and Practice”, Fifth Edition, Delmar. Cengage Learning, New York, 2013.
2. Robert B, Northrop, “Introduction to Instrumentation and Measurements”, CRC press, Taylor and Francis group, Second Edition 2011
3. J Larminie J, Lowry, “Electric Vehicle Technology Explained”, John Wiley, & Sons, New York 2013
4. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al- Haddad, “Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons Limited, Sussex, 2014.

5. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
6. Thomas Floyd, “Digital Fundamentals”, Prentice Hall, 10th Edition, 2011.
7. Tony Givargis Frank Vahid, “Embedded System Design: A Unified Hardware / Software Introduction”, Wiley, 2006.
8. Jochen Schiller, “Mobile Communications”, Pearson Education Asia Ltd., Second edition, 2016.

19EC1002	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:
1. To impart practical knowledge on basics of Electrical Engineering
2. To impart practical knowledge on basics of Electronics Engineering
3. To impart knowledge on selection of electrical and electronics components

Course Outcome:
At the end of the course students will be able to
1. Design, solder and prepare Printer Circuit Board (PCB) for simple circuits
2. Test the electric components
3. Study and use of electric equipments
4. Perform domestic wiring
5. Identify control circuits of electrical equipments
6. Demonstrates simple applications based on embedded and IoT systems

Experiments
1. Domestic wiring
2. Earthing
3. Test the working of different types of switches, relays, connectors and cables
4. Study of control circuit of Home inverters and solar inverters
5. Motor speed control
6. PCB layout design using software
7. Prepare a PCB for a simple circuit
8. Signal generation and measurement
9. Transistor as a Switch
10. Test & Verification of active and passive components
11. Seven Segment display
12. LED ON-OFF circuit using Arduino
13. Demonstration on temperature monitoring using IoT

19EC1003	BASIC PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives:
1. To understand the functioning of electrical systems, home power supply and electric motors used in various fields.
2. To learn about various electronic components, its applications and circuit design.
3. To impart the basic knowledge on recent advancements in sensors, instrumentation technology and communication engineering

Course Outcome:
At the end of the course, the student will be able to
1. Recognize importance and judicious use of energy systems in everyday life
2. Identify the types of electrical machines used for various applications.
3. Understand and apply the concept of electronics to design simple circuits.
4. Understand and relate various digital circuits.
5. Understand the various sensing and instrumentation applications
6. Identify the various generations of wireless communications

Module 1: Electrical Engineering: Concept of current, voltage, power and energy, Conventional Power Plants, Non-conventional Sources, photovoltaic technology. Home Power Supply: Single phase, Three phase, Domestic Wiring, Energy Meter (Digital/Smart), Electricity Tariff, Star Rating for Electrical Appliances, Fluorescent lamp, CFL, LED. Batteries and Chargers, Home UPS, Stabilizers. Heating application Electric heaters. Electrical Safety.
Module 2: Electrical Motors: Construction and Working of Electrical Motor, Types and Applications of Motors: Home appliances (Fan, Laptop, Hair dryer, Mixer, Refrigerators), Machine Tools (Lathe, CNC machines), Agriculture (Water pump), Textile industry, Medical (Motorized catheters, Implanted blood pumps), Nano motors, motors in Robots. Electricity in Transportation: Electric Train, Electric Car, Electric bike, Solar Powered Airplane, Personal Flying Cars
Module 3: Introduction to Analog Electronics: Evolution and impact of electronics in industry and society, Resistors and Capacitors: types and specifications, Inductors and Transformers: types and specifications, Diodes, Transistors, Electro Mechanical components: relays and switches.
Module 4: Introduction to Digital systems: Logic Gates, block diagram of combinational circuits, Block diagram of ALU, Block diagram of sequential circuits, Flip-flop definition and types, memory classification, Block diagram of processor, Introduction to Embedded systems.
Module 5: Instrumentation Technology & IOT applications: Types of Sensors with applications: Overhead tank water level indicator, Biosensors, Altitude and Pressure measurement in Aircrafts Gyro and accelerometers in Space crafts, Biomedical Instruments: ultrasound scanner, Agricultural Instruments: Soil moisture measurement, Ground water level monitoring, Automatic irrigation system, Food Processing (Case study with sensor application)
Module 6: Modern wireless communications: General block diagram of communication system, Simplified reference model, wireless transmission, Cellular Mobile Communication: Reuse, handoff, 1G, 2G, 3G, 4G and Beyond: Comparison, Satellite system for global mobile communication.

Reference Books:

1. A. H Robbins, W.C. Miller, “Circuit Analysis: Theory and Practice”, Fifth Edition, Delmar. Cengage Learning, New York, 2013.
2. Robert B, Northrop, “Introduction to Instrumentation and Measurements”, CRC press, Taylor and Francis group, Second Edition 2011
3. J Larminie J, Lowry, “Electric Vehicle Technology Explained”, John Wiley, & Sons, New York 2013
4. Haitham Abu-Rub, Mariusz Malinowski, Kamal Al- Haddad, “Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications, John Wiley & Sons Limited, Sussex, 2014.
5. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
6. Thomas Floyd, “Digital Fundamentals”, Prentice Hall, 10th Edition, 2011.
7. Tony Givargis Frank Vahid, “Embedded System Design: A Unified Hardware / Software Introduction”, Wiley, 2006.
8. Jochen Schiller, “Mobile Communications”, Pearson Education Asia Ltd., Second edition, 2016.

19EC2001	ELECTRONICS FOR INTELLIGENT MACHINES	L	T	P	C
		2	0	0	2

Course Objective:
The main objective of the course is
1. To make the students understand the requirements of Industry 4.0 standards
2. To enable the students to get familiarized with the concepts connected to intelligent machines
3. To make the students understand the need for data transformation in intelligent machines

Course outcomes:
1. To compare the different industry standards
2. To articulate the structure of an Intelligent machine
3. To illustrate the m2m interface needed in intelligent machining

4. To be able to categorize the sensors for various intelligent machines
5. To assess the data requirements for cloud storage
6. To be able to grade various types of Intelligent machines

Module 1: Industry 4.0

The Various Industrial Revolutions, Digitalisation and the Networked Economy ,Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 , Developments in USA, Europe, China and other countries , Comparison of Industry 4.0 Factory and Today's Factory ,Trends of Industrial Big Data and Predictive analytics for smart business transformations

Module 2: Intelligent machines

Definition of an Intelligent machine, Intelligent machining and manufacturing, AI robot: how machine intelligence is evolving

Module 3: m2m Interface

Introduction to Machine-to-Machine (M2M), Internet of Things (IoT), Standards, M2M Node Manufacturing

Module 4 : SENSORS FOR INTELLIGENT MACHINES

Sensor Basics , Different Types of Sensors with Working Principles, **Working of GSM and GPS interface modules**

Module 5: DATA PROCESSING

Data as new resource for organizations, Transforming data into information: 4 important steps**, Introduction to Big Data and cloud computing**

Module 6: APPLICATION

Case studies on design of intelligent machines & Implementation in supply chain management

Reference Books

1. The creativity code by Marcus Du Sautoy March 7,2019, Fourth Estate Publishers
2. Intelligent Machining by Tugrul Ozim and Paulo Davim , First Edition, Wiley ISBN : 9781848211292, May 2009
3. M2M Communications: A Systems Approach by David Boswarthick , Omar Elloumi , Olivier Hersent, ISBN: 978-1-119-99475-6 April 2012
4. Handbook of Modern sensors by Fraden, Jacob, Springer-2010
5. Handbook of Research on Cloud Computing and Big Data Applications in IoT, by Gupta, B. B., Agrawal, Dharma P, IGI publishers

19EC2002	ELECTRONICS FOR INTELLIGENT MACHINES LABORATORY	L	T	P	C
		0	0	3	1.5

Course Objectives:

1. To make the students get familiarized with a development tool
2. To enable the students to understand the means to interface I/O devices to a processor board
3. To enable the students to develop an IoT based system

Course outcomes:

1. To identify a basic development platform and tool
2. To identify the software requirements for an intelligent machine
3. To classify the sensors for various applications
4. To be able to apply programming to interface sensors
5. To analyse the data requirements for cloud computing
6. To be able to assess the data in cloud

List of Experiments

1. Basic programming with Arduino platform
2. Basic C programming using Keil C compiler
3. Basic arithmetic operations using C
4. Program to interface I/O devices'
5. Program to interface sensors
6. Serial interface using Arduino
7. Program to interface GSM

8. Program to Interface GPS
9. Program to enable the basic interface needed for Robotic control
10. Program to send data to cloud
11. Program to send real time data to cloud
12. Program to analyse data in cloud

19EC2003	MICROWAVE AND OPTICAL COMMUNICATION LABORATORY	L	T	P	C
		0	0	2	1

Course Objectives:

1. To understand the characteristics of different microwave components.
2. To study the performance parameters of optical source and detector.

Course outcomes:

1. Demonstrate the characteristics of Microwave sources, directional coupler, E/H plane Tee and Magic Tee.
2. Observe and analyse the radiation patterns of antenna.
3. Measurement frequency and wavelength of microwave.
4. Demonstrate a fiber optic communication link and analyze its frequency responses.
5. Determine the characteristics of optical source and detector.
6. Measure optical losses and Numerical aperture in optical fiber that affect the performance of the transmission system.

List of Experiments

A. Microwave Experiments

1. Mode Characteristics of Reflex Klystron Oscillator.
2. Characteristics of Gunn Diode Oscillator.
3. Impedance measurement by Slotted Line Method.
4. Radiation pattern of Horn Antenna

B. Optical Communication Experiments

1. D.C. Characteristics of LED and PIN Photo Diode.
2. Optical transmission using Analog and Digital Link.
3. Study of Losses and Measurement of Numerical Aperture in Optical Fiber.
4. Study of Time Division Multiplexing and System bandwidth determination by Intensity Modulation.
5. PI characteristics of LASER diode.

19EC3001	HDL LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives:

1. To learn various VHDL modeling and Verilog HDL modeling.
2. To familiarize with VHDL sub program and packages technique.
3. To design transistor level modeling using Verilog

Course Outcomes:

After completion of the course, students will be able to

1. Design for combinational and sequential circuits using VHDL and Verilog HDL
2. Develop package for digital circuits using VHDL
3. Develop test bench for digital circuits using VHDL and Verilog HDL
4. Design gates using transistor level modeling using Verilog HDL
5. Synthesize the circuits after programming.
6. Implement circuit on FPGA using VHDL and Verilog HDL.

List of experiments

1. Design and Simulation of Combinational Circuit using VHDL
2. Design and Simulation of Sequential Circuit using VHDL
3. Design and Simulation of Combinational Circuit using Verilog
4. Design and Simulation of Sequential Circuit using Verilog
5. Design and Simulation of Memory Module using HDL

6. Design and Simulation of ALU using HDL
7. Implementation of Combinational Circuit using FPGA
8. Implementation of Sequential Circuit using FPGA
9. Implementation of Traffic light Controller
10. Implementation of FSM
11. Mini Project
12. Mini Project

19EC3002	DIGITAL CIRCUIT DESIGN AND VERIFICATION USING CADENCE TOOL	L	T	P	C
		0	0	4	2

Course Objectives:
1. To learn Genus, Innovus, Tempus and Voltus tools and MODUS Tool (CADENCE TOOL)
2. To familiarize with Physical Design and Verification using Genus, Innovus, Tempus and Voltus tools
3. To complete testing flow using MODUS Tool

Course Outcomes:
After completion of the course the students will be able to :
1. Extract Digital model parameters
2. Design and Verify the Combinational Circuits
3. Design and Verify the Sequential Circuits
4. Determine various fault verifications
5. Generate test pattern generation
6. Model DFT and BIST architectures

Experiments:
Physical design and Verification of the following modules using Cadence -Genus, Innovus, Tempus and Voltus tools:
1. Characterization of PDK Devices to Extract Device Digital Model Parameters.
2. Adders
3. Subtractors
4. Flip-flops
5. Mealy and Moore FSMs
6. Array Multiplier

Testing and Verification of the following modules using Cadence Modus Tool:
7. Study of UNIX Commands and writing shell scripts for DFT flow.
8. Pre and Post synthesis simulation of 4 bit binary counter and timing analysis
9. Stuck at faults in computational and sequential blocks - Identifying and resolving stuck at faults
10. Modeling of DFT and BIST architecture
11. Test pattern generation using ATPG
12. Memory Built in Self Test (MBIST) for a given memory block

ELECTRONICS AND COMMUNICATION ENGINEERING

LIST OF COURSES

Course Code	Name of the Course	Credits [L:T:P:C]
18EC1001	CAD tools for Electronics Engineers	0:0:2:1
18EC1002	PCB Design and Fabrication Laboratory	0:0:1:1
18EC2001	Electronic Devices	3:0:0:3
18EC2002	Electronic Devices Laboratory	0:0:2:1
18EC2003	Digital System Design	2:1:0:3
18EC2004	Digital System Design Laboratory	0:0:2:1
18EC2005	Signals and Systems	2:1:0:3
18EC2006	Analog and Digital Communication	3:0:0:3
18EC2007	Analog and Digital Communication Laboratory	0:0:2:1
18EC2008	Analog Circuits	3:0:0:3
18EC2009	Analog Circuits Laboratory	0:0:3:1.5
18EC2010	Microcontrollers	3:0:0:3
18EC2011	Microcontrollers Laboratory	0:0:2:1
18EC2012	Linear Integrated Circuits	3:0:0:3
18EC2013	Electromagnetic Waves Laboratory	0:0:2:1
18EC2014	Computer Architecture	3:0:0:3
18EC2015	Digital Signal Processing	3:0:0:3
18EC2016	Digital Signal Processing Laboratory	0:0:2:1
18EC2017	Computer Network	3:0:0:3
18EC2018	Computer Network Laboratory	0:0:2:1
18EC2019	Digital IC Design	3:0:0:3
18EC2020	Antenna Theory and Wave Propagation	3:0:0:3
18EC2021	Microwave and Optical Communication	3:0:0:3
18EC2022	Object Oriented concepts using C++	3:0:0:3
18EC2023	Electromagnetic Waves & Wave guides	2:1:0:3
18EC2024	Internet of Things (IoT)	3:0:0:3
18EC2025	Machine learning Techniques	3:0:0:3
18EC2026	Fundamentals of Digital Image Processing	3:0:0:3
18EC2027	Biomedical Signal Processing	3:0:0:3
18EC2028	Microprocessor and Microcontroller	3:0:0:3
18EC2029	Microprocessor and Microcontroller Laboratory	0:0:2:1
18EC2030	Digital Electronics	3:0:0:3
18EC2031	Digital Electronics Laboratory	0:0:2:1
18EC2032	Electron Devices and Circuits	3:0:0:3
18EC2033	Electron Devices and Circuits Laboratory	0:0:2:1
18EC2034	Digital Electronics and Microprocessors	3:0:0:3
18EC2035	Sensors and Signal Processing	3:0:0:3
18EC3001	Advanced Digital Signal Processing	3:0:0:3
18EC3002	Advanced Digital Signal Processing Laboratory	0:0:4:2
18EC3003	Wireless and Mobile Communication	3:0:0:3
18EC3004	Optical Networks and Photonic Switching	3:0:0:3
18EC3005	Antennas and Radiation Systems	3:0:0:3
18EC3006	Advanced Communication Laboratory	0:0:4:2
18EC3007	Antenna and Radiation Systems Laboratory	0:0:4:2
18EC3008	Advanced Communication Networks Laboratory	0:0:4:2
18EC3009	DSP Architecture	3:0:0:3
18EC3010	Global Positioning System	3:0:0:3
18EC3011	Computational Intelligence and Optimization Techniques	3:0:0:3

18EC3012	Data Compression Techniques	3:0:0:3
18EC3013	Advanced Digital Image Processing	3:0:0:3
18EC3014	Pattern Recognition and Machine Learning	3:0:0:3
18EC3015	MIMO Systems	3:0:0:3
18EC3016	Modern Digital Communication Techniques	3:0:0:3
18EC3017	Communication Network Routing Algorithms	3:0:0:3
18EC3018	Satellite Communication	3:0:0:3
18EC3019	Wireless Sensor Networks	3:0:0:3
18EC3020	Software Defined Radio	3:0:0:3
18EC3021	High Performance Networks	3:0:0:3
18EC3022	Cognitive Radio	3:0:0:3
18EC3023	Statistical Information Processing	3:0:0:3
18EC3024	Advanced Communication Networks	3:0:0:3
18EC3025	RF and Microwave Circuit Design	3:0:0:3
18EC3026	Internet of Things	3:0:0:3
18EC3027	CMOS VLSI Design	3:0:0:3
18EC3028	Solid State Device Modeling and Simulation	3:0:0:3
18EC3029	Analysis and Design of Analog Integrated Circuits	3:0:0:3
18EC3030	Hardware Description Languages	3:0:0:3
18EC3031	Signal Integrity for High Speed Devices	3:0:0:3
18EC3032	Digital System and ASIC Design	3:0:0:3
18EC3033	VLSI Circuits for Bio Medical Applications	3:0:0:3
18EC3035	HDL Laboratory	0:0:4:2
18EC3036	Compact Modeling & Simulation using Verilog A in CADENCE Tool	0:0:4:2
18EC3037	Low Power VLSI Design	3:0:0:3
18EC3038	Analog VLSI Design	3:0:0:3
18EC3039	Testing and Testability	3:0:0:3
18EC3040	VLSI Technology	3:0:0:3
18EC3041	IP based VLSI Design	3:0:0:3
18EC3042	CAD for VLSI Circuits	3:0:0:3
18EC3043	Data Converters	3:0:0:3
18EC3044	CMOS Mixed Signal Circuit Design	3:0:0:3
18EC3045	Analog Circuit Design Laboratory using CADENCE Tool	0:0:4:2
18EC3046	ASIC Design Laboratory	0:0:4:2
18EC3047	Hardware Design Verification Techniques	3:0:0:3
18EC3048	Design of Semiconductor Memories	3:0:0:3
18EC3049	System On Chip Design	3:0:0:3
18EC3050	Solid State Device Modeling and Simulation-MOS Model	3:0:0:3
18EC3051	Nanoscale Devices And Circuit Design	3:0:0:3
18EC3052	Nanoscale FET	3:0:0:3
18EC3053	Photonics	3:0:0:3
18EC3054	High Speed VLSI Design	3:0:0:3
18EC3055	VLSI for Wireless Communication	3:0:0:3

18EC1001	CAD Tools for Electronics Engineers	L	T	P	C
		0	0	2	1

Course Objectives:

1. To understand and study of Express PCB and it's applications
2. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
3. To create learning, development and testing environment to meet ever challenging needs of the electronic industry

4. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration
5. Design, build and test analog & digital electronic systems for given specifications.

Course Outcomes:

1. To learn how schematics/ PCB designs are done on software and implemented on the board.
2. To illustrate the role of computer programming in solving engineering problems.
3. To design various CMOS Design Styles and various applications of digital logic in CMOS using Tanner EDA Tool.
4. To provide an introduction to the fundamentals of Computer-Aided Design tools for the modelling, design, analysis, test and verification of digital systems.
5. Apply EDA tools to design linear and digital IC systems.
6. Design of Digital Circuits for synthesis and simulation using HDL and Schematic Entry.

Name of the Experiments:

1. PCB Schematic of Half Wave Rectifier.
2. PCB Schematic of Multiplexer using Digital Ics..
3. To design and simulate the CMOS inverter, 2-input CMOS NAND gate and 2-input NOR gate using Tanner EDA Tool.
4. Design and Simulation of BICMOS Inverter using Tanner EDA Tool.
5. Design and Simulation of Adder using IC741 in PSIM Tool
6. Design and Simulation of Subtractor using IC741 in PSIM Tool
7. Design of Inverting and Non Inverting Amplifier in Pspice Tool
8. Project Phase –I – Students as team has to choose a application based Projects

18EC1002	PCB Design and Fabrication Laboratory	L	T	P	C
		0	0	2	1

Course Objectives:

1. To give hands-on learning with PCB design simulation tool.
2. To understand steps involved in PCB fabrication process.
3. To develop skills in basic electronic component testing, assembly and soldering practices.

Course Outcomes:

The Student will be able to:

1. Construct the circuit schematic for single layer PCB using simulation tool.
2. Develop the relevant routing procedures in the PCB board layout.
3. Prepare the pre requisite materials and solutions for the PCB fabrication process.
4. Examine the bare board PCB for open and shorts.
5. Assemble the electronic components in the prepared PCB board.
6. Conduct prototype board testing with necessary measuring equipments.

LIST OF EXPERIMENTS

1. Study of PCB Simulation Tool
2. Study of Schematics of PCB Simulation Tool
3. Design of PN Junction Diode as a switch using simulation tool
4. Design of Zener Diode as voltage Regulator using simulation tool
5. Design and study of ON/OFF characteristics of LED
6. Design and study of Transistor as a switch using simulation tool
7. Fabrication of PCB Circuit (Diode/ZENER/LED/BJT)
8. Assembling and Testing of PCB

18EC2001	Electronic Devices	L	T	P	C
		3	0	0	3

Course Objectives:

1. To explain the mechanisms of current flow in semi-conductors.
2. To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.

3. To design practical circuits and to analyze various device components.

Course Outcomes:

The students will be able to

1. Describe the principles of semiconductor Physics
2. Demonstrate the flow of charge carriers in semiconductor and interpret the V-I relations.
3. Explain the basic principles of bipolar junction transistors.
4. Represent the mathematical models of MOS transistors for circuits and systems.
5. Define the fundamental operation principles, applications and limitations of special semiconductor devices.
6. Infer the knowledge of power devices and display devices

Module 1: Introduction to Semiconductor

Properties of semiconductor, Intrinsic Semiconductor, Extrinsic Semiconductor, Energy band diagram, temperature dependence, Hall effect, Poisson and continuity equation, formation of PN junction.

Module 2: Semiconductor Diode

PN junction diode, Current equations, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.

Module 3: Bipolar Junction Transistors

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid -π model - h-parameter model, Ebers Moll Model.

Module 4: Field Effect Transistors

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET Characteristics – MOS Capacitor, Comparison of MOSFET with JFET.

Module 5: Special Semiconductor Devices

Metal-Semiconductor Junction- MESFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-avalanche photo diode, Tunnel diode- LASER diode.

Module 6: Power Devices And Display Devices

SCR, Diac, Triac, Power MOSFET- DMOS-VMOS. LED, Photo transistor, Solar cell.

Text Books

1. 1.D. Neamen , D. Biswas "Semiconductor Physics and Devices," 4th edition, McGraw-Hill Education, 2012.
2. M.S. Tyagi, “Introduction to Semiconductor Materials and Devices” John Wiley & Sons, 2008.
3. Robert Boylestad and Louis Nashelsky, ―Electron Devices and Circuit Theory‖ Pearson, Prentice Hall, 10th edition, July 2008.

Reference Books

1. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.
2. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
3. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991
4. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ.Press, 2011.
5. Jacob Millman & Halkias,"Electronic Devices & Circuits",Tata McGraw Hill second edition,2013.
6. David.A.Bell, "Electronic Devices & Circuits ", 5th edition, PHI, 2008.

18EC2002	Electronic Devices Laboratory	L	T	P	C
		0	0	2	1

Course Objective:

1. To understand the characteristics of semiconductor and special purpose electron devices.
2. To design rectifiers, amplifiers and regulators.

3. To design power control devices
4. To learn the properties of a photovoltaic cell.

Course Outcomes:

Students will be able to

1. Classify the basic properties and characteristics of semiconductor devices.
2. Identify, differentiate and construct the circuit of rectifiers, amplifiers and regulator.
3. Construct the experiments, as well as to analyze and interpret data
4. Analyze practically the response of various special semiconductor devices.
5. Relate the circuit models to perform parameter analysis.
6. Explain the response of devices in power control.

List of experiments

1. PN diode – Characteristics and its Applications – Full Wave Rectifier
2. Zener diode – Characteristics and its Applications – Voltage Regulator
3. Characteristics of BJT (CE Configuration) and hybrid (h) parameters Evaluation
4. BJT as an amplifier and as a switch
5. Characteristics of JFET
6. Characteristics of MOSFET
7. Characteristics of SCR
8. Characteristics of Solar Cell
9. Characteristics of LED and Photodiode
10. Clipper and Clamper
11. Full wave rectifier.

18EC2003	Digital System Design	L 2	T 1	P 0	C 3

Course Objective:

1. To learn basic postulates of Boolean algebra and to study formal procedures for the analysis and design of combinational and sequential circuits.
2. To learn about logic families, semiconductor memories and implementation of digital circuits in programmable logic devices.
3. To illustrate the concept of designing combinational and sequential circuits using HDL.

Course Outcome:

The students will be able to

1. illustrate the basic postulates of Boolean algebra and the operation of logic gates.
2. choose an optimal method for simplification of Boolean expressions.
3. design and distinguish various combinational logic circuits.
4. design and compare various sequential logic circuits.
5. illustrate different logic families; classify memory devices and identify methods for implementation of logic circuits.
6. design simple logic circuits using HDL codes.

Module 1: Minimization Techniques And Logic Gates

Minimization Techniques: Boolean postulates and laws – DeMorgan‟s Theorem Principle of Duality Boolean expression Minimization of Boolean expressions –– Minterm – Maxterm Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don‟t care conditions - Binary codes – code conversion. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations Multi output gate implementations.

Module 2: Combinational Circuits

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Carry Look Ahead adder – Serial Adder/Subtractor BCD adder – Binary Multiplier – Barrel Shifters - Multiplexer/ Demultiplexer – decoder encoder – Driver – multiplexed display - Magnitude Comparator - ALU.

Module 3: Sequential Circuits
Latches, Flipflops SR, JK, D, T, and MasterSlave – Characteristic table and equation –Clock generation & Parameters – Pulse width, setup, hold, propagation delay – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops –Asynchronous Ripple or serial counter – Asynchronous Up/Down counter Synchronous counters – Synchronous Up/Down counters – Design of Synchronous counters: state diagram State table –State minimization –State assignment - Excitation table and maps - Circuit implementation Modulo–n counter, Registers – shift registers - Universal shift registers – Johnson Counter - Ring counter – Sequence generators - Synchronous Sequential Circuits & Asynchronous Sequential Circuits : General Model – Classification – Use of Algorithmic State Machine - Races and Cycles.
Module 4: Logic Families
TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing.
Module 5: Memory Devices
Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle Timing wave forms – Memory decoding – memory expansion – Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) Implementation of combinational logic circuits using ROM, PLA, PAL.
Module 6: HDL: Introduction to VERILOG – Modules – Ports – Operators – Data types – Different types of Modelling: Dataflow – behavioural – structural and switch level modelling - Design of Combinational and Sequential circuits using VERILOG.

Text Books:

1. M. Morris Mano, “Digital Design”, 4th Edition, Prentice Hall of India Pvt. Ltd., 2008.
2. Samir Palnitkar, “Verilog HDL”, Pearson Publication”, II Edition. 2003

Reference Books:

1. John F.Wakerly, “Digital Design Principles and Practices”, Fourth Edition, Pearson/PHI, 2008.
2. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
3. Donald P.Leach and Albert Paul Malvino, “Digital Principles and Applications”, 6th Edition, TMH, 2006.
4. John.M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006
5. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011

18EC2004	Digital System Design Laboratory	L 0	T 0	P 2	C 1

Course Objectives:
1. To learn about the basic characteristics of all logic gates.
2. To design combinational and sequential circuits.
3. To design and simulate digital circuits using HDL.

Course Outcomes:
The students will be able to
1. Demonstrate the basic characteristics of all logic gates.
2. Illustrate different methods for realizing logic gates using universal gates.
3. Design and verify combinational logic circuits.
4. Design and inspect sequential logic circuits.
5. Design digital circuits for practical applications
6. Design and test digital circuits using HDL.

Experiments:
1. Realization of logic gates using universal gates
2. Design, implementation and verification of full adder and full subtractor
3. Design, implementation and verification of multiplexer and demultiplexer
4. Design, implementation and verification of encoder and decoder
5. Design, implementation and verification of flip flops

6. Design, implementation and verification of magnitude comparator using HDL.
7. Design, implementation and verification of counters using HDL.
8. Design, implementation and verification of shift registers using HDL.

18EC2005	Signals and Systems	L 2	T 1	P 0	C 3

Course Objectives:
1. To explain the basic properties of signal & systems and the various methods of classification
2. To introduce Fourier Series, Fourier transform, Laplace Transform and their properties
3. To paraphrase Z transform and their properties

Course Outcome:
At the end of the course the students will be able to
1. Analyze different types of signals for mathematical modelling
2. Realize the system properties to build basic model
3. Represent continuous time system using fourier series and fourier transform
4. Investigate the sampling process and Laplace Transform
5. Signify discrete time system using fourier series and fourier transform
6. Familiarize the frequency analysis of discrete time system using Z transform

Module 1: Classification of signals
Continuous Time (CT) signals – CT signal operations – Discrete Time (DT) signals – Representation of DT signals by impulses – DT signal operations – CT and DT systems and discrete amplitude signals.

Module 2: Classification of system
Linear Time Invariant(LTI)-Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input output behavior with aperiodic convergent inputs-System properties-Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.

Module 3: Fourier Analysis of CT Signals And Systems
Fourier series representation of periodic signals – Properties – Harmonic analysis of LTI systems – Convergence of Fourier series – Representation of a periodic signals by Continuous Time Fourier Transform (CTFT) – Properties – Frequency response of systems characterised by Differential Equations – Power and Energy Spectral Density – Parseval's Relation.

Module 4: Discretisation of CT Signals Representation of CT signals by samples – Sampling Theorem – Sampling Methods– Effect of under sampling – Aliasing Error –- The Laplace Transform-properties- region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

Module 5: Fourier Analysis of DT Signals And Systems
Discrete Time Fourier series representation of DT periodic signals – Properties – Representation of DT aperiodic signals by Discrete Time Fourier Transform (DTFT) – Properties – Frequency response of systems characterised by Difference Equations – Power and Energy Spectral Density concepts related to DT signals – Parseval's Relation.

Module 6 : Transform Operations of DT Signals and Systems
Z transform and its properties – Inverse Z transform – Solution of Difference equations –Z Transform analysis of Recursive & Non-Recursive systems-

Text Books

1. Allan V. Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, Indian Reprint, 2009.
2. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons Inc., 2005

References Books

1. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford, Second Edition, 2009.
2. Samir S Solimon and Srinath M.D., "Continuous and Discrete Signals and Systems", II Edition, PHI, 2003.
3. Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, 2002.

4. P.Ramakrishna Rao, “Signals and Systems” , Tata Mc Graw Hill Publications, 2008.
5. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007

18EC2006	Analog and Digital Communication	L	T	P	C
		3	0	0	3

Course Objective:

Students will learn:

1. The fundamentals of basic communication system, types of noise affecting communication system and noise parameters.
2. Need of modulation, modulation processes and different amplitude modulation schemes
3. Different angle modulation schemes with different generation and detection methods**.**

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Distinguish different analog modulation schemes for their efficiency and bandwidth
2. Predict the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Recognize various optimal detection schemes
5. Analyze different digital modulation schemes and can compute the bit error performance
6. Relate different digital demodulation techniques

Module 1: Analog Modulation Techniques

Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals.

Module 2: Noise in Analog Modulation

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and Deemphasis, Threshold effect in angle modulation.

Module 3: Pulse Modulation

Pulse modulation. Sampling process. Pulse modulation (PAM, PCM.PWM, PPM) Differential pulse code modulation. Delta modulation

Module 4: Detection Theory and ISI

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference and Nyquist criterion. Pass band

Module 5: Digital Modulation

Digital Modulation schemes- Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying. Digital Modulation tradeoffs.

Module 6: Equalization Techniques

Optimum demodulation of digital signals over band-limited channels- Maximum likelihood sequence detection (Viterbi receiver). Equalization Techniques. Synchronization and Carrier Recovery for Digital modulation.

Text/Reference Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems”, Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

18EC2007	Analog and Digital Communication lab	L 0	T 0	P 2	C 1

Course Objectives:

1. To analyze, design and implement AM and FM modulation experiments using discrete electronic components
2. To study the basic of MATLAB

Course Outcome:

1. Comprehend the fundamentals in explain the functionality of modulation and demodulation environment
2. Analyze the concepts, write and simulate the concepts of AM and AM Demodulation process in Communication.
3. Know the origin and simulation of FM and FM-Demodulation process in communication
4. Acquaint with AM and FM basic functionalities
5. Discriminate the AM and FM functionalities
6. Interpret with various angle modulation and demodulation systems

List of Experiments:

1. Generation of AM signals
2. Demodulation of AM signals
3. Frequency modulation
4. FM Demodulators
5. Digital Modulation: FSK
6. Pre-emphasis & De-emphasis
7. Pulse code modulation
8. MATLAB basic for communication system design

18EC2008	Analog Circuits	L 3	T 0	P 0	C 3

Course Objectives:

1. To know about the design and analysis of transistor biasing and amplifier circuits.
2. To understand the design and working of power amplifiers and feedback amplifiers.
3. To impart knowledge about the oscillators in various practical applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Summarize the application of diodes
2. Classify the characteristics of BJT and JFET amplifiers
3. Design and construct various amplifier circuits
4. Describe the function of power amplifier
5. Construct the differential amplifier for a given specification
6. Identify sinusoidal and non-sinusoidal oscillators

Module 1: Rectifier and Filter

Half wave rectifier, full wave rectifier, capacitor filter, inductor filter and voltage regulator. Simple diode circuits: clipper and clamper.

Module 2: Amplifier models

Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features.

Module 3: Small signal analysis

Low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

Module 4: Power amplifier

High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier, Various classes of operation (Class A, B, AB and Class C), their power efficiency and linearity issues.

Module 5: Feedback amplifier
Feedback topologies, voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR.
Module 6: Oscillators
Review of basic concepts- Barkhausen criterion, RC oscillators(phase shift and Wien bridge), LC oscillators (Hartley and colpitts), non-sinusoidal oscillators. Introduction to tuned amplifier, Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load.

Text Books

1. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
2. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
3. A.S.Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College115. Publishing, Edition V.
4. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition.

Reference Books

1. Millman.J. & Halkias.C, "Electronic Devices and Circuits", Third Edition, Tata McGraw Hill, 2013.
2. Robert L Boylestad and Louis Nashelsky, “Electronic Devices and Circuits Theory”, Eleventh Edition, PHI, 2015.

		L	T	P	C
18EC2009	**Analog Circuits Laboratory**	**0**	**0**	**3**	**1.5**

Hands-on experiments related to the course contents EC09
Course Objectives:
1. To design and implement amplifier circuits using BJT and JFET
2. To analyze various configurations of feedback amplifiers and oscillators
3. To generate waveforms using Op-amp circuits.

Course outcomes:
1. Construct basic amplifier circuits using BJT,JFET and op-amps
2. Determine the frequency response of feedback amplifier.
3. Classify large signal amplifiers and oscillators.
4. Identify filters using op-amps
5. Differentiate op-amp based linear and non linear circuits
6. Design adc and dac using op-amps

List of Experiments:
1. Full wave rectifier with filters.
2. Clipper and clamper.
3. Frequency response of a single stage BJT amplifier.
4. Differential amplifiers-Transfer characteristics and CMRR measurement.
5. Frequency response of Voltage shunt feedback amplifier
6. Design of RC phase shift Oscillator
7. Design of Inverting and Non Inverting Amplifier
8. Design of Integrator and Differentiator
9. Design of Active Filters
10. Digital to Analog Converter
11. Analog to Digital Converter

18EC2010	Microcontrollers	L 3	T 0	P 0	C 3

Course Objectives:

1. To gain knowledge about architecture & programming concepts of 8051 and PIC microcontrollers.
2. To understand the concepts on peripheral interfacing of microcontrollers.
3. To design Microcontroller based systems.

Course Outcomes:

On successful completion of the Course, students can be able to:

1. Describe the architecture of 8051 microcontroller.
2. Discus 8051 assembly language programs for the given applications.
3. Illustrate the memory and I/O interfacing concepts for any microcontroller design.
4. Illustrate the architectures of PIC microcontroller.
5. Develop Microcontrollers based systems using C.
6. Select the Microcontroller with proper specifications for various applications.

Module 1: 8051 Microcontrollers

Introduction to microcontrollers -8051 Microcontroller Architecture - Memory organization - SFRs – Addressing modes- 8051 Instruction Set- Programming examples- External Memory Interface.

Module 2: 8051 Microcontroller Interfacing

I/O Ports - Serial communication. Timer/Counter - Interrupts – Programming examples

Module 3: PIC 18 Microcontrollers

PIC 18 Microcontroller Architecture - Memory organization - SFRs - Interrupts – Addressing modes - Instruction set – Programming examples

Module 4: PIC 18 Microcontroller Interfacing

Timers - PWM module - I/O Expansion – SPI - I2C bus - A/D Converter - UART – Programming examples

Module 5: Introduction to Embedded C Programming

Data Types and Storage Classes - Operators and Expressions - Control Statements - Functions - Pointers and Arrays

Module 6: Applications

LCD and Keyboard Interface- ADC Interface, Stepper motor interfacing, DC motor interfacing – Programming examples using C

Text Books

1. Kenneth J.Ayala "The 8051 Microcontroller Architecture, Programming & Applications" Penram International Publishing –2008.
2. Muhammad Ali Mazidi, R.D.Mckinlay, Danny Causey, "PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18", Pearson Prentice Hall-2008.

Reference Books

1. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2011.
2. Ajay Deshmukh, "Microcontrollers: Theory and Applications", Tata McGraw Hill, 2010.
3. Muhammad Ali Mazidi, J.G.Mazidi, R.D.Mckinlay, "The 8051 Microcontroller and Embedded Systems", Second Edition Prentice Hall-2007.
4. John B Peatman, "Design with PIC Micro Controllers", Pearson Education India Series, New Delhi, 2005.
5. Brain Kernighan and Dennis Ritchie, "The C Programming Language", Second Edition-Pearson Education India -2015
6. Yashavant P. Kanetkar, "Let Us C", 15th Edition - BPB Publications India – July 2016

18EC2011	Microcontrollers Laboratory	L	T	P	C
		0	0	2	1

Course Objectives:

1. To acquire programming skills for 8051 and PIC Microcontrollers.
2. To understand the concepts of memory and peripheral interfacing chips.
3. To design 8051 and PIC microcontroller based systems.

Course Outcomes:

On successful completion of the Course, students can be able to

1. Demonstrate Arithmetic operations and sorting using 8051.
2. Demonstrate I/O operations and verify using 8051
3. Compute delay calculations and verify using Timers of 8051.
4. Show serial communication between 8051 and peripheral devices.
5. Demonstrate ADC and sensor interfacing using PIC.
6. Demonstrate and verify I2C communication using PIC.

Experiments:

1. Demonstrate and verify arithmetic operations and sorting using 8051.
2. Demonstrate and verify I/O operations using 8051.
3. Demonstrate and verify delay generation using Timers of 8051.
4. Demonstrate and verify serial communication and verify using 8051.
5. Demonstrate ADC with sensor Interface and verify using PIC.
7. Demonstrate and verify I2C communication using PIC.

18EC2012	Linear Integrated Circuits	L	T	P	C
		3	0	0	3

Course Objectives:

1. To gain knowledge in IC 741 and its applications.
2. To develop a fundamental understanding about IC 555 and its applications.
3. To understand Integrated Circuit Fabrication.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the fundamentals of OP-AMP and its characteristics.
2. Use OP-AMP to design circuits such as Amplifiers, differentiator and Integrator.
3. Infer the significance of OP-AMP in Multivibrators and Oscillators.
4. Design filters using OP-AMP.
5. Explore the usefulness of IC555 timer and Phase Locked Loop
6. Design ADC, DAC and understand the IC fabrication.

Module 1: OP-AMP Fundamentals and Characteristics

Introduction, DC Characteristics, Ideal Characteristics of Op. Amp, Inverting amplifier and Non inverting amplifier, Adder, Subtractor and Adder-Subtractor.

Module 2: OP-AMP Applications

Design of differentiator and Integrator, Differential Amplifier, Rectifiers, Log Amplifier, Mutiplier and Divider, Comparator – Schmitt Trigger.

Module 3: OP-AMP in Multivibrators and Oscillators

Multivibrator- Introduction, Astable Multivibrator – Square Wave Generator, Monostable Multivibrator, Triangular Wave Generator. Oscillators- Barkhausen Criteria, RC phase shift Oscillator, Wein’s Bridge oscillator. Voltage Regulator- 723 low voltage regulator.

Module 4: OP-AMP in Filters

Filters- Introduction, Low pass filters- First order and second order filters, High pass filters, Band pass filters, Band Reject filters.

Module 5: IC 555 Timer and Phase Locked Loop

555 Timer Functional diagram, Monostable operation and application, Astable operation and application and Schmitt trigger.PLL- basic principle and applications.

Module 6: DAC, ADC and IC Fabrication
DAC- weighted resistor and R-2R ladder. ADC- Successive Approximation and Flash, Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc. Basic Planar processes, Fabrication of Bipolar Junction Transistor- chemical vapor deposition, sputtering, n-tub, p-tub and twin-tub CMOS process.

Text Book
1. Roy Choudhury.D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 5th Edition, 2018.

Reference Books
1. 1. Gayakwad.A.R., "Op-Amps & Linear IC's", PHI, 4th Edition,2004
2. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & Linear Integrated Circuits", PHI 6th Edition, 2001.
3. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", TMH, 3rd Edition, 2002.

18EC2013	Electromagnetic Waves Laboratory	L	T	P	C
		0	0	2	1

List of Experiments
1. Measurement of Standing Wave pattern, (Z_o) Characteristic Impedance, (€) Dielectric Constant of Transmission Line.
2. Measurement of Attenuation Constant, Reflection Coefficient, VSWR and Return Loss in Transmission Line.
3. Design a lumped-element matching network to match 100Ω load to 50 Ω using Electromagnetic Software tool
4. Design and simulate a Microstrip planar transmission line with Characteristic Impedance Z_0.
5. Determine the frequency and guide wavelength inside a waveguide using slotted line.
6. Measurement of unknown load impedance Using Slotted Line & Smith Chart.
7. Measurement of Coupling factor, Isolation Loss, Insertion loss and Directivity in Directional Coupler
8. Study of Power Distribution in E/H Plane Tee, Magic Tee

18EC2014	Computer Architecture	L	T	P	C
		3	0	0	3

Course Objectives:
1. To impart basic concepts computer architecture and design of ALU
2. To study the basic concepts of microprocessor 16 bit (8086).
3. To introduce interfacing devices, Memory, programmable peripheral devices and applications

Course Outcomes:
At the end of the course, the students should be able to:
1. Illustrate the basics of computer organization.
2. Compute Arithmetic and Logic Unit
3. Categorize the performance of memory systems.
4. Illustrate and Implement programs on 8086 microprocessor.
5. Compute I/O and Memory circuits and 8086 ALP.
6. Formulate Memory Interfacing circuits.

Module 1: Basic Computer Organization and Programming
Basic Structure of Computers: Functional units- software, performance issues software, machine instructions and programs, computer registers & instructions – Timing and Control – instruction Cycle. Assembly language: Stacks- Queues- Subroutines- Programming arithmetic and logic operations.

Module 2: Processor and Control Unit
CPU: Register organization - Information representation, number formats - Stack organization – Instruction Formats – Addressing modes – Data transfer manipulation – Program control. ALU design- Floating Point arithmetic – Microprogrammed Control
Module 3: Memory and System Organization
Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory. System organization, Input - Output systems, Interrupt, DMA.
Module 4: 8086 Microprocessor
Architecture – Signals - Memory Organization - Bus Operation - Minimum Mode & Maximum Mode - 8086 system Timing and Troubleshooting.
Module 5: 8086 Programming
8086 Instruction Description and assembler directives – Strings, Procedures and Macros - Addressing modes - Assembly Language Programming - I/O and Memory Interfacing concepts.
Module 6: Interfacing Techniques
Parallel Peripheral interface (8255) – Serial communication interface (8251) –Timer (8254) – Interrupt controller (8259) – Case studies: Stepper motor interfacing – Analog interfacing and Industrial control.

Text/ Reference Book

1. M.Morris Mano, “Computer System Architecture” Third Edition, Pearson - 2013
2. V.Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, “Computer Organisation“, VI edition, Mc Graw-Hill Inc, 2012.
3. William Stallings “Computer Organization and Architecture”, Seventh Edition, Pearson Education, 2006.
4. Vincent P. Heuring, Harry F. Jordan, “Computer System Architecture”, Second Edition, Pearson Education, 2005.
5. Govindarajalu, “Computer Architecture and Organization, Design Principles and Applications”, first edition, Tata Mc Graw Hill, New Delhi, 2005.
6. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata Mc Graw Hill, 1998.
7. David A. Patterson and John L. Hennessey, “Computer Organization and Design“, Fifth edition, Morgan Kauffman/ Elsevier, 2014.
8. Doughlas V.Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,201
9. Ramesh.S.Goankar “Microprocessor Architecture, Programming &Applications with 8085” – Penram International, Fifth Edition, 1999

18EC2015	Digital Signal Processing	L	T	P	C
		3	0	0	3

Course Objective:
1. To impart basic knowledge about digital time signals and systems.
2. To understand digital (IIR and FIR) filter design procedures.
3. To know about the finite word length effects and PDSPs.

Course Outcomes:
At the end of this course, students will be able to:
1. **Define** signals and system mathematically in discrete time domain.
2. **Formulate** the Discrete-Fourier Transform (DFT) and the FFT algorithms.
3. **Explain** the various transformations for digital IIR filter design procedures.
4. **Design** FIR digital filters for various applications.
5. **Demonstrate** the signal processing concepts and the practical issues with the help of finite word length effects.
6. **Compare and select** the DSP processor and techniques, suitable for the analysis of real-life signals.

Module 1: Introduction to Discrete time signals and systems
Review on Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Sample rate conversion; Introduction: multi-rate signal processing. Review on Discrete Time LTI Systems: Discrete systems attribute; Analysis of LTI systems: convolution.
Module 2: Discrete Fourier Transform
Discrete Fourier Transform (DFT); Fast Fourier Transform computations using DIT and DIF algorithms; Implementation of Discrete Time Systems.
Module 3: Design of IIR filters
Butterworth, Chebyshev and Elliptic approximations; Impulse invariant method and Bilinear transformation method; Realization structures of IIR filters.
Module 4: Design of FIR filters
Window method; Frequency sampling method; Park-McClellan's method; Realization structures of FIR filters.
Module 5: Finite Word Length Effects
ADC quantization noise; coefficient quantization error; Product quantization error; Limit cycles.
Module 6: Adaptive filter and DSP Processors
Basic wiener filter theory; LMS adaptive algorithm. Introduction to DSP Processors: Harvard architecture; Pipelining; Special instruction; Replication; Hardware filter. Application of DSP: Echo Cancellation, Channel Equalization.

Text Books

1. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson, Fourth Edition, 2007.
2. Alan V. Oppenheim and Ronald W. Schafer, "Discrete-Time Signal Processing", Prentice Hall,3rd edition, 2010.

Reference Books

1. Emmanuel C. Ifeacher and Barrie W. Jervis, “Digital Signal Processing – A Practical Approach”, Wesley Longman Ltd., 2nd Edition, 2004.
2. Sanjit K.Mitra, “Digital Signal Processing - A Computer Based Approach”, Tata McGraw Hill, New Delhi, 2011.
3. Johny R. Johnson, “Introduction to Digital Signal Processing”, PHI, 2006.
4. D.J.DeFatta, J. G. Lucas and W.S.Hodgkiss, Digital Signal Processing, John Wiley & Sons, 1988.
5. 5.Lonnie. C. Ludemann,"Fundamentals of Digital Signal Processing",Wiley India Pvt. Limited, 2009.
6. 6.S. Salivahanan, A. Vallavaraj and C. Gnanapriya, ‘Digital Signal Processing’, McGraw Hill International, 2007.

18EC2016	Digital Signal Processing Laboratory	L	T	P	C
		0	0	2	1

Course Objectives:
1. To gain skills in DSP concepts like FIR, IIR filters and FFT using software.
2. To impart knowledge on Texas TMS processors and work on real time applications.

Course Outcomes:
The students will be able to:
1. **Interpret** the basic signal processing concepts (Convolution) using programming software
2. **Assess** the Discrete Fourier Transform using programming software
3. **Design** the digital filters by applying suitable techniques using programming software
4. **Translate** the basic signal processing concepts using DSP Processor
5. **Implement** the mathematical transforms using DSP Processor
6. **Demonstrate** the real time (FIR) filtering of audio signals using DSP Processor

List of Experiments:
Using Software
1. Generation of DT Signals and sample rate conversion

2. Convolution and its properties
3. Calculation of DFT of a Signal
4. Design of IIR Filters (Butterworth/Chebyshev)
5. Design of FIR Filter.

Using DSP Processor

6. Waveform Generation
7. Implementation of Convolution
8. Implementation of DFT
9. Configuration of CODEC
10. Implementation of FIR Filter

18EC2017	Computer Network	L 3	T 0	P 0	C 3

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks
3. (WANs), local area networks (LANs) and Wireless LANs (WLANs).
4. To provide an opportunity to do network programming
5. To provide a WLAN measurement ideas.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Demonstrate the functions of the different layers of the OSI protocol
2. Identify the performance of different kinds of switching in the network.
3. Design a network for a particular application using IEEE standards
4. Interpret the concepts of networking thoroughly.
5. Develop TCP/IP protocol for suitable application
6. Configure application layer protocol

Module 1: Data Communication Components

Introduction to networks-Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, TOPOLOGY, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN,

Module 2: Physical Layer

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch. and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical multiplexing.

Module 3: Data Link Layer

ALOHA, Multiple access protocols, IEEE 802 standards,(802.11,802.3,802.4 and 802.5) Local Area Networks, addressing, HDLC, Hubs, Switches.

Module 4: Network Layer

Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithm (Distance vector and Linkstate), Broadcast and Multicast routing

Module 5: Transport Layer

Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call. Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service

Module 6: Application Layer

Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

Text Reference Books

1. J.F. Kurose and K. W. Ross, “Computer Networking – A top down approach featuring the Internet”, Pearson Education, 5th Edition,2010
2. L. Peterson and B. Davie, “Computer Networks – A Systems Approach” Elsevier Morgan Kaufmann Publisher, 5th Edition,2011
3. T. Viswanathan, “Telecommunication Switching System and Networks”, Prentice Hall,2004
4. S. Keshav, “An Engineering Approach to Computer Networking” , Pearson Education,2007
5. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition,2007
6. Andrew Tanenbaum, “Computer networks”, Prentice Hall,2010
7. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall,2009
8. William Stallings, “Data and computer communications”, Prentice Hall,2009

18EC2018	Computer Network Laboratory	L 0	T 0	P 2	C 1

Course objectives:
1. To know the different functions/commands used in networking.
2. To learn about Flow /Error control protocols
3. To program different routing algorithms and able to analyze their characteristics

Course Outcomes:

At the end of this course students will demonstrate the ability to:
1. Demonstrate the functions of the bit stuffing in HDLC
2. Identify the performance of stop and wait protocol.
3. Design a network which performs ARQ protocol
4. Interpret the concepts of IEEE standards thoroughly.
5. Configure a network with CSMA/CA channel accessing method
6. Develop routing protocolsTCP/IP protocol for suitable application

List of Experiments

I Matlab:
1. High-Level Data Link Control (Bit Stuffing)
2. Stop –and – wait protocol
3. Go-Back-N ARQ Protocol
4. Selective Repeat ARQ Protocol

II LAN Trainer Kit

5. Token Ring
6. CSMA with Collision Avoidance (CSMA/CA)
7. Distance Vector Routing Protocol
8. Link stste Routing protocol

18EC2019	Digital IC Design	L 3	T 0	P 0	C 3

Course Objective:
1. To learn about the basic concepts of MOS transistor.
2. To study about second order effects to analyse MOS transistor.
3. To learn the concept of designing CMOS inverter and analysing its static and dynamic behaviour.
4. To illustrate the concept of designing combinational and sequential circuits using different logic styles.

Course Outcome:

The students will be able to
1. Understand the basic concepts of MOS transistor.
2. Illustrate different second order effects of MOS transistor.
3. Analyse static and dynamic behaviour of CMOS inverter.
4. Design combinational logic circuits in CMOS.

5. Interpret different logic style for design of sequential logic circuits.
6. Comprehend the significance of optimising the logic circuit design.

Module 1: Deep Submicron Digital Ic Design & Mos Transistor
Basic Logic Functions-Implementation of Logic Circuits-Definition of Noise Margin-Transient Characteristics-Power Estimation- Structure and Operation of MOS Transistor-Threshold Voltage of the MOS Transistor-Capacitance of MOS Transistor: Thin Oxide Capacitance-pn junction capacitance-Overlap Capacitance
Module 2: Fabrication And Simulation
Overview of IC Fabrication Process-IC Photolithographic process-Making Transistors-Making Wires-Wire Capacitance and Resistance-Modeling the MOS Transistor for circuit Simulation-MOS Models in SPICE-Specifying MOS Transistors-SPICE MOS LEVEL1 Device Model-BSIM3 Model-Latch up
Module 3: Static Mos Gate Circuits
CMOS Gate Circuits: Basic CMOS Gate Sizing-Fan in and Fanout Characteristics-Voltage Transfer Characteristics of CMOS Gates-Complex CMOS Gates-XOR and XNOR Gates-Multiplexer Circuits-Flip-flops and Latches-Power Consumption in CMOS Gates
Module 4: Transfer Gate And Dynamic Logic Design
Pass Transistors-Capacitive Feedthrough-Charge Sharing-CMOS Transmission Gate Logic-Multiplexers using CMOS Transfer Gates-CMOS Transmission Gate Delays-Logical effort with CMOS Transmission Gates-Domino Logic-Logical effort for Domino Gates-Limitations of Domino Gates-Dual-Rail Domino Logic
Module 5: Semiconductor Memory Design
Memory Organization-Types of Memory-Static RAM Cell Design: Static Memory Operation-Read Operation-Write Operation-Three-Transistor Dynamic Cell-One Transistor Dynamic Cell-Read Only Memories-EPROMs-E^2PROMs-Flash Memory
Module 6: Implementation Strategies For Digital IC
Full custom and semi-custom design - Standard Cell design and cell libraries - FPGA building block architectures - FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow - Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

Text Book
1. Analysis and Design of Digital Integrated Circuits,David A.Hodges,Horace G.Jackson,Resve A.Seleh,McGraw- Hill Series,2003

Reference Books
1. Weste and Haris ,CMOS VLSI Design 4e:" A circuits and systems perspective" Pearson Education India; 4 edition (2015)
2. Michael John Sebastian Smith "Application specific integrated circuits." Addison, Wesly Longman Inc., 2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. A.Pucknell, Kamran Eshraghian, ―BASIC VLSI DESIGN Third edition, Prentice Hall of India, 2007
5. 5.R.Jacob Baker, Harry W.LI., David E.Boyee, ―CMOS Circuit Design, Layout and Simulation, Prentice Hall of India, 2010.
6. Jan.M.Rabaey, AnanthaChandrakasan, Borivoje Nikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education India; Second edition 2016

18EC2020	Antennas and Propagation	L	T	P	C
		3	0	0	3

Course Objectives:
1. To understand basic terminology in an antenna.
2. To impart the knowledge of field distribution characteristics due to various types of antennas.
3. To familiarize on special antenna types and wave propagation.

Course Outcomes:
The students will be able to:

1. Examine the antenna basic parameters
2. Interpret the array factor for uniform and non-uniform arrays
3. Relate the fundamental concepts to obtain field distributions of broad band antennas
4. Infer the field characteristics of special type antennas
5. Categorize the radio wave propagation regions
6. Design and analyze various types of antennas using simulation tools

Module 1: Antenna Fundamentals
Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, Reciprocity concept, Antenna temperature, radiation integrals and auxiliary potential functions.

Module 2: Radiation from **Wire Antennas**
Radiation from Wires and Loops- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Assumed current distribution for wire antennas - Use of capacity hat and loading coil for short antennas-array antenna design using simulation tools.

Module 3: Antenna Arrays
Antenna Arrays- Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method - design using simulation tools..

Module 4: Aperture and Reflector Antennas
Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas - design using simulation tools.

Module 5: Travelling Wave Antennas
Resonant and Non resonant antennas - **Rhombic Antenna:** Analysis and design **Coupled Antennas**: Self and mutual impedence-2 and 3 element yagi antennas-Log periodic antennas-feeding and transposing of lines- design using simulation tools.

Module 6: Microstrip, Adaptive antennas and Antenna Propagation
Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas. Basic Concepts of Smart Antennas-Concept and benefits of smart antennas, fixed weight beamforming basics, Adaptive beam forming. Different modes of Radio Wave propagation used in current practice.

Text Books

1. John D Kraus and Ronalatory Marhefka "Antennas" Tata Mc Graw Hill 2002
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 2005.

Reference Books

1. R.E. Collins "Antennas and Radio wave propagation" Mc Graw Hill 1987
2. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
3. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
4. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
5. R.E. Crompton, Adaptive Antennas, John Wiley

18EC2021	Microwave and Optical communication	L 3	T 0	P 0	C 3

Course Objectives:
Students will learn

1. Waveguides and gain complete knowledge about Microwave Components.
2. Microwave tube Generators and Amplifiers, microwave measurements
3. The basic elements of optical fiber transmission link, fiberglass modes configuration s and structures

Course Outcome:
The students will be able to:

1. Recognize the operation of passive waveguide components.

2. Distinguish the limitations of existing vacuum tubes and solid state devices at microwave frequencies
3. Predict the performance of specialized microwave tubes such as klystrons, reflex klystron, magnetron and Travelling wave tube.
4. Classify microwave circuits using scattering parameters
5. Relate the characteristics of Optical Fiber components
6. Summarize optical source, Fiber and Detector operational parameters

Module 1: Microwave Passive Devices
Passive microwave devices: Coaxial Connectors and Adapters - Waveguide Choke Flanges - Matched Terminations - Short Circuit Plunger - Rectangular to circular Waveguide transition -Tuning screws - Waveguide Corners - Bends and Twists – Windows-
Module 2: Coaxial line to Waveguide Adapters - Coupling Loops and Coupling Aperture – Attenuators-Phase shifters - Waveguide Tees - E plane Tee - H plane Tee - Magic Tee - Circulators - Directional couplers - Scattering matrix derivation for all components.
Module 3: Microwave Vacuum Tube Devices
Introduction - Two cavity Klystron Amplifier – Mechanism and mode of Operation Reflex Klystron Oscillator – Mechanism and mode of Operation TWT amplifier - Principle of Operation-Magnetron Oscillator - Mechanism of Operation
Module 4: Microwave Solid State Devices and Measurement
Microwave diodes– Gunn diode – Mode of operation - TRAPAT – IMPATT – BARITT diodes - .Microwave measurement- Power, VSWR, Impedance measurement using smith chart
Module 5: Optical Communication
Overview of optical communication - Need for optical communication – Comparison with the electrical communication - Optical Fiber light guides theory: Ray theory – Mode theory. Snell'slaw – Critical angle – Acceptance angle – Numerical Aperture. Types of fibers: Step and Graded index fibers. Wave propagation in multi mode and single mode optical fibers Attenuation – dispersion.
Module 6: Optical Transmitters and Receivers
Optical sources and Transmitters: LEDs - types of LEDs – principle of operation - Laser Diodes – working principle. Optical Detectors and Receivers: Photo detectors - photodiodes - pin and Avalanche photo detectors

Text Book

1. Samuel.Y.Liao, "Microwave Devices and Circuits", Prentice Hall of India Pvt Ltd., 3rd Edition, Reprint 2011
2. 2.John Senior "optical communications" Prentice Hall India , Third Edition, 2009.

Reference Books

1. Collin. R.E, "Foundation of Microwave Engineering", McGraw-Hill, II Edition, 1992.
2. Annapurna Das, Sisir K. Das, "Microwave Engineering", Tata McGraw-Hill Co., Ltd., 1st Edition, 1999. Reprint 2001.
3. Keiser.G. "Optical Fiber Communications", McGraw Hill, 4th edition, 2010

18EC2022	Object oriented concepts using C++	L	T	P	C
		3	0	0	3

Course Objectives:
The course will
1. Introduce standard tools and techniques for software development using object oriented approach,
2. Enable the student to understand appropriate use of various concepts for specific applications.
3. Provide an appropriate framework for automated unit.

Course Outcome:
After taking the course, students will be able to:
1. Exhibit basic knowledge in object oriented programming for developing programming skills.
2. Recognize features of object-oriented design such as encapsulation, inheritance, and composition of systems based on object identity for appropriate applications.

3. Illustrate the concept of polymorphism and exceptions using object oriented approach.
4. Specify simple data types and design implementations, using functions to document them.
5. Identify the suitable data structure for the storage of data involved in the application and develop applications using various linear data structures.
6. Choose the appropriate techniques in algorithmic design strategies for real time application development.

Module 1: Objects and Classes

A Simple Class- C++ Objects as Physical Objects - C++ Objects as Data Types - Object as function argument -Constructors - - Returning Objects from functions - Structures and Classes – Array fundamentals-Initializing arrays-Multidimensional arrays-Array as function arguments-Strings-String variables-String constants-Reading Embedded blanks-Reading multiple lines

Module 2: Principles of Object Oriented Programming

Overloading Unary and Binary Operator - Data Type Conversion and its Pitfalls- Inheritance: Derived Class and Base Class - Overloading Member Functions- Public and Private Inheritance - Types of Inheritance.Pointers: Address and Pointers - Pointers and Arrays - New and Delete Operator

Module 3: Advanced Object Oriented Programming

Virtual Functions and Polymorphism - Friend Functions - Static Functions - this Pointer - Templates and Exception: Function Templates - Class Templates - Exceptions.

Module 4:File Operations

Streams and Files: Stream Classes - Stream Errors - Disk File I/O with Streams - File Pointers.

Module 5:Introduction To Data Structures

Linked List Introduction-Implementation of Linked Lists Using Arrays-Linear Linked List-Basic Operations on linear linked List-Searching-Reversing-Concatenating-Disposing on linear linked Lists-Doubly linked List- Basic Operations on Doubly Linked List- Circular Linked List- Basic Operations on Circular Linked List.

Module 6:Sorting and Searching Techniques

Sorting - Bubble Sort- Insertion Sort- Selection Sort- Quick Sort- Heap Sort- Merge Sort. Searching-Linear Search- Binary Search.

Text Books

1. Robert Lafore, "Object Oriented Programming in C++", Third Edition, Galgotia Publishers,Pune, Reprint, 2006.
2. Bronson , "C++ for Engineers and Scientists", 4th Ed. ISBN: 978-1133187844, 2013

Reference Books

1. Herbert Schildt, " C++, The Complete Reference" , Mc Graw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2002
2. Owen L. Astrachan, "Programming with C++ - A Computer Science Tapestry", Special Indian edition 2007, Tata McGraw-Hill, Second reprint, 2008.
3. Abhishek Daya Sagar,"Expert Data Structures using C/C++", BPB Publications, New Delhi 2004.
4. Al Stevens , "C++ Programming" , Wiley Dreamtech India (P) Ltd. , 7th edition, 2003.

18EC2023	Electromagnetic Waves and Waveguides	L 2	T 1	P 0	C 3

Course Objective:

1. To impart basic knowledge about static electric and magnetic fields.
2. To describe the electric and magnetic field in materials.
3. To learn the characteristics of guided waves and wave guides.

Course Outcomes:

At the end of this course, students will be able to:

1. Demonstrate an ability to apply the co-ordinate systems and are familiar with the different vector operators.
2. Formulate the electric flux density and define potential and potential gradient.
3. Describe the current and current density from ohm's law and Design the capacitance using Poisson's equations and Laplace's equations

4. Design the magnetic flux density from the Biot Savart's law and the Ampere's circuital law.
5. Differentiate the TE, TM and TEM –guided wave solutions
6. Evaluate TE and TM mode patterns of field distributions in a wave-guides

Module 1: Vector Analysis

Basic Laws of Vector Algebra, Introduction to Co-ordinate Systems, Line, Surface and Volume Integrals, Vector Calculus - Curl, Divergence, Gradient and Laplacian Operator, Stokes theorem and Divergence theorem, Problems.

Module 2: Basic Laws of Electromagnetics

Coulomb's Law and its applications, Gauss Law and its applications, Capacitance, Electrostatic energy and energy density, Point form of ohm's law, Continuity equation for current, Poisson's and Laplace's equation, Biot-Savart Law: Its applications, Ampere's circuital law: Its applications, Steady magnetic field laws. Force on a wire carrying a current, Torque, Magnetic moment, Scalar and vector magnetic potentials, Lorentz force equation, Inductance, Energy density in magnetic fields.

Module 3: Uniform Plane Wave

Propagation of wave, Wave Polarization, Wave equation, Poynting vector. Plane waves: propagation through various media; reflection and refraction; phase and group velocity; skin depth, Maxwell's equations: differential and integral forms.

Module 4: Transmission Lines

General equations, Line constants, Impedance matching**,** Standing waves and standing wave ratio on a line – VSWR measurements - impedance matching - half wave line - One eighth wave line – Quarter wave Transformer

Module 5: Guided Waves

Waves between Parallel Planes, TE Waves, TM Waves, Characteristics of TE and TM waves, TEM Waves, Velocity of Propagation, and Attenuation in parallel plane Guides, Wave impedance.

Module 6: Waveguides

Rectangular Waveguides, TM Waves, TE Waves, Impossibility of TEM waves in Waveguides, TM and TE Waves in circular waveguides, Wave impedances and Characteristic Impedances, Attenuation factor and Q of Waveguides, Circular Waveguides

Text Books

1. William H.Hayt Jr., John A.Buck, "Engineering Electro Magnetics", Tata McGraw- Hill Education India Private Limited, New Delhi, 3rd Edition, 2014.
2. E.C. Jordan and K.G.Balmain, "Electro Magnetic Waves and Radiating System", 2nd Edition, PHI Learning, New Delhi, 2011.

Reference Books

1. Joseph. A.Edminister, "Theory and Problems of Electro Magnetics", Schaum's Outline Series,
2. Tata Mc Graw- Hill Publishing Company Limited, New Delhi, Revised 2nd Edition, 2015.
3. J.D. Ryder, "Networks, Lines and Fields", 2nd Edition, PHI, New Delhi, 2011.
4. Matthew N.O. Sadiku, "Elements of Engineering Electromagnetics" Oxford University Press, 4th Edition, 2007.
5. Clayton R.Paul, Keith W.Whites, Syed A. Nasar, "Introduction to Electromagnetic Fields", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
6. David M. Pozar, "Microwave Engineering", 4th Edition, John Wiley 2013.
7. R.E. Collin, "Foundations for Microwave Engineering", McGraw-Hill, 2010.
8. David K.Cheng, "Field and Waves in Electromagnetism", New International edition, Pearson Education, 2013.

18EC2024	Internet of Things (IoT)	L 3	T 0	P 0	C 3

Course Objectives:

1. To understand the basic concepts of IoT and device connectivity.
2. To acquire Knowledge in Real time data logging and data analytics on cloud.
3. To explore the potential areas utilizing Wi-Fi enabled embedded controllers/processors in real time systems.

Course Outcomes:

The students are able to

1. Understand the basic conceptual functions of embedded systems.
2. Discuss the various hardware modules, protocols used for IoT.
3. Demonstrate real time monitoring of real time data and cloud storage.
4. Examine the architectural and pipelining feature of Arduino, ESP8266 and Raspberry PI.
5. Develop Embedded C, Python and Java script programs to develop prototype for solving societal problems.
6. Choose the flavours of scripting languages for cross platform OS.

Module 1: Introduction:

Introduction to IoT, OSI model Vs. IoT stack protocol, basics of networking- hubs, switches, routers, IoT scalability, IoT Architecture, core IoT models, IoT ecosystems.

Module 2: Communication Protocols

PAN protocols, IEEE 802.15 Bluetooth protocol, IEEE 802.15.4 security protocol, IEEE 802.11/a/b/w protocols, Zigbee protocols, LORA, IPV4, and IPV6.

Module 3: IoT with Arduino

Architecture, pin diagram, Arduino IDE, Internet connectivity with Arduino, Interacting with basic sensors-Analog, Digital, Serial communication, Configuring Arduino board for IoT, Securing online data, Monitoring sensor data from cloud platform, Interfacing with web services- Twitter, Facebook, IFTTT.

Module 4: IoT with ESP8266 and Cloud data Analytics

Choosing Esp8266 module, pin diagram, installation in Arduino IDE, connecting module with Wi-Fi network, controlling an LED, GPIO pins interfacing, grabbing content from webpage- HTTP-TCP/UDP protocol, sending notifications, sending email- SMTP protocol, creating cloud and data logging, Data analytics

Module 5: Internet of things: Raspberry Pi Approach

Preparing raspberry pi, Internal- External representation of sensor data, parsing sensor data on import, displaying measured information on webpage, Camera interfacing, CoAP protocol. Triggering event notification, MQTT protocol, Mobile device connectivity.

Module 6: Real Time IoT Applications

Agriculture, Healthcare, Smart Cities and Smart Homes, Industrial IoT, Smart Grid

Text Books

1. Perry Lea, ”Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security”, Packt Publishing Limited (22 January 2018).
2. Olivier Hersent, “The Internet of Things: Key Applications and Protocols”, Delmar publishers, Wiley (2015).

Reference Books

1. Marco Schwartz, “Internet of Things with ESP8266”, Packt Publishing Ltd, 2016.
2. Cuno Pfister , “Getting Started with the Internet of Things”, Shroff; First edition-2015.
3. Marco Schwartz, “Internet of Things with Arduino Cookbook”, Packt Publishing Limited, 2016
4. Arnold Berger, “Embedded System Design: An Introduction to Processes, Tools, and Techniques” CMP Books, 2006.
5. Andrew NSloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide, Designing and Optimizing System Software”, Morgan Kaufmann Publishers, Elsevier, 2004.

18EC2025	Machine Learning Techniques	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the concepts of machine learning algorithms
2. To understand the performance and limitations of various machine learning algorithms
3. To get familiarized with the use of neural networks in pattern recognition

Course Outcomes:

The student will be able to

1. Understand the techniques, mathematical concepts of machine learning
2. Select the appropriate machine learning algorithm to solve real time problems.
3. Compare the data and efficiently execute the algorithm to solve the problem
4. Analyze and compare the results of different machine learning algorithms
5. Comprehend the statistical techniques to analyze the results
6. Acquire knowledge about the artificial neural networks.

Module 1: Introduction to machine learning- Application of machine learning - types of learning-supervised, unsupervised, reinforcement, classification learning, representations.
Module 2: Hypothesis space, inductive bias, under fitting and over fitting, evaluation of learning algorithm, cross validation, limitations.
Module 3: Linear regression and decision tree, LMS algorithm, Delta rule, Entropy, information gain, splitting rule, model selection.
Module 4: Logistic regression, introduction to support vector machine, Dual, maximum margin with noise, non-linear SVM and kernel function, SMO algorithm.
Module 5: Neural Networks, perceptron, multilayer network, deep learning network, convolution neural network and recurrent neural network.
Module 6: Applications-machine learning for pattern recognition-biometrics-natural language processing.

Text Books

1. Ethem Alpaydin, "Introduction to machine learning", MIT Press, 2010.
2. Robert Schalkoff, "Pattern Recognition-Statistical, Structural and Neural Approaches", John Wiley & sons,Inc, New York, 2005.

Reference Books

1. David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012
2. Duda, R. O., Hart, P. E., and Stork, D. G,"Pattern Classification", 2nd edition, John Wiley & Sons, NewYork,2001.
3. Tou and Gonzales,"Pattern Recognition Principles", Wesley Publication Company, Lon-don, 1974.

18EC2026	Fundamentals of Digital Image Processing	L	T	P	C
		3	0	0	3

Course Objectives:

The student should be made to:

1. Learn digital image fundamentals.
2. Understand the image enhancement, restoration techniques.
3. Explore image segmentation techniques in practical cases

Course Outcomes:

Students will be able to

1. Understand the image fundamentals
2. Perform color image processing
3. Apply image enhancement and restoration techniques
4. Relate different image processing algorithms
5. Analyze the images in spatial and frequency domain
6. Develop the algorithms for image processing

Module 1: Digital Image Fundamentals

Elements of digital image processing systems, Vidicon and Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two- dimensional mathematical preliminaries,

Module 2: Image Enhancement
Image Enhancement Fundamental steps in Digital Image Processing – Basic Gray Level Transformations – Point processing, Histograms, Histogram Equalization & Matching –Image Subtraction & Averaging – Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters
Module 3: Image Denoising Techniques
Noise models, image denoising using linear filters, order statistics based filters and wavelet shrinkage methods, image sharpening, image super-resolution
Module 4: Color Image Enhancement
Introduction to Fourier Transform – Filtering InThe Frequency Domain - Smoothing & Sharpening Frequency Domain filters, Homomorphic filtering. Color image enhancement
Module 5: Image Restoration
Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations-spatial transformations.
Module 6: Image Segmentation
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation– Region growing – Region splitting and Merging – Segmentation by morphological watersheds – Hybrid methods

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, Inc., 2002.

Reference Books

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.
3. D,E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. Alan C. Bovik, "Handbook of image and video processing", Elsevier Academic press, 2005
5. S.Sridhar, "Digital Image processing", Oxford University press, Edition 2011

18EC2027	Biomedical Signal Processing	L 3	T 0	P 0	C 3

Course Objectives:
1. To introduce biomedical concepts that are fundamental across different applications, and captures the underlying commonalities across applications.
2. To study about signal processing and physiological signals through the application of signal processing methods to biomedical problems.
3. Provide the students with mathematical and computational tools to design their own analysis and interpretation strategies when facing different biomedical applications.

Course Outcomes:
The students will be able to:
1. Gain knowledge to outline the theoretical and practical aspects of biomedical signals.
2. Appraise and get familiarized with the bioelectric potentials.
3. Evaluate various signal processing techniques to extract the characterisitcs of biomedical signals.
4. Apply the signal processing techniques to remove the interference and artifacts of bio-medical signals.
5. Analyze the given bio medical signal for diagnosis.
6. Design and develop the processing and analysis strategies for biomedical signal applica-tions.

Module 1: Introduction to biomedical signals
The nature of biomedical signals – Examples of biomedical signals ECG, EEG, and EMG– Objectives of biomedical signal analysis – Difficulties in biomedical signal analysis – Computer-aided diagnosis

– Origin of bioelectric potentials and their Significance – Spectral analysis – Filtering methods – Correlation and estimation techniques.

Module 2: Analysis of ECG signals

ECG: Pre-processing – Wave form recognition –Morphological analysis – Rhythm analysis – Automated diagnosis based on decision theory – Evoked potential estimation – QRS detection – Detection of P-wave – Arrhythmia analysis. Baseline Wandering – Power line interference – Muscle contraction Interference – Removal of interference – Muscle noise – Removal of Arti-facts.

Module 3: Analysis of EEG signals

EEG: EEG rhythms & waveform – Categorization of EEG activity – Recording techniques – Evoked potential estimation. Evoked responses – Average techniques – Pattern recognition of EEG waves – Sleep stages and disorders – Epilepsy detection – Brain computer interface. Linear and nonlinear modelling of EEG – Artifacts in EEG – Model based spectral analysis – EEG segmentation – Joint Time-Frequency analysis – Correlation analysis of EEG channels.

Module 4: Analysis of EMG signals

The Electromyogram (EMG) – Generation of electrical changes during muscle contraction –Wave pattern studies. Recording Techniques and Applications – Amplitude and Power estimation of EMG signals – Time delay estimation in EMG signals – Modeling and decomposition of the EMG signal.

Module 5: Signal Processing Techniques

Linear prediction – Lattice - filtering – Adaptive filtering – Wavelets & time frequency models – Data compression and reduction tech-niques.

Module 6: Applications

Time frequency representation: Spectrogram – Wigner distribution – Scalogram –Feature extraction – Wavelet packets. Applications to heart sounds, faetal ECG & vesicular sound signals.

Text Books:

1. Rangaraj M. Rangayyan, "*Biomedical Signal Analysis*", 2nd Edition, John Wiley and Sons, 2015.
2. D.C.Reddy,“*Biomedical Signal Processing: Principles and techniques*”,Tata McGraw Hill, New Delhi, 2016.

Reference Books:

1. E.N. Bruce, "Biomedical Signal Processing and Signal Modelling", 2nd Edition, John Wiley and Sons, 2007.
2. K. Najarian and R. Splinter, "Biomedical Signal and Image Processing", 2nd Edition, CRC Press, 2016.
3. Willis J Tompkins, "Biomedical Signal Processing", 2nd Edition, Prentice -Hall, 1993.
4. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2006.
5. M. Akay,"Time-Frequency and Wavelets in Biomedical signal Processing", Wiley, 1998.
6. Arnon Cohen, "Bio-Medical Signal Processing, Volume I and II ",CRC Press, 1986.

18EC2028	Microprocessor and Microcontroller	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart basic knowledge about architecture of processor & controller.
2. To get familiarized with the interfaces in processors and instruction sets in controller.
3. To explore the necessity of controller in real time applications.

Course Outcomes:

At the end of the course, the student will be able to

1. Discuss the microprocessor organization and its evolution.
2. Describe the architecture of 8051 controllers.
3. Express their knowledge in designing a system using 8051
4. Differentiate controller / processor architecture and features.
5. Write processor / controller specific programs in Embedded C.
6. Simulate the real time system using integrated development environment.

Module 1: Fundamentals of Microprocessors: (6 Hours)
Fundamentals of Microprocessor Architecture. 8-bit Microprocessor and Microcontroller architecture - Comparison of 8-bit microcontrollers - 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics - Role of microcontrollers in embedded Systems. Overview of the 8051 family.
Module 2: The 8051 Architecture (8 Hours)
Internal Block Diagram - CPU - ALU - address - data and control bus - working registers - SFRs - Clock and RESET circuits - Stack and Stack Pointer - Program Counter - I/O ports - Memory Structures - Data and Program Memory - Timing diagrams and Execution Cycles.
Module 3: Instruction Set and Programming (8 Hours)
Addressing modes: Introduction - Instruction syntax - Data types - Subroutines Immediate addressing - Register addressing - Direct addressing - Indirect addressing - Relative addressing - Indexed addressing - Bit inherent addressing - bit direct addressing. 8051 Instruction set - Instruction timings. Data transfer instructions - Arithmetic instructions - Logical instructions - Branch instructions - Subroutine instructions - Bit manipulation instruction. Assembly language programs - C language programs. Assemblers and compilers. Programming and debugging tools.
Module 4: Memory and I/O Interfacing (8 Hours):
Memory and I/O expansion buses - control signals - memory wait states. Interfacing of peripheral devices such as General Purpose I/O - ADC - DAC - timers - counters - memory devices.
Module 5: External Communication Interface (8 Hours)
Synchronous and Asynchronous Communication. RS232 - SPI - I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.
Module 6: Applications (07 Hours)
LED - LCD and keyboard interfacing. Stepper motor interfacing - DC Motor interfacing - sensor interfacing.

Text Book

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “ The8051Microcontroller and Embedded Systems: Using Assembly and C” ,Pearson Education, 2007.

Reference Books

1. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2005.
2. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
3. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085” , Penram International Publishing, 1996
4. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
5. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991

18EC2029	Microprocessor and Microcontroller Laboratory	L 0	T 0	P 2	C 1

Course Objectives:
1. To enable the students to understand the programming techniques of Microprocessor.
2. To enable the students to understand the programming techniques of Microcontrollers.
3. To design suitable control application using Microcontrollers.

Course Outcomes:
After completion of the course, students will be able to
1. Understand and apply the fundamentals of assembly level programming of Microprocessor and Microcontroller.
2. Work with standard realtime interfaces of Microprocessor and Microcontroller.
3. Generate signals with Microprocessor and Microcontroller.
4. Perform timer-based operation with Microcontroller.
5. Develop a motor control with Microprocessor and Microcontroller.
6. Troubleshoot interactions between software and hardware.

List of Experiments
1. Arithmetic Operations using 8085

2. Code Conversion using 8085
3. Sorting using 8085
4. Stepper Motor Control using 8085
5. Interfacing D/A and A/D converter and wave form generation
6. Assembly Language Programming using 8051
    a. Arithmetic Operations
    b. Searching of a number
7. Embedded C programming in 8051
    a. Square wave generation using Embedded C
    b. Counter Program Using Embedded C.
8. Interfacing A/D and D/A converter with 8051
9. Interfacing keyboard and Display unit
10. Timer Programming with 8051
11. PWM signal generation with 8051
12. Stepper Motor Control with 8051

18EC2030	Digital Electronics	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce number systems, binary codes
2. To explain the basic postulates of Boolean algebra, methods for simplifying Boolean expressions
3. To explain the design procedure for combinational circuits and sequential circuits

Course Outcomes:

The students will be able to:

1. Compute The Number System Conversions.
2. Simplify The Boolean Expression Using Various Simplification Techniques.
3. Design Various Combinational Circuits
4. Design Various Sequential Circuits .
5. Implement Combinational Circuits Using Pld.
6. State And Compare Different Digital Logic Families.

Module 1: Number Systems & Boolean Algebra

Number Systems - Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive OR and Exclusive NOR .Boolean postulates and laws – De- Morgan’s Theorem Principle of Duality Boolean expression Minimization of Boolean expressions –– Minterm – Maxterm - SOP – POS- Canonical Forms.

Module 2: Simplification of logic functions & Binary Codes

Karnaugh map Minimization – Don’t care conditions – Quine Mc Cluskey method of minimization. - Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations - Multi output gate implementations. Representation of Signed Numbers -Floating point number representation Binary Codes - BCD -ASCII-EBCDIC-Excess 3 codes-Gray code-error detecting & correcting codes

Module 3: Combinational Logic Design

Implementation of Combinational Logic Functions – Half Adder and Full Adder – Half and Full subtractor – Parallel Adder/Binary Adder – Encoders & Decoders – Multiplexers & Demultiplexers – Code Converters – Comparator - Parity Generator/Checker – Implementation of Logical Functions using Multiplexers.

Module 4: Latches, Flip Flops & Synchronous Sequential Logic Design

Latches, Different types of clocking , Clock Parameters: Pulse width, setup, hold, propagation delay RS, JK, D&T flip flops – JK Master slave flip flop –Excitation tables – Basic models of sequential machines – Concept of State Table – State diagram – State Reduction through Partitioning - Implementation of Synchronous Sequential Circuits-Sequence Generator.

Module 5: Counters & Registers

Asynchronous Counters- Modulus Counters – Timing Waveforms-Counter Applications.- Synchronous Counters–Synchronous Modulus Counters- Shift Register –Johnson Counter- Ring Counter.

Module 6: Digital Logic Families:
Basic structure of PLDS: PAL-PLA-PROM Implementation of simple combinational circuits using PLDS. LOGIC FAMILIES: TTL families, Schottky Clamped TTL- Emitter Coupled (ECL)- MOS inverter- CMOS Logic Gates -Comparison of performance of various logic families.

Text Book

1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008

Reference Books

1. John F.Wakerly, "Digital Design Principles and Practices", Fourth Edition, Pearson/PHI, 2008.
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
5. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
6. Donald D.Givone, "Digital Principles and Design", TMH, 2003.

18EC2031	Digital Electronics Laboratory	L 0	T 0	P 2	C 1

Course Objectives:

1. To learn about the basic characteristics of all logic gates.
2. To design combinational circuits.
3. To design sequential circuits.
4. To design and simulate digital circuits using Verilog code.

Course Outcomes:

The students will be able to

1. Understand the basic characteristics of all logic gates.
2. Illustrate different methods for realizing logic gates using universal gates.
3. Design and verify combinational logic circuits.
4. Analyze and inspect sequential logic circuits.
5. Design digital circuits for practical applications
6. Design and test simple digital circuits using Verilog code.

Experiments: [Any 8 experiment]

1. Verification of logic gates
2. Realization of logic gates using universal gates
3. Design, implementation and verification of half adder and full adder
4. Design, implementation and verification of half subtractor and full subtractor
5. Design, implementation and verification of multiplexer and demultiplexer
6. Design, implementation and verification of code converters
7. Design, implementation and verification of encoder and decoder
8. Design, implementation and verification of magnitude comparator
9. Design, implementation and verification of flip flops
10. Design, implementation and verification of counters
11. Design, implementation and verification of shift registers
12. Design and simulation of combinational and sequential circuit using Verilog

18EC2032	Electron Devices and Circuits	L 3	T 0	P 0	C 3

Course Objectives:

1. To provide a basic introduction and an understanding of Semiconductor devices.
2. To design and analyze transistor and FET biasing circuits.
3. To know the design of amplifier and oscillator circuits.

Course Outcomes:

After completion of the course, students will be able to

1. Describe the basic properties of solid state devices like diode, transistor and FET.
2. Identify and differentiate rectifiers, amplifiers and oscillators.
3. Analyze the amplitude and frequency response of general amplifier circuits.
4. Describe the types of power amplifiers and their transfer characteristics.
5. Classify the power amplifiers to meet certain specifications.
6. Distinguish between amplifiers and oscillators.

Module 1: Theory of Semiconductor

Energy band structure of conductors, insulators and semiconductors – Comparison of Germani-um, Silicon and gallium arsenide – Electron hole generation and recombination –Intrinsic and extrinsic semiconductors – Conductivity – Temperature dependence – Hall effect – drift and dif-fusion in semiconductors.

Module 2: Theory of PN junction and BJT

PN junction -depletion region – barrier potential – diode equation – Forward and Reverse charac-teristics – Transition and diffusion capacitance. Static characteristics of transistors. Analysis of CE, CB and CC circuits – Voltage gain – Current gain – Input impedance.

Module 3: Special Semiconductor Devices (Qualitative Treatment Only)

Zener diodes – Schotky Barrier Diode – Tunnel diodes – DIAC – TRIAC – Photo diodes-Photo transistors –LCD- LED-Gunn diodes -Varactor diode.

Module 4: Design of DC Power Supply

Half wave rectifier – Full wave rectifier – ripple factors – DC and AC components in rectifiers. Full wave rectifier with Capacitor and inductor filters. Voltage regulators-Transistorized series pass regulator.

Module 4: Amplifiers

Single stage- RC coupled amplifiers- Power amplifiers: Class A, AB, B power amplifiers Push Pull amplifiers- Feedback amplifier – Differential ampliier.

Module 5: Oscillators

RC Phase shift-Hartley Oscillator-Crystal Oscillator, Colpitts Oscillator – single tuned amplifier - Double tuned amplifier.

Text Book

1. Robert Boylestad and Louis Nashelsky, “Electronic Devices & Circuit Theory”, 9th Pearson Education Edition, 2016.
2. Millman &Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 3rd Edition, 2013.

Reference Books

1. V.K.Metha,“Principles of Electronics”,Chand Publications,2015.
2. Malvino.A P, “Electronic Principles”, McGraw Hill International, 7th Edition 2016.
3. David .A .Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2010.

18EC2033	Electron Devices and Circuits Laboratory	L 0	T 0	P 2	C 1

Course Objectives:

1. To understand the characteristics semiconductor and special purpose electron devices.
2. To design rectifiers, amplifiers and regulators.
3. To understand the basic Network theorems.

Course Outcomes:

After completion of the course, students will be able to

1. Classify the basic properties and characteristics of semiconductor devices.
2. Identify, differentiate and construct the circuit of rectifiers, amplifiers and regulator.
3. Construct the experiments, as well as to analyze and interpret data
4. Analyze practically the response of various special semiconductor devices.
5. Explain the basic Network theorems.
6. Justify and simulate practical circuits using PSPICE software.

List of Experiments

1. Characteristics of PN diode and Zener diode
2. Characteristics of Shunt voltage regulator

3. Characteristics of BJT(CE Configuration)
4. Characteristics of JFET
5. Characteristics of UJT
6. Types of Clippers
7. Characteristics of Photo diode and LDR
8. Verification of Network Theorem
9. Characteristics of BJT amplifier

18EC2034	Digital Electronics and Microprocessors	L	T	P	C
		3	0	0	3

Course Objectives:
To impart knowledge on
1. The basics of logic families, Sequential and Combinational Logic circuits
2. The fundamentals of Apply the knowledge of Electrical machines in industrial applications
3. The concept of semiconductor memories and their application in microprocessor architecture

Course Outcomes:
At the end of this course, students will demonstrate the ability to
1. Recall the concepts of logic gates and tri state logic
2. Design and implement Combinational and Sequential logic circuits.
3. Outline the process of Analog to Digital conversion and Digital to Analog conversion.
4. Apply PLDs to implement the given logical problem.

Module 1: Fundamentals of Digital Systems and logic families (8Hours)
Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of ICgates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic,one’s and two’s complements arithmetic, codes, error detecting and correctingcodes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-statelogic.

Module 2: Combinational Digital Circuits (8Hours)
Standard representation for logic functions, K-map representation, simplification oflogicfunctions using K-map, minimization of logical functions. Don’t care conditions, Multiplexer,De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder,serialadder, ALU, elementary ALU design, popular MSI chips, digital comparator, paritychecker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Module 3: Sequential circuits and systems (7Hours)
A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D- type flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC’s, asynchronous sequential counters, applications of counters.

Module 4: A/D and D/A Converters (7Hours)
Digital to analog converters: weighted resistor/converter, R-2R Ladder, D/Aconverter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/Dconverter, successive approximation A/D converter, counting A/D converter, dualslopeA/Dconverter, A/Dconverter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

Module 5: Semiconductor memories and Programmable logic devices. (7Hours)
Memory organization and operation, expanding memory size, classification and characteristicsof memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

Module 6: Fundamentals of Microprocessors: (7Hours)
Basic blocks of a microcomputer, Functional block diagram of 8 bit Microprocessor, Registers, ALU, Bus Systems, Memory, Input Output Devices, Programming Concepts.

Text Books
1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. R. S. Gaonkar, ", Microprocessor Architecture: Programming and Applications with the 8085", Penram International Publishing, 1996

Reference Books
1. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. M. Rafiquzman, Fundamentals of Digital Logic and Microcomputer Design, Wiley-Interscience, 2005.
3. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The8051Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, 2007.

108EC2035	Sensors and Signal Processing	L	T	P	C
		3	0	0	3

Course Objectives:
1. The course provides knowledge on understanding the aesthetics and pre-requisites required for
2. This course helps students to understand and utilize concepts of sensors interfacing with microcontrollers
3. Required for solving societal problems.

Course Outcomes:
The students will be able to:
1. Understand the basic concepts of sensors
2. apply the interfacing techniques for designing and developing prototypes
3. Experiment and interpret the behavior of signal processing in sensors
4. identify and investigate a particular IDE to develop applications
5. visualize mechatronics case studies and simulate the same using IDE
6. integrate sensors with DSP for decision making capabilities for inspecting behavior of kinematic objects

Module 1: Introduction to Sensors
Sensor basics, sensor types, power supply requirement, Types of output signal, Measurement systems, Analog sensors, Digital Sensors.
Module 2: Sensors and Actuators
Classification, linear Actuators, Rotary Actuators, Magnetic sensors, Motors, Thermal Sensors Principle, Sensors based on Thermal measurements- Micro calorimeter, IR sensor, EM field sensor, Acceleration sensors.
Module 3: Data Acquisition for time domain and frequency domain sensors
Introduction, DAQ boards, DAQ board for smart sensors, Universal frequency to digital conversion, applications
Module 4: Microcontrollers and DSP for smart sensor systems
Introduction, MCU and DSP architectures, Structures, low power MCU, Timer modules, ADC and DAC modules for Microcontrollers, Development tools
Module 5: Actuators and Mechatronic System Design
Stepper Motor, Servo Motor, Design process, Case studies – Pick and Place robot, Car Engine management system.
Module 6: Interfacing Sensors with Microcontrollers
Choosing Microcontrollers, Development tools and IDE, Interfacing-Piezoelectric sensors, Force Pressure and Acceleration sensors, Acoustic sensors, temperature sensors, GSM, GPS - Vibration Measurement, Temperature monitoring in mechanical devices, Wheel rotation mechanism and control using PWM

Text/ Reference books:

1. Kishor Sonti V.J.K, “Mechatronics”, Pearson Education, AIRWALK PUBLICATIONS; 2 edition,2017
2. Paul P. L. Regtien, “Sensors for Mechatronics” 2nd Edition, Kindle Edition
3. R K Rajput, “A Textbook of Mechatronics”, S Chand & Company
4. G.K. Vijayaraghavan, “Mechatronics & Microprocessors”, Wiley (2009)
5. Marco Schwartz, “GSM & GPS Projects With Arduino”, Kindle Edition
6. W. Bolton, “Mechatronics: Electronic Control Systems in Mechanical”, Pearson Education; 4 edition (2010)
7. Andrea De Marcellis, “Analog Circuits and Signal Processing”, Prentice Hall, 2011
8. R Mittle, “ROBOTICS AND CONTROL”, McGraw Hill Education, 2017

18EC3001	Advanced Digital Signal Processing	L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop a fundamental understanding in the concepts of digital filter design and algorithms
2. To understand the methods of Power spectrum estimation, linear estimation and Prediction
3. To understand the concepts of multi-rate digital signal processing and adaptive filtering applicable in the areas of signal processing, control and communications.

Course Outcomes:

At the end of this course, students will be able to

1. Compute the digital filter coefficients for given specification.
2. Recognize the need for Multi-rate signal processing applicable to communication systems
3. Distinguish various types of prediction methods
4. Explore the usefulness of adaptive filters in communication systems
5. Compute the power spectrum estimation using various methods
6. Infer the relevance and significance of Signal Processing in various applications.

Module 1: Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filterdesign and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, parallel realization of IIR.

Module 2: Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub-band coding.

Module 3: Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Module 4: Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

Module 5: Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

Module 6: Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

References Books

1. J.G.Proakis and D.G. Manolakis, “Digital signal processing: Principles, Algorithm andApplications”, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets”, 1st Edition, John Wiley and Sons Ltd, 1999.

3. Bruce W. Suter, "Multirate and Wavelet Signal Processing", 1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6. D.G. Manolakis, V.K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000

18EC3002	Advanced Digital Signal Processing Laboratory	L 0	T 0	P 4	C 2

Course Objectives:

1. To gain knowledge in DSP concepts like FIR, IIR filters and FFT using software.
2. To gain skill in power spectrum estimation and filter structure realization.
3. To gain understanding in transfer function design, multirate concepts

Course Outcomes:

The students will be able to:

1. Use various transforms in time and frequency domain
2. Observe the Discrete Fourier Transform using programming software
3. Design the digital filters by applying suitable techniques using programming software
4. Solve normal equations and analyze stability of a system
5. Implement the Power spectrum estimation concepts
6. Perform decimation and interpolation

List of Experiments:

1. Correlation Auto and Cross
2. Stability Using Hurwitz Routh Criteria
3. Sampling FFT Of Input Sequence
4. Butterworth Low pass and High Pass Filter Design
5. Chebychev Type I,II Filter
6. State Space Matrix from Differential Equation
7. Normal Equation Using Levinson Durbin
8. Decimation and Interpolation Using Rationale Factors
9. Maximally Decimated Analysis DFT Filter
10. Cascade Digital IIR Filter Realization
11. Convolution and M Fold Decimation & PSD Estimator
12. Estimation Of PSD
13. Inverse Z Transform
14. Group Delay Calculation
15. Separation of T/F
16. Parallel Realization of IIR filter

18EC3003	Wireless and Mobile Communication	L 3	T 0	P 0	C 3

Course Objectives:

1. To gain knowledge in cellular communication
2. To understand spectral efficiency calculation
3. To comprehend the evolution of mobile communication technologies

Course Outcomes:

At the end of this course, students will be able to

1. Distinguish various mobile communication systems.
2. Use frequency-reuse concept in mobile communications, and to identify its effects on interference, system capacity, handoff techniques
3. Classify various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.

4. Identify path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
5. Select and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
6. Appraise upcoming technologies like 3G, 4G, etc.

Module 1: Cellular Communication Fundamentals

Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

Module 2: Spectral Efficiency Analysis Based On Calculations For Multiple Access Technologies

TDMA, FDMA and CDMA Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas Wireless network planning (Link budget and power spectrum calculations)

Module 3: Mobile Radio Propagation

Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Module 4: Equalization, Diversity

Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Module 5: Code Division Multiple Access

INTRODUCTION to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

Module 6: Higher Generation Cellular Standards

3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

Reference Books

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009. T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
3. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London,1997.

18EC3004	Optical Networks and Photonic Switching	L	T	P	C
		3	0	0	3

Course Objectives:
1. To learn various components of optical networks.
2. To understand various generation and broadcast optical networks.
3. To study the importance of Photonic Packet Switching

Course Outcomes:

After completion of the course, the students should be able to:
1. Illustrate the concept of telecom network

2. Select the components of optical networks based on their functions
3. Associate optical networks and its applications
4. Explain design of wavelength network and its test beds
5. Interpret Photonic Packet Switching and access network
6. Outline network design and management

Module 1: Introduction
Telecom Network Overview – Telecom Business Models, Roles of Three fields in Optical Networking, TE vs. NE v. NP; Wavelength-Division Multiplexing (WDM) – ITU Wavelength Grid, WDM Networking Evolution.
Module 2: WDM Network Elements
Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Line Terminals, Optical Amplifiers, Switches, Wavelength Converters – Optical Cross Connects, Optical OXC Configurations.
Module 3: Optical Network Architecutres
Introduction to Optical Networks; SONET / SDH, Metropoliton-Area Networks, Layered Architecture ; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Test beds for Broadcast & Select WDM; Wavelength Routing Architecture.
Module 4: Wavelength Network Design
The optical layer - Node Designs, Optical layer cost trade-off; A Detailed Ring Network Example; Routing and wavelength assignment - Virtual topology design, Wavelength Routing Test beds.
Module 5: Packet Switching And Optical Access Networks
Photonic Packet Switching – OTDM, Synchronisation, Broadcast OTDM networks, Switch-based networks; Optical Access Network Architectures – PON Technologies, Ethernet PON (EPON), Fiber to the Curb (FTTC).
Module 6: Network Design and Management
Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface

Reference Books

1. Rajiv Ramaswamy& Kumar N.Sivarajan, "Optical Networks: A practical perspective", Harcourt Asia Private Limited, Singapore, 2nd edition 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.
3. D.W.Smith, Ed., “Optical Network Technology”, Chapman and Hall, London, 1995.
4. Biswanath Mukherjee, "Optical Communication Networks", McGraw-Hill, 1997.
5. P.E.Green Jr, “Fiber optic network”, Prentice Hall, NJ 1993.
6. http://nptel.ac.in/courses/117101002/27, http://nptel.ac.in/courses/117101002/25 & other relevant materials from internet

18EC3005	Antennas and Radiation Systems	L 3	T 0	P 0	C 3

Course Objectives:
1. To learn the fundamental parameters of antenna radiation and its significance in antenna design for specific applications.
2. To study different types of antenna and its design methodology.
3. To understand various numerical methods in antenna design and simulation.

Course Outcomes:
At the end of this course, students will be able to
1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2. Estimate the input impedance, efficiency and ease of match for linear wire antennas.
3. Explain the array factor for an array of antennas.

4. Use aperture concept for efficient antenna design
5. Design Micro strip antennas for various desired radiation pattern characteristics.
6. Determine the desired parameters of reflector antennas for specific application.

Module 1: Types of Antennas
Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. **Fundamental Parameters of Antennas**
Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Module 2: Linear Wire Antennas
Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non-uniform current.

Module 3: Linear Arrays
Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Module 4: Aperture Antennas
Huygen’s Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Module 5: Micro strip Antennas
Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Module 6: Reflector Antennas
Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.

Reference Books

1. Constantine A. Balanis, “Antenna Theory Analysis and Design”, John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, “Antennas for All Applications”, Tata McGraw-Hill, 2002.
3. J.D. Krauss, “Antennas”, McGraw Hill, 2005.
4. I.J.Bhal and P.Bhartia, “Micro-strip antennas”, Artech house, 1980.
5. R.E. Collin, “Antennas and Radio Wave Propagation”, McGraw Hill, 1985.
6. R.C. Johnson and H. Jasik, “Antenna Engineering Handbook”, McGraw Hill, 1984.
7. Ramesh Garg, I. Bahl, ApisakIttipiboon and P. Bhartia, “Microstrip Antenna Design Handbook”, Artech house,2001
8. Hubregt.J.Visser, “Antenna Theory and applications”, John Wiley & Sons Ltd, New York, 2012.

<table>
<tr><td rowspan="2">18EC3006</td><td rowspan="2">Advanced Communication Laboratory</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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Course Objectives:
1. To study and experiment different Cellular concepts (GSM and CDMA) and various mobile communication standards.
2. To demonstrate the concepts of Software Radio in real time environment.
3. To identify the different operational modes of GPS and Satellite.

Course Outcomes:
At the end of this course, students will be able to
1. Compare the Cellular concepts, GSM and CDMA networks
2. Assess the GSM handset by experimentation and fault insertion techniques
3. Describe the 3G communication system by means of various AT commands usage in GSM
4. Explain the CDMA concept using DSSS kit
5. Develop concepts of Software Radio in real time environment
6. Identify the different modes of GPS.

List of Experiments

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.
2. Knowing GSM and CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types etc.
3. Study of GSM handset for various signalling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.
5. To study various GSM AT Commands their use and developing new application using it. Understating of 3G Communication System with features like; transmission of voice and videocalls, SMS, and TCP/IP by AT Commands in 3G network.
6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.
8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.
9. To study and analyze different measurements and applications using GPS.
10. To study and transfer data using satellite trainer kit.

18EC3007	Antenna and Radiation Systems Laboratory	L	T	P	C
		0	0	4	2

Course Objectives:

1. To design and construct different types of antenna.
2. To explore and use tools for designing, analyzing and testing antennas. These tools include Antenna design and analysis software, network analyzers, spectrum analyzers, and antenna FAB machines.

Course Outcomes:

Upon Completion of the course, Student will able to

1. Design and simulate half wave dipole for the given specification.
2. Construct and analyse monopole antenna with and without ground plane.
3. Distinguish the effect of various parameters (distance between elements and phase difference between the elements) of antenna array.
4. Recognize the designing of various Horn antennas
5. Identify various methods to design and test the Patch antennas.
6. Use the network analyser to test RF components and antennas.

List of Experiments

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference between the elements of the array on the radiation pattern of the dipole array.
9. Design and testing of Horn Antenna (E-Plane and H-plane).
10. Design of Rectangular and Circular Patch Antenna.
11. Design of Impedance matching and Transformer network.

12. Design and testing of Microwave Active and passive Components.

18EC3008	Advanced Communication Networks Laboratory	L 0	T 0	P 4	C 2

Course Objectives:

1. To know the different functions/commands used in networking.
2. To learn about TCP Client-server communication model
3. To program different routing algorithms and able to analyze their characteristics

Course Outcomes:

At the end of this course, students will be able to

1. Identify the different types of networking commands and Network Configuration Files.
2. Demonstrate client-server communication model
3. Implement the different wireless networking routing protocols.
4. Implement different topologies used in network.
5. Compare various wired networking protocols using LAN trainer kit
6. Develop socket programming

List of Experiments

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
   a. Configuring NIC's IP Address.
   b. Determining IP Address and MAC Address using if-config command.
   c. Changing IP Address using if-config.
   d. Static IP Address and Configuration by Editing.
   e. Determining IP Address using DHCP.
   f. Configuring Hostname in /etc/hosts file.
3. Design TCP for Client and Server application to reverse the given input sentence to convert a given text into upper case
4. Design UDP Client Server to transfer a file.
5. Creating Ring topology using NS2.
6. TCP Congestion Control analysis using NS2
7. Performance evaluation of AODV and DSDV routing protocols in ad-hoc networks using NS2
8. Wireless LAN protocols. To create scenario and study the performance of network with CSMA/CA protocol and compare with CSMA/CD protocols.
9. Comparative study of distance- vector and link-state routing protocol using LAN trainer kit
10. File Transfer using Sockets (LAN trainer kit)

18EC3009	DSP Architecture	L 3	T 0	P 0	C 3

Course Objectives:

1. To study the fundamentals of Programmable DSPs.
2. To impart knowledge on the System Architecture of DSP Processors.
3. To develop a fundamental understanding in the advanced DSP architectures and some applications

Course Outcomes:

The students will be able to:

1. Identify and formalize architectural level characterization of P-DSP hardware
2. Distinguish the structural and architectural considerations for various DSP families.
3. Design, program (assembly and C), and test code using Code Composer Studio environment
4. Explain major areas and challenges in DSP based embedded systems.
5. Recognize the Limitations of P-DSPs in algorithm design for real-time DSP implementation.
6. Select DSP hardware for Control, Audio and Video Signal processing applications.

Module 1: Programmable DSP Hardware
Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating-Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.
Module 2: Structural and Architectural Considerations
Parallelism in DSP processing, Texas Instruments TMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family,TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.
Module 3: VLIW Architecture
Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.
Module 4: Multi-core DSPs
Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming – OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).
Module 5: FPGA based DSP Systems
Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.
Module 6: High Performance Computing using P-DSP
Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

Reference Books

1. B.Venkataramani and M.Bhaskar,” Digital Signal Processor, Architecture, Programming and Applications”,2nd Edition, McGraw- Hill,2010.
2. RulphChassaing, “Digital Signal Processing and applications with the C6713 and C6416 DSK”, John Wiley & sons,2005.
3. 1.M. Sasikumar, D. Shikhare, Ravi Prakash, “Introduction to Parallel Processing”, 1st Edition, PHI, 2006.
4. 2.Fayez Gebali, “Algorithms and Parallel Computing”,1st Edition, John Wiley & Sons, 2011
5. 3.Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,“Parallel Programming in OpenMP”, 1st Edition, Morgan Kaufman,2000.
6. 4.Ann Melnichuk,Long Talk, “Multicore Embedded systems”, 1st Edition, CRC Press,2010.
7. 5.Wayne Wolf, “High Performance Embedded Computing: Architectures, Applications and Methodologies”, 1st Edition, Morgan Kaufman, 2006.
8. S.Srinivasan and Avtar Singh, “Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X”, Brooks/Cole, 2004
9. S.M. Kuo and B.H.Lee,”Real-Time Digital Signal Processing, Implementations, Applications and Experiments with the TMS320C55X”, John Wiley, 2001.

18EC3010	Global Positioning System	L 3	T 0	P 0	C 3

Course Objectives:
1. To introduce different Global Positioning Systems
2. To understand types of signals used in the GPS and accuracy limits
3. Latest versions of GPS and its application

Course Outcomes:

After completion of the course, students will be able to

1. Develop a strong foundation in calculating the User position.
2. Explain GPS satellite constellation and its segments
3. Discuss and compute GPS signal characteristics
4. Classify various errors occurring in GPS and working of Global positioning receivers.
5. Categorize latest variant Differential GPS receivers
6. Illustrate different GPS applications

Module 1: Introduction

GPS and GLONASS Overview - Satellite Navigation -Time and GPS - User position and velocity calculations.

Module 2: GPS Satellite Constellation and Segments

GPS - Satellite Constellation - Operation Segment - User receiving Equipment -Space Segment Phased development

Module 3: Signal Characteristics

GPS signal components - purpose, properties and power level - signal acquisition and tracking - Navigation information extraction – pseudo range estimation - frequency estimation – GPS satellite position calculation

Module 4: GPS Receivers & Data Errors

Receiver Architecture - receiver design options - Antenna design - SA errors - propagation errors- Methods of multipath mitigation - Ephemeris data errors - clock errors

Module 5: Differential GPS

Introduction - LADGPS - WADGPS, Wide Area Augmentation systems - GEO Uplink subsystem - GEO downlink systems - Geo Orbit determination - Geometric analysis – covariance analysis - GPS /INS Integration Architectures

Module 6: GPS Applications

GPS in surveying, Mapping and Navigation - Precision approach Aircraft landing system – Military and Space application - Intelligent transportation system

Reference Books

1. MohinderS.Grewal, Lawrence R.Weill, Angus P.Andrews, “Global Positioning Systems Inertial Navigation and Integration”, John Wiley& sons, 2nd Edition 2007.
2. Elliott D. Kaplan, Christopher J. Hegarty, "Understanding GPS– Principles and Applications", Artech House, 2nd Edition 2006.
3. G. S. Rao, “Global Navigation Satellite Systems”, Tata McGraw-Hill publications, New Delhi, 2010.
4. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, "GPS – Theory and Practice”,Springer – Verlag Wien GmbH, New York ,2001.
5. James Bao – Yen Tsui, ‘Fundamentals of Global Positioning receivers – A software approach’, John Wiley & Sons, 2nd Edition 2005.

18EC3011	Computational Intelligence and Optimization Techniques	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the key aspects of Artificial Neural Networks
2. To analyze the various modules of Fuzzy logic and Genetic algorithm
3. To gain insight on Neuro Fuzzy modeling and support vector machines

Course Outcomes:

The students will be able to

1. Explain the principles of neural networks
2. Develop hybrid artificial neural networks
3. Frame fuzzy logic based expert systems
4. Determine the performances of hybrid neuro fuzzy algorithms
5. Distinguish the various evolutionary computation algorithms

6. Solve practical problems using intelligence techniques

Module 1: Principles of Artificial Neural Networks:
Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Potential Applications of ANN. Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.
Module 2: Supervised and Unsupervised Neural Networks:
Perceptron, Back Propagation neural network, Hopfield neural network, Kohonen neural network, Bidirectional Associative Memories, Radial basis function neural network, Counter propagation neural network, Adaptive Resonance Theory neural networks, Introduction to deep learning neural networks.
Module 3: Principles of Fuzzy Logic Theory:
Introduction to classical sets – properties, operations and relations; Fuzzy sets - Operations, properties and relations, Membership functions, Defuzzification methods, Extension principle, Approximate Reasoning, Rule based systems, Fuzzy Associative Memories(FAMs), Fuzzy inference systems, Fuzzy decision making, Fuzzy logic control.
Module 4: Neuro Fuzzy Systems:
ANFIS – Architecture and training algorithm, CANFIS, Rule based structure identification, Classification and Regression tree algorithm, Fuzzy inference systems, Fuzzy C-means algorithm, k-means algorithm, mountain clustering, subtractive clustering.
Module 5: Evolutionary Computation Algorithms:
Genetic Algorithm, Particle Swarm Optimization algorithm, Ant Colony Optimization algorithm, ABC algorithm, Gray Wolf optimization algorithm.
Module 6: Applications:
ANN for medical image analysis, Fuzzy systems for pattern recognition, Signal denoising using ANFIS and Feature selection using optimization techniques

Text Books
1. LaureneFausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Fourth edition, Pearson Education India, 2006.
2. Timothy J Ross, "Fuzzy logic with engineering applications", John Wiley & Sons, Third Edition, 2010.

Reference Books
1. J.S.R.Jang, C.T. Sun and E.Mizutani, "NeuroFuzzy and Soft Computing", PHI / Pearson Education, Third edition, 2004.
2. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.
3. Mohamad Hasoun, "Fundamentals of artificial neural networks", MIT Press, 2003.
4. A E Eiben and J E Smith, "Introduction to evolutionary computing" Springer, 2nd edition, 2015

18EC3012	Data Compression Techniques	L	T	P	C
		3	0	0	3

Course Objectives:
1. To explore the special features and representations of different data types.
2. To analyze different compression techniques for text data and audio signals
3. To analyze various compression techniques for image and video signals

Course Outcomes:
The students will be able to
1. Distinguish the pros and cons of lossy and lossless compression techniques.
2. Discriminate the compression algorithms of text data
3. Develop hybrid compression algorithms for audio data
4. Formulate methodologies for image compression approaches

5. Determine the performances of video compression algorithms
6. Solve practical problems using the coding techniques

Module 1: Introduction
Special features of Multimedia -Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications Need for Compression - Taxonomy of compression techniques - Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies
Module 2: Text Compression Techniques
Dictionary Techniques – Shannon Fano coding techniques - Huffmann coding – Adaptive Huffmann Coding – Variations of Huffman coding - Arithmetic coding and decoding– LZ77 algorithm – LZ78 algorithm – LZW algorithm.
Module 3: Audio Compression Techniques
μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic subband coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Channel vocoders - Formant vocoders - CELP Vocoders.
Module 4: Image Compression Techniques
Image formats - Transform Coding – JPEG Standard – Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG, JBIG2 Standards.
Module 5: Video Compression
Video compression techniques and standards – MPEG Video Coding - Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.
Module 6: Applications
Role of compression in Natural Language Processing (NLP), Satellite image compression, Compression techniques for object tracking in digital videos and speech signal compression.

Text Books

1. Khalid Sayood, " Introduction to Data Compression", Morgan Kauffman Harcourt India, 5th Edition, 2017.
2. David Salomon, "Data Compression – The Complete Reference", Springer Verlag, 4th Edition, 2007.

Reference Books

1. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering - Fundamentals, Al-gorithms& Standards", CRC press, 2003.
2. Peter Symes, "Digital Video Compression", McGraw Hill, 2004.
3. Mark S.Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, 2003.

18EC3013	Advanced Digital Image Processing	L	T	P	C
		3	0	0	3

Course Objectives:
1. To understand the image fundamentals and mathematical transforms necessary for image processing
2. To understand image analysis to extract features of interest.
3. To comprehend the concepts of image registration and image fusion

Course Outcomes:
Upon completion of the course, student will be able to
1. Explain the basic concepts of image formation and representation
2. Design techniques for enhancing the quality of the images
3. Frame morphology-based methodologies for image segmentation.
4. Assess the performances of various image registration approaches
5. Differentiate the concepts of 2D and 3D image processing approaches
6. Solve practical problems using image processing techniques

Module 1: Image Processing Fundamentals
Fundamentals: Definition and Applications, steps in Digital Image Processing, Visual perception and structure of Human eye, Digital Image representation, Spatial and intensity resolution.
Module 2: Image Enhancement
Image enhancement in spatial domain, Spatial filtering, 2D image transforms: DFT and its property, Cosine and sine transform, Hadamard and Haar transform, Image enhancement in frequency domain.
Module 3: Morphological Processing
Morphological image processing, Erosion and Dilation, Opening and Closing, Edge detection and model, Active contour, Texture.
Module 4: Registration
Wavelet based Segmentation, Localized feature extraction shape, boundary, Moments and Texture descriptors, Registration –basics, Transformation functions, Resampling, Image fusion – pixel, Multiresolution and region-based fusion
Module 5: 3D Image Processing
3D image visualization, 3D Data sets, Volumetric display, Stereo Viewing, Ray tracing, Image processing in 3D, Measurements on 3D images.
Module 6: Applications
Abnormality detection in medical images, Scene understanding in natural images, Virtual reality for image processing applications and Object detection in SAR images.

Text Books

1. John C.Russ, "The Image Processing Handbook", CRC Press,2007.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 2008.

Reference Books

1. ArdeshirGoshtasby, "2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications", John Wiley and Sons,2005.
2. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, Inc., Second Edition, 2004.
3. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education,Inc., 2002.
4. Rick S.Blum, Zheng Liu,"Multisensor image fusion and its Applications", Taylor and Francis, 2006.

18EC3014	Pattern Recognition and Machine Learning	L 3	T 0	P 0	C 3

Course Objectives:
1. To learn the basics of pattern recognition and machine learning
2. To learn the classifier used in different pattern recognition applications.
3. To know the concept of unsupervised learning and clustering

Course Outcomes:
At the end of this course, students will be able to
1. Explain the basics of pattern recognition and machine learning
2. Illustrate the linear models for classification
3. Select the neural network for classification
4. Summarize the concept of linear discriminant function.
5. Design algorithm independent machine learning
6. Develop unsupervised learning techniques and clustering.

Module 1: Introduction To Pattern Recognition
Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error analysis
Module 2: Linear Models
Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

Module 3: Neural Network
Neural Network: perceptron, multi-layer perceptron, backpropagation algorithm, error surfaces, practical techniques for improving backpropagation, additional networks and training methods, Adaboost, Deep Learning
Module 4: Linear Discriminant Functions
Linear discriminant functions - decision surfaces, two-category, multi-category, minimum-squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine
Module 5: Algorithm Independent Machine Learning
Algorithm independent machine learning – lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers
Module 6: Unsupervised Learning And Clustering
Unsupervised learning and clustering – k-means clustering, fuzzy k-means clustering, hierarchical clustering

Reference Books

1. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition John Wiley & Sons, 2001.
2. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, “The Elements of Statistical Learning”, 2nd Edition, Springer, 2009.
3. C. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

18EC3015	MIMO Systems	L	T	P	C
		3	0	0	3

Course Objectives:
1. To introduce the concepts of multi-antenna communication systems.
2. To understand the transmit and receive diversity techniques in MIMO communication.
3. To analyze MIMO multi user communications.

Course Outcomes:
At the end of this course, students will be able to
1. Demonstrate mathematical modeling and analysis of MIMO systems.
2. Explain channel modeling and propagation, MIMO Capacity, space-time coding techniques.
3. Design and Distinguish code book based MIMO beamforming.
4. Distinguish the principle behind MIMO receivers Vs MIMO for multi-carrier systems (e.g. MIMO-OFDM).
5. Illustrate the significance of multi-user MIMO communications.
6. Compare and contrast various types of Channel estimation techniques in MIMO communications.

Module 1: **Introduction to Multi-antenna Systems**
Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.
Module 2: Diversity
Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation
Module 3: MIMO
The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Pre-distortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of pre-coding and combining, Channel state information.
Module 4: Beamforming
Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer

Module 5: Case study

MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity-based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models

Module 6: Channel Estimation

Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

Reference Books

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.
3. Andreas Goldsmith, Wireless Communications, Cambridge University Press 2007
4. Arogyaswamipaulraj, Rohit Nabar and Dhanajay Gore, Introduction to space time wireless Communications, Cambridge University Press 2007
5. E. Biglieri, A. Constantinides, R. Calderbank, A. Goldsmith, A. Paulraj and V. Poor. Introduction to MIMO Wireless, Cambridge Univ. Press, Nov. 2006, Reprinted Japanese Ed. 2008

18EC3016	Modern Digital Communication Techniques	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the various digital communication concepts like coherent and noncoherent- band limited channels
2. To analyze block coded and convolution code and spread spectrum signals.

Course Outcomes:

1. Classify various coherent and non-coherent digital communication techniques.
2. Explain the significance of bandlimited channels
3. Compare various digital modulation techniques
4. Select block codes for digital communication
5. Use suitable convolution code
6. Illustrate spread spectrum signals

Module 1: Coherent and Non-Coherent Communication

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation –Noncoherent receivers in random phase channels; M-FSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; MPSK;M-DPSK--BER Performance Analysis.

Module 2: Bandlimited Channels

Band Limited Channels- ISI – Nyquist Criterion Eye pattern; demodulation in the presence of ISI and AWGN; Equalization techniques, Equalization algorithms

Module 3: Digital Modulations

IQ modulations; QPSK; QAM; QBOM; -BER Performance Analysis. – Continuous phase modulation; CPFM, CPFSK,MSK-OFDM. Matched filter

Module 4: Block Coded Digital Communication

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon’s channel coding theorem; Channel capacity theorem - Coded BPSK and DPSK demodulators – Linear block codes; Hamming-Cyclic codes- Golay codes- Cyclic BCH - Reed – Solomon codes.

Module 5: Convolutional Coded Digital Communication
Representation of codes using Polynomial-State diagram- Tree diagram- and Trellis diagram – Decoding techniques Maximum likelihood- Viterbi algorithm- Sequential decoding; Turbo Coding- BCJR algorithm.
Module 6: Spread Spectrum Signals for Digital Communication
Model of spread Spectrum Digital Communication System-Direct Sequence Spread Spectrum Signals- Error rate performance of the coder- Generation of PN Sequences and its properties - Frequency Hopped Spread Spectrum Signals- Performance of FH Spread Spectrum Signals in an AWGN Channel-Synchronization of Spread Spectrum Systems.

Reference Books

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, "Digital communication techniques; Signaling and detection; Prentice Hall India, New Delhi, 1995.
2. BernadSklar, "Digital Communication – Fundamentals and Applications", Pearson Education, India, 2001.
3. Simon Haykin, "Digital communications", John Wiley and sons, 1998
4. B.P.Lathi, "Modern digital and analog communication systems", 3rd Edition, OxfordUniversity press, 1998.
5. John G. Proakis, "Digital Communications" 4th Edition, McGraw-Hill, New York,2003.

18EC3017	Communication Network Routing Algorithms	L	T	P	C
		3	0	0	3

Course Objectives:
1. To create in-depth awareness of packet routing in computer communication networks.
2. To provide comprehensive details of routing algorithms, protocols and architectures of routers followed by the concepts of MPLS towards the next generation routing.
3. Introduction to Next Generation Routing

Course outcomes:
At the end of this course the student will be able to
1. Interpret the fundamentals and requirements for routing in computer communication networks.
2. Determine the routing protocol for any level of complex network design.
3. Examine different IP routing protocols and distance vector protocols configured in real routers along with the framework of the concerned routing algorithms.
4. 4 Compare the performance of OSPF and EGB protocols in the routing platform.
5. 5 Illustrate the internal architecture of routers.
6. Formulate new strategies towards next generation routing and in the domain of wireless networking.

Module 1: Networking and Network Routing: An Introduction
Addressing and Internet Service: An Overview, Network Routing: An Overview, IP Addressing, On Architectures, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology Architecture
Module 3: Routing Algorithms
Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra's Algorithm, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, k-Shortest Paths Algorithm.
Module 3: IP Routing and Distance Vector Protocol Family
Routers, Networks, and Routing Information: Some Basics, Static Routes, Routing Information Protocol Version 1 (RIPv1), Routing Information Protocol Version 2 (RIPv2), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution
Module 4: OSPF and BGP protocols
OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS: Key Features, Similarities and Differences Between IS-IS and OSPF **BGP:** A Brief

Overview, Basic Terminology, BGP Operations: Message Operations, BGP Timers, BGP Configuration Initialization, Two Faces of BGP: External BGP and Internal BGP, Path Attributes, BGP Decision Process.

Module 5: Towards Next Generation Routing: QoS Routing, MPLS and GMPLS
Background of QoS and QoS Routing, QoS Attributes, Traffic Engineering Extension to Routing Protocols, Multiprotocol Label Switching (MPLS), Generalized MPLS, MPLS Virtual Private Networks

Module 6: Router Architectures and Routing in Ad hoc Network
Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures

Routing in Ad hoc Network:
Introduction to Ad hoc Networks – Features/ Characteristics, Types and Applications, Limitations, Advantages and Disadvantages, Classification of Routing Protocols in Ad hoc Networks – Proactive Routing Protocols (DSDV, OLSR), Reactive Routing Protocols (DSR, AODV), Hybrid Routing Protocols (ZRP)

Reference Books

1. Deepankar Medhi, Kartikeyan Ramasamy , "Network Routing – Algorithms, Protocols, Architecture", Morgan Kauffman Series Publication 2010
2. Subir Kumar Sarkar, T G Basavaraju and C Puttamadappa, "Ad Hoc Mobile Wireless Networks – Principles, Protocols and Applications", Auerbach publications , 2nd edition, 2016
3. Dharma Prakash Agrawal and Carlos De Morais Cordeiro, "Adhoc and Sensor Networks – Theory and Applications", World Scientific publication, 2nd edition , 2011

18EC3018	Satellite Communication	L	T	P	C
		3	0	0	3

Course Objectives:
1. To gain knowledge on satellite system architecture
2. To acquire skills to solve numerical problems related to link budget
3. To get understanding of various subsystems of satellite communication

Course Outcomes:
At the end of this course, students will be able to
1. Explain the architecture of satellite systems as a means of high speed, high range communication system.
2. Interpret orbital equations
3. Illustrate sub-systems in a satellite
4. Examine typical phenomenon in satellite communication
5. Calculate link budget
6. Select suitable modulation and multiple access schemes and compare few communication satellites

Module 1: Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.
Module 2: Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.
Module 3: Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.
Module 4: Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Module 5: Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.
Module 6: Modulation and Multiple Access Schemes used in satellite communication, Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.

Reference Books

1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition,2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.
3. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
4. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

18EC3019	Wireless Sensor Networks	L	T	P	C
		3	0	0	3

Course Objectives:
1. To introduce the basic concepts of Sensor Networks.
2. To introduce the overview of communication Protocols
3. To introduce the Energy management and Security.

Course Outcomes:
At the end of this course, students will be able to
1. Design wireless sensor network system for different applications under consideration.
2. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3. Understand radio standards and communication protocols to be used for wireless sensor network-based systems and application.
4. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5. Handle special issues related to sensors like energy conservation and security challenges.
6. Students will be able to understand the concepts of sensor networks, applications and different types of protocols in WSN.

Module 1: Basics Concepts about Sensor Networks
Introduction –Difference between sensor networks and traditional networks- Functional architecture of sensor networks—Individual components of WSN-Sensor network node--Applications-Habitat monitoring-Tracking chemical plumps- Smart transportation.
Module 2: Hardware (Nodes)
mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.
Module 3: Communication Protocols
Time synchronization protocols-Transport Layer protocol Network layer protocol-Data link protocol-medium access control-The S-MAC protocol IEEE 802.15.4 standard and Zigbee - Error Control
Module 4: Tracking Technologies
Tracking scenario –Problem formulation –Sensing model-Fundamentals-ToA, TDoA, and AoA Positioning by signal strength-positioning and location tracking algorithms-Trilateration-Multilateration-Pattern matching-Nearest neighbor algorithms - probability based algorithms location tracking-network based tracking
Module 5: Sensor Network Data Bases
Sensor data base challenges- Querying the physical environment-High level data base organization-Data aggregation-types of aggregation-Packet level aggregation-total aggregation-Geographic aggregation-selection of the best aggregation points-Problem with high data rate.
Module 6: Energy Management and Security
Idle power management-Active power management-Design challenges in energy efficient medium access control –IEEE 802.11-operation-powersaving mode –merits-drawback simplications in

WSN.Blue tooth –operation-Merits implications.Security: Security architecture-Cell based WSNs-Privacy of local information.

Reference Books

1. Mohammad Ilyas and Imad Mahgoub, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems” CRC Press, 2009.
2. Feng Zhao, Leonidas J. Guibas, “Wireless Sensor Networks: An Information Processing Approach” Morgan Kaufmann Publishers, 2004.
3. Michel Banatre, Pedro Jose Marron, Anibal Ollero and Adam Wolisz, “Cooperating Embedded Systems and Wireless Sensor Networks”, ISTE Ltd,2008.
4. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India, 2012.
5. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
6. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.

18EC3020	Software Defined Radio	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce software-defined radios architectures and the systems required by the SDR to function.
2. To understand how analog and digital technologies are used for software-defined radio.
3. To understand the basics of designing antenna systems to accommodate the needs of SDR.

Course Outcomes:

After completion of the course, students will be able to

1. Reconstruct the Software defined radio architectures.
2. Point out the purpose of analog RF components
3. Express the Trade-offs in using the hardware and development methods
4. Describe Digital Generation of Signals for system-level decisions
5. Appraise the ADC and DAC conversion for embedded wireless systems
6. Implement different Smart Antenna Algorithms of SDR

Module 1: Introduction to software defined radio

SDR system overview; classes of software radios; historical trends, Characteristics and Benefits of a Software Radio, Design Principles of a Software Radio, Basic components of software defined radios, Software defined radio architectures

Module 2: Radio Frequency Implementation Issues

The Purpose of the RF Front-End, Dynamic Range: The Principal Challenge of Receiver Design, RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Importance of the Components to Overall Performance, Transmitter Architectures and their Issues, Noise and Distortion in the RF Chain, ADC and DAC Distortion

Module 3: Digital Hardware Choices

Introduction, Key Hardware Elements, DSP Processors, FPGA, Trade-offs in using DSPs FPGAs and ASICs, Power Management Issues, Combinations of DSPs, FPGAs and ASICs

Module 4: Digital Generation of Signals

Introduction, Comparison of Direct Digital Synthesis with Analog Signal Synthesis, Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Bandpass Signal Generation, Performance of Direct Digital Synthesis Systems, Hybrid DDS-PLL Systems, Applications of direct Digital Synthesis, ROM compression Techniques, Sine-Phase Difference algorithm approach

Module 5: Analog to digital and digital to analog conversion

Parameters of ideal data converters, Parameters of practical data converters, Techniques to improve data converter performance, Common ADC and DAC architectures

Module 6: Smart Antennas
Introduction, Vector Channel Modeling, Benefits of Smart Antennas, Structure for Beam Forming Systems, Smart Antenna Algorithms, Diversity and Space time Adaptive signal Processing, Algorithms for Transmit STAP, Hardware Implementation of Smart Antenna

Reference Books

1. Jeffrey H. Reed, "Software-Defined Radio", Prentice-Hall, 2002
2. Joseph Mitola, "Software Radio Architecture: Object-Oriented Approaches to Wireless Systems Engineering", Wiley-Interscience; 1st edition 2000.
3. C. Richard Johnson Jr., William A. Sethares,"Telecommunication Breakdown: Concepts of Communication Transmitted via Software-Defined Radio", Pearson Prentice Hall, 2004.
4. Jeffrey H. Reed," Software Radio: A Modern Approach to Radio Engineering" Pearson Education, 2002.
5. Wyglinski, Alexander M. Nekovee, Maziar, Hou, Y. Thomas, "Cognitive Radio Networks", Elsevier, 2010.
6. K. Fazel, S. Kaiser, "Multi-carrier and Spread Spectrum Systems", John Wiley and Sons, Ltd. Publication, 2010.
7. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, “Software Defined Radio”, John Wiley, 2003.
8. Huseyin Arslan, “Cognitive Radio, SDR and Adaptive System”, Springer, 2007.

18EC3021	High Performance Networks	L	T	P	C
		3	0	0	3

Course Objectives:
1. Study of internet protocols
2. Network security and example security systems
3. Network management and its protocols

Course Outcomes:
At the end of this course, students will be able to
1. Identify various type of networks and the protocols used for various applications
2. Explain VoIP system function and its applications
3. Outline the functioning of VPN
4. Apply different traffic modeling techniques to evaluate the network performance
5. Recognize the required security techniques used in different layer of communication
6. Illustrate various infrastructure framework for network management

Module 1: Network design and services
Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

Module 2: Voice over Internet Protocol
VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks. Providing IP quality of service for voice, signaling protocols for VoIP, PSTN gateways, VoIP applications.

Module 3: Virtual Private Networks
VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS-operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Module 4: Traffic Modeling
Little’s theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.

Module 5: Network Security
Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.

Module 6: Network Management
Infrastructure for network management, The internet standard management framework – SMI, MIB, SNMP, Security and administration, ASN.1.

Reference Books

1. Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993.
2. Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
3. Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
4. Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
5. Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
6. Leon Garcia, Widjaja, "Communication networks", TMH 7threprint 2002.
7. William Stalling, "Network security, essentials", Pearson education Asia publication, 4th Edition, 2011.

18EC3022	Cognitive Radio	L 3	T 0	P 0	C 3

Course Objectives:
1. To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
2. To enable the student to understand the essential functionalities and requirements in dynamic spectrum access.
3. To expose the student to the evolving next generation wireless networks and their associated challenges.

Course Outcomes:
At the end of this course, students will be able to
1. Discuss the fundamental concepts of cognitive radio networks.
2. Formulate different spectrum sensing techniques in cognitive radio for spectrum holes detection.
3. Explain different optimization techniques for better spectrum exploitation.
4. Examine fundamental issues regarding dynamic spectrum access and the radio-resource management.
5. Point-out different spectrum trading techniques used in dynamic spectrum access.
6. Determine the associated challenges in cognitive radio network.

Module 1: Introduction to Cognitive Radios
Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Module 2: Spectrum Sensing
Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Module 3: Optimization Techniques of Dynamic Spectrum Allocation
Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Module 4: Dynamic Spectrum Access and Management
Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

Module 5: Spectrum Trading
Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Module 6: Research Challenges in Cognitive Radio
Network layer and transport layer issues, cross layer design for cognitive radio networks.

Reference Books

1. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
3. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
4. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
6. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

18EC3023	Statistical Information Processing	L	T	P	C
		3	0	0	3

Course Objectives:
1. To introduce advanced techniques in statistical information processing with applications in the domain of telecommunication systems.
2. To acquire skills for applying theory of information methods, adaptative modulation and channel coding as well.
3. to provide a broad and coherent treatment of statistical signal processing concepts, techniques and algorithms, namely for discrete-time signal modeling, optimum estimation and filtering, and power spectrum estimation.

Course Outcomes:
At the end of this course, students will be able to
1. Explain the principles of random variables and random process
2. Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
3. Demonstrate mathematical modelling and problem solving using such models.
4. Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
5. Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.
6. To use statistical information processing for few applications

Module 1: Review of random variables
Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables.
Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.
Module 2: Random signal modeling
MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications,Linear System with random input, Forward and Backward Predictions, Levinson Durbin Algorithm.
Module 3: Statistical Decision Theory
Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing.
Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test,Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate , Multiple Parameter Estimation Best Linear Unbiased Estimator ,Least-Square Estimation Recursive Least-Square Estimator.

Module 4: Spectral analysis
Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.
Module 5: Information Theory and Source Coding
Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.
Module 6: Application of Information Theory
Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements ,Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes,& Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

Reference Books

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes",4th Edition, McGraw-Hill, 2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
3. Mourad Barkat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
4. R G. Gallager, "Information theory and reliable communication", Wiley, 1st edition, 1968. F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland, 1977.
5. Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

18EC3024	Advanced Communication Networks	L	T	P	C
		3	0	0	3

Course Objectives:
1. To develop understanding of some fundamental techniques used to model communication networks.
2. Analyze the various advanced networks.
3. Design and simulate innovative networks and topologies.

Course Outcomes:
At the end of this course, students will be able to
1. Illustrate the flow control and congestion control in Transmission control protocol
2. Demonstrate the challenges in packet classification and scheduling algorithm
3. Develop a framework based on IP network
4. Design and develop protocols for Communication Networks.
5. Understand the mechanisms in Quality of Service in networking.
6. Optimize the network design.

Module 1: Overview of Internet
Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.
Module 2: Real Time Communications over Internet
Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.
Module 3: Packet Scheduling
Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay

bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

Module 4: IP address lookup-challenges

Packet classification algorithms and Flow Identification Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Module 5: Admission control and differentiated services

Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.

Module 6: IP switching and MPLS

Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

Reference Books

1. Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag, 2001.
3. Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.
4. Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" , Morgan Kaufman Publishers, 2004.
5. George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005.

18EC3025	RF and Microwave Circuit Design	L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop high levels of technical competence in the field RF and Microwave circuit design
2. Be able to apply problem solving approaches to work challenges and make decisions using sound engineering methodologies
3. Fluent application of engineering techniques, tools and resources

Course Outcomes:

At the end of this course, students will be able to

1. Understand the behaviour of RF passive components and model active components.
2. Perform transmission line analysis.
3. Demonstrate use of Smith Chart for high frequency circuit design.
4. Justify the choice/selection of components from the design aspects.
5. Design and simulate microwave circuits
6. Select suitable measurement methodologies to characterize and verify the performance of RF and microwave circuits

Module 1: Transmission Line Theory

Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Module 2: Microwave Network Analysis

Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

Module 3: Microwave Components

Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

Module 4: Nonlinearity and Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

Module 5: Microwave Semiconductor Devices and Modeling

PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Module 6: Amplifiers Design
Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.

Reference Books

1. Matthew M. Radmanesh, “Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design”, AuthorHouse, 2009.
2. D.M.Pozar, “ Microwave engineering” ,Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, “R. F. Circuit Design”, Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, “Microwave Circuit Design Using Linear and Non Linear Techniques”, John Wiley 1990.
5. S.Y. Liao, “Microwave circuit Analysis and Amplifier Design”, Prentice Hall 1987.
6. Radmanesh, “RF and Microwave Electronics Illustrated”, Pearson Education, 2004.

18EC3026	Internet of Things	L	T	P	C
		3	0	0	3

Course Objectives:
1. To introduce the students to IoT technologies
2. To expose the students to application of IoT
3. To enable the students to choose appropriate technologies for implementing prototypes

Course Outcomes:
At the end of this course, students will be able to
1. Summarize the evolution of IoT
2. Classify IoT technologies that are used now
3. Explain the requirement of IoT in certain scenarios
4. Choose appropriate technologies to tackle scenarios using experimental platform for implementing prototypes
5. Use the types of technologies that are available to implement IoT solutions.
6. Examine IoT applications.

Module 1: IoT revolution
Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.
Module 2: Technologies supporting IoT
Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog.
Module 3: IoT Networks
Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.
Module 4: Building Blocks for IoT
Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts.
Module 5: OS for IoT
Operating systems requirement of IoT environment, study of mbed, RIoT, and Contiki operating systems, Introductory concepts of big data for IoT applications.
Module 6: Applications of IoT
Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation.

Reference Books

1. A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, VPT publisher, 2014.
2. A. McEwen, H. Cassimally, “Designing the Internet of Things”, Wiley, 2013.

3. CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011.
4. Samuel Greenguard, “Internet of things”, MIT Press, 2015.

Web Resources

1. http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2. https://developer.mbed.org/handbook/AnalogIn
3. http://www.libelium.com/50_sensor_applictions/M2MLabs Mainspring
4. http://www.m2mlabs.com/framework Node-RED http://nodered.org/

18EC3027	CMOS VLSI Design	L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop a fundamental Computing in the design of CMOS VLSI circuits.
2. To know the essentials of stick diagrams and Layouts.
3. To impart the knowledge of arithmetic design and to compute the CMOS design concepts with learn the concepts in data path circuits.

Course Outcomes:

The students will be able to:

1. Compute the MOS transistor theory
2. Sketch the Stick Diagram and Layout of CMOS Logic Gates , analyze the DC Characteristics of NMOS and CMOS Inverters and predict timing issues
3. Compute various CMOS Logic styles to construct Logic Circuits
4. Illustrate the performance of Sequential logic design
5. Determine and develop the various Arithmetic logic blocks based on CMOS design
6. Design various high speed building blocks based on CMOS design

Module 1: MOS Transistor Theory

MOS Transistor Theory: The Metal Oxide Semiconductor (MOS) Structure – The MOS System under External Bias – Structure and Operation of MOS Transistor (MOSFET) – Threshold Voltage-MOSFET Operation: A Qualitative View- MOSFET Current-Voltage Characteristics-Channel Length Modulation- Substrate Bias Effect- Measurement of Parameters-MOSFET Scaling and Small-Geometry Effects-MOSFET Capacitance: Oxide -related Capacitance-Junction Capacitance.

Module 2: CMOS Design & Delay Analysis

CMOS Design- MOS Transistor Switches - MOS Transistor Switches -Design logic gates using CMOS devices- Stick Diagram- Layout-The Complementary CMOS inverter - DC Characteristics – nMOS Inverter- Resistive-load Inverter-The Static Behaviour of CMOS Inverter: Switching Threshold-Noise Margins-Performance of CMOS inverter: Dynamic behaviour: Computing the capacitance -Propagation delay: First Order Analysis-RC Delay Model –Linear Delay Model

Module 3: Combinational Logic Design

Combinational Logic Design: Static CMOS Design: Complementary CMOS-Ratioed Logic-Pass Transistor Logic- Dynamic CMOS Design : Basic Principles-Speed and Power Dissipation of Dynamic Logic-Signal Integrity Issues in Dynamic Design-Cascading Dynamic Gates.

Module 4: Sequential Logic Design

Sequential Logic Design: Static Latches and Registers –Bi-stability Principle- Multiplexer based Latches-Master -Slave Edge- Triggered Register-Low -Voltage Static Latches- Dynamic Latches and Registers –Dynamic Transmission Gate Edge-triggered Registers-C^2MOS-A clock skew Insensitive Approach-True Single Phase Clocked Register-Alternative Register Styles: Pulse Registers-Sense Amplifier based Registers –Pipelining: Latch-NORA-CMOS.

Module 5: Basic Arithmetic Building Blocks

Arithmetic Building Blocks: Binary Adder-Full Adder Circuit Design Considerations-Mirror Adder Design-Transmission Gate Based Adder -Manchestor Carry-Chain Adder-The Binary Adder: Logic Design Considerations

Module 6: High Speed Buliding Blocks

Carry-By Pass Adder-Linear Carry Select Adder-Square Root Carry Select Adder-Carry Lookahead adder-Array Multipliers – Carry Save Multipliers-Tree Multipliers -Shifters-Barrel Shifters.

Reference Books

1. Kang ,Leblebigi “CMOS Digital IC Circuit Analysis & Design”, McGraw Hill, 2016.
2. Jan.M.Rabaey, AnanthaChandrakasan, Borivoje Nikolic, “Digital Integrated Circuits – A Design Perspective”, Pearson Education, 2014.
3. Weste and Haris ,CMOS VLSI Design 4e:” A circuits and systems perspective” Pearson Education India; 4th edition 2015.
4. Kamran Eshraghian, Douglas A.Pucknell, SholehEshraghian, “Essentials of VLSI Circuits and Systems”, Eastern Economy Prentice Hall of India, New Delhi, 2009.

18EC3028	Solid State Device Modeling and Simulation	L	T	P	C
		3	0	0	3

Course Objectives:

1. To develop mathematical techniques for device simulations
2. To know the essentials of Bipolar Devices and MOS Capacitors.
3. To impart the knowledge of MOS Devices and CMOS Device Design.

Course Outcomes:

The students will be able to:

1. Compute the Mathematical Techniques for Device Simulations
2. Predict the various Quantum Mechanical Concepts
3. Categorize the Bipolar Device Models
4. Compute the effects in MOS Capacitors
5. Illustrate the performance and characterize MOS Devices
6. Determine and develop CMOS design

Module 1: Mathematical Techniques For Device Simulations

Poisson equation-continuity equation-drift-diffusion equation-Schrodinger equation- hydrodynamic equations- trap rate-finite difference solutions to these equations in 1D and 2D space- grid generation.

Module 2: Quantum Mechanical Concepts

Quantum Mechanical Concepts-Carrier Concentration-Transport Equation-Band gap- Mobility and Resistivity-Carrier Generation and Recombination-Avalanche Process-Noise Sources- Injection and Transport Model-Continuity Equation-Diode Small Signal and Large Signal (Change Control Model)-Transistor Models: Ebber - Molls and Gummel Port Model-Mextram model-SPICE modeling temperature and area effects.

Module 3: Bipolar Devices

n–p–n Transistors, Basic Operation of a Bipolar Transistor, Modifying the Simple Diode Theory for Describing Bipolar Transistors, Ideal Current– Voltage Characteristics, Collector Current, Base Current, Current Gains, Ideal IC–VCE Characteristics, Characteristics of a Typical n–p–n Transistor, Effect of Emitter and Base Series Resistances, Effect of Base–Collector Voltage on Collector Current, Collector Current Falloff at High Currents, Non-ideal Base Current at Low Currents, Bipolar Device Models for Circuit and Time-Dependent Analyses Basic dc Model, Basic ac Model, Small-Signal Equivalent-Circuit Model, Emitter Diffusion Capacitance, Charge-Control Analysis, Breakdown Voltages, Common-Base Current Gain in the Presence of Base–Collector Junction Avalanche, Saturation Currents in a Transistor, Relation Between BVCEO and BVCBO.

Module 4: MOS Capacitors

Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, MOS under Non-equilibrium and Gated Diodes, Charge in Silicon Dioxide and at the Silicon–Oxide Interface, Effect of Interface Traps and Oxide Charge on Device Characteristics.

Module 5: Mosfet Devices

Long-Channel MOSFETs, Drain-Current Model, MOSFET I– V Characteristics, Subthreshold Characteristics, Substrate Bias and Temperature Dependence of Threshold Voltage,MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance

Effect, Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation and High-Field Transport Channel Length Modulation, Source–Drain Series Resistance.

Module 6: CMOS Device Design

MOSFET Scaling, Constant- Field Scaling, Generalized Scaling, Nonscaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Nonuniform Doping, Quantum Effect on Threshold Voltage, Discrete Dopant Effects on Threshold Voltage.

Text Books

1. Philip E. Allen, Douglas R. Hoberg, "CMOS Analog Circuit Design", Third Edition, Oxford University Press;2013.
2. S.M.Sze "Semiconductor Devices - Physics and Technology", Wiley; Eighth edition 2015.
3. Kiat Seng Yeo, Samir S.Rofail, Wang-Ling Gob, "CMOS / BiCMOS ULSI - Low Voltage, Low Power", Pearson Education India; First Edition edition 2011 .
4. Arora, N., MOSFET Models for VLSI Circuit Simulation, Springer-Verlag, 2012(Reprint).
5. Selberherr, S., Analysis and Simulation of Semiconductor Devices, Springer-Verlag.,2011.
6. Fjeldly, T., Yetterdal, T. and Shur, M., Introduction to Device Modeling and Circuit Simulation, Wiley-Interscience., 1997.
7. 7.Grasser, T., Advanced Device Modeling and Simulation, World Scientific Publishing Company., 2003.
8. Chua, L.O. and Lin, P.M., Computer-Aided Analysis of Electronic Circuits: Algorithms and Computational Techniques, Prentice-Hall., 1990.
9. 9.Trond Ytterdal, Yuhua Cheng and Tor A. FjeldlyWayne Wolf, Device Modeling for Analog and RF CMOS Circuit Design, Wiley India ,2015.

18EC3029	Analysis and Design of Analog Integrated Circuits	L 3	T 0	P 0	C 3

Course Objectives:

1. To develop a fundamental Computing in the concepts of amplifiers
2. To know the essentials of frequency response of amplifiers and the association of poles and nodes.
3. To impart the knowledge of feedback analysis, stability and compensation.

Course Outcomes:

The students will be able to:

1. Compute the single stage amplifiers
2. Identify various Differential amplifiers and current mirror circuits
3. Demonstrate the noise characteristics in amplifiers
4. Illustrate different types of feedback concepts in amplifiers
5. Determine the characteristics of operational amplifiers
6. Design various analog circuits for different applications

Module 1: Single Stage Amplifiers

Single stage Amplifiers-Common source Stage: Common Source (CS)stage with resistive load-CS stage with Diode Connected Load-CS with Current source load- CS with Triode Load- CS stage with source degeneration-Source follower-Common Stage Stage-Cascode Stage: Folded Cascode-Choice of Device models.

Module 2: Differential Amplifiers and Current Mirrors

Differential Amplifiers-Single Ended and Differential Operation- Basic Differential Pair: Qualitative Analysis-Quantitative Analysis-Common mode Response-Differential Pair with MOS Loads-Gilbert Cell-Passive and Active Current Mirrors-Basic Current Mirrors-Cascode Current Mirrors-Active current Mirrors: Large Signal Analysis-Small-Signal Analysis-Common-mode Properties.

Module 3: Frequency Response of Amplifiers

Frequency response of amplifiers-Miller Effect-Association of Poles and Nodes-Common source stage-Source Followers-Common-Gate Stage- Cascode Stage-Differential pair-Noise-Statistical Characteristics of Noise: Noise Spectrum-Amplitude Distribution-Types of Noise: Thermal Noise

,Flicker Noise-Noise in Single-stage Amplifiers-Common Source Stage-Common-Gate Stage -Source Followers-Noise in Differential Pairs.

Module 4: Feedback Topologies

Feedback-Properties of Feedback circuits-Types of Amplifiers-Feedback Topologies: Voltage-Voltage Feedback-Current-Voltage Feedback-Voltage-Current Feedback-Current Current Feedback-Effect of loading-Two-Port Network models-Loading in Voltage-Voltage Feedback- Loading in Current-Voltage Feedback - Loading in Voltage- Current Feedback- Loading in Current- Current Feedback.

Module 5: Operational Amplifiers

Operational Amplifiers -One stage op-amps-Two stage Op-amps-Gain boosting -Common-Mode Feedback-Input Range Limitations-Slew rate-Power supply Rejection.

Module 6: Stability and Frequency Compensation

Stability and Frequency Compensation-Multipole Systems-Phase Margin-Frequency Compensation-Compensation of Two stage op-amps-Band gap Reference-temperature independent References: Negative TC Voltage-Positive TC Voltage-Band gap Reference-Phase -Locked Loops-Simple PLL: Phase Detector-Basic PLL topology-Charge -Pump PLLs: Problem of Lock Acquisition-Phase/Frequency Detector and Charge Pump-Basic Charge -Pump PLL.

Reference Books

1. BehzadRazavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill Education; Second edition,2017.
2. Willey M.C. Sansen, “Analog design essentials”, Springer, 2006.
3. Grebene, “Bipolar and MOS Analog Integrated circuit design”, John Wiley &sons,Inc., 2003.
4. Phillip E.Allen, DouglasR.Holberg, “CMOS Analog Circuit Design”, Oxford University Press; Third edition ,2013.
5. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Fourth Edition, Wiley Student Edition, 2009.

18EC3030	Hardware Description Languages	L	T	P	C
		3	0	0	3

Course Objectives:

1. To know about the various Architecture styles in VHDL and Verilog.
2. To learn the circuit verification using VHDL and Verilog HDL
3. To get familiar with various Synthesis Techniques.

Course Outcomes:

1. After completion of the course, students will be able to
2. Compute basic terminologies and modeling types used in VHDL
3. Demonstrate combinational circuits and sequential circuits using VHDL
4. Compute a digital circuit test bench & packages using VHDL and Verilog HDL
5. Develop FSM using Verilog
6. Synthesis of digital circuits using VHDL
7. Synthesis of digital circuits using Verilog

Module 1: Basics of VHDL

VHDL Overview – FPGA Design flow Process -Software tools- Xilinx Tool Flow – Libraries – Data objects - Data types – Data operators – Entities – Architectures. Basic Concurrent Statements – Signal assignment statements – Conditional Signal assignment – Selected signal assignment – Usage of Blocks in Dataflow modeling – Implementations of different digital circuits in Dataflow modeling . Process – Delays – Basic Sequential Statements – if, if else statements, case statements – Loops– for loop, while loop, next, exit, null statements – Usage of Variables inside the process – Implementation of digital circuits using Sequential statements Multi Process statements.

Module 2: Implementation of Digital Circuits Using Structural Modeling

Component Declarations – Component Instantiation – Types of Component Instantiation- Examples – Packages with Components declaration & Instantiation –– Generics – Operator Overloading – Conversion functions – Attributes – File Concepts - Packages – Functions & Procedures – Predefined & User defined library implementations. FSM implementation – Moore & Mealy Machines –

Implementations of Basic digital circuit using structural modeling – Test benches – Combinational & Sequential Test benches – Examples – Traffic Light Controller – Toll both controller.

Module 3: Implementation of Digital Circuits Using Dataflow and Behavioral Modeling

Design Methodology – Module – Ports – Basicconcepts – Operators – Number specification – Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multiway branches - Loops - Switch – Modeling elements – Implementation of Basic circuit using Dataflow & Behavioral Modeling

Module 4: FPGA IMPLEMENTATION

Component Assignments – Switch level modeling – Applications of all dataflow, behavioral and Structural modeling in FPGA – FSM Implementation – Test Benches- Implementation of Combinational and Sequential Logic in FPGA Kits

Module 5: VHDL Synthesis

VHDL Synthesis: Synthesis basics-modeling a wire- modeling combinational logic- modeling sequential logic- Modeling Flip-flop-Flip-flop with Synchronous Preset and clear- Flip-flop with Asynchronous Preset and clear-Modeling a latch.

Module 6: Verilog Synthesis

Verilog Synthesis: Synthesis of combinational logic-synthesis of sequential logic with latches and flip flops- synthesis of explicit and implicit state machines- Synthesis of gated clocks and clock enables synthesis of Loops.

Reference Books

1. J. Bhaskar, "A VHDL Primer", PHI Learning, III Edition, 2009.
2. Bhasker, "A Verilog HDL Primer", Star Galaxy Publishing, 2010
3. Samir Palnitkar, "Verilog HDL", Pearson Education, 2004.
4. Charles H. Roth, Jr and Lizy Kurian John's Digital Systems Design Using VHDL Cengage Learning 2nd edition 2012.
5. Douglas L. Perry, "VHDL Programming by Example", Tata McGraw Hill, 4th Edition,2017.
6. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Pearson Education; Second edition , 2017.
7. 7.Stephen Brown, "Fundamentals of Digital Logic Design with VHDL", Tata Mcgraw-Hill Publishing Company Limited, McGraw Hill Education; 3 edition ,2017.

		L	T	P	C
18EC3031	**Signal Integrity for High Speed Devices**	**3**	**0**	**0**	**3**

Course Objectives:

1. To learn the fundamental and importance of signal integrity.
2. To Illustrate and minimize cross talk in unbounded conductive media.
3. To study about the different types of Di-Electric materials.
4. To learn about differential cross talk and CMOS based transmission line model

Course Outcomes:

Students will be able to

1. Implement signal integrity principles in the design of high speed circuits.
2. Illustrate about electrostatics
3. Illustrate about the different types of Di-Electric materials.
4. Perform signal modal analysis
5. implement ESSD protection Circuits.
6. Design various high speed devices by considering the signal integrity issues suitable for various applications.

Module 1: Signal Integrity

The importance of signal integrity: ComptingPower:Past and Future-Basics-A new realm of bus design- Electromagnetic fundamentals for signal integrity:Maxwell equations - Common vector operators: Vector-Dot Product-Cross Product-Vector and Scalar Fields-Flux-Gradient-Divergence-Curl-Wave propagations: Wave Equation-Relation between E and H and the Transverse Electromagnetic mode-Time-Harmonic Fields-Propagation of time harmonic plane Waves

Module 2: Electrostatics

Electrostatics: Electrostatic Scalar Potential in Terms of an Electric Field-Energy in and Electric Field-Capacitance-Energy stored in a Capacitor-Magneto statics:Magnetic Vector Potential-Inductance- Energy in a Magnetic Field-Power flow and the poynting vector: time Averaged Values-Reflections of electromagnetic waves: Plane Wave incident on a perfect conductor-Palne wave Incident on a Lossless Dielectric

Module 3: Mutual Inductance And Capacitance

Mutual inductance and capacitance: Mutual Inductance-Mutual Capacitance-Field Solvers-Coupled wave equation: Wave Equation Revisited-Coupled Wave Equations-Coupled line analysis: Impedance and Velocity-Coupled Noise-Modal analysis: Modal Decomposition-Modal Impedance and Velocity-Reconstructing the Signal-Modal Analysis-Modal Analysis of Lossy Lines- Cross talk minimization

Module 4: Signal Propagation

Signal propagation in unbounded conductive media: Propagation constant for conductive media:Skin Depth-Classic conductor model for transmission lines: DC Losses in conductors- Frequency-Dependent Resistance in Conductors -Frequency-Dependent Inductance-Power Loss in a Smooth Conductor

Module 5: DI-Electric Materials & Differential Signaling

Di-electric materials- Removal of common mode noise-Differential Cross talk-Virtual reference plane-Propagation of model voltages common terminology-Drawbacks of Differential signaling

Module 6: Physical Transmission Line Model

Introduction- non ideal return paths-Vias-IO design consideration-Push-pull transmitter-CMOS receivers-ESSD protection circuits-On chip Termination.

Reference Books

1. StephenHall,HowardL.Heck,"Advanced Signal Integrity for High-Speed Digital Designs",Wiley Publishers, Wiley-IEEE Press; 1 edition (21 September 2011).
2. JamesEdgar Buchanan, " Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS",McGraw-Hill,1996.

18EC3032	Digital System and ASIC Design	L	T	P	C
		3	0	0	3

Course Objectives:

1. To design combinational and sequential circuits using CPLDs
2. To Compute the types of ASIC s and design flow.
3. To acquire knowledge on Programmable ASICs and programmable ASIC logic cells.
4. To study the concepts of Programmable ASIC Interconnect and Programmable ASIC design software.

Course Outcomes:

On successful completion of the subject, students can be able to

1. Compute the steps to design combinational and sequential circuits.
2. Implement combinational and sequential circuits using PLDs and CPLDs
3. Construct the types of ASICs, Combinational and Sequential Logic Cells.
4. Demonstrate the Programmable ASICs and programmable ASIC logic cells.
5. Illustrate Programmable ASIC Interconnect and Programmable ASIC design software.
6. Compute the concepts of EDIF - CFI design representation.

Module 1: Digital Design

Design of combinational circuits - Adders, subtractors -multiplexers, demultiplexer decoders, encoders,code converters parity generators, magnitude comparators - Design of static hazard free and dynamic hazard free logic circuits - Mealy machine, Moore machine - Design of synchronous sequential logic circuits -

Module 2: Design with PLDS

Design of asynchronous sequential logic circuits .Design of combinational circuits using PLDs-Design of combinational circuits using CPLD's - Design of sequential circuits using PLDs- Design of sequential circuits using CPLD's -ASM Chart.

Module 3: Introduction to ASICS
Types of ASICs- Design Flow-CMOS Design Rules- Combinational Logic Cells- Sequential Logic Cells-Logical Effort
Module 4: Programmable ASICS, and Programmable ASIC Logic ELLS
The Antifuse - static RAM -EPROM and EEPROM Technology - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX.
Module 5: Programmable ASIC Interconnect
Actel ACT- Xilinx LCA- Xilinx EPLD- Altera MAX 5000 and 7000- Altera MAX 9000- Altera FLEX
Module 6: Programmable ASIC Design Software
Design Systems Logic Synthesis - The Half gate ASIC - Schematic Entry- PLA toolsEDIF - CFI design representation.

References Books

1. Morris Mano, “Digital Logic & Computer Design 1/e”, Pearson Education India; First edition ,2016.
2. Palmer, J.E., Perlman, D.E., "Introduction to Digital Systems", Tata McGraw Hill, New Delhi, Reprint 1996.
3. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", PrenticeHall International, Inc., New Jersey, 1995.
4. Robert K Dueck, “Digital Design with CPLD applications and VHDL”, Thomson Asia, 2002.
5. Michael John Sebastian Smith "Application specific integrated circuits." Addison, Wesly Longman Inc., 2006.
6. Kevin Skahill, “VHDL for Programmable Logic”, Pearson Education, First Indian Reprint, 2004.
7. FarzadNekoogar and FaranakNekoogar, “From ASICs to SOCs: A Practical Approach”, Prentice Hall PTR, 2003.

18EC3033	VLSI Circuits for Bio Medical Applications	L	T	P	C
		3	0	0	3

Course Objectives:
1. To impart knowledge on the basics of bio sensing units and implantable devices.
2. To impart knowledge on the essentials of interface circuits.
3. To design Interface circuits and CMOS VLSI circuits for bio medical applications.

Course Outcomes:
The students will be able to
1. Acquire knowledge on the basics of various bio sensing units
2. Identify various implantable devices in bio medical applications
3. Determine error coding techniques for wireless medical applications
4. Illustrate on the essentials of interface circuits
5. Compute Interface circuits for implantable bio medical devices
6. Design CMOS VLSI circuits for bio medical applications.

Module 1: Introduction
Circuits for Wireless Biosensing and Body Implants- Wireless Integrated Voltametric and Amperometric Biosensing.
Module 2: Visual Cortical Neuroprosthesis: A Systems Approach
Circuits for Biomedical Implantable Devices.Towards Self-Powered Sensors and Circuits for Biomechanical Implants.RF Circuits for Wireless Medical Applications. Error-Correcting codes for In-Vivo Wireless Links.
Module 3: Biosensing Interfacing Circuits
Microneedles: A Solid-State Interface with the Human Body. Integrated Circuits for Neural Interfacing: Neuroelectrical Recording, Neurochemical Recording, and Neural Stimulation.
Module 4: Circuits For Implantable Neural Recording And Stimulation
Neuromimetic Integrated Circuits. Interface Circuits for Amperometric Electrochemical Sensors. ADC Circuits for Biomedical Applications.

Module 5: Circuits For Molecular Biology
CMOS Circuit Design for Label-Free Medical Diagnostics. Silicon-Based Microfluidics for Nucleic Acid Analysis.
Module 6: CMOS Microelectronic Systems.
Architectural Optimizations for Digital Microfluidic Biochips. Magnetotactic Bacteria as Functional Components in CMOS Microelectronic Systems.
Reference Books:

1. Krzysztof Iniewski, **"**VLSI Circuits for Biomedical Applications", Artech House, 2008.
2. Rahul Sarpeshkar, "Ultra Low Power Bioelectronics: Fundamentals, Biomedical Applications, and Bioinspired Systems", Cambridge University Press, 2010.
3. E. Sanchez-Sinencio and A. G. Andreau "Low-voltage/Low-power Integrated Circuits and Systems ", Wiley,1998.

18EC3035	HDL Laboratory	L 0	T 0	P 4	C 2

Course Objectives:
1. To learn various VHDL modeling and Verilog HDL modeling.
2. To familiarize with VHDL sub program and packages technique.
3. To design transistor level modeling using Verilog

Course Outcomes:
After completion of the course, students will be able to
1. Design for combinational and sequential circuits using VHDL and Verilog HDL
2. Develop package for digital circuits using VHDL
3. Develop test bench for digital circuits using VHDL and Verilog HDL
4. Design gates using transistor level modeling using Verilog HDL
5. Synthesize the circuits after programming.
6. Implement circuit on FPGA using VHDL and Verilog HDL.

List of experiments
1. Design and Simulate Combinational circuits in all three modeling .
2. Design and Simulate 4-bit adder in structural and behavioral modeling.
3. Design and Simulate sequential circuits using VHDL.
4. Design and Simulate State machine using VHDL.
5. Design and Simulate Traffic Light Controller using VHDL.
6. Design and simulation of combinational circuit test bench.
7. Design and Simulate ALU using Packages and user defined data type.
8. Design and Simulate Flip-flops using VHDL
9. Design and Simulate Combinational circuits using Verilog HDL
10. Design and Simulate Sequential circuits using Verilog HDL
11. Design and Simulate logic gates using Switch level modeling
12. FPGA implementation of combinational circuit using VHDL and Verilog HDL

18EC3036	Compact Modeling & Simulation using Verilog A in CADENCE Tool	L 0	T 0	P 4	C 2

Course Objectives:
1. To learn various VerilogA Modeling.
2. To familiarize with analog design .
3. To complete full VerilogA flow

Course Outcomes:
After completion of the course, students will be able to
1. Calculate the intrinsic concentration with Temperature
2. Design Resistive , RC,RL and RLC circuit
3. Develop diode current model
4. Develop Gummel-Poon model for BJT
5. Design current mirror and current sink

6. Demonstrate analog behavior of analog circuits

List of Experiments

1. Calculating the variation of ni with Temperature
2. Model a simple RC circuit
3. Design and modeling of RL and RLC circuit.
4. Design and modeling of Resistive network
5. Diode current model (dc and transient; transient requires charge model)
6. Gummel-Poon model for BJT
7. MOS cap model implementation
8. Level-1,2,3 MOS models (at least DC)
9. Design and modeling of common controlled sources.
10. Design and analysis of VCO
11. Design and analysis of Ebersmoll model.
12. Design and analysis of current mirror and current sink

18EC3037	Low Power VLSI Design	L 3	T 0	P 0	C 3

Course Objectives:

1. To compute basic principles of low power concepts.
2. To acquire knowledge on circuit and logic level power reduction techniques
3. To design low power latches flip-flops and SRAM devices.

Course Outcomes:

On successful completion of the subject, students can be able to

1. Compute the basic principles and need for low power VLSI chips.
2. Summarize the various low power reduction techniques at circuit and logic level.
3. Demonstrate the application of probabilistic power analysis in VLSI chip design.
4. Design low power SRAM Architecture
5. Compute the energy recovery concepts to design low power circuits
6. Develop low power Latches and flip-flops.

Module 1: Simulation Power Analysis

Need For Low Power VLSI Chips- Charging And Discharging Capacitance- Short Circuit Current- Leakage Current- Static Current- Basic Principles of Low Power Design- Gate Level Logic Simulation- Architectural Level Analysis- Probability and frequency - Probabilistic Power Analysis Techniques.

Module 2: Circuit and Logic Level Power Estimation

Transistor and Gate Sizing- Equivalent Pin Ordering- Network Reconstructing and Reorganization- Gate Reorganization- Signal Gating - Logic Encoding- State Machine Encoding- Pre-Computation Logic- Power Reduction in Clock Networks- CMOS Floating Node- Low Power Bus- Delay Balancing.

Module 3: Architecture and System Level Power Estimation

Power and Performance Management- Switching Activity Reduction- Parallel Architecture- Flow Graph Transformation.Leakage Current in Deep Sub-Micrometer Transistors- Deep SubMicrometer Device Design Issues- Low Voltage Circuit Design Techniques- Multiple Supply Voltages.

Module 4: SRAM Architectures

MOS Static RAM- Memory Cell- Banked SRAM- Reducing Voltage Swing on Bit Lines- Reducing Power in the Write Driver and Sense Amplifier Circuits.

Module 5: Energy Recovery Circuit Design:

Energy Recovery Circuit Design - Design with Partially Reversible Logic- Energy Recovery SRAM circuits

Module 6: Low Power Latches and FLIP FLOPS:

Need for Low Power Latches and Flip Flops- Evolution of Latches and Flip Flops- Quality Measures for Latches and Flip Flops.

Reference Books:

1. Gary Yeap, “Practical Low Power Digital VLSI Design”, Springer; 1998 edition (2012).
2. Kaushik Roy, Sharatprasad, “Low Power CMOS VLSI Circuit Design”, John Wiley & Sons Inc., 2009.
3. AnanthaChadrasekaran and Robert Broderson, “Low Power CMOS Design”, Standard Publishers, 2000.
4. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, “CMOS/BiCMOS ULSI Low Voltage, Low Power”, Pearson Education India; First Edition edition ,2011.

18EC3038	Analog VLSI Design	L	T	P	C
		3	0	0	3

Course Objectives:
1. To develop a fundamental Computing in the concepts of device modeling.
2. To know the essentials of analog systems including ADC and DAC.
3. To impart the knowledge of circuit design and modeling and compute in CMOS amplifiers and Comparators.

Course Outcomes:

The students will be able to:
1. Compute the characteristics of MOS transistors and analyze the circuit characteristics through device modeling
2. utilize the analog design concepts in data converters
3. Illustrate different types of filters and switched capacitor circuits
4. perform analysis in CMOS amplifiers
5. Solve the issues in output amplifiers
6. design and develop various comparators and Illustrate the performance of analog circuits using EDA tools.

Module 1: Design Process For Analog Integrated Circuits

Design process for analog Integrated circuits-Approach to Device Modeling:MOS Models-dc MOSFET Model-Bipolar Models-dc BJT Model-Small Signal BJT Model-High Frequency BJT Model.

Module 2: Analog Systems

Analog Signal Processing-Digital-to-Analog Converters-Current Scaling D/A Converters-Voltage Scaling D/A Converters-Charge Scaling D/A Converters-Serial D/A Converter-Analog-to-Digital Converters-Serial A/D Converters-Successive Approximation A/D Converters-Parallel A/D Converters.

Module 3: Continuous Time Filters

Continuous Time Filters-Low Pass Filters- High Pass Filters- Band Pass Filters-Switched Capacitor Circuits-Resistor Emulation-Design of a Parallel switched capacitor resistor emulation-Design of a series parallel capacitor resistor emulation- Sampling Switches: MOSFETs as Switches-Speed Considerations-Switched-Capacitor Amplifiers_ Unity-Gain Sampler/Buffer-Noninverting Amplifier-Switched Capacitor Integrator-Switched Capacitor Common Mode Feedback.

Module 4: CMOS Amplifiers

CMOS Amplifiers: Active load Inverter-Performance of a current sink inverter-Push pull inverter-Differential Amplifiers: CMOS differential amplifier using a current mirror load- CMOS differential amplifier using a p-channel MOSFET-Current source load differential amplifier-Design of CMOS Differential amplifier with a current mirror load- Cascode amplifiers: Simple cascode amplifier-Design of a cascode amplifier-Current Amplifiers: Single-ended input current amplifier-Differential-input current amplifier.

Module 5: Output Amplifiers:

Output Amplifiers -Class A amplifiers-Design of a simple class A output stage-Push Pull common source amplifiers-High-Gain Amplifier Architectures: VCCS circuit-CCCS Circuit-CCVS Circuit

Module 6: Comparators:

Comparators: Characterization of a comparator-Two stage open-loop comparator performance-Design of a two stage open-loop comparator-Non inverting autozeroing comparator-Inverting autozeroed comparator.

Reference Books:

1. Philip E. Allen, Douglas R. Halberg, "CMOS Analog Circuit Design", Oxford University Press; Third edition ,2013.
2. Randall L.Geiger, Philip E.Allen, Noel K.Strader, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill International Co, 1990.
3. BehzadRazavi, "Design of Analog CMOS Integrated Circuits McGraw Hill Education; Second edition,2017.
4. YannisTsividis, "Mixed Analog – Digital VLSI Device and Technology" World scientific publishing Co. Pvt. Ltd., 2002

18EC3039	Testing and Testability	L 3	T 0	P 0	C 3

Course Objectives:

1. To develop a fundamental Computing in the concepts of testing combinational and sequential circuits
2. To know the essentials of various fault simulation techniques
3. To Compute the difference between DFT and BIST

Course Outcomes:

The students will be able to:

1. Identify the testing concepts at various levels of abstraction
2. Compute the knowledge of modeling of faults
3. Utilize the test generation algorithms for generating test vectors
4. Perform modal analysis for fault simulation techniques
5. Design and develop various architectures for DFT
6. Develop various BIST architecture

Module 1: Motivation Of Testing

Role of Testing-Testing and Diagnosis-Testing at different Levels of Abstraction-Errors and Faults-Modeling and Simulation-Test Evaluation-Digital and Analog VLSI Testing-Failures and Faults

Module 2: Modeling Of Faults

Modeling of Faults: Stuck-at faults-Bridging faults-Stuck-open faults-Delay Faults-Temporary Faults-Fault Detection and Redundancy-Fault Equivalence and Fault Location-Fault Dominance.

Module 3: Test Generation Algorithms

Test Generation algorithms-Test Generation For Combinational Logic Circuits-Fault Table-One-Dimensional Fault Sensitization-Boolean Difference-D-Algorithm-Test Generation for Sequential Logic Circuits: Testing of Sequential Circuits as Iterative Combinational circuits-State Table Verification-Designing checking experiments-Random Testing.

Module 4: Fault Simulation Techniques

Fault Simulation Techniques -Simulation for Design Verification-Algorithms for Fault Simulation-Serial Fault Simulation- Parallel Fault Simulation-Deductive Fault Simulation -Concurrent Fault Simulation.

Module 5: Design For Testability

Design for Testability-Controllability and Observability-Ad Hoc Techniques-Scan-Path Techniques for testable sequential circuit design-Level sensitive Scan Design (LSSD): Clocked Hazard-free latches-LSSD Design Rules-Advantages of LSSD techniques-Random Access Scan Techniques-Partial Scan-Boundary Scan.

Module 6: Built-In Self Test

Built-In Self Test-Test Pattern Generation for BIST: Exhaustive Testing-Pseudo exhaustive Pattern Generation-Pseudo random pattern Generator-Output Response Analysis: Transition Count-Syndrome Checking-Signature Analysis-BIST Architectures-Built-in Logic Observer- Specific BIST Architectures -CSBL-BEST-LOCST-STUMPS- CBIST-SST.

Reference Books:

1. Vishwani D. Agarwal,"Essential of Electronic testing for digital, memory and mixed signal circuits", Springer, 2009

2. Abramovici .M, Breuer , "Digital Systems Testing and Testable Design", Jaico Publishing House, 2001
3. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Cliffs, 1998.
4. ParagK.Lala, " Digital circuit Testing and Testability", Academic press, 1997
5. Abramovici .M, Breuer .M.A. and Friedman .A.D, "Digital Systems Testing and Testable Design", Wiley, 2001.

18EC3040	VLSI Technology	L	T	P	C
		3	0	0	3

Course Objectives:

1. To study the manufacturing concepts of VLSI devices.
2. To build a chip with the design rules or layout rules.
3. Fabrication process that allows this technology evolution is the minimum feature size that can be printed on the chip.

Course Outcomes:

The students will be able to:

1. Use the VLSI fabrication steps in detail.
2. Illustrate various oxidation techniques followed in the industry for every fabrication process.
3. Explain various fabrication steps to fabricate VLSI Devices.
4. Choose the various mechanisms for Diffusion and Ion Implantation process
5. Select proper metallization techniques in VLSI Technology.
6. Explore the application of technology customization for the chip design economically.

Module 1: Crystal Growth and Epitaxy

Introduction to VLSI fabrication, Crystal Growth – Electronic grade silicon, Czochralski Crystal Growing, Silicon Shaping ,Processing conditions; Epitaxy – Vapor Phase Epitaxy:Molecular Beam Epitaxy; Silicon on Insulators, epitaxial evaluation Silicon on Insulators, epitaxial evaluation;

Module 2: Oxidation

Kinetics of silicon dioxide growth for thick and thin films; Thinoxides; Oxidation techniques and systems:Oxide properties, Redistribution of dopants at interface:Oxidation of Polysilicon and oxidation induced effects

Module 3: Lithography, Etching & Deposition

Optical lithography-E-Beam lithography-X- Ray lithography -Ion Lithography-Reactive Plasma Etching-Introduction to Plasma Properties,Feature-size control and anisotropic etch mechanisms-Specific etch processes, Deposition Processes-Polysilicon Silicon di oxide, silicon nitride,Plasma assisted depositions,

Module 4: Diffusion & ION Implantation

Models of Diffusion in solids' Fick's One Dimensional Diffusion equations, Atomic diffusion mechanisms, diffusivities of B,P, As and Sb Measurement techniques, Diffusion in Polycrystalline silicon, SiO2 Diffusion enhancements and retardations, Ion implantation equipment, Annealing and shallow junctions, High energy implantation

Module 5: Metallization

Metallization applications and choices, Physical Vapor deposition, Patterning, Metallization problems.

Module VI: VLSI Process Integration:

NMOS IC technology CMOS IC technology, MOS memory IC technology Bipolar IC technology and IC fabrication VLSI Assembly technologies, Package Types, Packaging Design Considerations.

Text Books

1. S.M.Sze, "VLSI Technology", McGraw Hill Second Edition. 1998.
2. James D Plummer, Michael D. Deal, Peter B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Prentice Hall India.2000.

Reference Books

1. Wai Kai Chen, "VLSI Technology" CRC Press, 2003.
2. Rajesh Agarwal and Dr.LaxmanSahoo, "VLSI Technology and Design",Technical Publications Pune, 2008.

3. YasuoTarui, “VLSI Technology: Fundamentals and Applications”, 2011

18EC3041	IP based VLSI Design	L 3	T 0	P 0	C 3

Course Objectives:

1. To learn about IC manufacturing and fabrication
2. To analyse the combinational, sequential and subsystem design
3. To study about different floor planning techniques and architecture design
4. To have an introduction to IP design security

Course Outcomes:

After completion of the course, students will be able to

1. Summarize various CMOS technology, IC design techniques , IP based design and Fabrication process.
2. Design static complementary gates and complementary gates
3. Demonstrate subsystem design
4. Illustrate about floor planning and architecture design
5. Demonstrate Low Power Design
6. Identify security VLSI IP based protection application

Module 1: VLSI and Its Fabrication

Introduction, IC manufacturing, CMOS technology, IC design techniques, IP based design, Fabrication process-Transistors, Wires and Via, Fabrication Theory reliability, Layout Design and tools.

Module 2: Combinational Logic Networks

Logic Gates: Combinational Logic Functions, Static Complementary Gates, Switch Logic, Alternate Gate circuits, Low power gates, Delay, Yield, Gates as IP, Combinational Logic Networks-Standard Cell based Layout, Combinational network delay, Logic and Interconnect design, Power optimization, Switch logic network, logic testing.

Module 3: Subsystem Design

Sequential Machine-Latch and Flip flop, System design and Clocking, Performance analysis, power optimization, Design validation and testing; Subsystem Design-Combinational Shifter, Arithmetic Circuits, High Density memory, Image Sensors, FPGA,PLA, Buses and NoC, Data paths, Subsystems as IP.

Module 4: Floor Planning And Architecture Design

Floor planning-Floor planning methods, Global Interconnect, Floor plan design, Off-chip Connections Architecture Design- HDL, Register-Transfer Design, Pipelining, High Level Synthesis

Module 5: Architecture Of Low Power Design

Architecture for Low power, GALS systems, Architecture Testing, IP Components, Design Methodologies, Multiprocessor System-on-chip Design

Module 6: Design Security

IP in reuse based design, Constrained based IP protection, Protection of data and Privacy constrained based watermarking for VLSI IP based protection

Reference Books

1. Wayne wolf, “Modern VLSI Design:IP-based Design”, Pearson Education,2009.
2. Qu gang, Miodrag potkonjak, “Intellectual Property Protection in VLSI Designs: Theory and Practice”, kluwer academic publishers,2003.

18EC3042	CAD for VLSI Circuits	L 3	T 0	P 0	C 3

Course Objectives:

1. To design the circuit using Floor planning, Placement and Routing concepts.
2. To design and implement various algorithms onto FPGA.
3. To verify Simulation and Synthesis process in the circuit design.

Course Outcomes:

The students will be able to:

1. Use the basic VLSI design Automation Tools.
2. Solve the Tractable and Intractable problems.
3. Verify the VLSI design process through Simulation and Synthesis.
4. Explore the concepts of Partitioning and Floor planning.
5. Explain various techniques related to Placement , Routing, circuit extraction and DRC
6. Implement the various algorithms in FPGA

Module 1: Introduction

Introduction to VLSI Methodologies – Types of ASICs – Design flow -VLSI Physical Design Automation – Fabrication process and its impact on Physical Design.

Module 2: Automation Tools And Graph Theory

A quick tour of VLSI Design Automation Tools – Data structures and Basic Algorithms - Algorithmic graph theory and computational complexity – Tractable and Intractable problems.

Module 3: Simulation And Synthesis

Simulation – Logic synthesis – Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis- Verification – High level synthesis – Compaction.Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation

Module 4: Partitioning And Floor Planning

Partitioning methods –Floor planning concepts - shape functions and floor plan sizing-Floor Planning Methods

Module 5: Placement And Routing

Types of Placement Techniques- Types of local routing problems Area routing - channel routing - global routing - algorithms for global routing-circuit extraction –DRC.

Module 6: CAD Implementations in FPGA

Physical Design Automation of FPGAs – MCMS –Implementation of various Algorithms using VHDL & Verilog onto FPGA's.

Text Books

1. N.A. Sherwari, "Algorithms for VLSI Physical Design Automation", John Wiley, 2003.
2. Sabih H. Gerez," Algorithms for VLSI design automation", John Wiley, 2004.
3. M.J.S.Smith, "Application – Specific Integrated Circuits", Addison, Wesly Longman Inc.,1997.

18EC3043	Data Converters	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn the various techniques & architectures of D/A Converters.
2. To learn the various techniques & architectures of A/D Converters.
3. To study about the S/H circuit and testing of A/D and D/A Converters

Course Outcomes:

The students will be able to:

1. Compute the characteristics of D/A converters and A/D Converters and specifications of Data converters
2. utilize the basic specifications in high speed data converters
3. choose the various high resolution A/D Converters
4. Illustrate different types of sample-and -hold amplifiers
5. perform the analysis in delta sigma data converters
6. design and test various A/D and D/A data converters.

Module 1: Basic D/A and A/D Converter Function

Basic D/A and A/D converter function-Specifications of converters: Digital data coding-DC specifications: Accuracy-Nonlinearity-Offset-Temperature dependence-Supply voltage-Dynamic specifications: Signal-to-Noise Ratio-SFDR-ENOBs-Dynamic range-Required accuracy-Glitches-BER-Maximum sampling-rate-Power supply rejection ratio-Settling time-Acquisition time-Aperture time-Sample-to-hold step-Noise in sample-and -hold specifications-Figure of Merit.

Module 2: High Speed A/D Converters

High Speed A/D Converters : Design problems-Full-flash converter: Comparator input amplifier-Two-step flash converters: Twostep A/D Converter-Two-step capacitive MDAC A/D converter-Pipeline converter architecture: Single bit per stage sub-converter architecture-Multi bit pipeline converter-Sharing amplifiers in pipeline converters-High speed D/A converter architecture- Voltage weighting based architecture: Dual ladder 10-bit D/A converter-Data interleaved D/A converter

Module 3: High Resolution A/D Converters

High Resolution A/D Converters :Pulse width modulation D/A converters- Integrating D/A converters- Current weighting using ladder networks: R-2R ladder network-MOS only binary weighted current network-MOS R-2R implementation-Two-step current division network-MOS ladder network converter system-Weighted capacitor converter system-Monotonic by design operation: Voltage division operation-Current weighting operation-Current-to-voltage converter.

Module 4: Sample and Hold Amplifiers

Sample and hold amplifiers: Basic Sample –and –Hold Configuration: Signal Bandwidth-Acquisition time-Aperture time accuracy-Differential sample-and-hold circuit-Sample clock bootstrapping-Integrating S/H Circuit- Switched Capacitor S/H circuit-MOS differential sample-and-hold circuit.

Module 5: Sigma-Delta A/D CONVERSION and Testing Of Data Converters

Sigma-delta A/D conversion - General Filter Architectures: 1-bit Sigma-delta signal examples-Multi-bit Sigma-delta signal examples-Discussion of Basic Converter Architectures: First-order A/D converter-Second order A/D Converter-Multi Stage Sigma-Delta Converter (MASH)

Module 5: DC Testing of D/A Converters

DC Testing of D/A Converters: Temperature relations-Supply voltage dependence-Bit weight noise-Dynamic Testing of A/D Converters: Dynamic integral nonlinearity test-Spurious free dynamic range-Differential non linearity-Settling time measurement.

Reference Books

1. Rudy van de Plassche, “CMOS Integrated Analog to Digital and Digital to Analog Converters”, Springer International Edition, Second Edition, 2007.
2. R.Jacob Baker, Harry W.LI., David E.Boyee, ―CMOS Circuit Design, Layout and Simulation, Prentice Hall of India, 2010.
3. Randall L.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques for Analog and Digital Circuits”, McGraw Hill International Co, 2010.

18EC3044	CMOS Mixed Signal Circuit Design	L	T	P	C
		3	0	0	3

Course Objectives:

1. To impart knowledge on MOSFET models mixed signal design flow and data convertors.
2. To Illustrate CMOS based switched capacitor circuits and CMOS analog circuits.
3. To provide hands on using VLSI CAD tools to design and Illustrate mixed signal circuits.

Course Outcomes:

The students will be able to

1. Compute the concepts in current source and sinks
2. Design CMOS amplifiers to achieve performance specifications
3. Analyse Source coupled pair and op-amp
4. Identify the Non-Linear and Switched Capacitor circuits
5. Demonstrate the Performance and specifications of Data Converters
6. Compute VLSI CAD tools for design and analysis of mixed-signal circuits

Module 1: Current Sources And Sinks

The cascade connection, sensitivity and temperature analysis, transient response, layout of simple current mirror, matching in MOSFET mirrors, Other current Sources/Sinks.

Module 2: Amplifiers:

Gate drain connected loads, current sources loads, Noise and distortion.Feedback equation, properties of negative feedback and amplifer design, feedback topologies, amplifiers employing four types of feedback

Module 3: Source Coupled PAIR And OP-AMP
Stability- The source coupled pair, the source cross coupled pair, Wide Swing differential amplifiers.Basic CMOS OPAMP Design, Operational Trans conductance amplifiers, Differential output op amp.
Module 4: Non Linear & Switched Capacitor Circuits
Adaptive Design, Analog Multipliers.Non idealities in switch capacitor, Switched capacitor architecture, Switched capacitor applications.
Module 5: Data Convertor Architecture & Performance Metrics
Successive approximation ADC, Dual slope ADC, Flash ADC, Pipelined ADC, Hybrid ADC, High resolution ADC, DAC.
Module 6: Frequency Synthesizers And Synchronization
Basics of PLL, Analog PLL, Digital PLL, DLL. Mixed signal layout issues, interconnects and data transmission.

Reference Books

1. CMOS Circuits Design, Layout and Simulation- Baker, Li, Boyce, 3rd edition., 2011, TMH.
2. Analog Integrated Circuit Design – David A. Johnes, Ken Martin, 1997, John &Wilney Sons.
3. Design of Analog CMOS Design- B.Razavi, MGH,2003, TMH

18EC3045	Analog Circuit Design Laboratory using CADENCE Tool	L 0	T 0	P 4	C 2

Course Objectives:
1. Design of Analog Circuits.
2. Design of various steps involved in Physical Design such as Placement, Routing, DRC, Parasitic Extraction and Layout.
3. Analysis of Analog Circuits.

Course Outcomes:
The students will be able to
1. Illustrate the characteristics of CMOS Inverter
2. Design and simulate Differential amplifier
3. Design and simulate current mirror
4. Design and Simulate Comparator & Emitter Follower
5. Design and simulate various analog circuits
6. Demonstrate full ASIC Design flow for an CMOS inverter and CMOS Logic gates

List of Experiments:
1. Design and simulation of CMOS Inverter using Cadence Software.
2. Design and simulation of Differential Amplifier using Cadence Software.
3. Design and simulation of Current Mirror using Cadence Software.
4. Design and simulation of Single stage Op-amp using Cadence Software
5. Design and Simulation of Comparator using Cadence Software
6. Design and Simulation of Emitter Follower using Cadence Software
7. Design and Simulation of Sample and Hold circuit using Cadence Software
8. Design and Simulation of switched capacitor circuit using Cadence Software
9. Design and Simulation of Oscillators using Cadence Software
10. Design and Simulation of PLL using Cadence Software
11. Design and simulation of full ASIC Design flow of an inverter using Cadence Software
12. Design and simulation of full ASIC Design flow of CMOS logic gates using Cadence Software

18EC3046	ASIC Design Laboratory	L 0	T 0	P 4	C 2

Course Objectives:
1. Design of Digital Circuits for synthesis and simulation using HDL and Schematic Entry.

2. Design of various steps involved in Physical Design such as Placement, Routing, DRC, Parasitic Extraction and Layout.
3. Design and analysis of Analog Circuits

Course Outcomes:

The students will be able to

1. Perform various analysis for combinational circuits using Mentor Graphics EDA tools.
2. Design Bi-CMOS logic gates
3. Illustrate and develop analog circuits using Mentor Graphics EDA tools.
4. Perform analysis on sequential circuits using HDL Designer.
5. Examine and Illustrate the ASIC design flow process
6. Demonstrate the tools for their Projects and Research works.

List of Experiments

1. Design and simulation of CMOS logic gates using Mentor Graphics Software.
2. Design and simulation of half adder and full adder using Mentor Graphics Software.
3. Design and simulation of BICMOS logic gates using Mentor Graphics Software.
4. Design and simulation of emitter follower using Mentor Graphics Software .
5. Design and simulation of differential amplifier using Mentor Graphics Software .
6. Design and simulation Clippers and Clampers usingMentor Graphics Software.
7. Design and simulation of Schmitt trigger and level shifters using Mentor Graphics Software
8. Design and simulation of NMOS inverters and multiplexers using Mentor Graphics Software.
9. Design and simulation of FSM using HDL Designer.
10. Layout design for CMOS inverter, NAND Gate and NOR Gate using Mentor Graphics Software
11. Design and simulation of full ASIC Design flow of an inverter using Mentor Graphics.
12. Design and simulation of full ASIC Design flow of an CMOS NAND Gate using Mentor Graphics Software.

18EC3047	Hardware Design Verification Techniques	L	T	P	C
		3	0	0	3

Course Objectives:

1. To list functional design verification
2. To know about system verilog
3. To compute verification in various digital design.

Course Outcomes:

The students will be able to:

1. Compute the various functional design verification
2. Generalize the basics of system verilog
3. utilize the advanced system Verilog in digital design
4. Illustrate the open verification methodology
5. Evaluate about Universal Verification Methodology
6. perform verification in various digital design circuits

Module 1: Introduction to functional design verification

The Verification Process - Directed verification - Methodology Basics - Randomize -Functional Coverage - Layered Testbench - Building a Layered Testbench with example

Module 2 : Systemverilog - Basics

Data Types - Procedural Statements and Routines - Connecting the Testbench and Design -Basic Object oriented concepts

Module 3: Systemverilog - Advanced

Randomization - Threads and Interprocess Communication - Object oriented concepts Functional Coverage - Case studies

Module 4: Open Verification Methodology (OVM)

Introduction - Transaction-Level Modeling - OVM Mechanics - Testbench Fundamentals -Reuse - Complete Testbenches - Sequences - Block-to-System - Case studies

Module 5: UVM (Universal Verification Methodology)
Introduction - Difference between OVM and UVM - Object-oriented Testbench Design - UVM Tests - UVM Components - UVM Communication with Ports - UVM Configuration - UVM Agents - UVM Sequences
Module 6: Verification Case studies
Introduction - Hardware/Software Co-verification - Voice Over IP (VoIP) Network SoC Verification - CPU (soft core processor) Verification - Cache Memory Subsystem Verification

Text Books
1. SystemVerilog for Verification : A Guide to Learning the Testbench Language Features by Spear, Chris, Springer Publication
2. Open Verification Methodology Cookbook by Mark Glasser, Springer Publication
3. ASIC/SoC Functional Design Verification by Ashok B. Mehta, Springer Publication
4. The UVM Primer: A Step-by-Step Introduction to the Universal Verification Methodology by Ray Salemi

18EC3048	Design of Semiconductor Memories	L	T	P	C
		3	0	0	3

Course Objectives:
1. To know the guidelines and design challenges in designing semiconductor memories.
2. To know about the functionality of different types of memories and the methods of testing it.
3. To Compute the effects of radiation and reliability issues while designing application specific memories.
4. To know about the advanced memory technologies.

Course Outcomes:
The students will be able to
1. Design the architecture of Random Access Memory.
2. Choose the type of memory for a specific application.
3. Illustrate different types of faults that occur in memories.
4. Illustrate various reliability and radiation effects that occur in memories.
5. Prove the radiation effects that occur in memories
6. Comprehend the significance of technology development in memories.

Module 1: Random Access Memory Technologies
SRAM - Cell structures – MOS SRAM architectures **-** MOS SRAM cell and Peripheral Circuit Operation - SRAM Technologies **–** Bipolar, BiCMOS and SOI - Application Specific SRAMs - **DRAM –** Technology Development - DRAM cell theory - Advanced Cell structures - Soft error failures in DRAM - Application Specific DRAMs.
Module 2: Non Volatile Memories
Masked Read only Memories (MROM) – Programmable ROM (PROM) – Erasable (UV) Programmable ROM (EPROM) - Floating Gate EPROM cell - One time Programmable EPROM (OTPEPROM) - Electrically Erasable PROM (EEPROM) - EEPROM Technology and Architecture - Non volatile SRAM - Flash memories - Flash Architectures.
Module 3: Memory Fault Modeling And Testing
RAM Fault Modeling - RAM Electrical Testing – DC and AC Parametric Testing - Functional Testing – Pseudo Random Testing - Algorithms - IDDQ Fault Modeling and Testing - Application Specific Memory Testing.
Module 4: Semiconductor Memory Reliability
General Reliability Issues - RAM Failure Modes and Mechanism - Nonvolatile Memory Reliability
Module 5: Radiation Effects
Radiation Effects: Single Event Phenomenon (SEP) - Radiation Hardening Techniques – Radiation Hardening Process and Design Issues - Radiation Hardened Memory Characteristics.
Module 6: Advanced Memory Technologies
Ferroelectric Random Access Memories (FRAMs) - Gallium Arsenide (GaAs) FRAMs – Analog Memories – Magneto resistive Random Access Memories (MRAMs) - Experimental Memory Devices – case study: Technology developments in semiconductor memories.

Reference Books

1. Ashok K.Sharma, " Semiconductor Memories Technology, Testing and Reliability ", Wiley-IEEE Press, August 2002.
2. Ashok K.Sharma, “Advanced semiconductor memories –Architecture,design and applications , Wiley, 2002.
3. Santosh K.Kurinec and Krzysztof Iniewski, “Nanoscale Semiconductor Memories Technology and Applications”, CRC Press, Taylor & Francis Group, 2014.
4. Betty Prince, “ Emerging Memories: Technologies and trends”, Kluwer Academic publishers, 2002.
5. TegzeP.Haraszti, “CMOS Memory Circuits”, Kluwer Academic publishers, 2001.

18EC3049	**System On Chip Design**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To design combinational and sequential logic networks.
2. To learn optimization of power in combinational and sequential logic machines.
3. To study the design principles of FPGA and PLA.
4. To learn various floor planning methods for system design.

Course Outcomes:

After completion of the course, students will be able to

1. Summarize Combinational logic function, Switch logic
2. Illustrate Power optimization and combinational logic testing
3. Demonstrate Power optimization and sequential logic testing
4. Examine subsystem design
5. Outline system using various floor planning
6. Formulate Routing of Digital circuits

Module 1: Introduction to System on Chip

System Architecture - Components of the System - Hardware and Software - Processor Architectures - Memory and Addressing - System-Level Interconnection - An Approach for SOC Design - System Architecture and Complexity

Module 2: Chip Basics

Introduction - Cycle Time - Die Area and Cost - Ideal and Practical Scaling - Power - Area–Time–Power Trade-Offs in Processor Design - Reliability - Configurability

Module 3: Processor

Introduction - Processor Selection for SOC - Basic Concepts in Processor Architecture - Basic Concepts in Processor Microarchitecture - Basic Elements in Instruction Handling - Buffers: Minimizing Pipeline Delays - Branches: Reducing the Cost of Branches - Robust Processors - Very Long Instruction Word (VLIW) Processors -

Module 4: Memory Design

Introduction - Scratchpads and Cache Memory - Basic Notions - Cache Organization - Cache Data - Write Policies - Strategies for Line Replacement at Miss Time - Multilevel Caches - Virtual-to-Real Translation - On-Die AND Off-Die Memory Systems - Simple DRAM and the Memory Array - Models of Processor–Memory

Module 5: Interconnect

Overview of Interconnect Architectures - Bus:Basic Architecture - SOC Standard Buses - Analytic Bus Models - Beyond the Bus: NOC with Switch Interconnects and Examples - Layered Architecture and Network Interface Unit - Evaluating Interconnect Networks

Module 6: Reconfigurable Technologies and Application Studies

Introduction - Reconfigurable Technologies : FPGA based design - Application Study: AES - Application Study: 3-D Graphics Processors - Application Study: Image Compression - Application Study: Video Compression

Text book

1. Computer System Design: System-on-Chip by Michael J. Flynn, Wayne Luk, WILEY Publications

Reference Books

1. Wayne Wolf, “Modern VLSI Design – System – on – Chip Design”, Prentice Hall, 3rd Edi tion,2008.
2. Wayne Wolf , “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008

18EC3050	Solid State Device Modeling and Simulation-MOS Model	L	T	P	C
		3	0	0	3

Course Objectives:

1. To Compute the principles of various device modeling
2. To Know about the physics of solid state device modeling and simulation.
3. To know about the models and its effects behind semiconductor devices

Course Outcomes:

The students will be able to:

1. Compute new mathematical models for various devices.
2. Demonstrate the physics behind the semiconductor devices
3. Illustrate various noise modeling and non-linearities in CMOS Devices
4. Summarize various BSIM4 MOSFET Models
5. Choose EKV MOSFET Models
6. Develop various SPICE models for MOS devices

Module 1: Semiconductor Device Physics And Operation

Band theory of solids, carrier transport mechanism, MOS capacitor - surface potential accumulation, depletion, inversion, electrostatic potential and charge distribution, threshold voltage, polysilicon work function, interface states and oxide traps, drain current model, sub-threshold characteristics.

Module 2: MOSFET RF Modeling

Basic modeling, SPICE Level-1, 2 and 3 models, Short channel effects, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and AC small signal modeling.

Module 3: Noise Modeling

Noise sources in MOSFET, Flicker noise modeling, Thermal noise modeling, model for accurate distortion analysis, nonlinearities in CMOS devices and modeling, calculation of distortion in analog CMOS circuit.

Module 4: The BSIM4 MOSFET Model

Gate dielectric model, Enhanced model for effective DC and AC channel length and width, Threshold voltage model, Channel charge model, Mobility model, Source/drain resistance model, I-V model, gate tunneling current model, substrate current models, Capacitance models, High speed model, RF model, Noise model, Junction diode models , Layout-dependent parasitic model.

Module 5: Other MOSFET Models

The EKV model, model features, long channel drain current model, modeling second order effects of the drain current, modeling of charge storage effects,

Module 6: Simulation of MOSFET Models

Non-quasi-static modeling, Noise model, temperature effects, MOS model 9, MOSAI model, PSP model and its simulations Influence of process variation, Modeling of device mismatch for Analog/RF Applications.

References Books

1. TrondYtterdal, Yuhua Cheng and Tor A. Fjeldly, Wayne Wolf, “Device Modeling for Analog and RF CMOS Circuit Design”, Wiley India ,2015.
2. B. G. Streetman and S. Banarjee, “Solid State Electronic Devices”, Pearson Education India; Seventh edition ,2015.
3. A. B. Bhattacharyya, “Compact MOSFET Models for VLSI Design”, John Wiley & Sons Inc., 2009.

18EC3051	Nanoscale Devices and Circuit Design	L 3	T 0	P 0	C 3

Course Objectives:
1. To design device and circuit in Nano scale level.
2. To understand the importance of Nanodevices in systems.
3. To develop various device and circuit in nano scale.

Course Outcomes:

The students will be able to:
1. Use the effects of leakage current and its control and reduction techniques in CMOS devices.
2. Explore the device technologies for sub 100nm CMOS.
3. Comprehend the device scaling of single and multigate MOSFETs.
4. Familiarize the low power design and voltage scaling issues in Nano scale devices.
5. Gain knowledge on various nanoscale devices.
6. Design CMOS circuit using non-classical devices.

Module 1: Introduction Semiconductor Devices

Leakage current mechanisms in nanoscale CMOS, leakage control and reduction techniques, process variations in devices and interconnects. Device technologies for sub 100nm CMOS: Silicidation and Cu-low k interconnects, strain silicon – biaxial stain and process induced strain; Metal-high k gate; Emerging CMOS technologies at 32nm scale and beyond

Module 2: Nano Scale Semiconductor Devices

Nanosacle MOSFET , FINFETs, surround gate nanowire MOSFETs, heterostructure (III-V) and Si-Ge MOSFETs Device characteristics and operations.

Module 3: MOS Scaling Theory

Two dimensional scaling theory of single and multigate MOSFETs, generalized scale length, quantum confinement and tunneling in MOSFTEs, velocity saturation, carrier back scattering and injection velocity effects, scattering theory of MOSFETs.

Module 4: Nanoscale Advanced Devices

Si and hetero-structure nanowire MOSFETs, carbon nanotube MOSFETs, quantum wells, quantum wires and quantum dots; Single electron transistors, resonant tunneling devices.

Module 5: Performance And Issues Of CMOS Logic Design

CMOS logic power and performance, voltage scaling issues; Introduction to low power design; Performance optimization for data paths.

Module 6: Sequential Circits

Statistical circuit design, variability reduction, design for manufacturing and design optimization; Sequential logic circuits, registers, timing and clock distribution, IO circuits and memory design and trends. Non-classical CMOS: CMOS circuit design using non-classical devices – FINFETs, nanowire, carbon nanotubes and tunnel devices.

Text Books

1. Hanson, G.W., “Fundamentals of Nanoelectronics”, Pearson, India., 2008.
2. Wong, B.P., Mittal, A., Cao Y. and Starr, G., “Nano-CMOS Circuit and Physical Design”, Wiley, 2004

Reference Books

1. Lundstrom, M., “Nanoscale Transport: Device Physics, Modeling, and Simulation”, Springer. 2000
2. Maiti, C.K., Chattopadhyay, S. and Bera, L.K., “Strained-Si and Hetrostructure Field Effect Devices”, Taylor and Francis, 2007
3. Lavagno, L., Scheffer, L. and Martin, G., “EDA for IC Implementation Circuit Design and Process Technology”, Taylor and Francis, 2005.
4. Shunri Oda, David K. Ferry, “Nanoscale Silicon Devices”, CRC Press; 1 edition (27 July 2017).
5. Sandip Kundu, Aswin Sreedhar, “Nanoscale CMOS VLSI Circuits: Design for Manufacturability”, McGraw-Hill Education (1 July 2010).

18EC3052	Nanoscale FET	L T P C 3 0 0 3

Course Objectives:

1. To understand the concept of scaling in FET device
2. To explain various nano structures, and nano materials.
3. Study various types of nano scale devices.

Course Outcomes:

The students will be able to:

1. Use the important of nano structures and scaling in FETs.
2. Demonstrate the concept and structure of Nano scale MOSFET and its various parameters.
3. Explain the issues in scaling, interface issues in gate oxide and leakages.
4. Investigate compound materials and heterostructure devices.
5. Develop the Novel structures such as Finfet, MODFET, MESFET etc..
6. Explore various nano-structures such as SET, CNT, RTD etc..

Module 1: Introduction To Physics Of The Solid State Nano-Structures

Diversity in nanosytems-Evolving interfaces of nano structures, manipulating materials in the nano scale, Physical chemistry of solid surfaces, surface energy-electrostaic stabilize, DLVO theory-steric stabilization-Template based self-assembly of nano structures, Nano-Structures, Band theory of solids, carrier transport mechanism, Properties of Individual Nanoparticles, Metal Nanoclusters, Semiconducting Nanoparticles, Quantum Wells, Wires, And Dots

Module 2: Nano Scale- MOSFET

Basic Concepts Of MOSFET – Capacitance-Voltage Characteristics – Threshold Voltage of MOS Capacitor – Flat-Band Voltage – Gate Oxide Charges And Transport Through Gate Oxide– Current-Voltage Relation of Long Channel MOSFETS – Drain Conductance – Transconductance – Drain Current Saturation – Body Effect – Drift- Diffusion Model – Sub-Threshold Conduction, Slope And Mobility Models in MOSFETS – Temperature Effect

Module 3: MOSFET-Scaling

MOS Scaling theory, Issues in scaling MOS transistors, Short- Channel Effects, – Charge Sharing Model – Narrow Width Effect – Channel Length Modulation – Hot Carrier Effects. Requirements for Non-classical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k. Interface states, bulk charge, band offset, stability, reliability.

Module 4: Semiconductor Nano-Devices

Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot. SOI - PDSOI and FDSOI, Ultrathin body SOI - double gate transistors. Vertical transistors - FinFET and Surround gate FET,

Module 5: Advanced Semiconductor Nano-Devices

Germanium Nano MOSFETs, Advantages of Germanium over Silicon, Compound semiconductors - material properties, LDD MOSFET – VMOS, FAMOS – MESFET – Hetero structure MOSFETs and MODFET.

Module 6: Nanostructures

Carbon Nano-tube, Carbon Molecules, Carbon Clusters, Fabrication, Structure,Electrical Properties, Vibrational Properties, Mechanical Properties, Applications of Carbon Nanotubes, Resonant Tunneling Transistor, Single-Electron Transistor (SET), Principle of the Single-Electron Transistor , The Coulomb Blockade, Performance of the Single-Electron Transistor, Technology, SET Circuit Design, Comparison Between FET and SET Circuit Designs.

Text Books

1. B. G. Streetman and S. Banarjee, "Solid State Electronic Devices", Prentice-Hall of India Pvt. Ltd, New Delhi, India, (1995).
2. W. Ranier, "Nano Electronics and Information Technology", Wiley, (2003)

Reference Books

1. Charles p. Poole, Frank J. O " Introduction to nanotechnology" Wiley Interscience , 2003.
2. Y. Taur and T. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, 2013.

3. Yang, Nianjun, Jiang, Xin, Pang, Dai-Wen, "Carbon Nanoparticles and Nanostructures" Springer International Publishing, 2016.
4. O. Kononchuk B.-Y. Nguyen, "Silicon-On-Insulator (SOI) Technology" 1st Edition, Woodhead Publishing, 2014.
5. Jerry G. Fossum, Vishal P. Trivedi "Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs", Cambridge University Press; 1 edition, 2013.

18EC3053	Photonics	L 3	T 0	P 0	C 3

Course Objective:
1. To introduce to the students the basic principles of Nanophotonics.
2. To design and Compute various types of photonics devices opertaions.
3. To Visualize various photonics structures.

Course Outcomes:
The students will be able to:
1. Acquainted with the concepts of Nano photonics.
2. Describe the effects of quantization on the optical properties of semiconductors and metals.
3. Work on Plasmonic based structures and its applications.
4. Compute the importance of Quantum confined materials.
5. Illustrate the new approaches in Nano photonics.
6. Visualization of photonics structures and its applications.

Module 1: Introduction
Photons and electrons: similarities and differences, free space propagation. Confinement of photons and electrons. Propagation through a classically forbidden zone: tunneling. Localization under a periodic potential: Band gap. Cooperative effects for photons and electrons. Nanoscale optical interactions, axial and lateral nanoscopic localization. Nanoscale confinement of electronic interactions: Quantum confinement effects, nanoscale interaction dynamics, nanoscale electronic energy transfer. Cooperative emissions.

Module 2: Quantum Confinement Structures And Super Lattices
Inorganic semiconductors, quantum wells, quantum wires, quantum dots, quantum rings. Manifestation of quantum confinement: Optical properties nonlinear optical properties. Quantum confined stark effect. Dielectric confinement effect, super lattices. Core-shell quantum dots and quantum-dot-quantum wells. Quantum confined structures as Lasing media. Organic Quantum-confined structures

Module 3: **Plasmonics And Nano-Particles**
Internal reflection and evanescent waves –Plasmon and surface Plasmon resonance –Attenuated Total reflection – Grating SPR coupling –Optical waveguide SPR coupling-SPR dependencies and materials –Plasmonic and nanoparticles.

Module 4: Photonic Crystal Fabrication
Important features of photonic crystals-Presence of photonic band gap-anomalous group velocity dispersion Microcavity-effects in Photonic Crystals-fabrication of photonic Crystals-Dielectric mirrors and interference filters photonic crystal laser-PBC based LEDs-Photonic crystal fibers (PCFs)-Photonic crystal sensing.

Module 5: Photonic Microscopy
Near Field Optics-Aperture less near field optics-near field scanning optical microscopy (NSOM or SNOM)-SNOM based detection of Plasmonic energy transport-SNOM based visualization of waveguide structures

Module 6: Nano Photonic Structures
SNOM in nanolithography-SNOM based optical data storage and recovery-generation of optical forces-optical trapping and manipulation of single molecules and cells in optical confinement-laser trapping and dissection for biological systems.

Reference Books
1. H. Masuhara, S. Kawata and F. Tokunga, ―NanoBiophotoics", Elsevier Science, (2007).

2. B. E. A. Saleh and A. C. Teich, “Fundamentals of Photonics”, John Wiley and Sons, NewYork, (1993).
3. P. N. Prasad, ―Introduction to Biophotonics”, John Wiley and Sons, (2003).
4. M. Ohtsu, K. Kobayashi, T. Kawazoe and T. Yatsui, ―Principals of Nanophotonics (Optics and Optoelectronics)” University of Tokyo, Japan, (2003).
5. MotoichiOhtsu, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui and Makoto Naruse, Principles of Nanophotonics. New York, USA: CRC Press-Taylor & Francis Group, 2008.
6. Zhao, Yong Sheng (Ed.), “Organic Nanophotonics - Fundamentals and Applications”, Springer-Verlag Berlin Heidelberg, 2015

18EC3054	High Speed VLSI Design	L 3	T 0	P 0	C 3

Course Objective:
1. To develop a fundamental understanding in the concepts of Non clocked and Clocked Logic Styles
2. To know the essentials of Latching Strategies.
3. To impart the knowledge in Asynchronous Clocking Techniques

Course Outcome:
The students will be able to:
1. Summarize the characteristics of Non-Clocked Logic Styles.
2. Illustrate the characteristics of Clocked Logic Styles.
3. Generalize the circuit design margin.
4. Categorize the latching strategies.
5. Outline the Interface techniques in high-speed VLSI Design.
6. Design and develop high speed CMOS VLSI design circuits.

Module 1: Non-Clocked Logic Styles
Static CMOS Structure – DCVS Logic – Non-Clocked Pass-Gate Families – TG Logic-DCVSPG-CPL-SRPL-EEPL-PPL-LEAP-DPL
Module 2: Clocked Logic Styles
Single Rail Domino Logic Styles – Alternating-Polarity Domino Approaches – Dual-Rail Domino Structures – Latched Domino Structures – Clocked Pass-Gate Logic.
Module 3: Circuit Design Margin
Circuit Design Margin- Design Variability- Process Induced Variation – Design Induced Variation – Application Induced variation – Noise.
Module 4: Latching Strategies
Latching Strategies Basic Latch Design – Latching Single-Ended Logic – Latching Differential Logic – Race Free Latches for Precharged Logic – Asynchronous Latch Techniques.
Module 5: Interface Techniques
Interface Techniques Signaling Standards – Chip-to-chip Communication Networks – ESD Protection – Driver Design Techniques – Receiver Design Techniques.
Module 6: Clocking Styles
Clocking Styles Clock Jitter and Skew – Clock Generation – Clock Distribution – Single Phase Clocking – Multi Phase Clocking – Asynchronous Techniques.

Reference Books
1. Kerry Bernstein & et.al, “High Speed CMOS Design Styles”, Kluwer Academic Publishers, 2012.
2. Evan Sutherland, Bob Stroll, David Harris, “Logical Efforts, Designing Fast CMOS Circuits”, Kluwer Academic Publishers, 1999.

18EC3055	VLSI for Wireless Communication	L 3	T 0	P 0	C 3

Course Objectives:

1. To impart knowledge on the design concepts of low noise amplifiers, mixers designed for wireless communication.
2. To illustrate and design PLL and VCO used in communication systems.
3. To understand the concepts of CDMA in wireless communication.

Course Outcomes: The students will be able to

1. Acquire knowledge on the basic concepts of communication.
2. Illustrate various mixer circuits in communication systems.
3. Evaluation of gain, distortion and noise in various mixer circuits.
4. Design various frequency synthesizer circuits in communication systems
5. Realize various sub blocks in communication systems.
6. Implement VLSI circuits in communication systems.

Module 1: Components and Devices

Classical Channel - Wireless Channel Description - Path Loss - Channel Model and Envelope Fading - Multipath Fading: Frequency Selective and Fast Fading - Non idealities and Design Parameters - Nonlinearity –Noise - Derivation of Noise Figure.

Integrated inductors, resistors, Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers.

Module 2: Balanced Mixers

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer.

Module 3: Sampling Mixers

Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.

Module 4: Frequency Synthesizers

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design -Example (DECT Application).

Module 5: Sub Systems

Data converters in communications, adaptive Filters, equalizers and transceivers.

Module 6: Implementation of VLSI Architecture

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System- Application Example.

Reference Books:

1. B.Razavi ,”RF Microelectronics” , Prentice-Hall , Pearson Education India; 2 edition (2013).
2. Bosco H Leung “VLSI for Wireless Communication”, Pearson Education, Springer; 2nd ed., 2011.
3. Thomas H.Lee, “The Design of CMOS Radio –Frequency Integrated Circuits’, Cambridge University Press ,2003.
4. Emad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design - Circuits and Systems”, Kluwer Academic Publishers, 2000.
5. BehzadRazavi, “Design of Analog CMOS Integrated Circuits” McGraw-Hill, 1999.
6. J. Crols and M. Steyaert, “CMOS Wireless Transceiver Design,” Boston, Kluwer Academic Pub., 1997.

LIST OF COURSES

Course Code	Name of the Course	Hours Per Week			Total Credits
		L	T	P	
18MT2001	Technology of Digital Photography	2	0	4	4
18MT2002	Visual Design Lab	0	0	3	1.5
18MT2003	Technical Video Production	2	0	4	4
18MT2004	Audio Engineering	2	0	4	4
18MT2005	3D Animation	2	0	4	4
18MT2006	Visual Effects and Compositing	2	0	4	4
18MT2007	Game Design	2	0	4	4
18MT2008	Graphics and Animation	2	0	4	4
18MT2009	Post Production Techniques Lab	0	0	4	2
18MT2010	Video, Image and Audio Processing	3	1	2	5
18MT2011	Advertising	3	0	0	3
18MT2030	Essentials of Studio	3	0	0	3
18MT2031	Digital Television Engineering	3	0	0	3
18MT2032	Object Oriented Programming	3	0	4	5
18MT2033	Web Design	2	0	4	4

18MT2001	Technology of Digital Photography	L	T	P	C
		2	0	4	4

Course Objectives

1. To enrich the students with the technology of Photography
2. To provide knowledge on the recent trends of Digital Photography
3. To impart knowledge on the image processing techniques.

Course Outcome

The students will learn to:

1. Observe the principles in digital photography.
2. Review the technical requirements in capturing photos.
3. Discover the new advancements in digital photography.
4. Compare and contrast various types of photography techniques.
5. Find a feasible lighting design for the requirement.
6. Manipulate the image based on standard parameters.

Module 1: Photography and Cameras

Basics of Photography, Types of DSLR Cameras, Accessories Used. [5 Lectures]

Module 2: Optics In Digital Cameras

The lens designer's problems, Checking lens image quality, Understanding modulation transfer function, Buying lenses, Special lens types, Influences on image sharpness, Using lenses created for 35 mm systems on DSLRs. [5 Lectures]

Module 3: Color Theory and Its Application

Light and colour, The human visual system, Light sources and their characteristics, Colour temperature, Standard illuminants, Classification of colour, How we see colour. [5 Lectures]

Module 4: Basics of Image Sensors

An introduction to image sensors, Alternative sensor technologies, Image artefacts associated with sensors [5 Lectures]

Module 5:Lighting control

Size of light sources, Direction and angle of light, Distribution of light, Contrast and exposure, Colour and colour temperature ,Practical control of colour, Guidelines for lighting, Lighting equipment, Lighting principles in practice. [5 Lectures]

Module 6: Digital image manipulation

Workflow, General considerations in determining workflow, Capture workflow, Digital image files, Choosing file format, Image compression, Properties of common image file formats, Image processing, Image processing workflow, Digital colour [5 Lectures]

Text Books

1. Langford's Advanced Photography 8th Edition, Focal Press, 2011.
2. Image Sensors *and* signal Processing *for* digital Still cameras, Junichi Nakamura, Taylor and Francis 2006.

Reference Books

1. John Hedgecoe, "The Book of Photography", Dorling Kindersley, 2005.
2. John Hedgecoe, "The Art of Digital Photography", Dorling Kindersley, 2006.
3. Michael Langford & Efthimia Bilissi, "Advanced Photography", Focal Press, 7th Edition, 2008.
4. Bruce Barnbaum, "The Art of Photography",Rockynook, 2010.
5. Tomang, "Digital Photography Essentials", Dorling Kindersley, 2011

	TECHNOLOGY OF DIGITAL PHOTOGRAPHY LAB	L	T	P	C
		0	0	4	2

Lab Outcomes:

The students will learn to:

1. To understand Basics of camera handling.
2. To Practice the lighting techniques.
3. To learn the composition principles.
4. To practice latest Techniques in photography.
5. To Practice Photo Manipulation Techniques.
6. To create new techniques in photography.

Tutorial 1: Three point lighting technique
Lab1: Portrait photography.
Tutorial 2: Rim, Top, Half, Silhouette Lighting techniques.
Lab 2: Creative lighting techniques.
Tutorial 3: Capturing miniatures.
Lab 3: Macro Photography.
Tutorial 4: Long Exposure Technique.
Lab 4: Blurry Effect.
Tutorial 5: High Speed Photography.
Lab 5: Action Photography.
Tutorial 6: Techniques in Motion Blur.
Lab 6: Motion Blur.
Tutorial 7: Composing a Dual tone image.
Lab 7: Black and White Photography.
Tutorial 8: Learning to capture Painting with Lights.
Lab 8: Painting with Lights.
Tutorial 9: Composing reflection or Mirror
Lab 9: Reflection/Mirror.
Tutorial 10: Techniques in Levitation.
Lab 10: Levitation Photography
Tutorial 11 & 12: Capturing and Composing HDR
Lab 12: HDR

Text Books

1. Digital Camera School: The Step-by-Step Guide to Taking Great Pictures, Ben Hawkins, 2017.
2. Creative Lighting: Digital Photography Tips and Techniques , Harold Davis, 2011

Reference Books

1. 40 Digital Photography Techniques, John Kim, Youngjin.com, 2007

18MT2002	VISUAL DESIGN LABORATORY	L 0	T 0	P 3	C 1.5

Lab Objectives:

1. To understand the principles of design.
2. To ensure effective usage of principles of design.
3. To enrich the skill level of graphic design through the topic.

Course outcome:

The students will be able to:

1. Apply principles of design appropriately.
2. Enrich student's creative component.
3. Increase their designing skills
4. understanding of the text forms and the quality of projects will be better
5. Visualize and demonstrate an idea and express it.
6. Demonstrate an understanding of principles of design and colors and apply them effectively to various assignments.

Tutorial and Lab: (total 4 contact hours per week) (outline of topics)

Tutorial 1: Introduction to Image Editing

Lab1: Familiarization with basic tools

Tutorial 2: Setting up page layout

Lab 2: Creating a themed layout

Tutorial 3: Layers and Image Manipulation

Lab 3: Compositing various images into a single image

Tutorial 4: Filters

Lab 4: Adding filter effects and dimensionality

Tutorial 5: Blending Options and Modes

Lab 5: Blending text and Images

Tutorial 6: 3D visualization & Exporting

Lab 6: Adding a 3D perspective to an image.

Tutorial 7: Introduction to Page Layouts

Lab 7: Creating a page layout for different Mediums

Tutorial 8 : Adding Image and Text Content

Lab 8: Customizing text and images into a layout

Tutorial 9& 10 : Text Manipulation and Editing

Lab 9&10: Creating corporate identities including letter heads, visiting cards, etc

Tutorial 11: Compositing Text for Books and Magazines

Lab 11: Compositing a book, magazine and Newspapers.

Tutorial 12: Exporting to different Mediums

Lab 12: Exporting files based on different file formats.

Text Books

1. 1."Adobe Photoshop CC Classroom in a Book", Andrew Faulkner, Adobe Press, 2016.
2. 2."Adobe Indesign CC Classroom in a Book", Adobe Press, 2017.

Reference Books

1. The Adobe Photoshop CC Book for Digital Photographers, Scott Kelby, 2017 release.

18MT2003	Technical Video Production	L 2	T 0	P 4	C 4

Course Objectives:

1. To enrich the students with the technology of Video Production.
2. To provide knowledge on the recent trends of Cameras and lights.
3. To understand the working of light in different environments.

Course Outcomes:

The students will learn to:

1. Observe the principles in script writing.
2. Review the technical requirements of camera.
3. Discover the new advancements in video production.
4. Compare and contrast various types of visualization.
5. Find a feasible lighting design for the requirement.
6. Manipulate the video based on standard parameters.

Module 1: Script & Screenplay

Brain storming, Concept Development, Script, types of script, Basic shots, Camera Angles & Movements, Mise en scene, Screenplay, Celtex software, Characterization. [6 Lectures]

Module 2: Preproduction

Staging & Blocking, Shooting Script, Script breakdown, Story board, Casting, Location Scouting & scheduling, Set Design & Props. [3 Lectures]

Module 3: Lighting basics

Basic Electrical, Lighting Basics, Light Sources, Light control & uses. (6 Lectures]

Module 4: Lighting Plan & Systems

Lighting Setup, Lighting system (DMX), Stage lighting. [6 Lectures]

Module 5: Basic Camera Mechanism and Functions

Optical System, CCD mechanism, Camera Function, Camera control system,
Color signal forms. [3 Lectures]

Module 6: Advance Camera Techniques

Basis Digital Concepts, Anamorphic Cinematography, 3D Stereoscopic Cinematography
Greenscreen & Bluescreen Cinematography, Photographing Miniatures, Incamera Compositing of miniatures with full scale, digital terminology, Digital Cameras- Arri Alexa, Red weapon, Sony, Latest trends in camera and techniques, Future technology.

[6 Lectures]

Text Books

1. Michael Goi,ASC, “American Cinematographer Manual”, 10th edition, ASC press, 2013.
2. John Jackman, “Lighting for video & Television”, 3rd edition, Focal Press, 2010.
3. Brad Herring, “Sound, Lighting & Video, Focal Press”, Focal Press, 2009.
4. Herbert Zetti, “Handbook of Television production”, Cengage Learning, 2008.
5. Sydfield, “Screenplay: The Foundations of Screenwriting”, Paperback,2005.

Reference Books

1. Blain Brown, “Cinematography: Theory and Practice: Image Making for Cinematographers and Directors: Volume 3” Paperback, 2016.
2. David Landau, “Lighting for Cinematography: A Practical Guide to the Art and Craft of Lighting for the Moving Image (The CineTech Guides to the Film Crafts)”, Paperback, 2014.
3. Joseph V. Mascelli, “Five C's of Cinematography: Motion Picture Filming Techniques” Paperback, 1998.

	Technical Video Production Laboratory	**L** **0**	**T** **0**	**P** **4**	**C** **2**

Course Description:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

18MT2004	**Audio Engineering**	**L** **2**	**T** **0**	**P** **4**	**C** **4**

Course Objectives:

1. To develop a theoretical and practical understanding of the fundamentals of audio engineering
2. To enhance problem solving skills in the field of audio engineering.
3. To develop practical and creative approaches to setup Live Sound/ Studio Recording.

Course Outcome:
The students will learn to:
1. Identify different audio equipments in a signal chain.
2. Review audio equipments available currently.
3. Demonstrate skills to use industry standard audio products.
4. Analyze the specifications of particular audio equipment.
5. Visualize and develop a complete signal chain for a Live Sound Reinforcement/ Studio Production.
6. Estimate the cost incurred in Live Sound/ Studio setup.

Module 1:Fundamentals of Sound and Acoustics
Simple Harmonic Motion and the sine wave, Sound in Media, Wavelength and Frequency, Complex, Waves, Octaves, Spectrum, Electrical, Mechanical and Acoustical Analogs, Sound Levels and the Decibels, Sound in the Free Field, The Perception of Sound, Signals, Speech, Music and Noise. [10 Lectures]
Module :2 Microphones
Microphone Fundamentals, Classification of Microphones, Dynamic Microphones, Condenser Microphones, Special Purpose Microphones, Different Microphones Specifications, Miking Techniques, Application In formation/ Accessories, Microphone Selection. [10 Lectures]
Module 3: Loudspeakers and Power Amplifiers
Methods of Acoustic Transduction, Low frequency drivers and enclosures, High frequency drivers and horns, Crossovers, Loudspeaker Specification, Amplifier Power rating, Frequency response and Power bandwidth Slew rate, THD and Bridged operation, Considerations in choosing an Amplifier, Matching Amplifier and loud speaker [10 Lectures]
Module 4: Mixers and Signal Processors
Split line and Inline Mixers, Mixing Console, Understanding analog console specification, Signal Processors: General Discussion, Dynamic range processors, Equalizers and filters, Application – Mixers, Application – Signal Processors [10 Lectures]
Module 5: Digital Audio Analog and Digital Information, Analog to Digital Conversion, Digital to Analog conversion, Basic MIDI principles, MIDI messages, MIDI control, Networked Audio Protocol: DANTE [10 Lectures]
Module 6: Audio Consultation and Project management
Equipment selection, Live Sound setup, Customer engagement, Complete signal flow preparation, Budget estimation, Installation, Service. [10 Lectures]

Text Books
1. F.Alton Everest, Ken C Pohlmann, "Master Handbook of Acoustics", McGraw Hill, Sixth Edition, 2015.
2. Francis Rumsey, "Sound and Recording", Elseiver, 5th edition, 2006.

Reference Books
1. Stanley R. ALten, Audio in Media, Wadsworth, 2005.
2. Michael Talbot-Smith, Sound Engineering Explained, Focal Press, 2002.
3. IAN R. SINCLAIR, Audio and Hi-Fi Handbook, Newnes, 1998.

		L	T	P	C
	Audio Engineering Lab	**0**	**0**	**4**	**2**

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

18MT2005	3D Animation	L 2	T 0	P 4	C 4

Course Objectives

1. The course provides knowledge and understanding about various three dimensional animation process
2. This course helps students to understand the concepts of modeling, texturing, lighting and animation
3. The course provides details information about advanced strategies of animating human character.

Course Outcome

The students will learn to:

1. Relate the various 3D software's
2. Identify the efficient modeling techniques
3. Apply lighting to modeled objects
4. Experiment various lighting techniques
5. Develop a plan for architectural modeling
6. Evaluate the rendering process.

Module 1: Pre Production

Introduction – Principles of Animation - Storyboarding: Preliminary, Presentation and Production – character and model design - sound design –technical tests –Production scheduling [8 Lectures]

Module 2:Modeling Basics

Introduction –polygonal modeling –splines and patches –coordinate systems –viewing windows – Geometric primitives –transformations –common modeling techniques –hierarchies –booleans and trims. [7 Lectures]

Module 3:Rendering Basics

The camera –Lights –Surface characteristics –shading algorithms –rendering algorithms –background images –Surface texture mapping –solid texture mapping –final rendering. [8 Lectures]

Module 4:Animation Basics

Introduction –Key framing –interpolations –parameter curve editing –dope sheet editing –forward kinematics –inverse kinematics –motion plans [8 Lectures]

Module 5:Cameras and Lights

shape deformations –camera animation –animating lights and surface properties –pose based animation.
[7 Lectures]

Module 6:Retouching and Post Production Techniques

Virtual sculpting –hair and fur –texturing polygons –Rendering algorithms –cloth dynamics – Facial animation- compositing –Editing. [7 Lectures]

Text Books

1. Michael O'Rourke, "Principles of Three – Dimensional Computer animation", 3rd edition,W.W. Norton & company, 2003.

Reference Books

2. John Vince, "Essential Computer Animation", Springer UK , FirstEdition 2000.
3. John Edgar Park, "Understanding 3D animation using Maya", Springer Science & business Media. Inc, 2005.
4. Marcia Kuperberg, Martin W. Bowman, "Guide To Computer Animation", Focal press ,2002.

	3D ANIMATION LAB	L 0	T 0	P 4	C 2

Lab Outcomes:

The students will learn to:

1. Relate the various 3D softwares
2. Identify the efficient modelling techniques
3. Apply lighting to modelled objects

4. Experiment various lighting techniques
5. Develop a plan for architectural modelling
6. Evaluate the rendering process

Tutorial and Lab: (total 4 contact hours per week) (outline of topics)
Tutorial 1: Interface and Basic Interaction
Lab1: Modelling using basic primitives
Tutorial 2: Polygon Modelling and Nurbs Modeling
Lab 2: Creating basic Models using Polygon Modelling and Nurbs Modeling
Tutorial 3: Menu options for Polygon Modelling
Lab 3: Creating Models using Polygon Modelling
Tutorial 4: High and Low poly Modeling Techniques
Lab 4: Creating Organic Models
Tutorial 5:Texturing and Shading
Lab 5: Texturing Models using different Techniques
Tutorial 6: Lighting
Lab 6: Lighting up a modelled scene
Tutorial 7 : Rigging
Lab 7: Adding Skeleton and Constraints to the Models
Tutorial 8 : Cameras and Animation
Lab 8: Adding Interactivity to the scene using keyframing techniques
Tutorial 9: Rendering
Lab 9: Exporting the finished output into different forms
Tutorial 10: CAD Design
Lab 10: Understanding the basics of CAD and layout drawing
Tutorial 11 &12: Planning a 3D Animation in CAD
Lab 11 & 12: Implementing a architectural layout in CAD

Text Books
1. Kelly L. Murdock, "Autodesk Maya 2018, Basics Guide", SDC Publications, 2018.
2. Chris Maraffi, "Maya Character Creation: Modeling and Animation Controls", New Riders Publishing.
3. Lee Lanier, "Maya Professional Tips and Techniques", Autodesk Maya Press

18MT2006	VISUAL EFFECTS AND COMPOSITING	L T P C 2 0 4 4

Pre Requisite - 18MT2005 Introduction to 3D Animation

Course Objectives:
1. To understand the basic working of the human perception system and camera parameters to better do compositing.
2. To examine the various tools of compositing and choose the right tool for the application.
3. Help the student visualize and comprehend the current state of the VFX industry.

Course Outcome:
The students will learn to:
1. Make better choices when making technical and creative decisions using the understanding of human perception and camera parameters.
2. Manipulate image data using mathematical formulae to obtain the required result.
3. Compare the feature set available in various software and select the optimal set required.
4. Stabilize and get measureable data from images for use in Post Production.
5. Separate foreground from background and reconstruct the image using another background.
6. Compose a realistic image from various 2D and 3D source elements.

Module 1: Introduction
History and Evolution of VFX and Compositing, Basics of Human perception, Camera Basics, Nodal Pans and Tilts, Camera Array, High Speed Photography, Motion Control, Multi pass Photography,

Stereoscopic 3D, Stereo Camera Set up, Miniatures, Stop Motion Characters, Compositing-Optical technique, Matte Painting. [5 Lectures]

Module 2: Data representation

Digital representation of visual information - Image Generation, Pixels, Components, Channels, Spatial Resolution, Resolution and Image Formats, HDRI, Colour Models, Colour Management, Plate Photography, Preproduction, Previs. [5 Lectures]

Module 3: Manipulations

Basic Image Manipulations using single and multi operators, Spatial filters and working, Geometric transformations, Expression Language, Masks, Pre-multiplied images, Morphing, Motion Blur. [5 Lectures]

Module 4: Standards

Film vs Digital, Analog and Digital Film formats – Analog and Digital Television Formats- Aspect Ratio and Format Conversion Pipeline, UI, Dope Sheet, Curve editor [5 Lectures]

Module 5: Compositing Techniques

Rotoscopy, Travelling Matte, Automated keying techniques- Luma, Chroma, Difference keying, Keylight, Primatte, Ultimatte, Matte Backgrounds, Retiming techniques-optical flow analysis - Image tracking and stabilization-Camera Tracking, Scene tracking, Lighting parameters, Camera Parameters. [5 Lectures]

Module 6: Compositing Parameters

Interactive Colour and lighting, Light wrapping, Relighting, Shadows, digital colour matching, spill suppression, Atmosphere, camera characteristics, Digital Intermediary, Matching Film Grain and sensor Noise, Multi-pass Compositing, Deep Compositing, Stereoscopy, Focus, Future, Game engines and VFX. [5 Lectures]

Text Books

1. Ron Brinkmann, The Art and Science of Digital Compositing, second edition, Morgan Kaufmann, 2008.
2. S. Zwerman and J. Okun, The VES Handbook of Visual Effects. Burlington: Focal Press, 2015.

Reference Books

1. Steve Wright, Digital Compositing for Film and Video, Focal Press, 2006.
2. R. Ganbar, Nuke 101: Professional Compositing and Visual Effects, Second Edition, 2nd ed. Peachpit Press, 2014.
3. Dough Kelly, Digital Composting in-Depth, Coriolis, 2000.

		L	T	P	C
	VISUAL EFFECTS AND COMPOSITING LAB	**0**	**0**	**4**	**2**

Course Description:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

		L	T	P	C
18MT2007	**GAME DESIGN**	**2**	**0**	**4**	**4**

Course Objectives

1. The course provides knowledge on understanding the aesthetics and pre-requisites required for game designing.
2. This course helps students to understand and utilize physics and mathematical concepts required for game environments and game development.

Course Outcome

The students will be able to:

1. Infer and inherit capability of designing 2D /3Dgames.
2. Apply their skills on concepts like camera movement and dynamics of game designing.
3. Design and develop 2D/3D games on various platforms.

4. Identify and construct design game objects and provide them behavioral characteristics to interact in game environment.
5. Formulate the design of suitable game environment and skyboxes.
6. Design various 3D menu, cut scenes and UI elements

Module 1:Introduction to Game Design
Game play and game data, designers and development process, modeling factor, fudge factor, logic and scripting languages [8 Lectures]
Module 2:Game mechanics design
scale, graphical interfaces, terrain features, movement rates and algorithms, regulating movements, game statistics for movements, Items, characters and combat [7 Lectures]
Module 3:Implementing the Design
storytelling, designing playfields, interface design, dialogues, 2d/3d maps, POV [8 Lectures]
Module 4: 2D Background Design and physics materials
sprite designing, background designing, UI designing, designing and implementing physics for 2d game objects, collisions, threading , scripting [7 Lectures]
Module 5: 3D Game design
3 C's in 3D game designing, designing and importing 3D game object in 3D game engine, designing skyboxes, icon designing, 3D movement, collisions, designing cut scenes, designing for 3D game menu, introduction to 3d UI element designing. [8 Lectures]
Module 6:Game Design projects
Creating a terrain and adding assets , Create a suitable skybox, creating a character motor and adding physics- gravity, kimenatics via keyboard, coin pick up, HUD [7 Lectures]

Text Books
1. Michael Moore, Basics of Game Design, CRC Press, 2016
2. Scott Rogers, “Level Up! The Guide to Great Video Game Design”, John Wiley Publishers, 2010.

Reference Books
1. Jonathan S. Harbour, “Advanced 2D Game Development”, PTR Publishers, 2009.
2. Ernest Adams, “Fundamentals of Game Design”, Pearson Education, 2012.
3. Jesse Schell, “The Art of Game Design: A book of lenses”, Morgan Kauffman Publishers, 2008.

	GAME DESIGN LAB	L	T	P	C
		0	0	4	2

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

18MT2008	GRAPHICS AND ANIMATION	L	T	P	C
		2	0	4	4

Pre Requisite - 18MT2005 Introduction to 3D Animation
Course Objectives
1. 1.To understand the basic working and the technical concepts of the graphical system
2. 2.To examine the various geometrical transformations
3. Help the student visualize and comprehend the graphic tools to create two dimensional computer animation.

Course Outcome
The students will learn to:
1. Outline the two dimensional graphic production process
2. Classify the various algorithms for generating graphical components

3. Demonstrate skills to use industry standard graphical productions.
4. Experiment with different light sources based on visible surface determination
5. Setup an graphical production.
6. Discriminate two and three dimensional graphical production.

Module 1: Basic Principles of Two Dimension Graphics
Raster versus vector graphics- Basic geometric objects-Geometric transformations-Homogenous coordinates- Applications of transformations-Geometric transformations in java 2D-Animation and movements based on transformations- Interpolators for continuous changes- implementations of interpolators in Java 2D-Single or double precision [7 Lectures]
Module 2: Drawing lines and curves
Lines and pixel graphics-The midpoint algorithm for lines- Structural algorithms-Pixel densities and line styles-Line clipping-Midpoint algorithm for circles- Drawing arbitrary curves- Antialiasing-Drawing thick lines-Filling areas-Buffered images in java 2D-Displaying text-Text in java 2D-Grey images and intensities-Colour Model-Colour Interpolation with java 2D. [8 Lectures]
Module 3: Basic Principles of Three-Dimensional Graphics
Geometric transformations-The scenegraph- Elementary geometric objects in java 3D-The scenegraph in java 3DAnimations and moving objects- Projections in Java 3D [7 Lectures]
Module 4:ModellingThree-Dimensional Graphics
Modelling Three dimensional objects-Three Dimensional objects and their surfaces-Topological notions-Modelling techniques-Surface Modeling with polygons in java 3D-importing geometric objects in to java3D-Parametric curves and freedom surfacesnormal vectors for surfaces [8 Lectures]
Module 5: Visible Surface Determination
Clipping volumes- Algorithms for visible surface determination- Image precision techniques-Priority algorithms- Illumination and shading- Light sources- Light sources in java 3D-Reflection- Shading in java 3D- Shading- Shadows- Transparency- Textures- Textures in java 3D- The radiosity model- Ray tracing. [7 Lectures]
Module 6: Special Effects and Virtual Reality
Fog and particle systems**-** Fog in Java 3D- Dynamic surfaces- Interaction-Interaction in Java 3D-Collision detection-Collision detention in Java 3DSound effects-Sound effects in Java 3D-stereoscopic viewing [7 Lectures]

Text Books
1. Rick Parent, Computer Animation Algorithms and Techniques, Morgan Kaufmann publishers, 2002.
2. F.S.Hill,jr ,Computer graphics using Open GL,Prentice Hall of India,2006.

Reference Books
1. Peter Shirley, et al, Fundaments of Computer Graphics, AK Peters Ltd, 2005.
2. Issac Victor Kerlow, The Art of 3D Computer Animation and Effects, John Wiley, 2004.

	GRAPHICS AND ANIMATION LAB	**L** **0**	**T** **0**	**P** **4**	**C** **2**

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

18MT2009	**POST PRODUCTION TECHNIQUES LAB**	**L** **0**	**T** **0**	**P** **4**	**C** **4**

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

18MT2010	VIDEO, IMAGE AND AUDIO PROCESSING	L 3	T 1	P 2	C 5

Pre Requisite - 18MT2005 Introduction to 3D Animation

Module 1: Image processing
Fundamentals of digital image: Digital image representation and visual perception, image sampling and quantization.Image enhancement: Histogram processing; Median filtering; Low-pass filtering; High-pass filtering; Spatial filtering; Linear interpolation, Zooming. Image coding and compression techniques: Scalar and vector quantizations; Codeword assignment; Entropy coding; Transform image coding; [8 Lectures]

Module 2: Image Analysis and Segmentation
Wavelet coding; Codec examplmentaes.Image analysis and segmentation: Feature extraction; Histogram; Edge detection; Thresholding. Image representation and description: Boundary descriptor; Chaincode; Fourier descriptor; Skeletonizing; Texture descriptor; Moments. [8 Lectures]

Module 3: Audio processing
Fundamentals of digital audio: Sampling; Dithering; Quantization; psychoacoustic model. Basic digital audio processing techniques: Anti-aliasing filtering; Oversampling; Analog-to-digital converion; Dithering; Noise shaping; Digital-to-analog Conversion; Equalisation. [7 Lectures]

Module 4:Digital Audio compression:
Critical bands; threshold of hearing; Amplitude masking; Temporal masking; Waveform coding; Perceptual coding; Coding techniques: Subband coding and Transform coding; Codec examples. [7 Lectures]

Module 5: Fundamentals of Video processing
Fundamentals of digital video: Basics of digital video; Digital video formats. Basic digital video processing techniques: Motion estimation; Interframe filtering; Motion-compensated filtering; [7 Lectures]

Module 6: Estimation and Coding
Error concealment. Video coding techniques: Temporal redundancy; Spatial redundancy; Block-based motion estimation and compensation; Coding techniques: Model-based coding, Motion-compensated waveform coding; Codec examples. [7 Lectures]

	VIDEO, IMAGE AND AUDIO PROCESSING LAB	L 0	T 0	P 2	C 1

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

18MT2011	ADVERTISING	L 3	T 0	P 0	C 3

Course Objectives
1. To define and understand principles of advertising
2. To translate skills making advertisements and Branding
3. To design and evaluate quality advertising output.

Course Outcome
The students will learn to:
1. Student will gain professional knowledge on advertising
2. Student will use the skills in designing advertising campaigns
3. Student will gain insight on the creative aspects of advertising
4. Students will evaluate the relation of public relations in advertising
5. Students will list and demonstrate ability to understand varied nuances of advertising in the industry
6. Students will learn the idea of social advertising

Module 1: Introduction to Advertising
Definition and types of Advertising -Advertising Industry- Advertising Media - Types of advertisements- Indoor and Outdoor Advertising. [8 Lectures]
Module 2: Advertising Campaigns
Multinational campaign strategies and cost considerations - Creativity and content in International advertisements – Creative ad campaigns [8 Lectures]
Module 3: Creativity in Advertising
Creative Strategy-Advertising budget-Branding-Pretest and posttest – Role of creative advertisements in reaching audience. [7 Lectures]
Module 4: Advertising and PR
Sponsorship and Publicity – Advertising concept-Media relations Techniques- social media and advertising- Public Opinion- propaganda- Advertising tools – roles and responsibilities of different creative and production departments -Legal and Voluntary roles- Research in Advertising.[9 Lectures]
Module 5:Role of advertising in the society
Contemporary trends in Advertising. - Case Studies. - Roles and responsibilities - Career Opportunities in Advertising. [6 Lectures]
Module 6: Social Media Advertising
Social media ads – Facebool ads – Online ads – Web ads – Advertising techniques for online ads [6 Lectures]

Text Books

1. Tony Yeshin, “Advertising”, McGraw Hill, Cengage Learning EMEA, 2006.
2. Otto Kleppner, “Fundamentals of Advertising”, Prentice Hall, New Jersey, 2000.

Reference Books

1. Courtland L. Bovee, “Advertising Excellence” McGraw Hill Publications, Delhi, 2001.
2. Sean Brierley, “The Advertising and Hand book”, New York, 2000.
3. McGraw Hill, “Principles of Advertising and IMC”, McGraw Hill, 2000.

18MT2030	ESSENTIALS OF STUDIO	L 3	T 0	P 0	C 3

Course Objectives:

- To learn the various administrative structure of a video production studio
- To study the standards and protocols in studio administration
- To learn the essential logistics and safety standards.

Course Outcomes:
The students will be able to:

- Outline the basic operational structure of a studio
- Choose the best acoustic design of a studio
- Estimate the ideal studio furniture and equipments needed
- Categorize digital content and communicate with other employees
- Formulate strategies for budgeting and staffing
- Judge the right fire, safety and security issues.

Module 1: Essentials of a Studio
Studio layout, infrastructural requirements of an ideal studio, studio types, performance studios, production studios, postproduction studios, and mobile studios, modelling studios, broadcast & non broadcast studio, norms for planning power, crafting a shooting floor- stage, set, blue/green screen, & virtual studio, insight into Indian & international studios. [10 Lectures]
Module 2: Studio Acoustics and Design
Primary factors governing studio and control room acoustics, acoustic isolation, walls, floors, risers, ceilings, windows and doors, noise isolation within the control room, frequency balance, room proportions, reverberation time, diffusion noise, studio design procedure, studio features, elements common to all studios, minimizing structure-borne sound, studio frequency managing, limitations to studio design. [10 Lectures]

Module 3: Studio Furniture and Equipment
Audio and video studio equipment, studio lights, lighting equipment, grid, mounts, accessories, light modification and control, lighting safety, planning, studio furniture's, response disturbances due to mixing consoles and studio furniture, data communication, ventilation and air conditioning, power cabling, earthing. [06 Lectures]
Module 4 :Studio Communication
Set etiquettes & studio, procedure, establishing communication & talkback system, studio calls, shooting floor & control, room dialogue, non-verbal cues during shoot, audience management, stagecraft & show control, graphic station, AVG Chain from Studio to Storage, Tape & E-Library, hardware & software for audio & video NLE, basic transmission equipment. [04 Lectures]
Module 5:Budgeting & Staffing
Scope for generating income for a broadcast & non-broadcast studio, cost of operating & maintaining a studio, budgeting for and marketing a TV program / music recording, staff pattern & hierarchy in a mid & large size studio, roles and responsibilities of staff - administrative, technical, supervisory, cast, crew & talents. [04 Lectures]
Module 6 :Fire, Safety, Security & Legal Issues
Work place conditions, fire hazard & risk assessment, prevention of fire, chemical fire, extinguishers & firefighting methods, electrical shock, means to prevent electricity related accidents. [04 Lectures]

Text Books:
1. Philip Newell, *Recording Studio Design*, Focal Press, 2007.
2. Ronald J. Compesi, Jaime S. Gomez, *Introduction to Video Production: Studio, Field, and Beyond*, Pearson, 2006.

Reference Books:
1. Don Davis, *Sound System Engineering*, Focal Press, 2007.
2. Alton Everest, *Master Hand Book of Acoustics*, McGraw Hill, 2001.

18MT2031	DIGITAL TELEVISION ENGINEERING	L 3	T 0	P 0	C 3

Course objective:
- To overview the current and emerging trends in digital television.
- To understand the different propagation channels in digital television transmission.
- To apply the concepts in design of real-time broadcast television setup.

Course outcome:
The students will be able to:
- Observe the principles in digital television systems.
- Review the advantages of digital over analogue televisions.
- Discover the new advancements in digital television broadcast.
- Compare and contrast various types of television standards.
- Find a robust prorogation medium for television signals.
- Evaluate the performance of the optimum medium.

Module 1: Introduction to Digital Television
Shannon's Information Theorem - Digitizing a Video Signal - Measuring and Compressing Digital Video Signals - Digital Video Broadcasting -Picture and Sound Quality - MPEG-4: HDTV Compression [7 Lectures]
Module 2: Digital TV by Satellite
SatellitePositions and Power - Finding the Satellite - Positioning the Dish - Low Noise Block Converters (LNBs) - The Satellite Receiver [7 Lectures]
Module 3: Modulation and Antennas
Modulating Digital Signals -Error Protection and Transmitted Bitrate -Dish Size - Multi-Satellite Antennas -Installing Multi-Focus Antennas - Optimizing Parabolic Antennas [7 Lectures]
Module 4: DIGITAL TV BY CABLE
The Head end: The Heart of the Cable TV Network - Channel Capacity -The MATV (Master Antenna TV) Network - UHF Coaxial Networks - Coaxial Cable TV Networks - Hybrid Fiber Coaxial

Networks (HFC) -Digital Cable Television - SMATV, Satellite MATV Systems - Terrestrial Digital TV Signals in Coaxial Cable Systems [8 Lectures]

Module 5: DIGITAL TV BY TERRESTRIAL TRANSMITTERS

Antennas for Terrestrial TV Reception - Digital Terrestrial TV - Multi-Directional Antenna Systems - Indoor Antennas -Digital Terrestrial Receivers -DVB-T Receivers -Terrestrial TV for Mobile Devices; DVB-H [7 Lectures]

Module 6: DIGITAL TV BY BROADBAND

Broadband IPTV –Internet TV - Software Media Player Options - Internet Via Satellite - Digital Receivers - Digital TV with Interactive Services - Digital Receiver Firmware - The Application Interface - The API of the Future - The Media Gateway Dream -The Media Terminal [7 Lectures]

Text Book

1. Lars-Ingemar Lundstrom,"Understanding Digital Television-An Introduction to DVB Systems with Satellie, Cable, Broadband and Terrestrial TV Distribution, Focal Press; 1 edition (august 30, 2006).

Reference Books

1. Michael Robin, Michael Poulin "Digital Television Fundamentals", McGraw Hill 2nd Edition 2000.
2. Gerald W.Collins, "Digital Television Transmission", John Wiley & Sons 2001
3. Marcelo S. Alencar, "Digital television Systems", Cambridge University Press 2009.
4. Walter Fisher. " Digital Video And Audio Broadcasting Technology", Springer 2nd Edition 2008.

18MT2032	OBJECT ORIENTED PROGRAMMING	L	T	P	C
		3	0	4	5

Course Objectives:

The course will

- Introduce standard tools and techniques for software development using object oriented approach,
- Enable the student to understand appropriate use of various concepts for specific applications.
- Provide an appropriate framework for automated unit.

Course Outcome:

After taking the course, students will be able to:

- Exhibit basic knowledge in object oriented programming for developing programming skills.
- Recognize features of object-oriented design such as encapsulation, inheritance, and composition of systems based on object identity for appropriate applications.
- Illustrate the concept of polymorphism and exceptions using object oriented approach.
- Specify simple data types and design implementations, using functions to document them.
- Identify the suitable data structure for the storage of data involved in the application and develop applications using various linear data structures.
- Choose the appropriate techniques in algorithmic design strategies for real time application development.

Module 1: Objects and Classes

A Simple Class- C++ Objects as Physical Objects - C++ Objects as Data Types - Object as function argument -Constructors - - Returning Objects from functions - Structures and Classes – Array fundamentals-Initializing arrays-Multidimensional arrays-Array as function arguments-Strings-String variables-String constants-Reading Embedded blanks-Reading multiple lines [7 Lectures]

Module 2: Principles of Object Oriented Programming

Overloading Unary and Binary Operator - Data Type Conversion and its Pitfalls- Inheritance: Derived Class and Base Class - Overloading Member Functions- Public and Private Inheritance - Types of Inheritance.Pointers: Address and Pointers - Pointers and Arrays - New and Delete Operator 8 Lectures]

Module 3: Advanced Object Oriented Programming

Virtual Functions and Polymorphism - Friend Functions - Static Functions - this Pointer -

Templates and Exception: Function Templates - Class Templates - Exceptions. [7 Lectures]

Module 4:File Operations

Streams and Files: Stream Classes - Stream Errors - Disk File I/O with Streams - File Pointers. [7 Lectures]

Module 5:Introduction To Data Structures

Linked List Introduction-Implementation of Linked Lists Using Arrays-Linear Linked List-Basic Operations on linear linked List-Searching-Reversing-Concatenating-Disposing on linear linked Lists-Doubly linked List- Basic Operations on Doubly Linked List- Circular Linked List- Basic Operations on Circular Linked List. [8 Lectures]

Module 6:Sorting and Searching Techniques

Sorting - Bubble Sort- Insertion Sort- Selection Sort- Quick Sort- Heap Sort- Merge Sort.
Searching- Linear Search- Binary Search. [6 Lectures]

Text Books

1. Robert Lafore, "Object Oriented Programming in C++", Third Edition, Galgotia Publishers,Pune, Reprint, 2006.
2. Bronson , "C++ for Engineers and Scientists", 4th Ed. ISBN: 978-1133187844, 2013

Reference Books

1. Herbert Schildt, " C++, The Complete Reference" , Mc Graw-Hill Publishing Company Limited, New Delhi, 3rd Edition, 2002
2. Owen L. Astrachan, "Programming with C++ - A Computer Science Tapestry", Special Indian edition 2007, Tata McGraw-Hill, Second reprint, 2008.
3. Abhishek Daya Sagar,"Expert Data Structures using C/C++", BPB Publications, New Delhi 2004.
4. Al Stevens , "C++ Programming" , Wiley Dreamtech India (P) Ltd. , 7th edition, 2003.

		L	T	P	C
	OBJECT ORIENTED PROGRAMMING LAB	**0**	**0**	**4**	**2**

Course Description:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

		L	T	P	C
18MT2033	**WEB DESIGNING**	**2**	**0**	**4**	**4**

Course objective:

- To understand and use HTML tags for designing web pages.
- To experiment with various CSS Styles
- To learn Java-script for developing dynamic pages.\

Course outcome:

The students will be able to:

- **E**valuate the basic and advanced features in Server side scripting.
- Create a complete webpage with responsive feature
- Experiment about HTML programming and designing a web page
- Practice basic web pages using HTML, HTML5 and CSS.
- Recognize the JavaScript program as an aid for web design.
- Reproduce the unique design problems involved in web design.

Module 1: Introduction to HTML

HTML: Introduction – Editors – Basic structure – Elements – Attributes – Headings – Paragraphs – Styles – Formatting - Comments – Colors – Links – Images – Tables – Lists –Classes – Iframes – Forms [7 Lectures]

Module 2:HTML 5

HTML 5 & CSS : Introduction – HTML 5 Elements – Semantics – Canvas - HTML Audio – HTML Video – HTML Media – HTML API [7 Lectures]

Module 3: CSS
CSS – Backgrounds – Borders – Margins – Padding – Box Model – CSS responsive – CSS 3 [7 Lectures]
Module 4: BOOTSTRAP
Introduction - Grid Basics- Typography – buttons – pagination – panels – dropdowns – carousel – popover - Tooltip [7 Lectures]
Module 5: JAVASCRIPT
Introduction – keywords – Data types – Variables – Operators – Comments – Arrays – Expressions – Control Structures – Functions (calling a function, returning values, integrating function & HTML) - JSON [7 Lectures]
Module 6: SERVER SIDE SCRIPTING
SQL – SQL database – SQL Functions - PHP – PHP variables – PHP Forms – MySql database - ASP – ASP VB function [7 Lectures]

Text Book
1. H.M. Deitel, P.J. Deitel, “Internet & World Wide Web – How to program”, 3rd Ed. Prentice Hall, 2003.Author, “Book”, Publisher, Year of Publishing
2. Thomas A. Powell, “HTML: The Complete Reference”, McGraw Hill, 2001.

Reference Books
1. 1. Danny Goodman, Michael Morison, Paul Novitski, “Java Script Bible”, Wiley Publication, 7th Edition Author, “Book”, Publisher, Year of Publishing
2. David Crowder and Rhona Crowder,“Web Design with HTML/Flash/Javascript & Ecommerce BIBLE”, Wiley DreamTech India Pvt. Ltd,2001
3. Luke welling and Laura Thomson “PHP and MYSQL web development”, III Edition,, 2005

		L	T	P	C
	WEB DESIGNING LAB	**0**	**0**	**4**	**2**

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

LIST OF COURSES

Sl. No.	Course Code	Name of the Course	Credits
1	17EC1001	Basic Electronics Engineering	3:0:0
2	17EC2001	Digital Electronics	3:1:0
3	17EC2002	Electron Devices	3:0:0
4	17EC2003	Signals and Systems	3:1:0
5	17EC2004	Digital Electronics Laboratory	0:0:2
6	17EC2005	Electron Devices Laboratory	0:0:1
7	17EC2006	Electronic Circuits	3:0:0
8	17EC2007	Electronic Circuits Laboratory	0:0:1
9	17EC2008	Microprocessor and Microcontroller	3:0:0
10	17EC2009	Microprocessor and Microcontroller Laboratory	0:0:2
11	17EC2010	Digital Signal Processing	3:1:0
12	17EC2011	Digital Signal Processing Laboratory	0:0:2
13	17EC2012	Communication Theory and Systems	3:0:0
14	17EC2013	Communication System Laboratory	0:0:2
15	17EC2014	Transmission Lines and Wave guides	3:1:0
16	17EC2015	Linear Integrated Circuits	3:0:0
17	17EC2016	Linear Integrated Circuits Laboratory	0:0:2
18	17EC2017	Wireless and Networking Laboratory	0:0:1
19	17EC2018	Pulse and Wave Shaping Circuits	3:0:0
20	17EC2019	Antenna Theory and Wave propagation	3:1:0
21	17EC2020	Digital Communication	3:1:0
22	17EC2021	Microwave and Optical Communication	3:0:0
23	17EC2022	Microwave and Optical Communication Laboratory	0:0:2
24	17EC2023	VLSI Design	3:0:0
25	17EC2024	VLSI Design Laboratory	0:0:1
26	17EC2025	CAD for Electronics Engineers	3:0:0
27	17EC2026	Fiber Optic Communication	3:0:0
28	17EC2027	Advanced Microprocessor Architecture	3:0:0
29	17EC2028	Embedded System Design	3:0:0
30	17EC2029	ARM Processors	3:0:0
31	17EC2030	Embedded System Design Laboratory	0:0:2
32	17EC2031	Computer Communication	3:0:0
33	17EC2032	Telecommunication Switching Networks	3:0:0
34	17EC2033	Cellular Mobile Communication	3:0:0
35	17EC2034	Mobile Computing	3:0:0
36	17EC2035	IoT for Communication Engineering	3:0:0
37	17EC2036	High Speed Networks	3:0:0
38	17EC2037	Wireless Sensor Networks	3:0:0
39	17EC2038	Optoelectronics	3:0:0
40	17EC2039	Basics of Satellite Communication	3:0:0
41	17EC2040	Bio-Medical Signal Processing	3:0:0
42	17EC2041	Principles of Digital Image Processing	3:0:0
43	17EC2042	Neural Networks and Fuzzy Systems	3:0:0
44	17EC2043	Multimedia Compression Techniques	3:0:0
45	17EC2044	Machine Learning Algorithms for Image Processing	3:0:0
46	17EC2045	Information Theory and Coding	3:0:0
47	17EC2046	Digital System Design	3:0:0
48	17EC2047	Verilog HDL	3:0:0
49	17EC2048	VHDL	3:0:0
50	17EC2049	ASIC Design	3:0:0
51	17EC2050	Analysis and Design of Digital IC	3:0:0

52	17EC2051	Low power techniques in VLSI Design	3:0:0
53	17EC2052	Nano electronics	3:0:0
54	17EC2053	RF Circuit Design	3:0:0
55	17EC2054	Electronics and Communication Laboratory	0:0;2
56	17EC2055	Advanced Communication Laboratory	0:0:2
57	17EC2056	Microprocessor and Interfacing Techniques	3:0:0
58	17EC2057	Microprocessor Laboratory	0:0:1
59	17EC2058	Microcontroller and its Applications	3:0:0
60	17EC2059	Microcontroller Laboratory	0:0:1
61	17EC2060	Semiconductor Device Modelling	3:0:0
62	17EC2061	Electron Devices and Instrumentation	3:0:0
63	17EC2062	Electron Devices and Instrumentation Laboratory	0:0:2
64	17EC2063	Micro Electro Mechanical Systems	3:0:0
65	17EC2064	MATLAB programming for Engineers	3:0:0
66	17EC2065	Digital system design using HDL	3:0:0
67	17EC2066	Artificial neural network	3:0:0
68	17EC2067	PCB design Laboratory	0:0:2
69	17EC2068	Fundamentals of Electronics	3:0:0
70	17EC2069	Fundamentals of Wireless Communication	3:0:0
71	17EC2070	Linear and Digital IC Laboratory	0:0:2
72	17EC2071	Communication Engineering	3:0:0
73	17EC2072	Electron Devices and Circuits	3:0:0
74	17EC2073	Electron Devices and Circuits laboratory	0:0:2
75	17EC3001	Statistical Digital Signal Processing	3:0:0
76	17EC3002	Data Compression Techniques	3:0:0
77	17EC3003	Optical Networks and Photonic Switching	3:0:0
78	17EC3004	Modern Digital Communication Techniques	3:0:0
79	17EC3005	Wireless Communication Networks	3:0:0
80	17EC3006	Advanced Radiation Systems	3:0:0
81	17EC3007	Satellite Communication	3:0:0
82	17EC3008	Error Control Coding	3:0:0
83	17EC3009	Computational Intelligence and Optimization Techniques	3:0:0
84	17EC3010	Communication Laboratory – I	0:0:2
85	17EC3011	Communication Laboratory – II	0:0:2
86	17EC3012	Advanced Digital Signal Processing Laboratory	0:0:2
87	17EC3013	Digital Communication Receiver	3:0:0
88	17EC3014	Detection and Estimation Theory	3:0:0
89	17EC3015	DSP Architecture and Programming	3:0:0
90	17EC3016	Global Positioning System	3:0:0
91	17EC3017	Optical Signal Processing	3:0:0
92	17EC3018	Advanced Digital Image Processing	3:0:0
93	17EC3019	Microwave Integrated Circuits	3:0:0
94	17EC3020	Electromagnetic Interference and Compatibility	3:0:0
95	17EC3021`	RF System Design	3:0:0
96	17EC3022	Telecom Network Management	3:0:0
97	17EC3023	RF MEMS	3:0:0
98	17EC3024	Neural Network for RF and Microwave Design	3:0:0
99	17EC3025	Smart Antennas	3:0:0
100	17EC3026	Communication Network Security	3:0:0
101	17EC3027	Communication Network Routing Algorithms	3:0:0
102	17EC3028	Wireless Communication for Sensor Networks	3:0:0
103	17EC3029	Mobile Communication Networks	3:0:0
104	17EC3030	Hardware Description Languages	3:0:0
105	17EC3031	Digital System and ASIC Design	3:0:0

106	17EC3032	CMOS VLSI Design	3:0:0
107	17EC3033	Analysis and Design of Analog Integrated Circuits	3:0:0
108	17EC3034	VLSI Technology	3:0:0
109	17EC3035	Solid State Device Modeling and Simulation	3:0:0
110	17EC3036	Low Power VLSI Design	3:0:0
111	17EC3037	CAD for VLSI Circuits	3:0:0
112	17EC3038	Testing And Testability	3:0:0
113	17EC3039	VLSI Digital Signal Processing	3:0:0
114	17EC3040	ASIC Design Laboratory	0:0:2
115	17EC3041	HDL Laboratory	0:0:1
116	17EC3042	System On Chip Design	3:0:0
117	17EC3043	Reconfigurable Computing	3:0:0
118	17EC3044	IP Based VLSI Design	3:0:0
119	17EC3045	Design of Semiconductor Memories	3:0:0
120	17EC3046	Hardware Design Verification Techniques	3:0:0
121	17EC3047	High Speed VLSI Design	3:0:0
122	17EC3048	Analog VLSI Design	3:0:0
123	17EC3049	CMOS Mixed Signal Circuit Design	3:0:0
124	17EC3050	VLSI Circuits for Bio-Medical Applications	3:0:0
125	17EC3051	VLSI for Wireless Communication	3:0:0
126	17EC3052	Data Converters	3:0:0
127	17EC3053	Signal Integrity for High Speed Devices	3:0:0
128	17EC3054	Nanoscale FET	3:0:0
129	17EC3055	Nanoscale Devices and Circuit Design	3:0:0
130	17EC3056	Photonics	3:0:0
131	17EC3057	Advanced Embedded Systems	3:0:0
132	17EC3058	Wireless and Optical Networks	3:0:0
133	17EC3059	VLSI Design Techniques	3:0:0
134	17EC3060	Embedded systems Laboratory	0:0:1
135	17EC3061	Advanced Signal Processing Laboratory	0:0:1
136	17EC3062	Scripting Languages and Verification	3:0:0
137	17EC3063	Advanced Digital Signal Processing	3:0:0
138	17EC3064	Embedded Image processing	3:0:0
139	17EC3065	Software for Embedded systems	3:0:0
140	17EC3066	Embedded LINUX	3:0:0
141	17EC3067	Distributed Embedded Computing	3:0:0
142	17EC3068	Wireless and mobile communication	3:0:0
143	17EC3069	Embedded Open Source Software	3:0:0
144	17EC3070	Electronic product design	3:0:0
145	17EC3071	Embedded system networks	3:0:0
146	17EC3072	Speech and Audio Processing	3:0:0
147	17EC3073	Biological Signal Processing	3:0:0
148	17EC3074	Medical Image Processing	3:0:0
149	17EC3075	VLSI Digital Signal Processing	3:0:0
150	17EC3076	Advances in Electronics Applied to Hospital Engineering	3:0:0
151	17EC3077	Computer based Medical Instrumentation	3:0:0
152	17EC3078	Medical Signal Processing	3:0:0

Sl. No.	Course Code	Name of the Course	Credits
1	17MT2001	Technical Writing for Electronic Media	3:0:0
2	17MT2002	Digital Compositing	3:1:0
3	17MT2003	Audio Engineering	3:0:0
4	17MT2004	Audio Engineering and Production Lab	0:0:2
5	17MT2005	Graphics and Animation	3:0:0

6	17MT2006	Graphics and Animation Lab	0:0:2
7	17MT2007	Web Designing	3:0:0
8	17MT2008	Digital Television Engineering	3:0:0
9	17MT2009	Introduction to 3D Animation	3:0:0
10	17MT2010	Digital Photography	3:0:0
11	17MT2011	Photography Lab	0:0:2
12	17MT2012	Video Production Lab	0:0:2
13	17MT2013	Video Post Production Lab	0:0:2
14	17MT2014	Visual Effects Lab	0:0:2
15	17MT2015	Web Designing Lab	0:0:2
16	17MT2016	Visual Design Lab	0:0:2
17	17MT2017	Theories of Game Production	3:0:0
18	17MT2018	Mobile Application and Gaming Lab	0:0:2
19	17MT2019	3D animation Lab	0:0:2
20	17MT2020	Studio Acoustics	3:0:0
21	17MT2021	Media Laws and Ethics	3:0:0
22	17MT2022	Streaming Media	3:0:0
23	17MT2023	Video Editing	3:0:0
24	17MT2024	Principles of Cinematography	3:0:0
25	17MT2025	Advertising	3:0:0
26	17MT2026	Digital Music	3:0:0
27	17MT2027	Computer Based Music Production	3:0:0
28	17MT2028	Computer Based Music Production Lab	0:0:2
29	17MT2029	Live Sound Reinforcement Lab	0:0:2
30	17MT2030	Artificial Intelligence for Games	3:0:0
31	17MT2031	Game Design	3:0:0
32	17MT2032	VR Technologies and Applications	3:0:0
33	17MT2033	Game Production Lab	0:0:2
34	17MT2034	Advanced Animation Lab	0:0:2
35	17MT2035	Animatronics	3:0:0
36	17MT2036	Live Multi- Camera Production Lab	0:0:2
37	17MT2037	Broadcast Technology	3:0:0
38	17MT2038	Audio Signal Processing	3:0:0
39	17MT2039	Photography Theory and Practice	3:0:0
40	17MT2040	Electronic Media Management	3:0:0

17EC1001 BASIC ELECTRONICS ENGINEERING

Credits: 3:0:0

Course objective:

- To impart the basic knowledge about the passive components
- To know about the fundamentals of electronics, some electronic devices and digital circuits
- To get the knowledge about the various analog communication techniques and applications

Course outcome:

The students will be able to:

- Understand the difference between active and passive components
- Comprehend the basic physics behind the semiconductor devices.
- Select the electronics devices based on their characteristics.
- Design basic structures using logic gates
- Acquire knowledge of basic communication systems.
- Apply the basic electronics concepts in real time systems.

Unit I - Passive Components and Semiconductor Physics: Resistors – Types of resistors – color coding, Capacitors – Types of capacitors, Inductors – Types of inductors - Covalent bond – N type & P type semiconductor – conduction in semiconductor.
Unit II - Electron Devices: PN diode –Application: Half wave rectifier, Zener diode - Application: Zener Voltage Regulator-Bipolar Junction Transistor (CB configuration only) - Field Effect Transistors (JFET, MOSFET) - UJT.
Unit III - Digital System: Number system – Boolean algebra – logic gates –truth table - simplification of logic functions using karnaugh map (4 variables), combinational circuit -Half Adder - 4 x 1 multiplexer – 1 x 4 demultiplexer – 3 x 8 Decoder
Unit IV - Communication System: Basic block of communication system – need for modulation – types of modulation, Derivation of AM signal - Block diagram of AM transmitter - Superheterodyne receiver, Introduction to wireless Communication - 2G, 3G, 4G, 5G, Bluetooth, Wifi.
Unit V - Applications: (Block diagram description only): Satellite communication –Introduction to Computer Architecture - Introduction to Embedded Systems – Elements of Embedded Systems – Introduction to IOT, Smart Home, Smart Health care.

Text Book

1. Muthusubramanian ,R, Salivahanan S, Muraleedharan K.A, “Basic Electrical, Electronics & Computer Engineering “Tata Mc.Graw Hill, 2009.

Reference Books

1. Robert Boylestad and Louis Nashelsky, “Electronic Devices & Circuit Theory”, 9th Pearson Education Edition, 2009.
2. Anokh Singh, “Principles of Communication Engineering” S.Chand Co., 2001
3. V.K.Metha.”Principles of Electronics”, Chand Publications,2008
4. Rappaport.T.S., “Wireless Communication”, Pearson Education, 2003
5. Dr.Ovidiu Vermesan, Dr.Peter Friess, “ Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers 2013

17EC2001 DIGITAL ELECTRONICS

Credits: 3:1:0

Course objective

- To learn about number systems, binary codes and the basic postulates of Boolean algebra.
- To study formal procedures for the analysis and design of combinational and sequential circuits.
- To learn the concept of memories and implementation of digital circuits in programmable logic devices and about different logic families.
- To illustrate the concept of designing combinational and sequential circuits using VERILOG.

Course outcome

The students will be able to:

- Understand the basic postulates of Boolean algebra and logic gates.
- Illustrate different methods for simplification of Boolean expressions.
- Design combinational logic circuits.
- Analyze synchronous and asynchronous sequential logic circuits.
- Design simple logic circuits using HDL codes.
- Interpret different methods for implementation of digital circuits.

UNIT I Minimization Techniques And Logic Gates: Number Systems - Boolean postulates and laws – De-Morgan’s Theorem Principle of Duality Boolean expression Minimization of Boolean expressions –– Minterm – Maxterm - SOP – POS – Karnaugh map Minimization – Don’t care conditions – Quine Mc Cluskey method of minimization. Binary Codes - Gray Code – BCD Code - Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive OR and Exclusive NOR - Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations - Multi output gate implementations - TTL and CMOS Logic and their characteristics
UNIT II Combinational Circuits: Design procedure: Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder – Carry Look Ahead adder – Serial Adder - BCD adder – Binary Multiplier – Multiplexer - Demultiplexer – Implementation of logic functions using multiplexers - decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III Sequential Circuits: Latches, Flipflops SR, JK – Realization of one flip flop using other flip flops - D, T - Master Slave – Characteristic table and equation – Clock Parameters: Pulse width, setup, hold, propagation delay – Asynchronous, Ripple or serial counter – Asynchronous Up/Down counter Synchronous counters – Synchronous Up/Down counters – Design of Synchronous counters: state diagram State table –State minimization –State assignment - Excitation table - Modulo–n counter, Registers – shift registers - Universal shift registers – Johnson Counter - Ring counter – Sequence generators.
UNIT IV Memory Devices: Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle Timing wave forms – Memory decoding – memory expansion – Static RAM Cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) Implementation of combinational logic circuits using ROM, PLA, PAL.
UNIT V Synchronous And Asynchronous Sequential Circuits: Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: General Model – Races and Cycles – Introduction to VERILOG - Design of Combinational and Sequential circuits using VERILOG.

Text Book:
1. M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008

Reference Books:
1. John F.Wakerly, "Digital Design Principles and Practices", Fourth Edition, Pearson/PHI, 2008.
2. John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
5. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
6. Donald D.Givone, "Digital Principles and Design", TMH, 2003.

17EC2002 ELECTRON DEVICES

Credit: 3:0:0

Course objectives:
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits and to analyze various components.

Course outcomes:
The students will be able to
- Demonstrate the flow of charge carriers in semiconductor and interpret the VI relations.
- Gain the knowledge of physical fundamentals of semiconductor.
- Analyze the basic properties of semiconductor devices such as diodes and transistors.
- Understand the fundamental operation principles, applications and limitations of special semiconductor devices.
- Analyze the behavior of semiconductor devices for designing VLSI circuits.
- Design simple practical circuits using electronic components and to do the necessary analysis.

Unit I - Semiconductor in Equilibrium: Charge carriers in semiconductors- Extrinsic semiconductor-Charge neutrality-Position of Fermi energy level-Carrier transport phenomena-Carrier generation and recombination-Continuity equation -Hall effect-Quasi Fermi energy levels.
Unit II - Theory of PN Diodes: PN junctions : Basic structure- Applied bias- PN junction current- Small signal model of the PN junction: Diffusion resistance, Small signal Admittance(Qualitative analysis) ,Diffusion Capacitance, Transition Capacitance.
Unit III - Theory of Junction transistors: Bipolar transistor action-Transistor current components: Emitter injection efficiency, Base transport factor, Collector efficiency, Large signal current gain-Static characteristics of transistor: CB, CE and CC –Ebers Moll model.
Unit IV - Theory Of JFET, UJT and SCR: Junction FET operation - Static characteristics - Enhancement MOSFET- Depletion MOSFET -Comparison of JFET and MOSFET- UJT : Operation, Static characteristics - SCR: Construction, Static Characteristics .

Unit V - Special Semiconductor Devices (Qualitative Treatment Only): Zener diode and its application -Tunnel diodes – DIAC- TRIAC- Photo diodes and its applications-Circuit simulation using software tools

Text Books :

- Donald A. Neamen, " Semiconductor physics and Devices ",Tata McGraw Hill, 4th Edition, 2012.
- Jacob Millman & Halkias,"Electronic Devices & Circuits",Tata McGraw Hill second edition,2013.
- Malvino A P, "Electronic Principles", McGraw Hill International, 7th Edition 2016.
- David.A.Bell, "Electronic Devices & Circuits ", Oxford University Press, 4th Edition 2010.
- Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Edition, Pearson Education, 2016.

17EC2003 SIGNALS AND SYSTEMS

Credits: 3:1:0

Course objectives:

- To understand the basic properties of signal & systems and the various methods of classification
- To learn Laplace Transform & Fourier transform and their properties
- To know Z transform & DTFT and their properties
- To categorize LTI systems in the Time domain and various Transform domains

Course Outcomes:

The students will be able to

- Recognize the continuous time, discrete time signal operations and system properties
- Express the continuous time signals in Fourier transform and Laplace Transform domains.
- Demonstrate the properties of discrete time- signals in the Fourier transform and Z transform domains.
- Categorize the continuous time system in the time domain, Fourier Transform domain and Laplace Transform domain.
- Categorize the discrete time system in the time domain, Fourier Transform domain and Z-transform domain.
- Design and develop the continuous time and discrete time systems

Unit I - Classification of signals and systems: Continuous Time (CT) signals – CT signal operations – Discrete Time(DT) signals –Waveform generation using software– Representation of DT signals by impulses – DT signal operations – CT and DT systems – Properties of the systems – Linear Time Invariant(LTI) and Linear Shift Invariant(LSI) systems – Continuous and Discrete Convolutions – CT system representations by differential equations – DT System representations by difference equations.

Unit II - Fourier Analysis of CT Signals And Systems: Fourier series representation of periodic signals – Properties – Harmonic analysis of LTI systems – Convergence of Fourier series – Representation of a periodic signals by Continuous Time Fourier Transform (CTFT) – Properties – Frequency response of systems characterised by Dif ferential Equations – Power and Energy Spectral Density – Parseval's Relation.

Unit III - Discretisation of CT Signals: Representation of CT signals by samples – Sampling Theorem – Sampling Methods – Impulse, Natural and Flat Top Sampling – Reconstruction of CT signal from its samples – Effect of under sampling – Aliasing Error – Discrete Time processing of CT signals

Unit IV - Fourier Analysis of DT Signals And Systems: Discrete Time Fourier series representation of DT periodic signals – Properties – Representation of DT aperiodic signals by Discrete Time Fourier Transform(DTFT) – Properties – Frequency response of systems characterised by Difference Equations – Power and Energy Spectral Density concepts related to DT signals – Parseval's Relation.

Unit V - Transform Operations of CT and DT Systems: Laplace Transform-Properties-System Analysis-Z transform and its properties – Inverse Z transform – Solution of Difference equations –Z Transform analysis of Recursive & Non-Recursive systems-System Properties using software tools.

Text books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, ―Signals and Systems‖, Pearson, Indian Reprint, 2009.
2. Simon Haykin and Barry Van Veen, "Signals & Systems", John Wiley and Sons Inc., 2005

Reference Bookss:

1. B. P. Lathi, Principles of Linear Systems and Signals, Oxford, Second Edition, 2009.
2. Samir S Solimon and Srinath M.D., "Continuous and Discrete Signals and Systems", II Edition, PHI, 2003.

3. Rodger E Zaimer and William H Tranter, “Signals & Systems – Continuous and Discrete”, McMillan Publishing Company, 2002.
4. P.Ramakrishna Rao, Signals and Systems‖ , Tata Mc Graw Hill Publications, 2008.
5. John Alan Stuller, An Introduction to Signals and Systems‖, Thomson, 2007

17EC2004 DIGITAL ELECTRONICS LABORATORY

Credits: 0:0:2

Course objectives:

- To learn about the basic characteristics of all logic gates.
- To design combinational circuits.
- To design sequential circuits.
- To design and simulate digital circuits using Verilog code.

Course outcomes:

The students will be able to

- Understand the basic characteristics of all logic gates.
- Illustrate different methods for realizing logic gates using universal gates.
- Design and verify combinational logic circuits.
- Analyze and inspect sequential logic circuits.
- Design digital circuits for practical applications
- Design and test simple digital circuits using Verilog code.

Experiments:

1. Realization of logic gates using universal gates
2. Design, implementation and verification of half adder and full adder
3. Design, implementation and verification of half subtractor and full subtractor
4. Design, implementation and verification of multiplexer and demultiplexer
5. Design, implementation and verification of code converters
6. Design, implementation and verification of encoder and decoder
7. Design, implementation and verification of magnitude comparator
8. Design, implementation and verification of flip flops
9. Design, implementation and verification of counters
10. Design, implementation and verification of shift registers
11. Design and simulation of combinational circuit using Verilog
12. Design and simulation of sequential circuit using Verilog

17EC2005 ELECTRON DEVICES LABORATORY

Credits: 0:0:1

Course Objective:

- To understand the characteristics of semiconductor and special purpose electron devices.
- To design rectifiers, amplifiers and regulators.
- To design power control devices

Course Outcomes:

Students will be able to

- classify the basic properties and characteristics of semiconductor devices.
- identify, differentiate and construct the circuit of rectifiers, amplifiers and regulator.
- construct the experiments, as well as to analyze and interpret data
- analyze practically the response of various special semiconductor devices.
- relate the circuit models to perform parameter analysis.
- explain the response of devices in power control.

List of experiments

1. PN diode – Characteristics and Applications – Full Wave Rectifier
2. Zener diode – Characteristics and Applications – Voltage Regulator
3. Characteristics of BJT (CE Configuration) and hybrid (h) parameters Evaluation
4. BJT as an amplifier and as a switch

5. Characteristics of JFET– Drain and Transfer Characteristics
6. Characteristics of SCR

17EC2006 ELECTRONIC CIRCUITS

Credits 3:0:0

Course Objectives:

- To introduce the students the operational principle and the analysis of diode in analog circuits together with the design of rectifiers and regulated power supplies.
- To understand the various methods of biasing a transistor and to perform an analysis on BJT amplifiers.
- To acquaint students with the list of improvements achieved on negative feedback amplifiers and the design of various oscillator circuits.

Course Outcomes:

Students will be able to:

- Describe the impacts of negative feedback on gain, input impedance and output impedance of different feedback configurations.
- Identify suitable rectifier and regulator circuits to construct Regulated Power Supply.
- Apply how positive feedback is used in the design of sinusoidal oscillators.
- Analyze various transistor biasing configurations and to calculate the stability factor of different biasing circuits.
- Design transistor amplifier circuits using discrete components.
- Choose suitable passive and active components to design any electronic circuits.

Unit I - Regulated Power Supply: Half Wave Rectification: Derivation of Ripple Factor, Rectification Efficiency - Full Wave Rectification: Center-Tapped Transformer, Derivation of Ripple Factor, Rectification Efficiency - Full Wave Rectification with Inductor Filter: Derivation of Ripple Factor - Full Wave Rectification with Capacitor Filter: Derivation of Ripple Factor - Voltage Regulation using Zener Diode.

Unit II - BJT and FET Biasing: BJT Biasing: Operating Point – Fixed Bias Configuration: Forward Bias of Base Emitter, Collector - Emitter Loop, Load Line Analysis and Derivation of Stability Factor - Voltage Divider Bias Configuration: Exact Analysis and Derivation of Stability Factor – FET Biasing: Fixed Bias Configuration – Voltage Divider Biasing Configuration.

Unit III - BJT Amplifiers: BJT Single stage RC Coupled amplifier: The ac analysis of Mid-Frequency Small Signal Transistor Amplifier – Frequency Response: Logarithms, Decibels, General Frequency Considerations, Normalization process – Multistage Cascaded R-C Coupled Amplifier: The Voltage Gain, The current Gain, Power Gain, Multistage Frequency effects – Power Amplifiers: Transformer-Coupled Class A Amplifier: Transformer Action, Operation of Amplifier Stage, Maximum Theoretical Efficiency - Class B amplifier Operation: Input DC Power, Output AC Power, Derivation of Maximum Efficiency, Transformer-Coupled Push-Pull Circuits, Complementary-Symmetry Circuits, Amplifier Distortion – Class C Amplifier- Class D Amplifier - Class E Amplifier.

Unit IV - Feedback Amplifiers: Feedback Concepts – Feedback Connection Types - Gain Derivations with Feedback – Input Impedance Derivations with Feedback – Output Impedance Derivations with Feedback – Reduction in Frequency Distortion – Reduction in Noise and Nonlinear Distortion – Effect of Negative Feedback on Gain and Bandwidth.

Unit V - Oscillators: Oscillator Operation – RC Phase Shift Oscillator – Wein Bridge Oscillator – Tuned Oscillator Circuit: Colpitts Oscillator, Hartley Oscillator, Crystal Oscillator.

Text Books:

1. Robert L. Boylestad, Louis Nashelsky, “Electronic Devices And Circuit Theory”, Pearson Publications, Eleventh Edition, 2016 Reprint.
2. Jacob Millman, Christos C Halkias, Satyabrata JIT., "Millman’s Electronic Devices And Circuits", Tata McGraw Hill Publications, 3rd Edition, 2011 Reprint.

Reference Books:

1. Malvino A.P., “Electronic Principles”, McGraw Hill International, 2005.
2. Jimmie J Cathey., “Electronic Devices And Circuits”, Tata McGraw Hill Publications, 3rd Edition, 2013 Reprint.

17EC2007 ELECTRONICS CIRCUITS LABORATORY

Credits: 0:0:1

Objective:

- To simulate amplifier circuits .
- To design oscillator circuits.
- To analyze amplifier and tuned circuits.

Course outcomes:

The students will be able to

- Apply engineering mathematical concepts to design basic circuitry and connections.
- Express the practical knowledge of various electronic circuits.
- Demonstrate skills by using modern tools to analyze problems.
- Employ appropriate components by effective application of the knowledge gained.
- Mathematically analyze and predict appropriate circuits.
- Assess on power amplifier circuits.

Experiments

1. Frequency Response of CE, CB amplifiers and its Spice simulation
2. Design of Differential amplifiers and its CMRR measurement
3. Design and analysis of feedback amplifiers
4. Design and analysis of RC phase shift oscillator
5. Design and analysis of Single tuned amplifier
6. Design and analysis of class A amplifier and spice simulation of class B power amplifier.

17EC2008 MICROPROCESSOR AND MICROCONTROLLER

Credits: 3:0:0

Course Objectives:

- To impart basic knowledge about architecture of processor & controller.
- To get familiarized with the interfaces in processors and instruction sets in controller.
- To explore the necessity of controller in real time applications.

Course outcome:

The students will be able to:

- Discuss the microprocessor organization and its evolution.
- Describe the architecture of 8051 controller.
- Express their knowledge in designing a system using 8051
- Differentiate ARM architecture and features from other processor.
- Write ARM coding in Embedded C.
- Apply the concept to simulate real time system using IDE.

Unit I - Microprocessor Organization & Evolution: Introduction to microprocessors, computer and its organization, Programming system, address bus, Data bus and Control bus, Tri state bus, clock generation, Connecting microprocessor to I/O devices, data transfer schemes, Architectural advancements of microprocessors, Evolution of microprocessors.
Unit II - 8051 Microcontroller: Introduction to 8051 micro-controller, Architecture, Memory organization, Special function registers, Port operation, Memory interfacing, I/O interfacing, Interrupts, Power down operation, Instruction set and Embedded C Programming, 8051 micro controller based system designs.
Unit III - ARM Architecture: Acorn RISC machine, Architecture inheritance, ARM Programming model, ARM development tools, 3 and 5 stage pipeline organization, ARM instruction execution and implementation, ARM co-processor interface.
Unit IV - Programming in ARM: ARM instruction types, Coprocessor instructions, Programming In Embedded C.
Unit V - Applications: Introduction to IDE, Interfacing of motor, interfacing of sensors, Real time applications.

Text Books:

1. Krishna Kant, "Microprocessors and Microcontrollers – Architecture, programming and system design 8085, 8086, 8051, 8096", Prentice Hall of India, New Delhi, 2007.

2. Muhammad Ali Mazidi, “The 8051 Microcontroller and Embedded systems”, Prentice Hall India, New Delhi, 2006
3. Steve Furber, “ARM system – on – chip architecture”, Prentice Hall of India, New Delhi, 2009.

Reference Books:

1. Kenneth J Ayala, “The 8051 Microcontroller – Architecture, Programming and Applications”, Penram International Publications, Mumbai, India, 1996.
2. Andrew Sloss & Dominic Symes & Chris Wright, “ARM System Developer's Guide, 1st Edition”, Elsevier, Morgan Kaufmann Publishers.

17EC2009 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

Credits: 0:0:2

Course Objectives:

- To enable the students to understand the programming techniques of Microprocessor.
- To enable the students to understand the programming techniques of Microcontrollers.
- To design suitable control application using Microcontrollers.

Course Outcomes:

After completion of the course, students will be able to

- Review the programming skills in Microprocessor and Microcontroller.
- Develop coding in assembly language in 8051.
- Practice the coding in Embedded C.
- Use the programming skill to code for interfacing devices in 8051.
- Compose the coding using Embedded C for ARM.
- Write programs to interface with ARM.

Assembly Language Programming using 8051

1. Arithmetic Operations
2. Searching of a number.

Embedded C programming in 8051

3. Square wave generation using Embedded C
4. Counter Program Using Embedded C.

Interfacing experiments

5. Interfacing ADC with 8051
6. Interfacing DAC with 8051
7. Interfacing keyboard and Display unit
8. Timer Interfacing

Experiments using ARM

9. Timer programming in ARM
10. LED interfacing with ARM.
11. Switch interfacing with ARM.
12. PWM in ARM

17EC2010 DIGITAL SIGNAL PROCESSING

Credits: 3:1:0

Course Objective:

- To impart basic knowledge about digital signal processing
- To understand Digital (IIR and FIR) filter design procedures.
- To know about the finite word length effects and PDSPs.

Course Outcome:

The students will be able to:

- Outline the digital signal processing concepts.
- Analyze the discrete time signals for DSP applications.
- Apply various transformations for Digital (IIR and FIR) filter design procedures.
- Relate the signal processing concepts practically with the help of finite word length effects and PDSPs.
- Compare and select the DSP processor suitable for a specific application.

- Design and develop algorithms for signal processing applications.

Unit I - Introduction to DSP and Fourier Transform Review of Discrete Time LTI Systems – Linear, circular and sectioned convolutions. Sample rate conversion. Discrete fourier transform. Fast Fourier transform computations using DIT and DIF algorithms.
Unit II - Infinite Impulse Response Filters: Calculation of IIR coefficients using pole –zero placement method-Review of classical analog filters-Butterworth,Chebyshev and Elliptic filters–Transformation of analog filters into equivalent digital filters using impulse invariant method and Bilinear transformation method. Realization structures of IIR filters-Direct and cascade forms
Unit III - Finite Impulse Response Filters: Symmetric and Antisymmetric FIR filters – Linear phase response and its implication – FIR filter design using window method – frequency sampling method – design of optimal linear phase FIR filters – realization structures of FIR filters – transversal and linear phase structures.
Unit IV - Finite Word Length Effects: Representation of numbers in registers-ADC quantization noise-coefficient quantization error-Product quantization error –Limit cycles due to product round-off error, Round –off Noise reduction scheme-Addition over flow errors-Principle of scaling.
Unit V - Adaptive filtering and DSP Processors: Adaptive filtering – basic wiener filter theory – LMS adaptive algorithm. Introduction to general and special purpose hard ware for DSP – Harvard architecture –pipelining-Special instruction-Replication-Hardware digital filter – Texas Instruments TMS320C6416 – Instruction set of TMS320C6416 – Simple programs. Applications of DSP – Case studies.

Text Books:

1. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson, Fourth Edition, 2007.
2. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall, Upper Saddle River, NJ.

Reference Books:

1. Emmanuel C. Ifeacher and Barrie W. Jervis, “Digital Signal Processing – A Practical Approach”, Wesley Longman Ltd., 2nd Edition, 2004
2. SanjitK.Mitra, “Digital Signal Processing - A Computer Based Approach”, Tata McGraw-Hill, New Delhi, 2nd Edition, 2001
3. Johny R. Johnson, “Introduction to Digital Signal Processing”, PHI, 2006
4. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, “Digital Signal Processing”, McGraw Hill International, 2007
5. Venkatramani B, M. Bhaskar, ‘Digital Signal Processors Architecture, Programming and Applications’, Tata McGraw– Hill Publishing Company Limited, New Delhi, 2002.
6. Texas Instruments Manuel for TMS320C6416 Processor.

17EC2011 DIGITAL SIGNAL PROCESSING LABORATORY

Credits: 0:0:2

Course Objective:
- To gain knowledge in DSP applications like FIR,IIR filters and FFT using MATLAB
- To gain knowledge on Texas instrument TMS320C6416/6713 DSK and work on real time applications.

Course Outcome:
The students will be able to:
- Translate the basic signal processing concepts using softwares
- Analyze the various mathematical transforms using softwares
- Design the digital filters by applying suitable transformations or techniques using softwares
- Express the basic signal processing concepts using DSP Processor
- Implement the mathematical transforms using DSP Processor
- Demonstrate the real time filtering of audio signals using DSP Processor

List of Experiments:
Using Softwares
1. Generation of DT Signals and sample rate conversion
2. Convolution and its properties
3. Calculation of DFT of a Signal
4. Design of IIR Filters-1 (Butterworth)

5. Design of IIR Filters-2 (Chebyshev)
6. Design of FIR Filter.

Using DSP Processor

7. Waveform Generation
8. Implementation of Convolution
9. Implementation of DFT
10. Configuration of ADC
11. Implementation of FIR Filter
12. Implementation of IIR Filter

17EC2012 COMMUNICATION THEORY AND SYSTEMS

Credits: 3:0:0

Course objective:

- To impart the basic concepts of communication systems, transmitter and receiver.
- To understand analog modulation and demodulation techniques.
- To analyze the adverse effect of noise on signals.

Course outcome:

- Apply engineering mathematical concepts in various communication techniques.
- Identify the required system for a better communication technique.
- Analyze and interpret data considering the limitations of various modulation techniques.
- Employ appropriate modulators and demodulators for transmitters and receivers
- Predict and mathematically design an appropriate modulation technique.
- Assesson the adverse effect of noise on signals.

Course Contents:

Unit I - AMPLITUDE MODULATION & DEMODULATION TECHNIQUES: Introduction, Communication system block diagram –-Need for modulation – Types of Modulation-Amplitude Modulation: Theory of Amplitude Modulation – AM power calculations – Need for suppression of carriers – Suppressed carrier systems (DSB SC, SSB SC & VSB systems). Generation of AM signal–Square law diode modulation –Suppressed carrier AM generation Balanced Modulator. AM Demodulation: Square law detector, envelope detector – synchronous demodulation.

Unit II - ANGLE MODULATION & DEMODULATION TECHNIQUES: Angle Modulation: Theory of Frequency modulation, Mathematical analysis of FM and representation of FM – Narrow band FM and wide band FM - Comparison of AM & FM. Frequency modulation: Generation - FM signal by Direct method (Varactor diode modulator) – Indirect generation of FM-Armstrong method -FM Demodulation: Balanced slope detector, Foster Seeley discriminator, Ratio detector, Theory of phase modulation.

Unit III - AM TRANSMITTERS AND RECEIVERS: AM Transmitter and Receiver: AM transmitters block schematic- high level and low level transmitters-SSB transmitters- ISB transmitters - Characteristics of Receivers - Tuned radio frequency receivers – Super heterodyne receiver- Basic elements of AM super heterodyne receiver: - Image frequency rejection – frequency conversion – IF amplifier.

Unit IV - FM TRANSMITTERS AND RECEIVERS: Allocation of frequency for various services FM Transmitter and Receivers: Block diagram of FM transmitter and methods of frequency stabilization – FM stereo-Pre-emphasis. Block diagram of FM receiver – De-emphasis – Noise Limiter- Automatic Frequency Control.

Unit V - NOISE: Noise and Interference-Thermal and Shot noise-Signal to Noise ratio – Noise-figure – Noise temperature – Noise figure of cascaded stage-Noise in AM- SSB SC calculation of output signal to noise ratio - DSBSC Calculation of output signal to noise ratio - Figure of merit.

Text Book:

1. Anokh Singh, A.K.,"Principles of Communication Engineering", S.Chand Co.,7th Edition, 2013.

Reference Books:

1. Simon Haykins, "Communication Systems" John Wiley, 4th Edition, 2004.
2. G.Kennedy, "Electronic Communication Systems", McGraw Hill, 5th Edition, 2012.
3. Taub and Schilling , "Principles of Communication Systems", McGraw Hill, 2ndEdition, 2003
4. Dennis Roddy & John Coolen, "Electronic Communication", Pearson Education Limited, 4th Edition, 2012.

17EC2013 COMMUNICATION SYSTEM LABORATORY

Credits: 0:0:2

Course objective:

- To understand analog communication systems and its channel characteristics
- To implement various coding format schemes
- To learn the digital modulation techniques

Course outcomes:

The students will be able to

- define various modulation schemes .
- discuss communication systems in system level and sub-block levels
- design and simulate various modulation schemes
- critically assess the performance of wired communication systems and filters
- analyze the performance of digital MODEM to given specifications emphasizing the use of tools in engineering practice
- ability to write report on the design and implementation of the circuits and systems

List of Experiments:

1. Amplitude Modulation and Demodulation
2. Frequency Modulation and Demodulation
3. Time Division multiplexing
4. Equalizers
5. IF amplifier
6. Generation of various line coding formats
7. M-ary Signaling schemes (ASK,FSK,PSK)
8. Sampling, Quantization effects and error correction code in Pulse Code Modulation
9. Generation and detection of delta MODEM (Granular noise and overload noise)
10. Test and measurement of RF filters (LPF, HPF, BPF, BRF) using Spectrum analyzer
11. Design and simulation of Superheterodyne receiver
12. Study of wireless communication using WiCOMM-T/SDR platform or data communication trainer module.

17EC2014 TRANSMISSION LINES AND WAVEGUIDES

Credits: 3:1:0

Course objective:

- To develop a fundamental understanding in the concepts of transmission lines.
- To know the essentials of impedance matching using Smith chart.
- To impart the knowledge of mode analysis in waveguides and to apply basic electromagnetic concepts for Microwave resonators.

Course outcome:

The students will be able to:

- recognize the characteristics of transmission lines.
- summarize the knowledge of impedance matching through Smith chart and simulation tools.
- apply the electromagnetic concepts in waveguides
- analyze different types of waveguide and resonators
- perform modal analysis to waveguide structures
- design and develop planar transmission lines and waveguide structures for different frequencies.

Unit I - Transmission Line Theory: General Solution – Types – Primary and Secondary constants – Physical significance of infinite line – reflection coefficient – wavelength and velocity of propagation - Waveform distortion – distortion less transmission line – Reflection on a line not terminated in Z_o – Short circuited and Open circuited line – Loading - Input impedance – Transfer impedance – Reflection factor and Reflection loss – T and Π Section equivalent to lines – Numerical Problems.

Unit II - The Line at Radio Frequencies: Parameters of open wire and coaxial lines at Radio Frequency- Standing waves and standing wave ratio on a line – VSWR measurements - impedance matching - half wave line - One eighth wave line – Quarter wave Transformer – The Smith Chart and its application – single stub matching and double stub matching – Problems using Smith Chart.

Unit III - Network Components: Constants of symmetrical Networks – Filter fundamentals – Filter design (Constant K Low pass and High Pass Filters) - lumped element and distributed element approach to filter design –Design of Attenuators and Equalizers – Lattice type , Concept of inverse networks–Transients in transmission lines, Lattice diagram – Numerical Problems

Unit IV - GuidedWaves: Waves between parallel planes of perfect conductors – characteristics of TE and TM and TEM Waves – Velocities of propagation – Attenuation of TE and TM waves in parallel plane guides – Wave impedances - Solution of wave Equation in Rectangular guides ,TE and TM modes , Dominant Mode – Mode Analysis in rectangular waveguide – Mode Excitation – Numerical Problems.

Unit V - CircularWave Guides and Resonators: Bessel functions – Solution of field equations in cylindrical coordinates – TM and TE waves in circular guides – wave impedances and characteristic impedance – Dominant mode in circular waveguide – excitation of modes – Microwave cavities, Rectangular cavity resonators, circular cavity resonator, semicircular cavity resonator, Q factor of a cavity resonator for TE101 mode – Microstrip transmission lines.

Text Books:

1. J.D. Ryder, "Networks, Lines and Fields", 2nd Edition, PHI, New Delhi, 2011.
2. E.C. Jordan and K.G.Balmain, "Electro Magnetic Waves and Radiating System", 2nd Edition, PHI Learning, New Delhi, 2011.

Reference Books:

1. David M. Pozar, "Microwave Engineering", 4th Edition, John Wiley 2013.
2. R.E. Collin, "Foundations for Microwave Engineering", McGraw-Hill, 2010.
3. David K.Cheng, "Field and Waves in Electromagnetism", New International edition, Pearson Education, 2013.

17EC2015 LINEAR INTEGRATED CIRCUITS

Credits 3:0:0

Cource Objectives:

- To introduce the basic building blocks of linear integrated circuits.
- To learn the applications of operational amplifier.
- To introduce the theory of Filters and PLL.
- To learn the theory of ADC and DAC.
- To introduce the concepts of waveform generation and introduce some special function ICs.

Cource Outcomes:

Upon Completion of the course, the students will be able to:

- Design linear and non linear applications of op – amps.
- Design Filters using op-amp
- Design ADC and DAC using op – amps.
- Design Timer circuits using 555 IC
- Generate waveforms using op – amp circuits.
- Analyze performance of special function ICs.

Unit I - BASICS OF OPERATIONAL AMPLIFIERS: Current mirror and current sources- BJT Differential amplifier with active loads- Basic information about operational amplifiers – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics- Inverting and non inverting amplifier

Unit II - APPLICATIONS OF OPERATIONAL AMPLIFIERS: Voltage Follower- adder- subtractor- Instrumentation amplifier- Integrator- Differentiator- Logarithmic amplifier- Antilogarithmic amplifier- Comparators- Schmitt trigger- Precision rectifier- peak detector -clipper and clamper.

Unit III - ACTIVE FILTERS AND PLL: Low-pass- high-pass ,band-pass and Band elimination Butterworth filters-Operation of the basic PLL- Voltage controlled oscillator- Monolithic PLL IC 565- application of PLL for AM detection- FM detection.

Unit IV - ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS: Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, A/D Converters – Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converter

Unit V - WAVEFORM GENERATORS AND SPECIAL FUNCTION LINEAR ICS: Sine-wave generators using op-Amp 741 : RC phase shift oscillator-wien bridge oscillator- Multivibrators using op-Amp 741 : Astable ,Monostable - Triangular wave generator- Saw-tooth wave generator- Timer IC 555:Astable-Monostable- Applications- IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator

Text Books:

1. 1.Roy Choudhury.D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 3rd Edition,2007.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.

Reference Books:

1. Gayakwad.A.R., "Op-Amps & Linear IC's", PHI, 4th Edition,2004
2. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & LinearIntegrated Circuits", PHI 6th Edition, 2001
3. B.S.Sonde, "System design using Integrated Circuits" , 2 nd Edition, New Age Pub, 2001
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2005.
5. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India, 1996.
6. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education, 2004.

17EC2016 LINEAR INTEGRATED CIRCUITS LABORATORY

Credits 0:0:2

Course objective:

- To design wave shaping circuits using opamps
- To design multi vibrators using opamps
- To design active filters using op amps

Course outcomes:

The students will be able to

- Design linear and non linear applications of op – amps.
- Discuss filters using op-amp
- Design adc and dac using op – amps.
- Employ linear and non linear circuits using ic 555
- Generate waveforms using op – amp circuits.
- Analyze performance of special function ics.

List of Experiments:

1. Design of Inverting amplifier, non-inverting amplifier, adder, and subtractor using Op-amp.
2. Design of differentiator and integrator using Op-amp.
3. Precision half wave and full wave rectifier using Op-amp.
4. Comparator, Zero crossing detector and Peak detector using Op amp
5. Design of Op amp Schmitt Trigger
6. Design of active Low Pass Filter and High Pass Filters
7. Design of active Band Pass Filter and Band Reject Filters
8. Astable and Monostable multivibrator using IC 555 timer
9. Voltage Controlled Oscillator
10. Digital to Analog convertor using R-2R ladder method
11. Analog to Digital convertor using R-2R flash method
12. Mini Project

17EC2017 WIRELESS AND NETWORKING LABORATORY

Credits 0:0:1

Course objective:

- To understand various protocols
- To implement various modulation techniques
- To learn the security issues in the wireless network

Course outcomes:

The students will be able to

- define wireless channel characteristics .
- discuss equalization techniques
- design and simulate various modulation schemes
- implement security algorithms
- analyze the performance of various coding schemes
- evaluate the channel for wireless communication

List of Experiments:

1. Characterization of Wireless Channels (Simulation/Experiment)
2. Equalization Techniques for Wireless Channels
3. Simulation/Implementation of Multicarrier Modulation
4. Simulation/Implementation of Space Time Block Codes
5. Performance Studies of Adaptive Modulation and Coding
6. Network Security Protocols and QoS analysis

17EC2018 PULSE AND WAVE SHAPING CIRCUITS

Credits: 3:0:0

Course Objective:

- To acquaint students with the basic concepts of linear and nonlinear wave shaping circuits.
- To design and analyze bistable multivibrator, Schmitt trigger circuit, monostable and astable multivibrators using BJT.
- To make the students learn the ideas behind time base generators, blocking oscillators and sampling gates.

Course Outcome:

Students will be able to

- Describe the operation and application of blocking oscillator and sampling gates.
- Classify different types of time base generators.
- Sketch the response of linear and nonlinear wave shaping circuits to different input signals.
- Analyze the operation of bistable multivibrator and Schmitt trigger circuit.
- Design monostable multivibrator and astable multivibrator.
- Choose the suitable wave shaping and pulse generator circuits for real time applications.

Unit I - Linear and Nonlinear wave shaping circuits: High pass RC circuit: Response of high pass RC circuit to step input, square input, ramp input - High pass RC circuit as a differentiator- **Low pass RC circuit:** Response of low pass RC circuit to step input, square input, ramp input - Low pass RC circuit as an integrator- Attenuator- Diode Clipper circuits, Two level clipping circuits, Problems, Diode Clamper - Clamping circuit theorem.

Unit II - Bistable Multivibrator: Fixed Bias Transistor Bistable Multivibrator: Operation-Effects of loading – Collector catching diodes - Applications- Self bias Transistor Bistable Multivibrator - Commutating Capacitor-Triggering methods - Analysis and Design Problems - Schmitt trigger using BJT: Operation, Hysteresis and Applications - Design of Schmitt Trigger using BJT.

Unit III - Monostable Multivibrator and Astable Multivibrator: Collector coupled monostable multivibrator using BJT: Operation, Waveforms, Applications-Gate width calculation - Design of monostable multivibrator - Analysis and Design Problems - Collector Coupled Astable multivibrator using BJT: Operation, Waveforms, and Applications - Time period calculation.

Unit IV - Time base generators: General features of a time base signal - Methods to generate time base waveform - UJT sweep generator - Miller sweep generator - Bootstrap ramp generator – Basic concepts of Current time base generator.

Unit V - Blocking Oscillators and Sampling Gates: Basics of Pulse Transformer- Blocking oscillators – Monostable blocking oscillators: Base and emitter timing – Triggering circuits – RC controlled Astable blocking oscillators –Applications of Blocking Oscillators - Sampling gate: Basic operating principles of sampling gate-Unidirectional sampling gate - Applications of sampling gates.

Text Books:

1. Millman & Taub “Pulse Digital and Switching Waveforms”, McGraw Hill, 3rd Edition 2015.
2. David A Bell, “Solid State Pulse Circuits”, PHI, Fourth Edition, 2009.

Reference Books:

1. Ronald Tocci, "Fundamentals of Pulse and Digital Circuits", Merrill Publishing Company, 3rd Edition, 1997.
2. Suryaprakash Rao Mothiki, "Pulse and Digital Circuits", McGraw Hill, 2nd Reprint 2009.

17EC2019 ANTENNA THEORY AND WAVE PROPAGATION

Credits: 3:1:0

Course objective:

- To understand basic terminology in an antenna.
- To impart the knowledge of field distribution characteristics due to various types of antennas.
- To familiarise on special antenna types and wave propagation.

Course Outcome:

The students will be able to:

- Understand the antenna basic parameters
- Estimate the array factor for uniform and non-uniform arrays
- Apply the fundamental concepts to obtain field distributions of broad band antennas
- Examine the field characteristics of special type antennas
- Categorize the radio wave propagation regions
- Design and analyze various types of antennas using simulation tools

Unit I - Antenna Fundamentals: Basic antenna parameters – Radiation Pattern - Radiation intensity-Directive gain-Directivity Power gain-Beam area - Beam width-Bandwidth - Antenna Apertures - Effective Height and e fective area – Efficiency – Beam Solid angle – Polarisation –Reciprocity theorem – Antenna Temperature - Concept of retarded vector potential

Unit II - Wire Antennas and Antenna Arrays: Wire antennas : Short electric dipole – radiated fields – radiation resistance – directivity – Half wave dipole- Monopole antennas – Small loop antennas – radiation resistance – Helical antenna. Antenna arrays: Broad side array – End fire array -Uniform linear array – array factor – Radiated fields – Array synthesis - pattern multiplication – Non-uniform array: Binomial array – Assumed current distribution for wire antennas - Use of capacity hat and loading coil for short antennas-array antenna design using simulation tools.

Unit III - Travelling Wave Antennas: Resonant and Non resonant antennas - **Rhombic Antenna:** Analysis and design **Coupled Antennas**: Self and mutual impedence-2 and 3 element yagi antennas-Log periodic antennas-feeding and transposing of lines- design using simulation tools.

Unit IV - Aperture and Lens Antennas: Radiation from Huygen's source- Radiation from the open end of a coaxial line- Radiation from a rectangular aperture treated as an array of Huygen's source-Equivalence of fields of slot and complementary dipole- Relation between dipole and slot impedances. Feeding of slot antennas Thin slot in an infinite cylinder-Field on E plane horn-Radiation from circular aperture-Beam width and effective area - Reflector antennas-Lens antennas- design using simulation tools.

Unit V - Propagation: Sky wave propagation: Structure of ionosphere-Effective dielectric constant of ionized region-Refraction-Refractive index-critical frequency-Skip distance-Effect of earth's magnetic field-collisions-Max usable frequency-fading-diversity reception

Space wave propagation: Reflection of polarized waves-Reflection characteristics of earth- Resultant of direct and reflected wave at the receiver-Duct propagation

Ground wave propagation: Attenuation characteristics-calculation of field strength

Text Books:

1. John D Kraus and Ronalatory Marhefka "Antennas" Tata Mc Graw Hill 2002
2. Jordan and Balmain, "Electromagnetic waves and radiating systems", PHI, 1968, Reprint 2003

Reference Books:

1. R.E. Collins "Antennas and Radio wave propagation" Mc Graw Hill 1987
2. Balanis, C.S "Antenna Theory Analysis and Design" John Wiley & Sons, II Edition 2003.

17EC2020 DIGITAL COMMUNICATION

Credit: 3:1:0

Course objective:

- To learn about theoretical bounds on the rates of digital communication system which deals with the transmission of signals in their baseband form.
- To understand various baseband and pass band modulation techniques.
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams and the various spread spectrum modulation schemes.

Course Outcome:

At the end of course, student will be able to :

- Understand the basics of information theory and source coding techniques to determine the required data rate for a reliable communication over the channel.
- Depict the performance of different baseband modulation techniques.
- Acquire Knowledge on inter symbol interference and its solutions.
- Design and simulate various passband modulation schemes.
- Analyze and resolve various error control coding techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.
- Discern various spreading techniques and its applications.

UNIT I - Information theory and source coding: Basic building blocks of Digital communication - Analog versus Digital communication - Advantages and disadvantages of digital communication - Sources and Signals - Uncertainty - Information - Entropy - Source Coding Theorem - Source Coding Techniques: Prefix Coding, Huffman Coding - Channel coding theorem - Channel capacity theorem.

UNIT II - Baseband Modulation and Pulse Transmission: Sampling process: Impulse sampling, Natural sampling - Pulse Code Modulation - Quantization : Uniform Quantization (Midtread, Midriser and Biased Quantization) - Non Uniform Quantization - Fundamentals of Line coding - Limitation and modification of PCM - DPCM - Delta modulation - Adaptive delta modulation - Inter Symbol Interference - Nyquist criterion for zero ISI - Ideal Nyquist channel - Raised cosine channel - Eye pattern.

UNIT III - Digital Modulation Schemes: Introduction - Pass band Transmission model - Generation, Detection, Signal space diagram, Probability of error and Power spectra of : Binary Phase Shift Keying - Differential PSK - QPSK - M-ary PSK - Quadrature Amplitude Shift Keying - Binary Frequency Shift Keying - M-ary FSK - Minimum Shift Keying - Comparison between bandwidth efficiency and bit rate - Applications of digital modulation schemes.

Unit IV - Error Control Coding: Rationale for Coding- Types of errors and error control codes - Linear Block Codes : generator matrix, systematic linear block codes, parity check matrix, syndrome testing ,error correction, and decoder implementation - Cyclic Codes: Systematic and Non-systematic Encoding, Generator matrix, Encoder Design, Error detection - Convolution Codes: Time domain and transform domain approach, graphical representation, code tree, trellis, state diagram, decoding methods, Essentials of Turbo codes and Low density parity check codes.

Unit V - Spread Spectrum Systems: Pseudo Noise sequences - A notion of spread spectrum - PN sequence generation and properties - Direct sequence spread spectrum with coherent binary phase shift keying - Signal space Dimensionality and processing gain - Rake Receiver - Frequency Hopping Systems - Fast Hopping & Slow Hopping Techniques - Applications of spread spectrum: CDMA and Multipath Communication.

Text Books:

1. Simon Haykins, “Digital Communication Systems,” John Wiley and Sons, New Delhi, Forth Edition, 2011.
2. H. Taub, D. Schlling, and G. Saha, “Principles of Communication Systems,” Tata McGraw Hill, New Delhi, Third Edition, 2012.

Reference Books:

1. Bernard Sklar and Ray P. K., “Digital Communication: Fundamentals and applications,” Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009..
2. Lathi B P, and Ding Z., “Modern Digital and Analog Communication Systems,” Oxford University Press, Forth Edition, 2010.
3. Shu Lin, Daniel J Costello, ”Error control coding” , Pearson Education, New Delhi, 2004.

17EC2021 MICROWAVE AND OPTICAL COMMUNICATION

Credits: 3:0:0

Course objective:

- To understand all basic Microwave and Optical devices and components.
- To learn few microwave measurements and analyze parameters.
- To understand the principles of fiber optic communications

Course outcome:

The students will be able to

- Recognize the limitations of existing vacuum tubes and solid state devices at microwave frequencies
- Study the performance of specialized microwave tubes such as klystrons, reflex klystron, magnetron and Travelling wave tube.
- Understand the operation of passive waveguide components.
- Analyze microwave circuits using scattering parameters
- Identify and characterize different components of an Optical Fiber Communication link.
- Analyze optical source, Fiber and Detector operational parameters

Unit I - Microwave Passive Devices: Passive microwave devices: Coaxial Connectors and Adapters - Waveguide Choke Flanges - Matched Terminations - Short Circuit Plunger - Rectangular to circular Waveguide transition - Tuning screws - Waveguide Corners - Bends and Twists – Windows-Coaxial line to Waveguide Adapters - Coupling Loops and Coupling Aperture – Attenuators-Phase shifters - Waveguide Tees - E plane Tee - H plane Tee - Magic Tee - Circulators - Directional couplers - Scattering matrix derivation for all components.

Unit II - Microwave Vaccum Tube Devices: Introduction - Two cavity Klystron Amplifier – Mechanism and mode of Operation ReflexKlystron Oscillator – Mechanism and mode of Operation TWT amplifier - Principle of Operation-Magnetron Oscillator - Mechanism of Operation

Unit III - Microwave Solid State Devices and Measurement: Microwave diodes– Gunn diode – Mode of operation - TRAPAT - IMPATT diodes - Microwave measurement- Power,VSWR,Impedance measurements

Unit IV - Optical Communication: Overview of optical communication - Need for optical communication – Comparison with the

electrical communication - Optical Fiber light guides theory: Ray theory – Mode theory. Snell’s law – Critical angle – Acceptance angle – Numerical Aperture. Types of fibers: Step and Graded index fibers. Wave propagation in multi mode and single mode optical fibers Attenuation – dispersion.

Unit V - Optical Transmitters and Receivers: Optical sources and Transmitters: LEDs - types of LEDs – principle of operation - Laser Diodes – working principle. Optical Detectors and Receivers: Photo detectors - photodiodes - pin and Avalanche photo detectors

Text Books:

1. Samuel.Y.Liao, “Microwave Devices and Circuits”, Prentice Hall of India Pvt Ltd., 3rd Edition, Reprint 2011
2. Keiser.G. "Optical Fiber Communications”, McGraw Hill, 4th edition, 2010
3. 3.John Senior “optical communications” Prentice Hall India , Third Edition, 2009.

Reference Books:

1. Collin. R.E, “Foundation of Microwave Engineering”, McGraw-Hill, II Edition, 1992.
2. Annapurna Das, Sisir K. Das, “Microwave Engineering”, Tata McGraw-Hill Co., Ltd., 1st Edition, 1999. Reprint 2001.

17EC2022 MICROWAVE AND OPTICAL COMMUNICATION LABORATORY

Credits: 0:0:2

Course Objective:

- To understand the characteristics of different microwave components.
- To study the performance parameters of optical source and detector.

Course Outcomes:

After successful completion of this course, the students should be able to

- Demonstrate the characteristics of Microwave sources and directional couplers

- Analyze the radiation patterns of antenna.
- Demonstrate a fiber optic communication link and analyze its frequency responses.
- Determine the characteristics of optical source and detector.
- Assess the losses and measurement in microwave devices
- Identify the optical loss characteristics in optical fiber that affect the performance of transmission system

A. Microwave Experiments

1. Mode Characteristics of Reflex Klystron Oscillator.
2. Characteristics of Gunn Diode Oscillator.
3. Frequency and wavelength measurement.
4. Impedance measurement by Slotted Line Method.
5. Study of Power Distribution in directional coupler.
6. Study of Power Distribution in Magic Tee, E/H Plane Tee.
7. Radiation pattern of Horn Antenna

B. Optical Communication Experiments

1. D.C. Characteristics of LED and PIN Photo Diode.
2. Optical transmission using Analog and Digital Link.
3. Study of Losses and Measurement of Numerical Aperture in Optical Fiber.
4. Study of Time Division Multiplexing and System bandwidth Determination by Intensity Modulation.
5. PI characteristics of LASER diode.

17EC2023 VLSI DESIGN

Credits: 3:0:0

Course Objectives:

- To study about the MOS Transistor and its characteristics.
- To get familiarized with stick diagrams and Layout design.
- To understand the CMOS logic design styles, latches and registers.

Course Outcomes:

students will be able to

- recognize the MOS transistor structure and its characteristics.
- design CMOS circuit design using the various logic styles.
- understand the knowledge on design rules and layout.
- differentiate the analysis in combinational and sequential circuits
- perform analysis in MOS circuit design processes and circuit concepts
- design and develop combinational and sequential circuit design in EDA tools.

Unit I - MOS Transistor Principle: Architectural Design – Logical Design – Physical Design-MOS Transistors: Enhancement mode transistor-Depletion mode transistor-MOS Transistor Structure-Transistor Operation- I_{ds} Vs V_{ds}Characteristics: The Non-Saturated Region- The Saturated Region-MOS Transistor Threshold Voltage- Small signal AC Characteristics-NMOS Fabrication-CMOS Fabrication: P-well process-N-well process-Twin-tub process

Unit II - Combinational Logic Circuits: MOS Transistor Switches- Combinational Logic Design- NMOS Inverter-Pull-up to Pull-down ratio of an NMOS Inverter- CMOS Inverter-Latch up in CMOS Circuits-Pass Transistor-Transmission gate-CMOS logic styles: Pseudo NMOS Logic-Dynamic CMOS Logic-Domino CMOS Logic-C^2 MOS Logic -n-p CMOS Logic.

Unit III - MOS Circuit Design Processes and circuit concepts: Stick Diagrams : NMOS and CMOS Design style- Design rules and layout : Lamda-based design rules: N-well based CMOS design rules-Sheet resistance : Sheet resistance concepts applied in MOS transistors and Inverters-Silicides-Area Capacitance of layers- Standard unit of capacitance-Area Capacitance calculations.

Unit IV - Designing Sequential Logic circuits: Static Latches and Registers: Multiplexer based latches-Master-Slave edge triggered register-Low voltage static latches-Dynamic Latches and Registers: Dynamic Transmission gate edge triggered registers-C^2MOS -A clock insensitive approach.

Unit V - Designing Arithmetic Building Blocks: Arithmetic Building Blocks: Binary Adder-Full Adder Circuit-Ripple Carry Adder-Transmission Gate Based Adder-Carry-By Pass Adder-Linear Carry Select Adder-Carry Lookahead adder-Array Multipliers-Barrel Shifters.

Text Books:

1. PucknellEshraghian "Basic VLSI Design", PHI of India Ltd.,Third Edition,2004
2. Neil H. E. Weste,DavidHarrisayan Banerjee "Principles of CMOS VLSI Design : A Systems Perspective", ,Pearson Education India,2nd Edition ,2002.
3. Jan.M.Rabaey, Ananthachandrakasan and Borivoje Nikolic, **"**Digital Integrated Circuits –A Design Perspective", Pearson Education, 2nd Edition 2003.

Reference Books:

1. CMOS Digital Integrated Circuits Analysis and Design, " Sung-Mo-Kang,YusufLeblebici",Tata Mc Graw-Hill Third Edition,2003.
2. N.A. Sherwari, "Algorithms for VLSI Physical Design Automation", John Wiley, Third Edition,2003.

17EC2024 VLSI DESIGN LABORATORY

Credits: 0:0:1

Course objective:

- To study the characteristics of NMOS and PMOS transistors
- To understand the CMOS logic design styles.
- To get familiarized with Design rules and Layout design

Course outcomes:

The students will be able to

- recognize the MOS transistor structure and its characteristics.
- perform analysis in CMOS inverter and obtain its DC transfer characteristics.
- design and simulate pass transistors, transmission gate and static CMOS logic
- design and simulate CMOS circuit design using dynamic CMOS logic.
- design the layout based on design rules and to perform DRC check.
- design and analyze both combinational and sequential design in EDA tools

List of Experiments:

1. Study of the characteristics of NMOS and PMOS transistors
2. Design and Simulation of CMOS inverter and obtaining its transfer characteristics and Noise margin
3. Logic design using pass transistors, transmission gates and static CMOS logic
4. Design and Simulation of dynamic CMOS circuits
5. Design and Simulation of Multiplexer and Counter
6. Layout design of digital logic circuits

17EC2025 CAD FOR ELECTRONICS ENGINEERS

Credits 3:0:0

Course Objective:

- To provide an introduction to the fundamentals of Computer-Aided Design tools for the modelling, design, analysis, test, and verification of digital systems, Xilinx, LabVIEW, and advanced MATLAB.
- To design, code, and test programs that meet requirements expressed by engineers. This includes a basic understanding of top-down design.
- To illustrate the role of computer programming in solving engineering problems.

Course outcome:

- Working familiarity with GUI in MATLAB
- Learning advanced features in MATLAB
- Able to do graphical code that can solve the engineering problems – LabVIEW
- Working familiarity with XILINX
- Able to programme in all levels of modelling techniques through XILINX

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Unit I - NI LabVIEW: Introduction to LabVIEW - Modular Programming – Repetition and Loops – Arrays – Clusters - Plotting of Data – Structures - String and File I/O - Application Programme – Exercises

Unit II - VHDL Programming: Introduction to VHDL - Data Types & Operators - Programming -Different Styles of Modelling - Control, Loop, decision statements - User defined functions - Logic level synthesis - Floor-planning – Routing - VHDL Programming Exercises

Unit III - ADVANCED MATLAB – C++ Programming: OOP's using MATLAB – Introduction - MATLAB Class system - Constructors in MATLAB - Inheritance in MATLAB - File Handling and Arrays in MATLAB - Sorting – Bubble sort in MATLAB - Sorting – Insertion sort in MATLAB - Searching – Binary Search Algorithm - Searching – Divide and Conquer - Matlab-C++ Programming Exercises

Unit IV - MATLAB – SIMULINK: Introduction to MATLAB - Arithmetic Operations in MATLAB - Functions and variable assignment - Interacting with MATLAB – Graphics - Introduction to MATLAB-Simulink - Engineering applications of Simulink - Sampling using Simulink - Amplitude modulation using Simulink - Simulink Exercises.

Unit V - Application design on each tool process (LabVIEW, MATLAB and XILINX)

Text Book:

1. C. F. Van Loan and K.-Y. D. Fan. , Insight Through Computing: A Matlab Introduction to Computational Science and Engineering , SIAM Publication, 2009,

Reference Books:

1. Brian R. Hunt,Ronald L. Lipsman,Jonathan M. Rosenberg, A Guide to MATLAB, for Beginners and Experienced Users
2. G.DeMicheli," Synthesis and Optimization of Digital Circuits", McGraw-Hill, 1994.
3. T.R. Padmanaban, " Design through Verilog HDL", Wiley Interscience, IEEE Press, 2004.
4. Won.Y.Yang,Yong.S.Cho,Won.G.Jeon.,Jeong.W.Lee,Jong.H.Paik,Jaekwon Kim, Mi-Hyun Lee, Kyu. I.Lee, Kyung.W.Park, Kyung.S.Woo," MATLAB/Simulink for Digital Communication,Hongrung Publishing, 2012.

17EC2026 FIBER OPTIC COMMUNICATION

Credits: 3:0:0

Course Objective:

- To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.
- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes.
- To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration.
- To provide in-depth knowledge on Optical signal processing and spatial filters.

Course Outcome:

The students will be able to:

- Recognize and classify the structures of Optical fiber and types.
- Discuss the channel impairments like losses and dispersion.
- Analyze various coupling losses.
- Classify the Optical sources and detectors and to discuss their principle.
- Design various fiber optic systems.
- Design as well as conduct experiments in software and hardware; analyze the results to provide valid conclusions.

UNIT I - OVERVIEW OF OPTICAL FIBER COMMUNICATION SYSTEMS: Optical communication system evolution - Generic optical system - wireless optical systems - applications and design challenges.

UNIT II - WAVE PROPAGATION IN OPTICAL FIBER: Wave propagation in optical fiber - Analysis of optical waveguide using ray theory - Physical and electrical characteristics of fiber - Fiber nonlinearities - Polarization effects - Passive optical components.

UNIT III - OPTICAL COUPLERS, MODULATORS & AMPLIFIERS: Modes in a planar waveguide structure, ray optic approach to optical mode theory - Channel and strip loaded wave guides, losses - Input/output couplers - Coupling between wave guides - Optical modulators - Internal and external modulation techniques - Mack-Zehnder and electro absorption modulators - Optical amplifiers: Semiconductor - EDFA - Raman and hybrid amplifiers - Noise characteristics and applications of amplifiers.

UNIT IV - OPTICAL SOURCES & DETECTORS: Basic concepts of optical sources - Semiconductor lasers - Distributed feedback lasers - Frequency chirping – LED - Optical detectors: Principles of photo detector - PIN and avalanche photo diode - -Phototransistor.
UNIT V - OPTICAL FILTERS: Binary, magnitude, phase and real valued spatial filters - Spatial carrier frequency filters - Interferometric methods for constructing filters - Multiplexed filters - Optical signal processor and filter generator - Methods for handling non-uniform noise spectral density - Effect of small displacements of spatial filters.
.
Text Books

1. Senior, J.M., "Optical Fiber Communications", 2nd Ed., Prentice-Hall of India, 1999.
2. Keiser, G., "Optical Fiber Communications", 3rd Ed., McGraw-Hill, 2000.

Reference Books

1. Yariv, A., "Optical Electronics in Modern Communications", Oxford University Press, 2006.
2. Vanderlugt, A., "Optical Signal Processing", John Wiley & Sons, 2005.
3. Agrawal G.P., Fiber Optic Communication Systems, 3rd ED.,Wiley, 2002.

17EC2027 ADVANCED MICROPROCESSOR ARCHITECTURE

Credits: 3:0:0

Course Objectives:

- To impart knowledge in advanced microprocessors
- To impart knowledge of application development
- To train the students towards various architectures of advanced microprocessors

Course Outcomes:
After completion of the course, students will be able to

- Acquires knowledge about fundamental concepts of microprocessor architectures
- Acquires clear understanding about CISC and RISC architectures
- Work with suitable microprocessor for a specific real world applications
- Became familiar with importance and applications of advanced microprocessor
- Will be able to interface I/O devices with ARM

Unit I - ADVANCED MICROPROCESSOR ARCHITECTURE: Internal Microprocessor Architecture-Real mode memory addressing – Protected Mode Memory addressing –Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes – Data movement instructions – Program control instructions- Arithmetic and Logic Instructions
Unit II - HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM: CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.
Unit III - HIGH PERFORMANCE RISC ARCHITECTURE – ARM: Arcon RISC Machine – Architectural Inheritance – Core & Architectures – Registers – Pipeline – Interrupts – ARM organization – ARM processor family – Co-processors – ARM instruction set- Thumb Instruction set – Instruction cycle timings – The ARM Programmers model – ARM Development tools – ARM Assembly Language Programming – C programming – Optimizing ARM Assembly Code – Optimized Primitives.
Unit IV - ARM INSTRUCTION SET: Data processing instructions- Arithmetic and logical instructions- Rotate and barrel shifter- Branch instructions- Load and store instructions-Software interrupt instructions- Program status register instructions- Conditional execution- multiple register load and store instructions- Stack instructions- Thumb instruction set- advantage of thumb instructions.
Unit V - ARM APPLICATION DEVELOPMENT: Introduction to DSP on ARM –FIR filter – IIR filter – Discrete fourier transform – Exception handling – Interrupts – Interrupt handling schemes- Firmware and bootloader - Application of ARM Processor – Caches –Memory Management units – Future ARM Technologies

Text Book:

1. Andrew N.Sloss, Dominic Symes and Chris Wright " ARM System Developer"s Guide : Designing and Optimizing System Software" , First edition, Morgan Kaufmann Publishers, 2004.

Reference Books:

1. Steve Furber , "ARM System –On –Chip architecture", Addision Wesley, 2000.

2. Daniel Tabak , “Advanced Microprocessors”, Mc Graw Hill. Inc., 1995
3. James L. Antonakos , “ The Pentium Microprocessor”, Pearson Education, 1997.
4. Barry B.Brey, The Intel Microprocessors 8086/8088, 80, 86, 80286, 80386 80486,Pentium,
5. Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture,Programming and interfacing, Prentice Hall of India Private Limited, New Delhi,2003. (UNIT I, II and III)

17EC2028 EMBEDDED SYSTEM DESIGN

Credits: 3:0:0

Course Objectives:

- To understand the basic concepts of Embedded System.
- To acquire Knowledge in Real time Embedded system, programming languages and tools.
- To explore the potential areas utilizing embedded processors in real time systems.

Course Outcomes:

- Acquire knowledge about the basic functions of embedded systems
- Understand the basic structure and concepts of embedded systems
- Acquire designing skills in Hardware and software tools of embedded firmware
- Understand the applications of embedded systems
- Develop good programming skills to develop embedded projects
- Apply the acquired knowledge to develop embedded related projects

Unit I - INTRODUCTION: Differences between the Desktop PC and typical Embedded System - Applications of Embedded System – Microprocessor Vs Microcontroller Analysis. Embedded Design Life Cycle: Product Specification, Hardware/Software Partitioning, Iteration and Implementation, Detailed Hardware and Software Design, Hardware Software Integration, Product Testing and Release, Maintenance and Upgrading Existing products.
Unit II - HARDWARE MODULES AND INTERFACING TECHNIQUES): (Any Embedded Controller**)** Memory Mapping – Signal Description – Port Integration Module – Serial Communication Interface: SCI, SPI, I2C, CAN, Analog to Digital Converter, Pulse Width Modulator – Enhanced Capture Timer – Periodic Interrupt Timer . Interfacing Concepts: Hardware Initialization, Display Interfacing, Keyboard Interfacing, Concept of Touch Screen. ADC Interfacing, Serial Communication Interface: RS232, IIC. Real Time Clock (RTC) Intefacing- EEPROM Interfacing-Stepper Motor and DC Motor Interfacing Techniques.
Unit III - SOFTWARE DEVELOPMENT TOOLS & PROGRAMMING TECHNIQUES: Cross-Compilers, Cross-Assemblers, Linker/Locator, Debugger and Simulator - Introduction to Code Warrior Integrated Development Environment (IDE) – Embedded C Programming using IDE: I/O Port Programming, EEPROM Programming, Timer Programming, Programming ADC, Programming PWM Module, Serial Port Programming and Interrupts Programming.
Unit VI: INTEGRATION OF HARDWARE AND SOFTWARE MODULES: Host and Target Machines. Getting Embedded Software into Target System: In-Circuit Emulators. Debug Kernels: BDM and JTAG.
Unit V - REAL TIME OPERATING SYSTEMS (RTOS): Tasks and Task States, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory Management, Interrupt Routines in RTOS Environment. Design of Underground Tank Monitoring System using MUCOS RTOS.

Text Books:

1. Arnold Berger, “Embedded System Design: An Introduction to Processes, Tools, and Techniques” CMP Books, 2006.
2. Han–Way Huang, “The HCS12/9S12: An Introduction to Hardware and Software Interfacing”, Delmar publishers, New Delhi, 2009.

Reference Books:

1. David E Simon, “An Embedded Software Primer”, Pearson Education Asia, New Delhi, 2009.
2. Douglas V Hall, “Microprocessors and Interfacing: Programming and Hardware”, Tata McGraw-Hill Edition, New Delhi, 2005.
3. Rajkamal, ”Embedded Systems: Architecture, Programming and Design”, Tata McGraw-Hill, New Delhi, 2008.

4. Jonathan W Valvano, “Embedded Microcomputer Systems, Real Time Interfacing”, Brooks/Cole Thomson Learning, California, United States, 2007.

17EC2029 ARM PROCESSOR

Credits: 3:0:0

Course Objectives:

- To impart basic knowledge about architecture of ARM processor.
- To get familiarized with the instruction sets in ARM processors
- To explore the necessity of ARM processors in real time applications

Course Outcome:

The students will be able to:

- Summarize ARM7TDMI assembly instructions and their formats and usage.
- Write ARM7 based assembly level programs.
- Describe the architecture of ARM Processors.
- Express their knowledge in cache design, virtual memory and memory protection concepts.
- Discuss AMBA bus architecture, various HW peripherals.
- Apply their understanding and to handle issues in using any processor SW tools chain for embedded software solution development.

Unit I - ARM Introduction and Pipeline structures: Types of computer Architectures-ISA's and ARM History-Embedded System Software and Hardware, stack implementation in ARM- Endianess-condition codes-Processor core VS CPU core-ARM7TDMI Interface signals-Memory Interface-Bus Cycle types-Register set-Operational Modes-Instruction Format-ARM Core Data Flow Model-ARM 3 stage Pipeline-ARM family attribute comparison-ARM 5 stage Pipeline, Pipeline Hazards, Data forwarding - a hardware solution.

Unit II ARM7TDMI assembly instructions and modes: ARM ISA and Processor Variants-Different Types of Instructions-ARM Instruction set-data processing instructions-Shift Operations-Data processing Instructions-Addressing modes-Swap Instructions-Swap Register related Instructions-Program Control Flow-Control Flow Instructions-B & BL instructions-BX instruction-Interrupts and Exceptions-Exception Handlers-Aborts-software Interrupt Instruction-Interrupt Latency-Multiply Instructions-Instruction set examples. Thumb state-Thumb Programmers model-Thumb Implementation-Thumb Applications-Thumb Instructions-Interrupt processing-Interrupt Handelling schemes- Examples of Interrupt Handlers.

Unit III Caches: Memory Technologies-Need for memory Hierarchy-Hierarchical Memory Organization-Virtual Memory-Cache Memory- Mapping Functions-Cache Design-Unified or split cache-multiple level of caches-ARM cache features.

Unit IV Memory Protection Unit (MMU): Processes-Memory Map-Protected Systems-ARM systems with MPU-memory Protection Unit (MPU) -Physical Vs Virtual Memory-Paging-Segmentation-MMU Advantage-virtual memory translation-Multitasking with MMU-MMU organization.

Unit V ARM tools and Peripherals: ARM Development Environment-Arm Procedure Call Standard (APCS)-Example C program-Embedded software Development-Image structure-linker inputs and outputs-memory map-AMBA Overview-Typical AMAB Based Microcontroller-AHB bus features-AHB Bus transfers-APB bus transfers-APB bridge-DMA-Peripherals- Programming Peripherals in ARM.

Text Books:

1. SteveFurber, “ARM System on Chip Architecture”, Addison Wesley Professional, Second Edition, Aug 2000.
2. Andrew NSloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide, Designing and Optimizing System Software”, Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, “Design of System on a Chip: Devices and Components”, Springer FirstEdition, July 2004.
4. Jason Andrews, “Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)”, Newnes, Aug 2004.
5. Rashinkar P, Paterson and Singh L, “System on a Chip Verification – Methodologies and Techniques”, Kluwer Academic Publishers, 2001.

Reference Books:

1. Instructor reference material

2. ARM System Developers Guide, Designing and Optimizing System Software, by Andrew N.SLOSS, Dominic SYMES and Chris WRIGHT,ELSEVIER, 3004.
3. ARM System-on-Chip Architecture,Second Edition, by Steve Furber,PEARSON, 2013
4. Operating Systems, 5th Edition,By William Stallings
5. Manuals and Technical Documents from the ARM Inc, web site.

17EC2030 EMBEDDED SYSTEM DESIGN LABARATORY

Credits: 0:0:2

Course Objectives:

- To develop programming skills in Embedded C
- To understand interfacing concepts in Embedded C programming
- To test a embedded system based on test inputs provided

Course Outcomes:

After completion of the course, students will be able to

- Able to write an Embedded C program
- Understand what is a microcontroller, microcomputer, embedded system.
- ability to design a system to meet desired needs within realistic constraints
- Able to incorporate interfacing concepts in the Embedded C program
- Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices
- Able to test an embedded system based on the test inputs provided

List of Experiments

1. Activation of Buzzer using Atmega Microcontroller
2. Activation of LED using Atmega Microcontroller
3. Interfacing of IO module using Atmega Microcontroller
4. Generating delay using timer in Normal mode using Atmega Microcontroller
5. Generating delay using timer in CTC mode using Atmega Microcontroller
6. Interfacing timer using interrupt using Atmega Microcontroller
7. Interfacing seven segment display using Atmega Microcontroller
8. Real time clock using Atmega Microcontroller
9. Interfacing ADC – Digital voltmeter using Atmega Microcontroller
10. Keypad scanning using Atmega Microcontroller
11. Interfacing stepper motor using Atmega Microcontroller
12. Serial communication using Atmega Microcontroller

17EC2031 COMPUTER COMMUNICATION

Credits: 3:0:0

Course Objective:

- To introduce the concepts and technologies of modern data communication and computer networks.
- To enlighten the students about universal networking protocols and standards.
- To introduce IEEE standards employed in computer networking.

Course Outcome:

Students will be able to;

- Apply Engineering mathematical concepts in communication networks.
- Identify communication errors, formulate methods to solve and correct those errors.
- Analyze and interpret data to design system components or processes that meet the specified needs with appropriate considerations.
- Demonstrate skills to use modern engineering tools, software's and equipments to analyze problems.
- Show the understanding of impact of engineering solutions of different protocols and network components, on the society and also will be aware of contemporary issues.
- Will develop confidence for self education and ability for life-long learning about various IEEE standards.

Unit I - DATA COMMUNICATIONS: Components – Direction of Data flow – networks – Components and Categories – types of Connections – Topologies –Protocols and Standards – ISO / OSI model – Transmission Media – Coaxial Cable – Fiber Optics – Line Coding – Modems.
Unit II - DATA LINK LAYER: Error – detection and correction – Parity – LRC – CRC – Hamming code – Flow Control and Error control: stop and wait – go back N ARQ – selective repeat ARQ- sliding window techniques – HDLC.
Unit III - MEDIUM ACCESS TECHNIQUES: LAN: Ethernet IEEE 802.3, IEEE 802.4, and IEEE 802.5 – IEEE 802.11–FDDI, SONET –Bridges.
Unit IV - NETWORK LAYER: Internetworks - Packet Switching and Datagram approach – IP addressing methods – Subnetting – Routing – Distance Vector Routing – Link State Routing – Routers.
Unit V - TRANSPORT AND APPLICATION LAYER: Transport protocols-User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) –Application layer-Domain Name Space (DNS) – SMTP, FDP, WWW – Cryptography.

Text Book:

1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill,2004.

Reference Books:

1. James .F. Kurouse & W. Rouse, "Computer Networking: A Top down Approach Featuring", Pearson Education, 4th Edition 2008
2. Larry L.Peterson & Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., 3rd Edition, 2007
2. Andrew S. Tannenbaum, "Computer Networks", PHI, 4th Edition, 2003.
3. William Stallings, "Data and Computer Communication", 6th Edition, Pearson Education, 2000.
3. Prakash C.Gupta," Data Communication and Computer Networks, PHI Learning Private Limited, 2006

17EC2032 TELECOMMUNICATION SWITCHING NETWORKS

Credits: 3:0:0

Course objective:

- To impart the fundamental functions of a telecom switching office, namely, digital multiplexing, digital switching and digital subscriber access.
- To gain knowledge on the mathematical model for the analysis of telecommunication traffic.

Course outcome:

The students will be able to:

- Describe different multiplexing techniques.
- Express the concepts of Digital Switching.
- Review the performance analysis of network traffic.
- Outline the ISDN architecture and Digital Loop Carrier Systems.
- Analyze the Characteristics of a network.
- Characterize blocking probability holding service time distributions for in speech and data networks.

Unit I - SWITCHING SYSTEMS AND MULTIPLEXING: Evolution of Telecommunications; Basics of a Switching System; Principle of Crossbar Switching; Crossbar Switch Configurations; Crossbar Exchange Organization.Pulse Transmission, Line Coding Time Division Multiplexing, Time Division Multiplex Loops and Rings. SONET/SDH: SONET Multiplexing Overview, SONET Frame Formats, SONET Operations, Administration and Maintenance, SONET Optical Standards, SONET Networks. SONET Rings: Unidirectional Path-Switched Ring, Bidirectional Line-Switched Ring.
Unit II - DIGITAL SWITCHING: Switching Functions, Space Division Switching, Time Division Switching, two-dimensional Switching: STS Switching, TST Switching, No.4 ESS Toll Switch, Digital Cross-Connect Systems, Digital Switching in an Analog Environment.
Unit III - NETWORK SYNCHRONIZATION CONTROL AND MANAGEMENT: Timing: Timing Recovery: Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.
Unit IV - DIGITAL SUBSCRIBER ACCESS: ISDN: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. High-Data-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL. Digital Loop Carrier Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems,

Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems, Voice band Modems: PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.

Unit V - TRAFFIC ANALYSIS 9: Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.

Text Books :

1. Bellamy John, "Digital Telephony", John Wily & Sons, Inc. 3rd edn. 2000.
2. Viswanathan. T., "Telecommunication Switching System and Networks", Prentice Hall of India Ltd., 1994.

Reference Books :

1. R.A.Thomson, "Telephone Switching Systems", Artech House Publishers, 2000.
2. W. Stalling, " Data and Computer Communications" Prentice Hall, .2007
3. T.N.Saadawi, M.H.Ammar, A.E.Hakeem, "Fundamentals of Telecommunication Networks", Wiley Interscience, 1994.
4. W.D. Reeve, "Subscriber Loop Signaling and Transmission Hand book", IEEE Press(Telecomm Handbook Series), 1995.

17EC2033 CELLULAR MOBILE COMMUNICATION

Credits: 3:0:0

Course Objective:

- To study the state of art techniques in wireless communication
- To know the various wireless protocol architectures.
- Compare and contrast various generation of cellular system
- To study the various multiple accessing methods
- To Identify traffic channels for call processing
- To Calculate key performance metrics of a cellular system

Course Outcome:

The students will be able to

- Identify the state of art techniques in wireless communication
- Distinguish the various wireless protocol architectures.
- Compare and contrast various generation of cellular system
- Choose proper multiple accessing methods depending on channel model
- Combine traffic channels for call processing
- Assess key performance metrics of a cellular system

Unit I - INTRODUCTION TO WIRELESS MOBILE COMMUNICATIONS: History and evolution of mobile radio systems, Mobility vs. portability – Mobile devices – Cellular communications from 1G to 3G – Wireless 4G systems, Future wireless networks.

Unit II - CELLULAR CONCEPT AND SYSTEM DESIGN FUNDAMENTALS: Cellular concept and frequency reuse - Multiple Access Schemes - channel assignment and handoff - Interference and system capacity - Trunking and Erlang capacity calculations, Improving coverage and system capacity.

Unit III - MOBILE RADIO PROPAGATION: Large scale models - Free space propagation model, reflection – diffraction – scattering - Two ray ground reflection model - Outdoor and Indoor Propagation models - Durkins model & Attenuation factor model - Factors influencing small scale fading, Doppler shift - impulse response model - parameters of mobile multipath channels, types of small scale fading - Rayleigh and Ricean distributions.

Unit IV - DIGITAL MODULATION & MULTIPLE ACCESS TECHNIQUES

Digital Modulation types: MSK – GMSK – OFDM – Multiple access methods: FDMA – TDMA – Spread spectrum multiple access – FHMA – CDMA – SDMA – Packet Radio – Capacity of cellular systems.

Unit V - WIRELESS SYSTEMS AND STANDARDS: GSM features – Architecture – Radio subsystems – Traffic channels – call processing – CDMA features – Architecture – IS 95 – Forward and reverse channels – power control – Mobile IP, Role of IP on wirelss networks, Wireless Networking – WLAN – system architecture – IEEE802.11 – third generation UMTS system features – Cellular and WLAN Integration

Text Books:

1. T.S.Rappaport, "Wireless Communications; Principles and Practice", Prentice Hall, NJ, 2009.

2. Iti Saha Misra, “Wireless Communications and networks: 3G and Beyond”, McGraw Hill, Second Edition, 2017 Reprint.

Reference Books:

1. K.Feher, “Wireless Digital Communications”, PHI, New Delhi,1995
2. W.C.Y.Lee, “Mobile communications Engineering: Theory and Applications”,
3. McGraw Hill, New York, 2nd Edition, 1998.
4. Schiller, “Mobile Communications” Pearson Education Asia Ltd.,2000
5. Stallings, Wireless Communications and Networks, Prentice Hall, 2005.
6. Schwartz, Mobile Wireless Communications, Cambridge University Press, 2004.

17EC2034 MOBILE COMPUTING

Credits: 3:0:0

Course Objectives:

- To make the student understand the concept of mobile computing paradigm, its applications and limitations.
- To understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer
- To understand the ad hoc networks and related concepts.
- To understand the platforms and protocols used in mobile environment.

Course Outcomes:

After completion of the course, the students will be able to:

- explain the basics of mobile computing and mobile telecommunication system
- understand the different wireless MAC issues and solutions
- choose the required functionality at each layer for given application
- identify solution for each functionality at each layer
- acquire knowledge on basics concepts of Ad hoc network
- understand the platforms and protocols used in mobile application development.

Unit I - Introduction to Mobile Computing and Wireless Networking: Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. GSM: Services - System Architecture, GPRS: Services - System Architecture, Software Defined Radio.

Unit II - Wireless Medium Access Control: MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes – IEEE 802.11 MAC standard – MAC protocols for Adhoc Networks – Cognitive Radio Adhoc Network.

Unit III - Mobile Network Layer and Transport Layer: Overview of Mobile IP - Packet Delivery - Features of Mobile IP – Key Mechanism in Mobile IP – Route Optimization – Dynamic Host Configuration Protocol - Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

Unit IV - Mobile Ad-Hoc Networks: Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks – MANET Vs VANET – Security.

Unit V - Protocols and Platforms for Mobile Computing: Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems: Palm OS – iOS – Android – BlackBerry - Windows Phone – Mobile Application Development: HDML – WAP - J2ME - Android Application Development.

Text Books:

1. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, 2nd Edition, 2016.
2. Jochen Schiller, “Mobile Communications”, Addison-Wesley, 2nd Edition, 2009.

Reference Books:

1. Raj Kamal, “Mobile Computing”, Oxford University Press, 2nd Edition, 2012.
2. William C.Y. Lee “Mobile Cellular Telecommunications: Analog And Digital Systems” Tata McGrawHill, 2nd Edition, 1995.
3. Theodore S. Rappaport, “Wireless Communications: Principles and Practice” Pearson Education, 2010.

4. C.K.Toh, “AdHoc Mobile Wireless Networks: Protocols and Systems”, First Edition, Pearson Education, 2002.

17EC2035 IOT FOR COMMUNICATION ENGINEERING

Credits: 3:0:0

Course Objectives:

- To provide in depth knowledge in the basics, architecture and layering analysis of various protocols in IoT
- To comprehend on the various networks and development platforms in IoT
- To provide the various IoT applications

Course Outcomes:

Upon completion of the course, the students will be able to

- Identify and design the new models for market strategic interaction
- Design business intelligence and information security
- Analyze various protocols for IoT
- Design a middleware for IoT
- Analyze and design different models for network dynamics
- Apply the concepts in the applications of IoT

Unit I - Introduction: Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security

Unit II - IoT Protocols: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols –Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security

Unit III - Web Of Things: Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture

Unit IV - Integrated: Integrated Billing Solutions in the Internet of Things - Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects – Network Dynamics: Structural Models - Cascading Behaviour in Networks - The Small-World Phenomenon

Unit V - Applications: The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications – Smart home, Wearables, Health care, Smart retail, and Smart city

Text Books:

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
2. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
3. Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning, “The Internet of Things: From RFID to the Next-Generation Pervasive Network”, ed. 2008.

Reference Books:

1. Vijay Madisetti , Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)” , 2014.
2. Adrian McEwen , Hakim Cassimally , “Designing the Internet of Things” , Wiley,2013.
3. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
4. Data and Computer Communications; By: Stallings, William; Pearson Education Pte. Ltd., Delhi, 6th Edition
5. F. Adelstein and S.K.S. Gupta, “Fundamentals of Mobile and Pervasive Computing,” McGraw Hill, 2009.
6. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi, 4th Edition

17EC2036 HIGH SPEED NETWORKS

Credits: 3:0:0

Course Objectives:

- Recognize the networking principles
- Identify the role of internet protocols
- Gain knowledge on high speed wireless networks

Course Outcomes:

Students will be able to

- Describe basic networking principles
- Differentiate between packet and circuit switched networks
- Discover the significance of IPv4 and IPv6
- Categorize some high speed networks such as SONET/SDH, DSL, and etc.
- Summarize the features of ATM networking protocol over IP
- Appraise high speed internetwork access

Unit I - INTRODUCTION TO NETORKS: Networking Principles - Future Networks – Packet Switched Networks: OSI Model, Ethernet, Token Ring, FDDI, DQDB, Frame Delay, SMDS

Unit II - TCP/IP NETWORKS: IPv4, Multicast IP, Mobile IP, IPv6, SMTP, TFTP, HTTP, Performance of TCP/IP Networks

Unit III - CIRCUIT SWITCHED NETWORKS: SONET/SDH, WDM, FTTH, DSL, Intelligent Networks, CATV, MPEG

Unit IV - ATM: Features, Addressing, Structure, AAL, Management and Control, BISDN, Internet working with ATM

Unit V - WIRELESS NETWORKS: Link design, Network Design – Optical Networks: Links, WDM, Optical LAN, Wavelength Routing – Global Multimedia Network: Introduction to Bluetooth, VoIP, WiFi

Text Book:

1. Jean Walrand & Pravin Varaiya, " High Performance Communication Networks", Morgan Kauffmann Publishers, 2nd edition, 2000.

Reference Books:

1. James F. Kurose & Keith W. Ross, "Computer Networks", Pearson Education, 2nd edition, 2003.
2. Larry L. Peterson & Bruce S. Davie, "Computer Networks: A Syatems Approach", Morgan Kaufmann Publishers, 3rd edition, 2003
3. Rajeev Ramaswami & Kumar Sivarajan, "Optical Networks: A Practical Perspective", Morgan Kaufmann Publishers, 2nd edition, 2000.

17EC2037 WIRELESS SENSOR NETWORKS

Credits: 3:0:0

Course Objectives:

- To learn the architecture and protocols of wireless sensor networks.
- To understand the design issues in sensor networks.
- To introduce the tracking techniques, sensor database, energy management and security

Course Outcomes:

The students will be able to

- Recognize technologies and applications of wireless sensor networks
- Describe the architecture and protocols of wireless sensor networks.
- Choose suitable medium access protocols and radio hardware.
- Apply IEEE 802.15.4/ Zigbee/Bluetooth standards for Wireless Sensor Network application
- Illustrate tracking techniques and sensor database
- Analyze energy management and security in WSN applications.

Unit I - Basics Concepts of Sensor Networks: Introduction – Difference between sensor networks and traditional networks - sensor node architecture - Functional architecture of sensor networks — Individual components of WSN -Sensor network node - Applications

Unit II - Communication Protocols: Time synchronization protocols - Transport Layer protocol - Network layer protocol - Data link
Protocol - medium access control - Requirements and design constraints for MAC for WSN - The S-MAC protocol - IEEE 802.15.4 standard and Zigbee - Error Control
Unit III - Tracking Technologies: Tracking scenario – Problem formulation – Sensing model – Fundamentals - ToA, TDoA, and AoA Positioning by signal strength - positioning and location tracking algorithms –Trilateration - Multilateration - Pattern matching - Nearest neighbor algorithms, location tracking - network based tracking
Unit IV - Sensor Network Data Bases: Sensor data base challenges - Querying the physical environment - High level data base
Organization - Data aggregation - types of aggregation - Packet level aggregation - total aggregation - Geographic aggregation - selection of the best aggregation points - Problem with high data rate
Unit V - Energy Management And Security: Idle power management - Active power management - Design challenges in energy efficient medium access control – IEEE 802.11- operation - power saving mode – merits - drawbacks implications in WSN, Bluetooth – operation - Merits – implications, Security: Security architecture - Cell based WSNs - Privacy of local information

Text Book:

1. Mohammad Ilyas and Imad Mahgoub, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems" CRC Press 2009.

Reference Books:

1. Feng Zhao, Leonidas J. Guibas, "Wireless Sensor Networks: An Information Processing Approach" Morgan Kaufmann Publishers 2004.
2. Michel Banatre, Pedro Jose Marron, Anibal Ollero and Adam Wolisz,"Cooperating Embedded Systems and Wireless Sensor Networks", ISTE Ltd,2008.
3. Holger Karl and Andreas Willing, "Protocols and Architecture for Wireless Sensor Networks", Wiley, 2005.
4. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks: Technology, Protocols and Applications, WILEY , Second Edition (Indian) , 2014

17EC2038 OPTO ELECTRONICS

Credits: 3:0:0

Course objective:

- To design and understand various types of display devices.
- Design optoelectronic detection devices and modulators for optical communication
- To design optoelectronic integrated circuits and to understand various applications of opto-electronics integrated circuits in the field of electronic/optical communication.

Course outcome:

The students will be able to:

- Understand the basic elements of light sources along with its behavior.
- Analyze various semiconductor physics and Semiconductor junction device characteristics.
- Explore electronic displays with its working principle & characteristics
- Design the optical detection devices and its types.
- Investigation of Optical switching and logic devices.
- Develop various Applications of Optoelectronics Integrated circuits.

Unit I - Introduction to Physics of Light: Wave nature of light, Polarization, Interference, Diffraction, Light Source, review of Quantum Mechanical concept, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device.
Unit II - Lasers and Display Devices: Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, laser applications.
Unit III - Optical Detection Devices: Photo detector, Thermal detector, Photo Devices, Photo Conductors, Photo diodes, Detector Performance.

Unit IV - Optical Modulation and Devices: Introduction, Analog and Digital Modulation, Electro-optic modulators, Magneto Optic Devices, Acoustoptic devices, Optical, Switching and Logic Devices.
Unit V - Introduction to Optical -Electronics Integrated Circuits: Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

Text Book:

1. J.Willson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall of India Pvt.Ltd., New Delhi, 1995

Reference Books:

1. Bhattacharya, "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt. Ltd., New Delhi, 1996
2. Jasprit Singh, " Opto Electronics- An Introduction to materials and Devices", McGraw Hill International Edition, 1998
3. J.H. Franz and V.K. Jain, "Optical Communication – Components and Systems", Narosa Publishing House, 2000.

17EC2039 BASICS OF SATELLITE COMMUNICATION

Credits: 3:0:0

Course Objectives:

- To understand the basic elements of satellite communication systems.
- To understand the modulation techniques for satellite communication.
- To understand launch systems and analyze their effect on satellite and payload design.

Course Outcomes:
Students will be able to:

- Describe the principles, concepts and operation of satellite communication systems
- Recognize the concepts of link design, rain fading and link availability and perform interference calculations
- Employ the modulation techniques for satellite communication
- Analyze the design requirements and the performance of satellite communication systems
- Summarize the orbital determination and launching methods
- Interpret orbital mechanics formula and tools to spacecraft mission design.

Unit I - Elements of Satellite Communication: Introduction- frequency band designations- Kepler's laws and equations of motion- Satellite systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Launching satellites in to orbits, Range to satellite, Satellite – description of different Communication subsystems, Bandwidth allocation.
Unit-II: Earth Station: Earth Station Transmitters, Receivers-antenna types – Gain and radiated power – Poynting loss – Noise temperature – G/T ratio – High power amplifiers – Redundancy configurations – Carrier & power combining – Low noise amplifiers.
Unit III - Transmission, Multiplexing, Modulation, Multiple Access and Coding: Different modulation and multiplexing schemes, Multiple Access Techniques – Frequency division multiple access (FDMA) Intermodulation. Time division Multiple Access (TDMA) Frame structure, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA),Spread spectrum transmission and reception.
Unit IV - Satellite Link Design: Basic link analysis, Interference analysis, Adjacent channel and inter symbol Interference-Rain induced attenuation and interference, Ionospheric characteristics, Satellite link design -Link Design with and without frequency reuse.
Unit V - Applications and Services: Very small aperture terminal (VSAT) networks – Technologies & configurations – Mobile satellite (MSAT) networks – Low orbital satellites – space craft system design- Domestic satellite systems-the INSAT System-International systems-INTELSAT / INMARSAT

Text books:

1. D.Roddy, "Satellite Communication ",(4/e), McGraw- Hill, 2009.
2. B.N.Agrawal, "Design of Geosynchrons Spacecraft", Prentice- Hall,1986.

Reference books:

1. T.Pratt&C.W.Bostain, “Satellite Communication”, Wiley 2000.
2. Proakis, John, and MasoudSalehi, “ Communication Systems Engineering”,PHI, 2001..
3. Haykin, Simon. Communication Systems. 5th ed. New York, NY: Wiley, 2009.

17EC2040 BIOMEDICAL SIGNAL PROCESSING

Credits: 3:0:0

Course Objectives:

- To introduce biomedical concepts that are fundamental across different applications, and captures the underlying commonalities across applications.
- To study about signal processing and physiological signals through the application of signal processing methods to biomedical problems.
- Provide the students with mathematical and computational tools to design their own analysis and interpretation strategies when facing different biomedical applications.

Course Outcomes:

The students will be able to:

- Gain knowledge to outline the theoretical and practical aspects of biomedical signals.
- Appraise and get familiarized with the bioelectric potentials.
- Evaluate various signal processing techniques to extract the characterisitcs of biomedical signals.
- Apply the signal processing techniques to remove the interference and artifacts of biomedical signals.
- Analyze the given bio medical signal for diagnosis.
- Design and develop the processing and analysis strategies for biomedical signal applications.

Unit I - Introduction to biomedical signals: The nature of biomedical signals – Examples of biomedical signals ECG, EEG, and EMG– Objectives of biomedical signal analysis – Difficulties in biomedical signal analysis – Computer-aided diagnosis – Origin of bioelectric potentials and their Significance – Spectral analysis – Filtering methods – Correlation and estimation techniques.

Unit II - Analysis of ECG signals: ECG: Pre-processing – Wave form recognition –Morphological analysis – Rhythm analysis – Automated diagnosis based on decision theory – Evoked potential estimation – QRS detection – Detection of P-wave – Arrhythmia analysis. Baseline Wandering – Power line interference – Muscle contraction Interference – Removal of interference – Muscle noise – Removal of Artifacts.

Unit III - Analysis of EEG signals: EEG: EEG rhythms & waveform – Categorization of EEG activity – Recording techniques – Evoked potential estimation. Evoked responses – Average techniques – Pattern recognition of EEG waves – Sleep stages and disorders – Epilepsy detection – Brain computer interface. Linear and nonlinear modelling of EEG – Artifacts in EEG – Model based spectral analysis – EEG segmentation – Joint Time-Frequency analysis – Correlation analysis of EEG channels.

Unit IV - Analysis of EMG signals: The Electromyogram (EMG) – Generation of electrical changes during muscle contraction –Wave pattern studies. Recording Techniques and Applications – Amplitude and Power estimation of EMG signals – Time delay estimation in EMG signals – Modeling and decomposition of the EMG signal.

Unit V - Application of signal processing techniques: Time frequency representation: Spectrogram – Wigner distribution – Scalogram –Feature extraction – Wavelet packets.Signal processing techniques: Linear prediction – Lattice - filtering – Adaptive filtering – Wavelets & time frequency models – Data compression and reduction techniques. Applications to heart sounds, faetal ECG & vesicular sound signals.

Text Books:

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis", 2nd Edition, John Wiley and Sons, 2015.
2. D.C.Reddy,“Biomedical Signal Processing: Principles and techniques”,Tata McGraw Hill, New Delhi, 2016.

Reference Books:

1. E.N. Bruce, "Biomedical Signal Processing and Signal Modelling", 2nd Edition, John Wiley and Sons, 2007.
2. K. Najarian and R. Splinter, "Biomedical Signal and Image Processing", 2nd Edition, CRC Press, 2016.
3. Willis J Tompkins, "Biomedical Signal Processing", 2nd Edition, Prentice -Hall, 1993.
4. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2006.
5. M. Akay,"Time-Frequency and Wavelets in Biomedical signal Processing", Wiley, 1998.

6. Arnon Cohen, "Bio-Medical Signal Processing, Volume I and II ",CRC Press, 1986.

17EC2041 PRINCIPLES OF DIGITAL IMAGE PROCESSING

Credits: 3:0:0

Course Objectives:
The student should be made to:
- Learn digital image fundamentals.
- Understand the image enhancement, restoration techniques.
- Explore image segmentation techniques in practical cases

Course Outcomes:
Students will be able to:
- Understand the image fundamentals
- Perform color image processing
- Apply image enhancement and restoration techniques
- Relate different image processing algorithms
- Analyze the images in spatial and frequency domain
- Develop the algorithms for image processing

Unit I - DIGITAL IMAGE FUNDAMENTALS: Elements of digital image processing systems, Vidicon and Digital Camera working principles, - Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals - RGB, HSI models, Image sampling, Quantization, dither, Two- dimensional mathematical preliminaries,
Unit II IMAGE ENHANCEMENT: Image Enhancement Fundamental steps in Digital Image Processing – Basic Gray Level Transformations – Point processing, Histograms, Histogram Equalization & Matching –Image Subtraction & Averaging – Directional Smoothing, Median, Geometric mean, Harmonic mean, Contraharmonic mean filters
Unit III - COLOR IMAGE ENHANCEMENT: Introduction to Fourier Transform – Filtering InThe Frequency Domain - Smoothing & Sharpening Frequency Domain filters, Homomorphic filtering. Color image enhancement
Unit IV - IMAGE RESTORATION: Image Restoration - degradation model, Unconstrained and Constrained restoration, Inverse filtering, Wiener filtering, Geometric transformations-spatial transformations.
Unit V - IMAGE SEGMENTATION
Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation– Region growing – Region splitting and Merging – Segmentation by morphological watersheds – Hybrid methods

Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing‘, Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing‘, Pearson Education, Inc., 2002.

Reference Books:

1. Kenneth R. Castleman, ―Digital Image Processing‖, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, ‖Digital Image Processing using MATLAB‖, Pearson Education, Inc., 2004.
3. D,E. Dudgeon and RM. Mersereau, ―Multidimensional Digital Signal Processing‖, Prentice Hall Professional Technical Reference, 1990.
4. Alan C. Bovik, ―Handbook of image and video processing‖ Elsevier Academic press, 2005
5. S.Sridhar, ― Digital Image processing‖ Oxford University press, Edition 2011

17EC2042 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits 3:0:0

Course Objectives :
- To impart knowledge on the fundamentals of neural networks
- To gain an understanding about Fuzzy logic
- To get familiarized with the different architectures involved in neural networks

Course Outcomes:
The students will be able to

- Summarize the pros and cons of different artificial neural networks.
- Discuss the principles of fuzzy logic theory
- Develop novel artificial neural networks
- Formulate fuzzy logic based expert systems
- Apply fuzzy logic concepts for real-time applications
- Apply artificial neural networks for solving engineering problems.

Unit I - Introduction to Neural Networks : Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Potential Applications of ANN.
Unit II - Architectures and Training Algorithms: Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.
Unit III - Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Limitations of the Perceptron Model, Hebb network, BPN, Hopfield neural network, Kohonen neural network
Unit IV - Classical & Fuzzy Sets : Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership,
Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.
Unit V - Applications: Neural network applications: Process identification, control, fault diagnosis, Pattern Recognition and load forecasting. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

Text Books:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Fourth edition, Pearson Education India, 2006.
2. Timothy J Ross, "Fuzzy logic with engineering applications", John Wiley & Sons, Third Edition, 2010.

Reference Books:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "NeuroFuzzy and Soft Computing", PHI / Pearson Education, Third edition, 2004.
2. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.
3. Mohamad Hasoun, "Fundamentals of artificial neural networks", MIT Press, 2003.

17EC2043 MULTIMEDIA COMPRESSION TECHNIQUES

Credits: 3:0:0

Course Objectives:

- To understand the characterization of speech and image waveforms.
- To learn about the various compression techniques for text data, audio, image and video signals.
- To know about the speech and video coding standards

Course Outcomes:

The students will be able to

- Understand the basic concepts of multimedia data.
- Acquire knowledge about the principles of various coding techniques
- Develop hybrid coding techniques
- Frame new algorithms for signal processing techniques
- Analyze the performances of various compression algorithms
- Apply the coding techniques for real time text/audio data

Unit I - Introduction: Special features of Multimedia – Graphics and Image Data Representations -Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications Need for Compression - Taxonomy of compression techniques
Unit II - Text Compression: Compaction techniques – Huffmann coding – Arithmetic coding – Shannon Fano coding – Dictionary techniques – LZW family algorithms.
Unit III - Audio Compression: μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic subband coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio.

Unit IV - Image Compression: Transform Coding – JPEG Standard – Subband coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG.
Unit V - Video Compression: Video compression techniques and standards – MPEG Video Coding - Motion estimation and compensation techniques – H.261 Standard – DVI technology.

Text Books:
1. Khalid Sayood, " Introduction to Data Compression", Morgan Kauffman Harcourt India, 5th Edition, 2017.
2. David Salomon, "Data Compression – The Complete Reference", Springer Verlag, 4^{th} Edition, 2007.

Reference Books:
1. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards", CRC press, 2003.
2. Peter Symes, "Digital Video Compression", McGraw Hill, 2004.
3. Mark S.Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, 2003.

17EC2044 MACHINE LEARNING ALGORITHMS FOR IMAGE PROCESSING

Credits: 3:0:0

Course Objective:
- To understand the concepts of machine learning algorithms
- To understand the performance and limitations of various machine learning algorithms
- To explore how machine learning algorithms can be applied to image processing applications.
- To get familiarized with the use of neural networks in pattern recognition

Course Outcome:
The student will be able to
- understand the techniques, mathematical concepts, and algorithms of machine learning
- Select the appropriate machine learning algorithm to solve real time problems.
- Acquire knowledge about the artificial neural networks.
- Compare the data and efficiently execute the algorithm to solve the problem
- analyze and compare the results of different machine learning algorithms
- Comprehend the statistical techniques to analyze the results

Unit I - Fundamental steps in Image processing- Enhancement- Image analysis procedure – Application of machine learning - types of learning- supervised, unsupervised, reinforcement, classification learning, representations.
Unit II - Hypothesis space, inductive bias, underfitting and over fitting, evaluation of learning algorithm, cross validation, limitations.
Unit III - Linear regression and decision tree, LMS algorithm, Delta rule, Entropy, information gain, splitting rule, model selection.
Unit IV - Logistic regression, introduction to support vector machine, Dual, maximum margin with noise, nonlinear SVM and kernel function, SMO algorithm.
Unit V - Neural Networks, perceptron, multilayer network, deep learning network, convolution neural network and recurrent neural network.

Text Books:
1. Ethem Alpaydin, "Introduction to machine learning", MIT Press, 2010.
2. Robert Schalkoff, "Pattern Recognition-Statistical, Structural and Neural Approaches", John Wiley & sons,Inc, New York, 2005.

Reference Books:
1. David Barber, "Bayesian Reasoning and Machine Learning", Cambridge University Press, 2012
2. Duda, R. O., Hart, P. E., and Stork, D. G,"Pattern Classification", 2nd edition, John Wiley & Sons, NewYork,2001.
3. Tou and Gonzales,"Pattern Recognition Principles", Wesley Publication Company, London, 1974.

17EC2045 INFORMATION THEORY AND CODING

Credits 3:0:0
Pre requisite: 14EC2021 Digital Communication

Course objectives

- To learn the basics of information theory
- To calculate channel capacity and other measures
- To understand the source coding techniques for text, audio and speech
- To know the format of image compression
- To know the concept of error control techniques
- To understand how to calculate the rate and error probabilities.

Course outcome

- The students understand the basics of information theory
- The student gain knowledge to calculate channel capacity and other measures
- The students understand the source coding techniques for text, audio and speech
- The students understand the format of image compression
- The students understand the concept of error control techniques
- The students analyze and apply specific coding methods calculate the rate and error probabilities.

Unit I - Information Theory: Introduction – Information, Entropy, Information rate, classification of codes, Kraft McMillam inequality, Source coding theorem, Shannon Fano coding, Huffman coding – algorithm, tree construction, Efficiency – Joint and Conditional Entropies, Mutual information and its properities – Discrete Memory less channels – BSC, BEC, Channel capacity – Shannon limit

Unit II - Source Coding: Text, Audio and Speech: Introduction to text coding, Adaptive Huffman coding, Arithmetic coding, LZW algorithm - Introduction to Audio coding, Perceptual coding, Masking techniques, Psychoacoustic model, MPEG audio layers I, II, III – Dolby AC3 – Introduction to Speech Coding, Channel vocoder, Linear Predictive Coding.

Unit III - Source Coding: Image and Video: Image and Video formats – GIF, TIFF, SIF, CIF and QCIF – Image compression – READ, JPEG – Video compression – Principles I, B, P frames – Motion estimation – Motion Compensation – H.261 standard, MPEG standard

Unit IV - Error Control Coding: Block Codes: Introduction to error control coding – Definition and Principles – Hamming weight, Hamming distance, minimum distance decoding – Single parity codes, hamming codes, repetition codes – Linear block codes – Cyclic codes – Syndrome calculation – Encoder and decoder - CRC

Unit V - Error Control Coding: Convolutional Codes: Introduction to Convolutional codes – Code tree – Trellis codes – State diagram – Encoding and decoding – Sequential search – Viterbi algorithm – Principle of Turbo coding

Text Book:

1. Andre Neubauer, Jurgen Freudenberger, Volker Kuhn, “Coding theory: Algorithms, Architectures and Applications” John Wiley & Sons Ltd, Reprint 2012.

Reference Books:

1. Robert. H. Morelos- Zaragoza, “The Art of Error Correcting Coding”, Second Edition, John Wiley & Sons Ltd, Reprint 2013.
2. R. Avudaiammal, “Information Coding Techniques”, 2nd Edition, Tata McGraw Hill Education Pvt. Ltd., 2010.
3. R Bose, “Information Theory, Coding and Cryptography”, TMH 2007
4. Fred Halsall, “Multidedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002
5. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
6. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007
7. Amitabha Bhattacharya, “Digital Communication”, TMH 2006

17EC2046 DIGITAL SYSTEM DESIGN

Credits 3:0:0

Course Objective:

- Advanced digital system concepts are introduced.
- Various PLD's are discussed
- To learn about the different design methodologies involved in PLDs

Course outcome:

- To analyze operation and performance of fundamental combinational and sequential circuits
- Understanding FSM based circuits.
- Knowledge on synchronous and asynchronous circuits
- Architectures of various families of PLD's are learned
- To familiarize with basic structures and features of programmable logic devices (PLDs) and PLA
- Knowledge on ASM, FSM and their models.

Unit I - Combinational Logic Circuits: Review of Combinational Logic Circuits: Shannon's expansion theorem - Boolean Algebra – Basic Theorems and properties – Boolean Functions – Canonical and Standard Forms – Karnaugh Map Simplification – Two, Three, Four and Five Variables – NAND and NOR Implementation – Don't Care Conditions – Quine McCluskey Method.

Unit II - Sequential Logic Circuits: Mealy machine - Moore machine - State diagrams - State table minimization –State assignments, Introduction, Mealy and Moore models, State machine notation, synchronous sequential circuit analysis and design. Construction of state Diagrams, Counters Design.

Unit III - Synchronous and Asynchronous Circuits: Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode - Sequential circuits – Latches – Flip-flops – Triggering of Flip-Flops – Analysis of clocked sequential circuits – State reduction and state assignment – Design procedure of clocked sequential circuits

Unit IV - Programmable Logic Device Circuits: Programmable Logic Devices-Programmable Logic Element (PLE), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Basic concepts, Programming Techniques, PROM realization, Structure of standard PLD, Design of combinational and sequential circuits using PLD's.

Unit V - Algorithmic State Machine Circuits: Design of state machines using ASM chart, Minimum logic realization of ASM chart. Design of state machine using Algorithmic State Machines (ASM) chart as a design tool-CPLDS - Structure of Complex PLD's (CPLD)-Design of combinational and sequential circuits using CPLD's.

Text Books:

1. Charles H.Roth, " Digital system Design with VHDL", Thomson, 1998

Reference Books:

1. James E. Palmer, David E. Perlman, "Introduction to Digital Systems ", Tata McGraw Hill, 1996.
2. Robert Dueck ," Digital design with CPLD applications and VHDL ", Thomson ,2004
3. Bob Zeidman , "Designing with CPLDs and FPGAs ", CMP ,2002
4. Neil H. E. Weste,DavidHarrisayan Banerjee "Principles of CMOS VLSI Design : A Systems Perspective", Pearson Education India,2nd Edition ,2002.

17EC2047 VERILOG HDL

Credits: 3:0:0

Course Objectives:

- To learn various Verilog Programming Techniques.
- To understand different steps involved in Verilog Programming
- Knowledge about different types of modeling

Course Outcomes:

After completion of the course, students will be able to

- Understand basic terminologies involved in Verilog HDL
- Design Combinational digital circuits and sequential digital circuits
- Design gates using switch level modeling
- Develop a test bench for digital circuits
- Design state machine implementation using Verilog HDL

- Implement simple digital circuit application on FPGA using Verilog HDL

Unit I - Design Methodology – Module – Ports – Basic concepts – Operators – Number specification – Data types
Unit II - Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multi way branches Loops - Switch – Modeling elements
Unit III - Implementation of Basic circuit using Dataflow & Behavioral Modeling - Component Assignments – Switch level modeling
Unit IV - Applications of all dataflow, behavioral and Structural modeling in FPGA – FSM Implementation – Test Benches**.**
Unit V - FPGA – Xilinx XC4000 series – Logic Cell Array (LCA) – Configurable Logic Blocks(CLB) – Input/Output Blocks(I/OB) – Programmable Interconnection Points(PIP).

Text Books:

1. Samir Palnitkar, "Verilog HDL", Pearson Publication", II Edition. 2003.
2. M.D. Ciletti, "Advanced Digital Design with the VERILOG HDL" PHI, 2008.

Reference Books:

1. I.Bhaskar, "A VHDL Synthesis Primer", BS Publications,III edition, 2004.
2. SadiqM.Sait, Habib Youssef, "VLSI Physical Design Automation", World Scientific Publishing, 1998
3. M. Morris Mano,Micheal ciletti "Digital Design : With an Introduction to Verilog HDL" Pearson, 5th Edition, 2013.

17EC2048 VHDL

Credits: 3:0:0

Course Objectives:
- To learn various VHDL modeling techniques.
- To familiarize with VHDL sub program and packages techniques.
- To have an understanding about generics and modeling delays

Course Outcomes:
After completion of the course, students will be able to
- Understand basic terminologies and modeling types used in VHDL
- Design combinational circuits and sequential circuits using VHDL
- Develop a digital circuit test bench
- Develop a VHDL package for digital circuit
- Familiarized with FPGA architecture
- Implement simple digital circuit application on FPGA using VHDL

Unit I - Design flow process –Software tools – Data objects - Data types – Data operators – Entities and Architectures
Unit II - Data flow, Behavioral Modeling. Structural Modeling Component declaration and instantiation- Concurrent signal assignment – concurrent statement-conditional signal assignment - selected signal assignment – Sequential statement
Unit III - Modeling Delays-Inertial delay, Transport delay- Attributes -Test bench – Functions – Procedures – Packages – Libraries
Unit IV - Operator Overloading – Generics – Examples – CPU **-** Shift registers-Counters -State machine- Traffic light controller.
Unit V - FPGA – Xilinx Virtex II Pro Platform FPGA- Configurable Logic Blocks (CLB) – Input/Output Blocks(IOB) – Programmable Interconnection Points(PIP).

Text Books:

1. J. Bhaskar, "A VHDL Primer", PHI Learning, III Edition, 2009.
2. Charles H. Roth, Jr and Lizy Kurian John's Digital Systems Design Using VHDL Cengage Learning 2nd edition 2012

Reference Books:

1. Douglas L. Perry, "VHDL Programming by Example", TATA McGRAW-HILL Edition,2003.
2. Sadiq M.Sait, Habib Youssef, "VLSI Physical Design Automation", World Scientific Publishing,1998

3. Stephen Brown, "Fundamentals of Digital Logic Design with VHDL", Tata Mcgraw-Hill Publishing Company Limited, 2nd Edition, 2007.

17EC2049 ASIC DESIGN

Credit 3:0:0

Course Objective:
- To understand the types of ASIC s and design flow.
- To acquire knowledge on Programmable ASICs and programmable ASIC logic cells.
- To study the concepts of Programmable ASIC Interconnect and Programmable ASIC design software.
- To develop algorithms for physical design ASIC s.

Course Outcome:

On successful completion of the Course, students can be able to
- Define the types of ASICs, Combinational and Sequential Logic Cells.
- Describe the Programmable ASICs and programmable ASIC logic cells.
- Demonstrate Programmable ASIC Interconnect and Programmable ASIC design software.
- Illustrate the goals and objectives of partitioning, floorplanning and placement.
- Develop algorithms for various types of routing.
- Explain the concepts of Circuit Extraction and DRC.

Unit I - Introduction to ASICs: Types of ASICs- Design Flow-CMOS Design Rules- Combinational Logic Cells-Sequential Logic Cells.

Unit II - Programmable ASICs, and programmable ASIC logic cellsThe Antifuse - static RAM -EPROM and EEPROM Technology - Actel ACT - Xilinx LCA -Altera FLEX - Altera MAX.

Unit III - Programmable ASIC Interconnect and Programmable ASIC design software

Actel ACT- Xilinx LCA- Xilinx EPLD- Altera MAX 5000 and 7000- Altera MAX 9000- Altera FLEX- Design Systems Logic Synthesis - The Halfgate ASIC.- Schematic Entry.

Unit IV - System Partitioning, floorplanning and placement

System Partitioning- Partitioning Methods- Floorplanning Goals and Objectives- Measurement of Delay in Floorplanning- Floorplanning Tools - Channel Definition - I/O and Power Planning-

Placement Terms and Definitions - Placement Goals and Objectives - Measurement of Placement Goals and Objectives - Placement Algorithms.

Unit V - Routing: Global Routing -Goals and Objectives- Measurement of Interconnect Delay- Detailed Routing-Special Routing- Clock Routing - Power Routing - Circuit Extraction and DRC.

Text Books:

1. Michael John Sebastian Smith “Application specific integrated circuits.” Addison, Wesly Longman Inc., 2006.
2. Farzad Nekoogar and Faranak Nekoogar, “From ASICs to SOCs: A Practical Approach”, Prentice Hall PTR, 2003.

Reference Book:

1. 1.R. Rajsuman, “System-on-a-Chip Design and Test” Santa Clara, CA: Artech House Publishers, 2000

17EC2050 ANALYSIS AND DESIGN OF DIGITAL IC

Credits: 3:0:0

Course Objective:
- To learn about the basic concepts of MOS transistor.
- To study about second order effects to analyse MOS transistor.
- To learn the concept of designing CMOS inverter and analysing its static and dynamic behaviour.
- To illustrate the concept of designing combinational and sequential circuits using different logic styles.

Course Outcome:

The students will be able to
- Understand the basic concepts of MOS transistor.
- Illustrate different second order effects of MOS transistor.
- Analyse static and dynamic behaviour of CMOS inverter.

- Design combinational logic circuits in CMOS.
- Interpret different logic style for design of sequential logic circuits.
- Comprehend the significance of optimising the logic circuit design.

Unit I - MOS TRANSISTOR: Physical structure of MOS transistor – threshold voltage – body effect – dc equations – second order effects – MOSFET regions of operation – MOS as switch - MOS Models – Interconnect parameters – capacitance – resistance – inductance – Electrical wire model: ideal wire – lumped model – RC model – transmission line – switching characteristics : Analytical delay model – empirical delay model - case study: study of technology development in MOS.
Unit II - CMOS INVERTER: Static CMOS inverter – DC Characteristics – combinational logic gate implementation – CMOS gate transistor sizing –Static behavior: switching threshold – noise margin – Dynamic behavior: computing capacitance – propagation delay - power dissipation – case study: Technology scaling and its impact on inverter metrics.
Unit III - COMBINATIONAL LOGIC CIRCUITS IN CMOS: Static CMOS logic Design : complementary CMOS – Ratioed logic – pass transistor logic – CPL – transmission gate logic – Dynamic CMOS logic design : Basic principles – speed and power dissipation - signal integrity issues – domino logic – np CMOS logic – NORA logic.
Unit IV - SEQUENTIAL LOGIC CIRCUITS IN CMOS: Introduction – timing metrics for sequential circuits – classification of memory elements – static and dynamic latches and registers – C^2MOS approach – TSPCR – Pipelining : latch versus register based pipelines – NORA CMOS logic style for pipelined structures.
Unit V - IMPLEMENTATION STRATEGIES FOR DIGITAL IC: Full custom and semi custom design - Standard Cell design and cell libraries - FPGA building block architectures - FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow - Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

Text Book:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, ―Digital Integrated circuits: A design perspective‖. Second Edition, Prentice Hall of India, 2003

Reference Books:

1. N.Weste, K.Eshraghian, ―Principles of CMOS VLSI DESIGN‖, A system Perspective, second edition, Addision Wesley 2004.
2. M.J. Smith, ―Application specific integrated circuits‖, Addisson Wesley, 1997.
3. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4. A.Pucknell, Kamran Eshraghian, ―BASIC VLSI DESIGN‖, Third edition, Prentice Hall of India, 2007
5. **2.** 5.R.Jacob Baker, Harry W.LI., David E.Boyee, ―CMOS Circuit Design, Layout and Simulation, Prentice Hall of India, 2005.

17EC2051 LOW POWER TECHNIQUES IN VLSI DESIGN

Credits 3:0:0

Course Objective :
- To understand basic principles of low power concepts.
- To acquire knowledge on circuit and logic level power reduction techniques
- To design low power flipflops and SRAM devices.

Course Outcome:
On successful completion of the Course, students can be able to
- Describe the basic principles and need for low power VLSI chips.
- Define the various low power reduction techniques at circuit level.
- Demonstrate the various low power reduction techniques at logic level.
- Illustrate the architecture and system level power reduction techniques.
- Develop low power SRAM chips
- Apply the of energy recovery concepts to design low power circuits and to design low power flipflops.

Unit I - Simulation Power Analysis: Need For Low Power VLSI Chips- Charging And Discharging Capacitance- Short Circuit Current- Leakage Current- Static Current- Basic Principles of Low Power Design- Gate Level Logic Simulation- Architectural Level Analysis-

Unit II - Circuit and logic level power Estimation: Transistor and Gate Sizing- Equivalent Pin Ordering- Network Reconstructing and Reorganization- Gate Reorganization- Signal Gating - Logic Encoding- State Machine Encoding- Pre-Computation Logic- Power Reduction in Clock Networks- CMOS Floating Node- - Delay Balancing.
Unit III - Architecture and System level power Estimation: Power and Performance Management- Switching Activity Reduction- Parallel Architecture- Flow Graph Transformation. Leakage Current in Deep Sub-Micrometer Transistors- Deep SubMicrometer Device Design Issues- Low Voltage Circuit Design Techniques-
Unit IV - SRAM Architectures.: MOS Static RAM- Memory Cell- Banked SRAM- Reducing Voltage Swing on Bit Lines- Reducing Power in the Write Driver and Sense Amplifier Circuits.
Unit V Energy recovery and low power latches and Flip Flops: Energy Recovery Circuit Design - Design with Partially Reversible Logic- Need for Low Power Latches and Flip Flops- Quality Measures for Latches and Flip Flops.

Text Books:

1. Gary Yeap, "Practical Low Power Digital VLSI Design", Kluwer academic publishers, 2001.
2. Kaushik Roy, Sharat prasad, "Low Power CMOS VLSI Circuit Design", John Wiley & Sons Inc., 2000.

Reference Books:

1. Anantha Chadrasekaran and Robert Broderson, "Low Power CMOS Design", Standard Publishers, 2000.
2. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, "CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson edition, Second Indian reprint, 2003.

17EC2052 NANO ELECTRONICS

Credits: 3:0:0

Course objective:

- To design different Nano fabrication structures.
- To design memory devices & sensors.
- To understand the Nano computer architectures.

Course outcome:

The students will be able to:

- Study the overview of basic Nano electronics.
- Understand the Nano architectures.
- Design different types of Nano fabrication structures
- Explore various spintronics devices and its design aspects.
- Analyzes different memory devices and sensors
- Applications of various Nano electronic devices

Unit I - Introduction to Nano-electronics and Materials: Introduction of Nanoelectronics, Recent past, present and its challenges, Overview of Nano devices, Nano materials, Nano characterization.
Unit II - Nano-Electronics architecture and circuits: Introduction to Nanocomputers, Nanocomputer Architecture, Quantum DOT cellular Automata (QCA), QCA circuits, Single electron circuits, molecular circuits, Logic switches – Interface engineering – Properties (Self-organization, Size-dependent) – Limitations.
Unit III - Fabrication and measurement Techniques: Nanofabrication – Crystal Properties and Growth, Diffusion, Oxidation, Nanopatterning of Metallic/Semiconducting nanostructures (e-beam/X-ray, Optical lithography& Soft-lithography) – Ion Implantation – Thin Flim Deposition and Etching, Nano phase materials – Selfassembled Inorganic/Organic layers.
Unit IV - Nano-electronics and Spintronics: Overview of Spin Electronics, Spin Injection, spin relaxation and spin dephasing, Spin Dependent Transport, Spintronic devices and applications, spin filters, spin diodes, spin transistors.
Unit V - Properties and Applications of Nano-electronics: Memory devices and sensors – Nano ferroelectrics – Ferroelectric random access memory –Fe-RAM circuit design –ferroelectric thin film properties and integration – calorimetric -sensors – electrochemical cells – surface and bulk acoustic devices – gas sensitive FETs – resistive semiconductor gas sensors –electronic noses – identification of hazardous solvents and gases – semiconductor sensor array

Text Books:

1. Karl Goser, Jan Dienstuhl and others "Nanoelectronics and Nanosystems" From Transistor to Molecular & Quantum Devices, Springer, 2004
2. Rainer Waser "Nano Electronics and Information Technology" 3rd Edition, Wiley-VCH, 2012

Reference Books:

1. Sadamichi Maekawa "Concepts in Spintronics" Oxford Scholarship, 2007
2. David Awschalom "Spin Electronics" kluwer academic publishers- Springer, 2004
3. Y. Taur and T. Ning "Fundamentals of Modern VLSI Devices" Cambridge University Press, 2000.
4. Plummer, Deal, Griffin " Silicon VLSI Technology", Pearson Education India 2009 ,.
5. Encyclopedia of Materials Characterization, C .Richard Brundle, Charles A. Evans Jr., Shaun Wilson, Elsevier, I992.

17EC2053 RF CIRCUIT DESIGN

Credits: 3.0.0

Course objective:

- Analyze transmission-line circuits at RF frequencies
- Use the Smith chart for solving transmission-line problems
- Design impedance matching in transmission-line networks

Course outcome:

The students will be able to:

- Acquire basic knowledge of general RF circuits, components and systems.
- Interpret resonant circuits.
- Implement Smith Chart in RF applications.
- Design impedance matching networks and passive RF filters.
- Paraphrase two port networks and S parameters.
- Implement RF power amplifiers.

Unit I :INTRODUCTION: RF Behavior of Passive Components, Chip components and Circuit board considerations **:** Chip resistors, chip capacitors, surface mounted inductors.

Unit II - TRANSMISSION LINE ANALYSIS (REVIEW): General Transmission Line Equation,Lossless Transmission Line Model,Special Termination Conditions,Sourced and Loaded Transmission Lines

Unit III - THE SMITH CHART: Reflection coefficient in Phasor form, Normalized Impedance equation, the Parametric reflection coefficient equation, graphical representation, Impedance transformation for general load, Standing wave ratio, Special transformation conditions. Admittance Transformations **:** Parametric admittance equation, Additional graphical displays.Parallel and series Connections **:** Parallel connections of R and L connections, Parallel connections of R and C connections, Series connections of R and L connections, Series connections of R and C connections,Example of a T Network

Unit IV - RF FILTER DESIGN: Filter types and parameters, Low pass filter, High pass filter, Bandpass and Bandstop filter, nsertion Loss. Special Filter Realizations **:** Butterworth type filter, Chebyshev type filters, Denormalization of standard low pass design. Filter Implementation **:** Unit Elements, Kuroda's Identities and Examples of Microstrip Filter Design.Coupled Filters **:** Odd and Even Mode Excitation, Bandpass Filter Design, Cascading bandpass filter elements, Design examples

Unit V - RF AMPLIFIER: Biasing and Setting Operating Points,Power Flow of RF Active and Passive Devices,Stability/Constant Gain,One-Stage RF Amplifier Design Example,Mixer/Osc. design examples

Text Book:

1. R. Ludwig, G. Bogdanov, RF Circuit Design: Theory and Practice, 2nd edition, Prentice Hall,2009

Reference Books:

1. G. Gonzales, Microwave Transistor Amplifiers: Analysis and Design, 2nd edition, Prentice Hall, 1996.
2. D.M. Pozar, Microwave Engineering, Addison-Wesley, Reading, MA, 4^{th} edition, 2013

17EC2054 ELECTRONICS AND COMMUNICATION LABORATORY

Credits: 0:0:2

Objective:

- To design wave shaping circuits.
- To design multivibrator circuits.
- To analyze the different types of modulation and demodulation techniques.

Outcome:

- Apply engineering mathematical concepts to design basic circuitry and connections.
- Express the practical knowledge of various electronic and communication circuits.
- Demonstrate skills by using modern tools to analyse problems.
- Employ appropriate components by effective applyication of the knowledge gained.
- Mathematically analyze and predict appropriate circuits.
- Assess on the adverse effect of noise on signals.

Experiments

1. Design of RC Differentiator and Integrator
2. Design of Attenuator
3. Design of Astable multivibrator using BJT
4. Design of RC coupled Amplifier
5. Design of Single tuned amplifier
6. Amplitude Modulation and demodulation
7. Frequency Modulation
8. Balanced Modulator
9. Design of PLL
10. Pre-emphasis and De-emphasis
11. Equalizer
12. IF Amplifier

17EC2055 ADVANCED COMMUNICATION LABORATORY

Credits: 0:0:2

Course Objective:

- To demonstrate and understand concepts of line coding, digital modems and wireless transmission in communication systems.
- To understand testing and measurement of RF Circuits, Wired/Planar Antennas and Transmission Lines
- To implement digital communication techniques, system level and circuit level modeling using various simulation tools

Course Outcome:

At the end the Laboratory Course, the students will be able to

- understand the communication systems in system level and sub-block level design and testing.
- develop the ability to work as team in test and measurement of RF Circuits antennas and transmission lines
- experimentally test RF circuits and systems through hands-on experience in system development & Debugging.
- critically assess the performance of wired and wireless communications systems
- to design and implement a digital modems, RF Circuits and antennas to given specifications emphasizing the use of tools and engineering in practice
- ability to write report on the design and implementation of the circuits and systems

List of Experiments:

1. Generation of various Line Coding Formats
2. PAM, PWM & PPM Modulation schemes
3. M-ary Signaling Schemes (ASK, FSK PSK)
4. QPSK and MSK Signaling Scheme Using Matlab
5. Sampling , Quantization Effects & Error Correction Code in Pulse Code Modulation
6. Generation and Detection of Delta Modem (Granular Noise & Overload Noise)

7. Test and Measurement of Characteristic Impedance Z_0, dielectric Constant ε, Attenuation Level(α), Standing Wave Ratio(S), Reflection Coefficient (K), Return Loss(S_{11}) in various transmission Lines.
8. Test and Measurement of Gain/Directivity, Beam width, Radiation pattern plot and Return Loss of Wired antennas.
9. Test and Measurement of RF Filters(LPF, HPF, BPF, BRF) using Spectrum Analyser
10. Design and Simulate Super heterodyne Receiver using NI AWR Microwave office
11. Design and Simulate End-Fire and Broadside antenna element array Using FEKO.
12. Study wireless communication using WiCOMM-T /SDR platform or Data Communication Trainer Module

17EC2056 MICROPROCESSORS AND INTERFACING TECHNIQUES

Credits: 3:0:0

Course Objectives:
- To gain knowledge about architecture and programming concepts of 8085 and 8086 Microprocessors.
- To understand the concepts on memory and peripheral interfacing chips.
- To design microprocessor based systems.

Course Outcomes:
On successful completion of the Course, students can be able to
- Define the architecture of 8085 microprocessor.
- Describe the architecture of 8086 microprocessor and minimum /maximum modes of operation.
- Discuss 8086 assembly language programs for the given applications
- Apply the memory and I/O interfacing concepts for any microprocessor design.
- Develop microprocessor and Microcontrollers based systems
- Select the Microprocessor with proper specifications for various applications

UNIT I - 8085 MICROPROCESSORS: Organization of 8085 microprocessor –Timing and control signals-Addressing modes –Timing Diagram – Instruction set-– Assembly language programs-Memory interfacing.
UNIT II - 8086 MICROPROCESSORS: Organization of 8086 microprocessor – memory segmentation– Address formation –Addressing modes in 8086 – Assembly language programming – Minimum mode and maximum mode.
UNIT III - MICROPROCESSOR INTERFACING CHIPS: 8255 Programmable Peripheral interface - 8253 programmable interval timer- 8251A Programmable communication interface - 8259A Programmable interrupt controller
UNIT IV - MICROPROCESSOR INTERFACING CHIPS: 8257 DMA controller- 8279 Programmable Keyboard/display interface- 8295 Programmable printer controller – 8275 programmable CRT display controller.
UNIT V - APPLICATIONS: LCD and Keyboard Interface- ADC, DAC and Sensor Interface-Stepper motor-DC motor- Microprocessor based System design.

Text Books

1. Ramesh.S.Gaonkar "Microprocessor Architecture, Programming & Applications With 8085/8080a" – Penram International – 2006.
2. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", Tata McGraw Hill, 2012.

Reference Books

1. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2011.
2. Yu.Cheng Liu & Glenn A Gibson," Microcomputer System, 8086/8088 Family, Architecture, Programming and Design‖", 2nd Edition, PHI, 2007.
3. Rafiquzzaman.M. "Microprocessor Theory and Applications-Intel and Motorola", PHI, 2007.
4. A.K. Ray, K.M.Bhurchandi, "Advanced Microprocessor and Peripherals", 2nd edition, Tata McGrawHill, 2007.

17EC2057 MICROPROCESSOR LABORATORY

Credits: 0:0:1

Course Objectives

- To gain knowledge about various components of 8085 and 8086 Microprocessors kits.
- To acquire the programming skills for 8085 and 8086 Microprocessors kits.
- To understand the concepts on memory and peripheral interfacing chips.
- To design microprocessor based systems.

Course OutcomeS:

On successful completion of the Course, students can be able to

1. Define simple 8085 microprocessor programs.
2. Describe the Square wave generation using 8255 PPI.
3. Demonstrate 8086 assembly language programs.
4. Apply the memory and I/O interfacing concepts for any microprocessor design.
5. Construct Traffic Light Controller
6. Develop microprocessor based systems.

Using 8085 microprocessor

1. Programs involving Data Transfer and Arithmetic and Logical operations.
2. Square wave generation using 8255
3. Using 8086 microprocessor
4. To find largest/smallest number in an array
5. To arrange numbers in ascending/descending order.
6. Stepper motor Interfacing
7. ADC Interfacing
8. Traffic Light Controller
9. DAC Interfacing

17EC2058 MICROCONTROLLER AND ITS APPLICATIONS

Credits:3:0:0

Course Objectives:

- To gain knowledge about architecture and programming concepts of 8051 and PIC Microcontrollers.
- To understand the concepts on peripheral interfacing of microcontrollers.
- To design Microcontrollers based systems.

Course Outcomes:

On successful completion of the Course, students can be able to

- Describe the architecture of 8051 microcontroller.
- Discuss 8051 assembly language programs for the given applications.
- Apply the memory and I/O interfacing concepts for any microcontroller design.
- Illustrate the architectures of PIC microcontroller.
- Develop Microcontrollers based systems using C.
- Select the Microcontroller with proper specifications for various applications.

UNIT I- 8051 MICROCONTROLLERS: Introduction to microcontrollers -8051 Microcontroller Architecture -Memory organization - SFRs – Addressing modes- 8051 Instruction Set- Programming examples- External Memory Interface.

UNIT II - 8051 MICROCONTROLLER INTERFACING: Interrupts - Timer/Counter- Port operation - Serial communication. Programming 8051Timers - Serial Port Programming - Interrupts Programming.

UNIT 111 PIC 18 MICROCONTROLLERS: PIC 18 Microcontroller Architecture - Memory organization - SFRs - Interrupts – Addressing modes. Instruction set

UNIT IV - PIC 18 MICROCONTROLLER INTERFACING: Timers - PWM module - I/O Expansion – SPI-I2C bus - A/D Converter - UART

UNIT V –APPLICATIONS: LCD and Keyboard Interface- ADC, DAC and Sensor Interface, Stepper motor interfacing, DC motor interfacing.

Text Books

1. Kenneth J.Ayala “The 8051 Microcontroller Architecture, Programming & Applications” Penram International Publishing –2008.
2. Muhammad Ali Mazidi, , R.D.Mckinlay,Danny Causey, “PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18” Pearson Prentice Hall-2008.

Reference Books

1. Krishna Kant, “Microprocessor and Microcontroller Architecture, Programming and System Design using 8085,8086, 8051 and 8096”, PHI, 2011.
2. Ajay Deshmukh, “Microcontrollers: Theory and Applications”, Tata McGraw Hill, 2010.
3. Muhammad Ali Mazidi,J.G.Mazidi, R.D.Mckinlay, “The 8051 Microcontroller and Embedded Systems” Second Edition Prentice Hall-2007.
4. John B Peatman, “Design with PIC Micro Controllers”, Pearson Education India Series, New Delhi, 2005.

17EC2059 MICROCONTROLLER LABORATORY

Credits:0:0:1

Course Objectives

- To gain knowledge about various components of 8051 Microcontroller kit.
- To acquire the programming skills for 8051 and PIC Microcontrollers.
- To understand the concepts on memory and peripheral interfacing chips.
- To design 8051 and PIC microcontroller based systems.

Course OutcomeS:

On successful completion of the Course, students can be able to

1. Define simple 8051 microcontroller programs.
2. Describe the Serial data communication using 8051.
3. Demonstrate PIC controller programs.
4. Apply the memory and I/O interfacing concepts for any microcontroller design.
5. Construct DC motor interfacing using 8051.
6. Develop microcontroller based systems.

Using 8081 microcontroller

1. Programs involving Data Transfer and Arithmetic and Logical operations.
2. Block transfer
3. To arrange numbers in ascending/descending order.
4. DC Motor Interfacing
5. Serial data communication
6. Keyboard Display Interfacing

Using PIC microcontroller

1. Programs involving Data Transfer and Arithmetic and Logical operations.
2. To find largest/smallest number in an array

17EC2060 SEMI CONDUCTOR DEVICE MODELING

Credits: 3:0:0

Course Objective:

- To Know about the physics of Electrostatics
- To know about the physics behind semiconductor devices
- Toknow about thepractical applications of Semiconductor Devices

Course Outcome:

The students will be able to:

- Formulate new mathematical models for various devices.
- Learn the physics behind the semiconductor devices
- Deep understanding of PN Junction theory, heterojunctions and Contacts in the devices.
- Analyze the BJT device characteristics
- Explore the BJT, MOSFET and other semiconductor devices from semiconductor device perspective.
- Understand short channel effect and leakage mechanism in MOSFET devices.
- Advantages and applications of various SPICE models in the MOS devices.

Unit I - Semiconductor Physics and Materials: Semiconductor Materials and Structures- Band Structures – Electron-Hole Statistics – Carrier Mobility and Conductivity– Carrier Diffusion, Generation/Recombination – Avalanche Multiplication – Hall Effect, P-N Junction Theory – Built-In Potential – P-N Electrostatics – Abrupt And Linearly Graded P-N Junction Depletion Layers – Current-Voltage Relation In P-N Junction – Generation/Recombination Current – Diffusion Capacitance – Diode Equivalent Circuit – Breakdown Voltage – Junction Curvature Effect – Transient Behavior – Noise. Tunnel Diode – Metal-Semiconductor Junctions – Schottky Diode and Ohmic Contact – Hetero- Junctions.
Unit II - Bipolar Junction Transistors: BJT Current- Voltage Relation – Current Gain – Band Gap Narrowing – Auger Recombination – Early Effect – Punch-Through In BJT – Breakdown Voltage In BJT – Small Signal Equivalent Circuit – Cut-Off Frequency – Switching Behavior – HBT.
Unit III - Semi-Classical Bulk Transport Models: Basic Ebers-Moll Model – Basic Gummel-Poon Model – Model Derivation – Moll-Ross Equation – High Injection Effect – Knee Current – Early Effect – Base Widening Effects.
Unit IV - MOSFET Model: Structures and Characteristics: Basic Concepts Of MOSFET – Capacitance-Voltage Characteristics – Threshold Voltage of MOS Capacitor – Flat-Band Voltage – Gate Oxide Charges And Transport Through Gate Oxide– Current-Voltage Relation of Long Channel MOSFETS – Drain Conductance – Transconductance – Drain Current Saturation – Body Effect – Drift- Diffusion Model – Sub-Threshold Conduction, Slope And Mobility Models in MOSFETS – Temperature Effect – Equivalent Circuit of MOSFETS- Tailoring of MOSFET Parameters – Scaling of MOSFETs and Short- Channel Effects – Charge Sharing Model – Narrow Width Effect – Channel Length Modulation – Hot Carrier Effects. LDD MOSFET – VMOS, FAMOS – MESFET – MODFET.
Unit V - MOSFET Model: Equations, Boundary conditions and Approximations: Level-1 model of MOSFET – Level-2 model of MOSFET: Mobility modeling, Sub-threshold current- Channel length modulation- Short channel effect- Velocity saturation- Narrow width Effect- Gate capacitance- Junction capacitances – Level-3 model of MOSFET: Slope discontinuity Gate capacitances, BSIM model.

Text Book:

1. S.M. Sze, K. N. Kwok, "Physics of Semiconductor Devices", 3rd Edition, John Wiley & Sons, 2008.

Reference Books

1. S. M. Sze, "Semiconductor Devices: Pioneering Papers", World Scientific Publishing Company, 2004.
2. D. P. Foty, "MOSFET Modeling with SPICE, Principles and Practices", Prentice Hall PTR, 1997.
3. H. C. deGraff and F. M. Klaassen, "Compact Transistor Modeling for Circuit Design", Springer-Verlog Wein, New York, 1990.
4. E. Getreu, "Modeling the Bipolar Transistor", Elsevier Scientific Publishing Company, 1978.
5. Solid State Electronic Devices, Ben G. Streetman, Sanjay Banerjee, Pearson Prentice Hall, 2006
6. Compact MOSFET Models for VLSI Design A. B. Bhattacharyya, March 2009, Wiley-IEEE Press

17EC2061 ELECTRON DEVICES AND INSTRUMENTATION

Credits: 3:0:0

Course Objectives:
Enable the students to
- Learn the working principles and operational characteristics of semiconductor devices.
- Understand the applications of various electronic devices.
- Acquire knowledge on different electronic instruments.

Course Outcomes:
The students will be able to
- Describe the mechanisms of current flow in semiconductors.
- Distinguish the types of diodes and its characteristics.
- Apply the knowledge of electronic instrumentation for measurement of electrical quantities.
- Analyze the characteristics of transducers.
- Design amplifier circuits.
- Choose different semiconductor device for real time applications.

Unit I - Theory of PN Diodes Energy band structure of conductors, insulators and semiconductors – Electron-hole generation and recombination – Intrinsic and extrinsic semiconductors – drift and diffusion in semiconductors - Conductivity – Hall effect –– Continuity equation – PN junction – Diode equation-Forward and Reverse characteristics.
Unit II - Theory of Junction Transistors Basic principles-Operating modes of transistor -Transistor an Amplifier– Static characteristic of transistors. JFET: Operation – Static characteristics of JFET- MOSFET: Operation-static characteristics of MOSFET - SCR: Construction, Static Characteristics.
Unit III - Special Semiconductor Devices Zener diode – Schotky Barrier Diode – Tunnel diode – DIAC – TRIAC – Photo diode – Photo transistors – LED – LCD – photocouplers – Varactor diode.
Unit IV - Transducers - Classification, Characteristics, Selection – Resistive – Strain guage, Potentiometer, RTD, inductive transducers – LVDT, Accelerometer, Capacitive Transducer, Thermocouple, Piezoelectric transducers, Hall Effect Transducers, Smart sensors.
Unit V - Electronic Instruments Comparison of analog and digital techniques – digital voltmeter – multimeters – frequency counters – measurement of frequency and time interval, Signal generators, Function generator, Wave analyzer, Distortion analyzer, Spectrum analyzer, Logic analyzer.

Text Books:

1. Millman & Halkias,"Electronic Devices & Circuits",Tata McGraw Hill, 4th Edition,2015.
2. Robert Boylestad, "Electronic Devices & Circuit Theory", Pearson 11th Edition 2016.
3. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and Measurement Techniques, Pearson / Prentice Hall of India, 2015.

Reference Books:

1. David A. Bell, Electronic Devices and Circuits,Oxford University press, 5th Edition,2015.
2. Shawney A.K—A course in Electrical & Electronic Measurements, Dhanpat Rai & Co,19th Edition 2011.
3. D.V.S.Murty, Transducers and Instrumentation, PHI, 2nd Edition, 2009.

17EC2062 ELECTRON DEVICES AND INSTRUMENTATION LABORATORY

Credits: 0:0:2

Course Objectives:
Enable the student to

- Understand different semiconductor devices and its operation.
- Learn about the electronic instrument handling and its analysis
- Simulate various electronic circuits

Course Outcomes
The students will be able to

- Describe the fundamentals of semiconductor devices.
- Infer the characteristics of electronic devices.
- Operate and analyze the characteristics of transducers
- Identify suitable instruments to meet the requirements
- Design practical circuits for general applications
- Select suitable device for real time applications

LIST OF EXPERIMENTS

1. Characteristics of PN junction diode and Zener diode.
2. Static characteristics of Common Emitter configuration using BJT.
3. Transfer and output characteristics of JFET.
4. Characteristics of Photo-diode.
5. Characteristics of SCR
6. Half wave and Full wave Rectifier
7. Weight Measurement using Strain Gauge
8. Temperature Measurement Using Resistance Temperature Detector.
9. Displacement Measurement Using LVDT
10. Characteristics of Resistive Potentiometer
11. Pressure measurement using piezoelectric transducers.
12. Characteristics of thermocouple

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17EC2063 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 3:0:0

Course objectives:

- To understand the basic concepts of MEMS devices and materials for MEMS devices.
- To impart knowledge about the fabrication processes in MEMS Design.
- To impart knowledge about the different methodologies in MEMS packaging.
- To know the essentials of MEMS devices and its applications.

Course Outcomes:

Students will be able to,

- Acquire knowledge on the basic concepts of MEMS Design;
- Identify different materials used in MEMS devices;
- Acquire knowledge on the rudiments of Micro fabrication techniques;
- Develop MEMS structures based on various Micromachining techniques;
- Acquire knowledge on the basic concepts in Microsystem packaging;
- Apply MEMS devices to disciplines like Electrical and Mechanical Engineering.

Unit I - Introduction& Materials For Mems And Microsystems: Historical background of Micro Electro Mechanical Systems (MEMS)- Typical MEMS products- –Silicon based MEMS processes – Silicon Compounds- Silicon Piezoresistors- Gallium Arsenide-Quartz-Piezoelectric crystals-Polymers.
Unit II - Micro system Fabrication Processes: Photolithography- Ion Implantation- Diffusion- Oxidation- Chemical Vapor Deposition-Sputtering- Chemical Etching.
Unit III - Micromachining : Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon — Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Case studies – Basic surface micro machining processes – Structural and Sacrificial Materials – Problems in surface Micromachining – Bulk versus surface micromachining-Wafer Bonding- LIGA Process.
Unit IV - Microsystem Packaging: Different levels in Microsystem Packaging- Interfaces in Microsystem Packaging- Packaging Technologies- Three Dimensional Packaging- Assembly of Microsystems- Selection of Packaging Materials- Signal Mapping and Transduction- Case Study.
Unit V - Sensor & Actuators: Application of Microsystems in Automotive industry – Applications of Microsystems in health care devices- Microsensors: Pressure sensors- Chemical Sensors- Thermal Sensors- Optical Sensors- Micro actuators: Principle of Microactution-MEMS gyroscopes- Thermocouple- Digital Micro mirror device-MagMEMS Actuators.

Text Books:

1. 1.Tai Ran Hsu, “MEMS & Micro systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.
2. Nitagour Premchand mahalik, “MEMS”, Tata McGraw Hill, 2013.

Reference Books:

1. Marc Madou,Fundamentals of Microfabrication by, CRC Press, 1997.Gregory Kovacs, Micromachined Transducers Sourcebook WCB McGraw-Hill, Boston, 2006.
2. Stephen D Senturia, “Microsystem Design”, Springer Publication, 2000.32.
3. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000.
4. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2000.
5. James J.Allen, “Micro Electro Mechanical System Design”, CRC Press Publisher, 2010
6. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

17EC2064 MATLAB PROGRAMMING FOR ENGINEERS

Credits:3:0:0

Course Objectives:

- To enable the students to understand the fundamentals and programming knowledge in MATLAB.
- To provide the deeper understanding of the tools and processes that enable students to use MATLAB for the engineering problems.
- To assist the students with computational tools to design their own analysis and interpretation strategies when facing different engineering applications.

Course Outcomes:
The students will be able to:

- **Break down** computational problems into a series of simple steps.
- **Create** programs in the MATLAB language for engineering applications.
- **Process** numerical data and **perform** input and output operations on it.
- **Appraise** and get familiarized with the visualization techniques.
- **Expose** to the common algorithms and techniques that are the building blocks of MATLAB.

Unit I - - Introduction to MATLAB: Advantages of MATLAB – MATLAB Environment – Using MATLAB as a Scratch Pad –Variables and Arrays – Multidimensional Arrays – Scalar and Array Operations – Hierarchy of Operations – Built-in MATLAB Functions – Branching Statements and Program Design– Loops and Vectorization – User Defined Functions – Introduction to Plotting – Examples – Errors – Debugging MATLAB Programs.
Unit II - Input and Output Functions: Input / Output Functions: Text, Audio, Image and Video Read Functions – Load and Save –MATLAB File Processing – File Opening and Closing – Comparing Formatted and Binary I/O Functions – File Positioning and Status Functions – The text scan Function – Function uimport.
Unit III - Programs of Matrices and Polynomials: Vectors and Matrices – Mathematical Operations with Matrices – Polynomial Evaluation – Rots of a Polynomial – Mathematical Operations with Polynomial – Formulation of Polynomial Equation – Differentiation and Integration – Polynomial Curve Fitting – Evaluation of Polynomials with Matrix Arguments – Ordinary Differential Equation Solvers – Symbolic Mathematics.
Unit IV - Data Visualization: Data Visualization and Statistics – 2D Graphics: Plot and fplot COMMAND– Plotting Multiple Graphs in the Same Plot –Formatting a Plot. Logarithmic Axes – Error Bars – Special Graphics – Histograms – Putting Multiple Plots on the Same Page – Multiple Figure Windows – 3D Graphics: Line Plots – Mesh and Surface Plots – Examples of MATLAB Application.
UNIT V - Graphical User Interface: Introduction to Graphical User Interfaces in MATLAB – Designing GUI interfaces using MATLAB's GUIDE interface – MATLAB Handle graphics primitives – Cell-array – Structure of a Callback Subfunction – Get/Set Interface –Object Properties – Graphical User Interface Components – Additional Containers:Panels and Button Groups – Dialog Boxes – Menus – Creating Efficient GUI.

Text Books:

1. Stephen J. Chapman,"MATLAB Programming for Engineers", 5th Edition, Cengage Learning, 2015.
2. Amos Gilat,"MATLAB: An Introduction With Applications", John Wiley & Sons, 2009.

Reference Books:

1. R.K.Bansal, A.K.Goe, M.K.Sharma, "MATLAB and Its Applications in Engineering", Pearson Education India, 2009.
2. Edward B. Magrab,"An Engineer's Guide to MATLAB: With Applications from Mechanical, Aerospace, Electrical, Civil, and Biological Systems Engineering",3rd Edition, Prentice Hall, 2011.
3. Rudra Pratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 2010.
4. D. M. Etter, "Introduction to MATLAB for Engineers and Scientists", Prentice Hall, 1996.
5. William J. Palm III, "Introduction to MATLAB for Engineers", 3rd Edition, McGraw-Hill, 2005.

17EC2065 – DIGITAL SYSTEM DESIGN USING HDL

Credits:3:0:0

Course objective:

- Advanced digital system concepts are introduced.
- Various PLD's are discussed
- To learn about the Verilog HDL programming

Course outcome:
Students will be able to

- Obtain simplified digital circuit
- Design digital circuit.
- Understand different steps involved in Verilog Programming
- Get Knowledge about different PLDs
- Design real time circuits using Verilog HDL
- Have knowledge on FPGA.

Unit I - Number Systems & Boolean Algebra: Review of Number systems-Binary code-BCD-ASCII-EBCDIC-Excess 3 codesgray code-error detecting & correcting codes. Boolean Algebra:Postulates & theorems of Boolean Algebra –canonical forms –simplification of logic functions using karnaugh map Quine McClusky method.
Unit II - Combinational Circuit Design: Logic gates –implementation of combinational logic functions – encoders & decoders – multiplexers & demultiplexers –code converters – comparator - half adder, full adder – parallel adder – binary adder – parity generator/checker – implementation of logical functions using multiplexers.
Unit III - Sequential Circuit Design: Flip-Flops-Characteristic table-Excitation table- Mealy machine - Moore machine - State diagrams - State table minimization - State assignments. Shift registers, Counters. Design of synchronous counter. Asynchronous counter. Ring counter. Johnson counter.
Unit IV - Introduction to Verilog: Design methodology – Modules – Ports – Basic concepts – Operators – Nos. specification – Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multiway branches - Loops - Switch – Modeling elements. Design of FSM, Traffic Light Controller, Test bench.
UNIT V - PLD and FPGA: Programmable Logic Devices :PROM-PLA- PAL- FPGAs : Xilinx 3000 series and 4000 series- Altera complex programmable logic devices (CPLDs)- Altera flex 10k series CPLDs.

Text Books

1. MorrisMano,"Digital logic and computer Design", 3rd edition Prentice Hall of India,2002.
2. Charles. H. Roth, Jr, "Digital System Design using VHDL", PWS Publishing Company, 2001
3. Samir Palnitkar, "Verilog HDL", Pearson Publication", II Edition. 2003.

Reference Books

1. Jain R.P, "Modern Digital Electronics", Third edition, Tata Mcgraw Hill,2003
2. Floyd T.L., "Digital Fundamentals ", Prentice Hall, 9th edition, 2006.

17EC2066 ARTIFICIAL NEURAL NETWORKS

Credits:3:0:0

Course Objectives :

- To impart knowledge on the fundamentals of neural networks
- To gain an understanding about training methodologies of neural networks
- To get familiarized with the different architectures involved in neural networks

Course Outcomes:

The students will be able to

- Summarize the pros and cons of different artificial neural networks.
- Discuss the principles of training methodologies of neural networks
- Develop novel artificial neural networks
- Formulate neural networks based expert systems
- Analyze the single layer and multi-layer neural networks
- Apply artificial neural networks for solving engineering problems.

Unit I - Introduction to Neural Networks: Humans and Computers - Organization of the Brain - Biological Neuron, Biological and Artificial Neuron Models - Characteristics of ANN - McCulloch-Pitts Model - Historical Developments - Potential Applications of ANN.
Unit II - Essentials of Artificial Neural Networks: Artificial Neuron Model - Operations of Artificial Neuron - Types of Neuron Activation Function - ANN Architectures - Classification Taxonomy of ANN – Connectivity - Learning Strategy (Supervised, Unsupervised, Reinforcement) - Learning Rules.
Unit III - Single Layer Feed Forward Neural Networks: Introduction- Perceptron Models: Discrete, Continuous and Multi-Category- Training Algorithms: Discrete and Continuous Perceptron Networks - Limitations of the Perceptron Model.
Unit IV - Multilayer Feed forward Neural Networks: Generalized Delta Rule, Derivation of Backpropagation (BP) Training - Summary of Backpropagation Algorithm - Learning Difficulties and Improvements.
Unit V - Associative Memories: Paradigms of Associative Memory - Pattern Mathematics - Hebbian Learning - General Concepts of Associative Memory - Bidirectional Associative Memory (BAM) Architecture - BAM Training Algorithms: Storage and Recall Algorithm - BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions - Storage and Recall Algorithm - Stability Analysis.

Text Books:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Fourth edition, Pearson Education India, 2006.
2. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.

Reference Books:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, "NeuroFuzzy and Soft Computing", PHI / Pearson Education, Third edition, 2004.
2. Mohamad Hasoun, "Fundamentals of artificial neural networks", MIT Press, 2003.

17EC2067 PCB DESIGN LABORATORY

Credits 0:0:2

Course Objective:

- To familiarize the design of simple circuits using PCB
- To improve the knowledge on circuits design
- To encourage the students to have innovative ideas of their own

Course outcome:

- The student will be able to emulate PCBs for simple electronic circuits.
- Knowledge gained through PCB Tools
- Improved knowledge on circuit designs
- Learning Eleven Lab – tool machine, Eagle software for routing and placement
- Learning design rules on PCB design
- Confidence to work in core companies

Experiments

1. Study of Express PCB Design and its Applications.
2. PCB Schematic of Half Wave Rectifier.
3. PCB Schematic of Multiplexer using Digital Ics.
4. PCB Schematic of Demultiplexer using Digital Ics.
5. PCB Schematic of High Pass Filter using IC741.
6. PCB Schematic of Dual Voltage Power Supply.
7. PCB Schematic of Frequency Divider Circuit using IC 555.
8. PCB Schematic of Seven Segment Decoder using IC7447.
9. PCB Schematic of LDR Light Detector Circuit using IC741.
10. PCB Schematic of Adder and Subtractor using IC741.
11. PCB Schematic of Traffic Light Circuit – Project Phase I
12. Project Phase II

17EC2068 FUNDAMENTALS OF ELECTRONICS

Credits: 3:0:0

Course Objectives:

- To impart the basic knowledge about the principle of semiconductor devices.
- To understand the basic digital system and electronic instruments.
- To get the knowledge about the various analog communication techniques

Course Outcomes:

The students will be able to:

- Understand the design concepts of electron device architecture
- Select the op-amp ICs based on their characteristics
- Comprehend the digital system design
- Explain the architecture of Microprocessor
- Choose suitable transducers for the applications
- Acquire knowledge of analog basic communication systems

Unit-I: Introduction to Semiconductors and electron device architectures: P type Semiconductor – N type Semiconductor – Diodes - PN Junction, Zener – BJT Configurations, FET - JFET, MOSFET, UJT

Unit-II: Operational Amplifiers: Op-Amp – Applications – Adder, Subtractor, Differentiator, Integrator – Fabrication steps of Integrated Circuits
Unit-III: Digital System: Combinational circuit – Design of Half Adder, Full Adder, Decoder, Encoder – Sequential circuit – Flip-Flops – Latches – Memory – Types of Memory
Unit-IV: Microprocessor and Transducers: 8088 Configuration – architecture - Instruction set – programming - memory and I/O interfacing – Active and Passive Transducers – Resistive, Capacitive, Inductive, piezoelectric - Pressure sensors – bellows, diaphragm, Digital Transducer – shaft encoder, optical encoder - Hall effect transducer, vibration sensors – seismic transducer, chemical sensor – PH sensor, velocity transducer
Unit-V: Communication Systems: Block Diagram of Communication Systems – Need for Antenna - Modulation - Demodulation techniques – AM Transmitter – FM transmitter – Radio Receiver - Satellite communication – Fibre optics - RADAR.

Text Book:
1. Muthusubramanian R, Salivahanan S, "Basic Electrical Electronics & Computer Engineering, "Tata Mc.Graw Hill, 2010.

References:
1. Robert Boylestad, "Electronic Devices & Circuit Theory", Tenth Edition, Pearson Education, 2010.
2. A.K.Sawney, " A course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai &Co, 19^{th} Edition, 2011.
3. V.K.Metha."Principles of Electronics", Chand Publications,2014 reprint, Edition 2009.
4. Anokh Singh,A.K.Chhabra, "Principles of Communication Engineering" S.Chand Co., 2017

17EC2069 FUNDAMENTALS OF WIRELESS COMMUNICATION

Credits: 3:0:0

Course Objective:
- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods and Channel models.
- To enhance the understanding of various transceivers and its multiple access schemes.

Course Outcome:
After completion of the course, students will be able to
- Students learn the concepts of wireless communication.
- Students acquire knowledge about the various propagation methods and Channel models.
- Students have an enhanced understanding of various transceivers and its multiple access schemes.
- Students gain in understanding the ability of Multichannel Response
- Students develop knowledge skills in Wireless Channel Capacity.
- Students learn to analyze the design of any wireless system

Unit I - REVIEW OF WIRELESS SYSTEMS: History of Wireless Systems-Wireless Vision- Technical Issues-Current Wireless Systems-Cellular Telephone systems-Cordless Phones-Wireless LAN-Wide Area WDS-Broadband Wireless Access-Paging Systems-Satellite Networks-Low Cost-Low power Radio-Bluetooth-Zigbee-Ultraband Radio.
Unit II - WIRELESS SPECTRUM: Wireless Spectrum: Methods of Allocation-Spectrum Allocation of Wireless System-Cellular System Fundamentals: Frequency Reuse-Channel Assignment strategies-Handoff Strategies-Interference and system Capacity-Interference and Capacity-Improving Coverage and Capacity in Cellular system.
Unit III - PATH LOSS AND SHADOWING: Path Loss and Shadowing: Radiowave propagation-transmit and Receive signal Model-Free Space path loss-Ray Tracing: Two ray Model-Simplified Path loss Model-Shadow Fading-Combined path loss and shadowing-Outage Probability under path loss and shadowing.
Unit IV - STATISTICAL MULTIPATH CHANNEL: Statistical Multipath Channel Models: Time varying channel impulse response-Narrow band Fading Models: Level Crossing Rate –Average Fade Duration.
Unit V - WIDEBAND FADING MODELS: Wideband Fading Models: Power Delay Profile-Coherence Bandwidth-Doppler Spectrum –Coherence Time-Capacity of Wireless Channel: Capacity of AWGN Channel-Capacity of Frequency Selective Fading Channels.

Text Book:
1. Andrea Goldsmith, "Wireless Communications", Cambridge university Press, 2007.

Reference Books:

1. William C Y Lee, "Mobile Communication Engineering, Theory and Applications", Second Edition, McGraw Hill International Editions, 1998.
2. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia, New Delhi, Second Edition, 2002.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Prentice Hall, 2003.
4. Vijay K. Garg, "Wireless Communications and Networking", Elsevier-Morgan Kaufmann Publishers, Re-print 2013.

17EC2071 COMMUNICATION ENGINEERING

Credits: 3:0:0

Course objective:

- To learn the basic principles, concepts and types of communication systems.
- To understand the various design issues in a communication system.
- To gain knowledge about various communication channel.

Course outcome:

- Acquire the Knowledge and reproduce the importance of modulation
- Understand the procedures for various Analog and Digital modulation techniques
- Develop the ability to compare and contrast the strengths and weaknesses of various communication meth-ods.
- Employ appropriate modulators and demodulators for transmitters and receivers
- Mathematically analyze and predict appropriate modulation technique.
- Investigate on the adverse effect of noise on signals.

Unit I - AMPLITUDE MODULATION & DEMODULATION TECHNIQUES: Introduction, Definition of communication - Communication system block diagram –-Need for modulation – Types of Modulation-Amplitude Modulation: Introduction – Theory of Amplitude Modulation – AM power calculations – Need for suppression of carriers – Suppressed carrier systems (DSB, SC, SSB & VSB systems). Generation of AM signal–Square law diode modulation –Suppressed carrier AM generation (Balanced Modulator, Ring Modulator). AM Demodulation: Square law detector, envelope detector.
Unit II - ANGLE MODULATION & DEMODULATION TECHNIQUES: Angle Modulation: Theory of Fre-quency modulation, Mathematical analysis of FM and representation of FM – Narrow band FM and wide band FM - Comparison of AM & FM. Frequency modulation: Generation - FM signal by Direct method (Varactor diode modu-lator) – Indirect generation of FM-Armstrong method -FM Demodulation:(Balanced slope detector, Foster Seeley discriminator), Theory of phase modulation.
Unit III - TRANSMITTERS AND RECEIVERS: AM Transmitter and Receiver: AM transmitters block sche-matic- high level and low level transmitters - Tuned radio frequency receivers – Super heterodyne receiver- Charac-teristics of Receivers, **FM Transmitter and Receivers:** Block diagram of FM transmitter and methods of frequency stabilization –Pre-emphasis. Block diagram of FM receiver – De-emphasis.
Unit IV - DIGITAL COMMUNICATION: PAM, PPM, PDM, PCM, Delta modulation, Digital modulation and demodulation systems, Modem functions, Modem functions. Data Transmission - Twisted pair and coaxial cables, Fibre optics, Sources and detectors, Error detection and correction, Multiplexing, TDM and FDM.
Unit V - APPLICATIONS OF COMMUNICATION SYSTEMS: Television Transmitter & Receiver – Camera – Introduction to LCD and LED televisions.

Text Books:

1. Anokh Singh, A.K.,"Principles of Communication Engineering", S.Chand Co.,7th Edition, 2013.
2. Simon Haykins, "Communication Systems" John Wiley, 4th Edition, 2004.

Reference Books:

1. Dennis Roddy & John Coolen, "Electronic Communication", Pearson Education Limited, 4th Edition, 2012.
2. G.Kennedy, "Electronic Communication Systems", McGraw Hill, 5th Edition, 2012.
3. Taub and Schilling , "Principles of Communication Systems", McGraw Hill, 2ndEdition, 2003

17EC2072 ELECTRON DEVICES AND CIRCUITS

Credit: 3: 0 : 0

Course Objectives:

- To provide a basic introduction and an understanding of Semiconductor devices.
- To design and analyze transistor and FET biasing circuits.
- To know the design of amplifier and oscillator circuits.

Course Outcomes:

After completion of the course, students will be able to

- Describe the basic properties of solid state devices like diode, transistor and FET.
- Identify and differentiate rectifiers, amplifiers and oscillators.
- Analyze the amplitude and frequency response of general amplifier circuits.
- Describe the types of power amplifiers and their transfer characteristics.
- Classify the power amplifiers to meet certain specifications.
- Distinguish between amplifiers and oscillators.

UNIT I - Theory of Semiconductor: Energy band structure of conductors, insulators and semiconductors – Comparison of Germanium, Silicon and gallium arsenide – Electron hole generation and recombination –Intrinsic and extrinsic semiconductors – Conductivity – Temperature dependence – Hall effect – drift and diffusion in semiconductors.

UNIT II - Theory of PN junction and BJT: PN junction -depletion region – barrier potential – diode equation – Forward and Reverse characteristics – Transition and diffusion capacitance. Static characteristics of transistors. Analysis of CE, CB and CC circuits – Voltage gain – Current gain – Input impedance.

UNIT III - Special Semiconductor Devices (Qualitative Treatment Only): Zener diodes – Schotky Barrier Diode – Tunnel diodes – DIAC – TRIAC – Photo diodes-Photo transistors –LCD- LED-Gunn diodes -Varactor diode.

UNIT IV - Design of DC Power Supply: Half wave rectifier – Full wave rectifier – ripple factors – DC and AC components in rectifiers. Full wave rectifier with Capacitor and inductor filters. Voltage regulators-Transistorized series pass regulator.

UNIT V - Amplifiers and Oscillators: Single stage- RC coupled amplifiers- Power amplifiers: Class A, AB, B power amplifiers Push Pull amplifiers- Oscillators – RC Phase shift-Hartley Oscillator-Crystal Oscillator.

Text books:

1. Robert Boylestad and Louis Nashelsky, “Electronic Devices & Circuit Theory”, 9th Pearson Education Edition, 2016.
2. Millman &Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 3rd Edition, 2013.

References:

1. V.K.Metha,“Principles of Electronics”,Chand Publications,2015.
2. Malvino.A P, “Electronic Principles”, McGraw Hill International, 7th Edition 2016.
3. David .A .Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2010.

17EC2073 ELECTRON DEVICES AND CIRCUITS LAB

Credits: 0:0:2

Course Objectives:

- To understand the characteristics semiconductor and special purpose electron devices.
- To design rectifiers, amplifiers and regulators.
- To understand the basic Network theorems.

Course Outcomes:

After completion of the course, students will be able to

- Classify the basic properties and characteristics of semiconductor devices.
- Identify, differentiate and construct the circuit of rectifiers, amplifiers and regulator.
- Construct the experiments, as well as to analyze and interpret data
- Analyze practically the response of various special semiconductor devices.
- Explain the basic Network theorems.
- Justify and simulate practical circuits using PSPICE software.

LIST OF EXPERIMENTS

1. Characteristics of PN diode and Zener diode
2. Characteristics of Shunt voltage regulator
3. Characteristics of BJT(CE Configuration)
4. Characteristics of JFET
5. Characteristics of UJT
6. Types of Clippers
7. Characteristics of Photo diode and LDR
8. Verification of Thevenin's theorem (Hardware&Software)
9. Verification of Superposition theorem(Hardware&Software)
10. Verification of Kirchoff's Voltage Law(Hardware&Software)
11. Verification of Kirchoff's Current Law(Hardware&Software)
12. Characteristics of SCR

17EC3001 STATISTICAL DIGITAL SIGNAL PROCESSING

Credits: 3:1:0

Course objective:

- To develop a fundamental understanding in the concepts of discrete-time signal transforms, digital filter design, optimal filtering
- To understand the methods of Power spectrum estimation, linear estimation and Prediction
- To understand the concepts of multi-rate digital signal processing and adaptive filtering applicable in the areas of signal processing, control and communications.

Course outcome:

The students will be able to:

- identify and state the characteristics random signals
- infer the statistical relevance and significance of various theorems.
- compute the power spectrum estimation using various methods
- analyze and compare different types of estimation and prediction methods
- discover the usefulness of adaptive filters in communication systems
- explain and develop the need of multirate signal processing applicable to communication systems

Unit I - INTRODUCTION TO DISCRETE RANDOM SIGNAL PROCESSING: Review of Linear Algebra, and Discrete Random Processes for random signal processing, Parseval's Theorem, Wiener Khintchine Relation - Power Spectral Density, Sum Decomposition Theorem, Spectral Factorization Theorem - Discrete Random Signal processing by Linear Systems - Low Pass Filtering of White Noise.

Unit II - SPECTRUM ESTIMATION: Non-Parametric Methods-Correlation Method-Co-Variance Estimator-Performance Analysis of Estimators - Unbiased - Consistent Estimators - Periodogram Estimators - Barlett Spectrum Estimation - Welch Estimation - Model based Approach - AR - MA - ARMA Signal Modeling- Parameter Estimation using Yule - Walker Method.

Unit III - LINEAR ESTIMATION AND PREDICTION: Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion- Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter – Linear Prediction - Prediction Error - Whitening filter - Inverse filter - Levinson recursion – Lattice realization and Levinson Recursion algorithm for solving Toeplitz System of equations.

Unit IV - ADAPTIVE FILTERING: FIR adaptive filters - Newton's steepest descent method - Adaptive filter based on steepest descent method - Windrow Hoff LMS adaptive algorithm – Adaptive channel equalization - Adaptive echo chancellor - Adaptive noise cancellation - RLS adaptive filters – Exponentially Weighted RLS - Sliding window RLS - Simplified IIR LMS Adaptive filter.

Unit V - MULTIRATE SIGNAL PROCESSING: Mathematical description of change of sampling rate Interpolation and Decimation-continuous time model - Direct digital domain approach - Decimation by an integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

References:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc., Singapore, Reprint, 2008

2. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", 4 th Edition, Pearson India, 2007.
3. B. Farhang-Boroujeny, "Adaptive Filters: Theory and Application", 1 st Edition, John Wiley and Sons Ltd, United Kingdom, 1999.
4. Simon Haykin, "Adaptive Filter Theory", 5th Edition, Pearson, 2013.
5. Vaidyanathan P.P, "Multirate Systems and Filter Banks",1 st Edition, Pearson Education, 1996.

17EC3002 DATA COMPRESSION TECHNIQUES

Credits: 3:0:0

Course Objectives:

- To explore the special features and representations of different data types.
- To analyze different compression techniques for text data and audio signals
- To analyze various compression techniques for image and video signals

Course Outcomes:

The students will be able to

- Understand the pros and cons of lossy and lossless compression techniques.
- Analyze the different types of multimedia data
- Develop hybrid coding techniques
- Formulate new algorithms for signal processing techniques
- Evaluate the performances of various compression algorithms
- Apply the coding techniques for real time text/audio data

Unit I - INTRODUCTION: Special features of Multimedia -Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications Need for Compression - Taxonomy of compression techniques - Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies

Unit II - TEXT COMPRESSION TECHNIQUES: Dictionary Techniques – Shannon Fano coding techniques - Huffmann coding – Adaptive Huffmann Coding – Variations of Huffman coding - Arithmetic coding and decoding– LZ77 algorithm – LZ78 algorithm – LZW algorithm.

Unit III - AUDIO COMPRESSION TECHNIQUES: μ Law and A Law companding - Speech compression - Frequency domain and filtering – Basic subband coding – Application to speech coding – G.722 –Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Channel vocoders - Formant vocoders - CELP Vocoders.

Unit IV - IMAGE COMPRESSION TECHNIQUES: Image formats - Transform Coding – JPEG Standard – Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG, JBIG2 Standards.

Unit V - VIDEO COMPRESSION: Video compression techniques and standards – MPEG Video Coding - Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.

Reference Books:

1. Khalid Sayood, " Introduction to Data Compression", Morgan Kauffman Harcourt India, 5th Edition, 2017.
2. David Salomon, "Data Compression – The Complete Reference", Springer Verlag, 4th Edition, 2007.
3. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards", CRC press, 2003.
4. Peter Symes, "Digital Video Compression", McGraw Hill, 2004.
5. Mark S.Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, 2003.

17EC3003 OPTICAL NETWORKS AND PHOTONIC SWITCHING

Credits 3:0:0

Course Objective:

- To learn various components of optical networks.
- To understand various generation and broadcast optical networks.
- To study the importance of Photonic Packet Switching

Course Outcome:
Upon completion of the course, student will able to

- Understand the components of optical networks
- Know various generation of broadcast optical Networks.
- Acquire knowledge on Photonic Packet Swiching

Unit I - OPTICAL SYSTEM COMPONENTS: Light propagation in optical fibers – Loss & bandwidth, System limitations, NonLinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters
Unit II - OPTICAL NETWORK ARCHITECUTRES: Introduction to Optical Networks; SONET / SDH, Metropoliton-Area Networks, Layered Architecture ; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.
Unit III - WAVELENGTH ROUTING NETWORKS: The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Testbeds, Architectural
Unit IV - PACKET SWITCHING AND ACCESS NETWORKS: Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, OTDM networks; Optical Access Network Architectures; Future Access Networks.
Unit V - NETWORK DESIGN AND MANAGEMENT: Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface

Reference Booksss :

1. Rajiv Ramaswamy& Kumar N.Sivarajan, "Optical Networks: A practical perspective", Harcourt Asia Private Limited, Singapore, 2nd edition 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks : Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.
3. D.W.Smith, Ed., “Optical Network Technology”, Chapman and Hall, London, 1995.
4. Biswanath Mukherjee, "Optical Communication Networks", McGraw-Hill, 1997.
5. P.E.Green Jr, “Fiber optic network”, Prentice Hall, NJ 1993.
6. http://nptel.ac.in/courses/117101002/27, http://nptel.ac.in/courses/117101002/25 & other relevant materials from internet

17EC3004 MODERN DIGITAL COMMUNICATION TECHNIQUES

Credits: 3:0:0

Course Objectives:
Learner will

- Understand the baseband signal processing
- Compare various band pass high rate data modulation schemes
- Gain complete knowledge on modern communication scenario

Course Outcomes:
Learner can

- Describe sampling process and ISI free transmission
- Explain multi level modulation schemes supporting high rate data
- Employ channel coding techniques for error free reception
- Model high speed algorithms like trellis coding
- Synthesize spread spectrum technology for robust transmission
- Predict the right technique for error free high speed communication

Unit I - Baseband data transmission- Nyquist criterion for zero ISI, Correlative level coding, Optimum design of transmit and receive filters, Equalization.
Unit II - Passband Digital transmission- Digital modulation schemes, Carrier synchronization methods, Symbol timing estimation methods.

Unit III - Error control coding - Linear block codes, cyclic codes-encoding and decoding, Non-binary codes, Convolutional codes, Decoding of convolutional codes, Trellis coded modulation, Interleaver, Turbo coding, Performance measures.
Unit IV - Spread spectrum communication- DS and FH spread spectrum, CDMA system based on FH and DS spread spectrum signals, Applications, Synchronization of spread spectrum signals.
Unit V - Multichannel and Multicarrier communication Systems, Multi user communication systems

Reference Books:

1. S.Lin & D.J.Costello, Error Control Coding (2/e) Pearson, 2005 .
2. Recent literature in Advanced Digital Communication.
3. J.G.Proakis," Digital Communication (4/e)", McGraw- Hill, 2001.
4. S. Haykin, "Communication systems (4/e)", John Wiley, 2001
5. B.P. Lathi, Zhi Ding, "Modern Digital and Analog Communication Systems (4/e)", Oxford university Press, 2010

17EC3005 WIRELESS COMMUNICATION NETWORKS

Credits 3:0:0

Course Objectives:

- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.
- To enhance the understanding of Wi-fi, 3G systems and 4G networks.

Course Outcomes:

Upon Completion of the course, student will be able to

- Recognize the concepts of wireless communication.
- Apply knowledge of propagation methods and channel models to improve the system performance.
- Learn to model radio signal propagation issues and analyze their impact on communication system performance
- Understand how the various signal processing and coding techniques combat channel uncertainties
- Relate the techniques of radio spectrum allocation in multi-user systems and their impact on networks capacity
- Acquire knowledge on various wireless systems and standards and their basic operation cases

Unit I - WIRELESS CHANNEL PROPAGATION AND MODEL: Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification- channel models – COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading – shadowing Distributions, Link power budget Analysis.
Unit II - DIVERSITY: Capacity of flat and frequency selective fading channels-Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.
Unit III - MIMO COMMUNICATIONS: Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding: STBC, STTC, Spacial Multiplexing and BLAST Architectures.
Unit IV - MULTI USER SYSTEMS: Multiple Access: FDMA, TDMA, CDMA, SDMA, Hybrid techniques, Random Access: ALOHA, SALOHA, CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.
Unit V - WIRELESS NETWORKS: 3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture - Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sublayer.

Reference Books:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. HARRY R. ANDERSON, "Fixed Broadband Wireless System Design" John Wiley – India, 2003.
3. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2006.

4. Simon Haykin & Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
5. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.
7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007.
8. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.
9. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.
10. Sumit Kasera and Nishit Narang, “3G Networks – Architecture, Protocols and Procedures”, Tata McGraw Hill, 2007.

17EC3006 ADVANCED RADIATION SYSTEMS

Credits 3:0:0

Course Objective:

- To learn the fundamental parameters of antenna radiation and its significance in antenna design for specific applications
- To study different types of antenna and its design methodology.
- To understand various Numerical methods in antenna simulation.

Course outcome:

Upon completion of the course, student will able to

- Employ various numerical techniques for analysis of different antennas.
- Analyze the radiation system using linear and planar array elements.
- Extend the knowledge of aperture concept for efficient antenna design
- Evaluate the desired parameters for application specific antenna design.
- Design and simulate any type of antenna using simulation software tools. Ex. FEKO.
- Perform measurement of antenna parameters for antenna designs

Unit I - ANTENNA FUNDAMENTALS: Basic Antenna Parameters - Concepts of Radiation - Radiation from dipole, monopole and loop antenna -- The Lorentz gauge condition - Total power radiated and radiation resistance - Power radiated in the farfield – Reciprocity theorem – Broadband antennas – matching techniques – Numerical techniques.

Unit II - ANTENNA ARRAYS: Introduction - linear arrays - Phased arrays. Directivity of Broadside and End fire arrays - 3D characteristics - Binomial arrays and Dolph-Tchebycheff arrays - Circular array - Antenna Synthesis – frequency scanned arrays – analog beam forming matrices – digital beam forming – MEMS technology in arrays – Phased arrays.

Unit III - APERTURE ANTENNAS: Huyghens source - Radiation through an aperture in an absorbing screen - Fraunhoffer and Fresnel diffraction - Complimentary screens and slot antennas – Horn antenna - E and H plane sectoral Horns - Pyramidal horns - Conical and corrugated Horns - Multimode horns. – Reflector antenna - Parabolic Reflector antennas – Prime focus and cassegrain reflectors - Equivalent focal length of Cassegrain antennas - Spillover and taper efficiencies. Optimum illumination – aperture blockage -Design.

Unit IV - MICROSTRIP ANTENNAS: Microstrip antennas – feeding methods. Rectangular patch- Transmission line model – Cavity Model – Circular patch and ring antennas - input impedance – Microstrip feed and array network - Applications.

Unit V - ANTENNA MEASUREMENTS AND EMC ANTENNA: Simple relationship involving spherical triangles. Linear, Elliptical and circular polarization - Random polarization – Stokes parameters – Log periodic dipole – Biconical – Ridge guide – Multi turn loop - Antenna measurement and instrumentation – antenna test range design.

Reference Books:

1. J.D. Krauss, “Antennas”, McGraw Hill, 2005.
2. Balanis, “Antenna Theory - Analysis and Design”, John Wiley, 1982.
3. R.E. Collin, “Antennas and Radio Wave Propagation”, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, “Antenna Engineering Handbook”, McGraw Hill, 1984.

5. Ramesh Garg, I. Bahl, Apisak Ittipiboon and P. Bhartia, “Microstrip Antenna Design Handbook”, Artech house,2001
6. Hubregt.J.Visser, “Antenna Theory and applications”, John Wiley & Sons Ltd, Newyork, 2012.

17EC3007 SATELLITE COMMUNICATION

Credits 3:0:0

Course Objectives:
Learner will
- Understand the basic satellite elements
- Identify multiple access techniques used in satellites
- Gain knowledge on satellite link design

Course Outcomes:
Learner can
- Describe satellite orbits and orbital mechanisms
- Explain communication satellite design
- Interpret various multiple access schemes used for data transmission
- Appraise satellite link power budget
- Design OBP or FT type satellite transponder
- Select suitable satellite for particular service

Unit I - Elements of orbital mechanics, Equations of motion, Tracking and orbit determination, Orbital correction/control, Satellite launch systems, Multistage rocket launchers and their performance
Unit II - Elements of communication satellite design, Spacecraft subsystems, Reliability considerations, Spacecraft integration
Unit III - Multiple access techniques, FDMA, TDMA, CDMA, Random access techniques, Satellite onboard processing
Unit IV - Satellite Link Design: Performance requirement and standards. VSAT, Mobile satellite services: GSM, GPS, DBS, DTH, MATV, CATV, Satellite based personal communication.
Unit V - Earth station design, Configurations, Antenna and tracking systems, Satellite broadcasting,

Reference Books:
1. B.N.Agrawal, “Design of Geosynchrons Spacecraft”, Prentice-Hall,1986.
2. A.K. Maini, V.Agrawal, “Satellite Communications”, Wiley India PvtLtd,1999.
3. Recent literature in Satellite Communication. satellite navigation - recent advances
4. D.Roddy,“Satellite Communication (4/e)”, McGraw-Hill, 2009.
5. T.Pratt&C.W.Bostain, “Satellite Communication”, Wiley 2000.

17EC3008 ERROR CONTROL CODING

Credits 3:0:0

Course Objectives:
- To summarize the vector mathematics in the coding algorithms
- To assess various error control codes
- To interpret the encoding and decoding techniques of error control codes
- To evaluate the error control parameters in communication

Course Outcomes:
The student will be able to
- summarize the vector mathematics in the coding algorithms
- assess Galois field arithmetic
- evaluate different types of error control codes
- interpret the encoding and decoding of error control codes
- compose burst error correcting codes and convolutional codes
- describe the performance and applications of turbo codes

Unit I - VECTOR ALGEBRA: Introduction to error control coding - basics of vector algebra - construction of Galois field arithmetic – properties and computations - Implementation of Galois field arithmetic - vector spaces
Unit II - BASICS OF CYCLIC CODES: Introduction to cyclic codes - generator and parity check matrix of cyclic codes - basics of cyclic BCH Codes - encoding and decoding of cyclic Codes - primitive BCH code - implementation of error correction - non binary BCH - error detection of binary BCH codes
Unit III - ERROR CORRECTING CODES: Introduction on error correcting codes - burst error correcting codes - decoding of single burst error correcting cyclic codes - Fire code - interleaved codes - phased burst error correcting codes - concatenated codes.
Unit IV - CONVOLUTIONAL CODES: Introduction to convolutional codes - encoding of convolutional codes - Maximum likelihood decoding of convolutional codes - sequential decoding convolutional codes - Stack and Fano algorithm - application of viterbi decoding
Unit V - TURBO CODES: Introduction to turbo codes – turbo coed coding - performance - BCJR algorithm - examples - applications of turbo codes

Reference Books:

1. Shu Lin & D.J. Costello – "Error Control Coding", 2nd edition, Pearson Education, 2013.
2. Simon Haykin, "Digital Communication", John Wiley and Sons, 2006.
3. Rahashree Raut, "Error control coding for performance improvement", Lambert publisher, 2012.
4. Bernard Sklar, "Digital Communications, fundamentals and Applications", Pearson Education, 2009.

17EC3009 COMPUTATIONAL INTELLIGENCE AND OPTIMIZATION TECHNIQUES

Credits 3:0:0

Course Objectives:

- To learn the key aspects of Artificial Neural Networks
- To analyze the various modules of Fuzzy logic and Genetic algorithm
- To gain insight on Neuro Fuzzy modeling and support vector machines

Course Outcomes:

The students will be able to

- Understand the principles of neural networks and fuzzy logic systems
- Develop novel artificial neural networks
- Frame fuzzy logic based expert systems
- Evaluate the performances of hybrid neuro fuzzy algorithms
- Analyze the various evolutionary computation algorithms
- Apply artificial neural networks for solving engineering problems.

Unit I - PRINCIPLES OF ARTIFICIAL NEURAL NETWORKS: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Potential Applications of ANN. Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.
Unit II - SUPERVISED AND UNSUPERVISED NEURAL NETWORKS: Perceptron, Back Propagation neural network, Hopfield neural network, Kohonen neural network, Bidirectional Associative Memories, Radial basis function neural network, Counter propagation neural network, Adaptive Resonance Theory neural networks, Introduction to deep learning neural networks.
Unit III - PRINCIPLES OF FUZZY LOGIC THEORY: Introduction to classical sets – properties, operations and relations; Fuzzy sets - Operations, properties and relations, Membership functions, Defuzzification methods, Extension principle, Approximate Reasoning, Rule based systems, Fuzzy Associative Memories(FAMs), Fuzzy inference systems, Fuzzy decision making, Fuzzy logic control, Fuzzy pattern recognition.
Unit IV - NEURO FUZZY SYSTEMS: ANFIS – Architecture and training algorithm, CANFIS, Rule based structure identification, Classification and Regression tree algorithm, Fuzzy inference systems, Fuzzy C-means algorithm, k-means algorithm, mountain clustering, subtractive clustering, ANFIS for medical image classification
Unit V - EVOLUTIONARY COMPUTATION ALGORITHMS: Genetic Algorithm, Particle Swarm Optimization algorithm, Ant Colony Optimization algorithm, ABC algorithm, Gray Wolf optimization algorithm

Reference Books:

1. Laurene Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Fourth edition, Pearson Education India, 2006.
2. Timothy J Ross, “Fuzzy logic with engineering applications”, John Wiley & Sons, Third Edition, 2010.
3. J.S.R.Jang, C.T. Sun and E.Mizutani, “NeuroFuzzy and Soft Computing”, PHI / Pearson Education, Third edition, 2004.
4. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.
5. Mohamad Hasoun, “Fundamentals of artificial neural networks”, MIT Press, 2003.
6. A E Eiben and J E Smith, “Introduction to evolutionary computing” Springer, 2nd edition, 2015.

17EC3010 COMMUNICATION LABORATORY -I

Credits: 0:0:2

Course Objectives:

- To study and experiment different signaling techniques in communication system using OTDR and various mobile communication standards.
- To demonstrate modern digital communication techniques.

Course Outcomes:

Upon Completion of the course, student will able to

- Distinguish the different signaling techniques in digital communication.
- Analyze and apply a systematic design approach to digital communication system.
- Eavaluate the chaacteristics of APD and Laser
- Reconstruct the RF communication using SDR
- Demonstrate the working of Satellite Communication
- Develop different network topologies,routing techniquies and analysis the performance of the network in the simulation envirnment

LIST OF EXPERIMENTS

1. Digital Modulation (BPSK,QPSK,GMSK)
   Comparison of M-ary FSK and M-ary QAM Schemes
2. Pulse Amplitude modulation and Pulse Code Modulation
3. Direct Sequence Spread Spectrum
   Orthogonal Frequency Division Multiplexing
4. Linear block Codes,Cyclic Codes,Convolutional Codes
5. Optical time Domain Reflectometer
6. Wavelength Division Multiplexing.
7. Study of APD and Laser characteristics.
8. SDR: Study of wireless-telecommunication using Wicomm-T, Wireless digital communication.
9. Satellite Communication.
10. Creating Topology in Wireless using CBR and UDP and
11. Routing – Uni cast and Multicast Routing.
12. Performance Analysis in wireless Networks.

17EC3011 COMMUNICATION LABORATORY -II

Credits: 0:0:2

Course Objectives:

- To design, simulate and understand different types of antenna using EM Solvers.
- Involve students in studies of communication network and its performance through network simulation

Course Outcomes:

Upon Completion of the course, Student will able to

- Design and simulate antenna for the given specification.
- Construct and analyse communication networks.
- Measure various parameters of Microwave and RF components and antennas.
- Recognize various application of RF components and antennas.
- Employ the network analyser to test RF components and antennas.
- Recognize the working of GPS.

Course Contents:

1. Design of Dipole Antenna.
2. Design of Monopole Antenna.
3. Design of Horn Antenna.
4. Design of Rectangular and Circular Patch Antenna.
5. Design of Impedance Transformer network.
6. Design of Microwave passive Components.
7. Design of Microwave Active Components.

Hardware

8. Gain and return loss measurement of Microwave Integrated Circuits using Network analyser.
9. Radiation Pattern of Antenna Using X band.
10. Radiation Pattern of Antenna Using C band.
11. Dielectric measurement and analysis using Network analyser.
12. Study of GPS.

17EC3012 ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY

Credits: 0:0:2

Course Objective:

- To calculate the power spectrum by using Periodogram, Modified Periodogram, Barlett& Welch method.
- To design linear predictive system, Whitening filter, Inverse filter &Kalman filter and compression algorithms.

Course outcome:

Upon completion the student will be able to

- Calculate power spectrum and analyze the performance.
- Design various digital filters and analyze their performance.
- Select filters for various applications.
- Compare the characteristics of different compression techniques.
- Understand the significance of compression during storage and transmission.
- Comprehend the advantages of wavelet filter.

Experiments:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

17EC3013 DIGITAL COMMUNICATION RECEIVERS

Credits 3:0:0

Course Objectives:

- To learn wireless channel conditions
- To apply signal processing algorithms to design an optimum wireless reception.
- To design an Optimum multiuser detection for wireless environment

Course Outcomes:

The students will be able to

- Understand the detection procedures of digital modulation techniques
- Develop signal processing algorithms for wireless signal reception.
- Frame new algorithms for signal processing techniques
- Evaluate mathematical models for optimum detection of wireless signals
- Analyze the performances of various error detection algorithms
- Apply the wireless reception concepts in real- time applications

Unit I - REVIEW OF DIGITAL COMMUNICATION TECHNIQUES: Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

Unit II - OPTIMUM RECEIVERS FOR AWGN CHANNEL: Correlation demodulator, matched filter , maximum likelihood sequence detector, optimum receiver for CPM signals, Mary orthogonal signals, envelope detectors for M-ary and correlated binary signals.
Unit III - RECEIVERS FOR FADING CHANNELS: Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.
Unit IV - SYNCHRONIZATION TECHNIQUES: Carrier and signal synchronization, carrier phase estimation - PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation
Unit V - ADAPTIVE EQUALIZATION: Zero forcing algorithm, LMS algorithm, adaptive decision feedback equalizer, equalization of Trellis coded signals, Kalman algorithm, blind equalizers and stochastic gradient algorithm.

Reference Books:

1. John Proakis and Masoud Salehi, "Digital Communications", Mcgraw Hill, 5th edition, 2007.
2. Simon Haykin, "Digital Communications", Wiley & Sons, 2nd edition, 2013.
3. X.Wang & H.V.Poor, "Wireless Communication Systems", Pearson Education, 2004.
4. Mohamed Ibnkahla, "Adaptive Signal processing in Wireless Communications", CRC Press, 2008.
5. A.V.H. Sheikh, "Wireless Communications Theory & Techniques", Kluwer Academic Publications, 2004

17EC3014 DETECTION AND ESTIMATION THEORY

Credits: 3:0:0

Course Objectives:

- Understand basics of detection and estimation theory.
- Design and analyze optimum detection schemes.
- Study different estimation schemes such as MMSE estimators.

Course Outcomes:

Students will be able to;

- Apply their Engineering mathematical concepts for signal detection and estimation.
- Understand different estimation schemes.
- Analyze and interpret extracted data of useful information from random observations in communication through probabilistic framework..
- Design optimal estimators for signals with different noise parameters.
- Demonstrate knowledge of professional and ethical responsibilities.
- Develop confidence for self education and ability for life-long learning about security standards.

Unit I - HYPOTHESIS TESTING: Bayes Risk, Minimum Bayes Risk detector, Minimax and Neyman-Pearson testing, Receiver operating characteristics, Composite hypothesis testing, Generalized likelihood ratio tests.
Unit II - SIGNAL DETECTION APPLICATIONS:
Detection of deterministic signals, Matched filter and its performance, Detection of random signals, Energy detector and its performance, Detection of signals with unknown parameters and Sinusoid detection example, Chernoff and related performance bounds.
Unit III - RANDOM PARAMETER ESTIMATION:
Bayesian formulation, Minimum mean squared error and MAP estimation, Linear MMSE estimation, Orthogonality principle, Applications to channel estimation problems.
Unit IV - MINIMUM VARIANCE UNBIASED ESTIMATION:
MVUE criterion, finding MVUE, sufficient statistics, Neyman-fisher factorization, Rao-Blackwell theorem, Cramer-Rao lower bound, Fisher information matrix.
Unit V - NON-RANDOM PARAMETER ESTIMATION:
Least squares estimation, Best linear unbiased estimation, Geometric interpretations, Maximum likelihood Estimation, Efficiency and consistency of estimators and asymptotic properties.

References Books:
1. Harry .L. Van Trees, Kristine L Bell, ZhiTian, Detection, Estimation and Modulation theory, Part I, 2nd Edition, Wiley Publications 2013.
2. H.V. Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer, 1994.
3. Mourad Bakat, "Signal Detection and Estimation", 2nd Edition, Artech House, 2005.
4. Athanasios Papoulis, S Unnikrishna Pillai, "Probabilty, Random Variabes and Stochastic Processes", 4th Edition, Mc Graw Hill, 2002.
5. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
6. Mandyam D. Srinath, P.K. Rajasekaran and R. Viswanathan, "Introduction to Statistical Signal Processing with Applications", Prentice Hall, 1st Edition, 1995.

17EC3015 DSP ARCHITECTURE AND PROGRAMMING

Credits: 3:0:0

Course Objectives:
- To study the fundamentals of Programmable DSPs.
- To impart knowledge on the operation of ADSP and Analog Processors.
- To develop a fundamental understanding in tha advanced DSP architectures and some applications

Course Outcomes:
The students will be able to:
- Infer about the control instructions, interrupts, and pipeline operations, memory and buses.
- Illustrate the features of on-chip peripheral devices and its interfacing with real time application devices.
- Diagnose the design methodologies in hardware and software.
- Recognize the trade-offs necessary in algorithm design for real-time DSP implementation
- Analyse the procedure for various DSP System Architecture.
- Design and implement various signal processing algorithms and applications using DSP processors.

Unit I - FUNDAMENTALS OF PROGRAMMABLE DSPS: Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in P-DSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in PDSPs– On chip Peripherals.
Unit II - TMS320C3X PROCESSOR: Architecture – Data formats - Addressing modes – Groups of addressing modes- Instruction sets - Operation–Generating and finding the sum of series- Convolution of two sequences- Programs for FIR and IIR filters.
Unit III - TMS320C5X PROCESSOR: Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure– Operation – Programs for FIR and IIR filters.
Unit IV - ADSP PROCESSORS: Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs – Programs on ADSP21xx for FIR and IIR filters.
Unit V - ADVANCED PROCESSORS: Architecture of TMS320C54X - Pipe line operation, Code Composer studio - Architecture of TMS320C6X -Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors-real time filtering-adaptive filtering

Reference books:
1. B.Venkataramani and M.Bhaskar," Digital Signal Processor, Architecture, Programming and Applications",2nd Edition, McGraw- Hill,2010.
2. S.Srinivasan and Avtar Singh, "Digital Signal Processing, Implementations using DSP Microprocessors with Examples from TMS320C54X", Brooks/Cole, 2004
3. Rulph Chassaing, "Digital Signal Processing and applications with the C6713 and C6416 DSK",John Wiley & sons,2005.
4. S.M.Kuo and Woon-Seng S.Gan, "Digital Signal Processors: Architectures, Implementations,and Applications", Printice Hall, 2004.
5. N. Kehtarnavaz and M. Kerama, "DSP System Design using the TMS320C6000", Printice Hall, 2001.
6. S.M. Kuo and B.H.Lee,"Real-Time Digital Signal Processing, Implementations, Applications and Experiments with the TMS320C55X", John Wiley, 2001.

17EC3016 GLOBAL POSITIONING SYSTEM

Credits: 3:0:0

Course Objective:

- To introduce Global Positioning Systems
- To understand types of signals used in the GPS and accuracy limits
- Latest versions of GPS and its application

Course Outcome:

After completion of the course, students will be able to

- develop a strong foundation in the field of Global Positioning Systems.
- understand GPS signal characteristics
- acquire in-depth knowledge about working of Global positioning receivers.
- understand and analyze various errors occurring in GPS
- familiarize in latest variant Differential GPS receivers
- expose different GPS applications

Unit I - INTRODUCTION: GPS and GLONASS Overview - Satellite Navigation -Time and GPS - User position and velocity calculations - GPS - Satellite Constellation - Operation Segment - User receiving Equipment - Space Segment Phased development

Unit II - SIGNAL CHARACTERISTICS: GPS signal components - purpose, properties and power level - signal acquisition and tracking - Navigation information extraction - pseudorange estimation - frequency estimation – GPS satellite position calculation

Unit III - GPS RECEIVERS & DATA ERRORS: Receiver Architecture - receiver design options - Antenna design - SA errors - propagation errors- Methods of multipath mitigation - Ephemeris data errors - clock errors

Unit IV - DIFFERENTIAL GPS: Introduction - LADGPS - WADGPS, Wide Area Augmentation systems - GEO Uplink subsystem - GEO downlink systems - Geo Orbit determination - Geometric analysis – covariance analysis - GPS /INS Integration Architectures

Unit V - GPS APPLICATIONS: GPS in surveying, Mapping and Navigation - Precision approach Aircraft landing system - Military and Space application - Intelligent transportation system

Reference Books:

1. Mohinder S.Grewal , Lawrence R.Weill, Angus P.Andrews, “Global Positioning Systems - Inertial Navigation and Integration”, John Wiley& sons, 2nd Edition 2007.
2. Elliott D. Kaplan, Christopher J. Hegarty, "Understanding GPS– Principles and Applications", Artech House, 2nd Edition 2006.
3. G. S. Rao, “Global Navigation Satellite Systems”, Tata McGraw-Hill publications, New Delhi, 2010.
4. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, "GPS – Theory and Practice”, Springer – Verlag Wien GmbH, New York ,2001.
5. James Bao – Yen Tsui, ‘Fundamentals of Global Positioning receivers – A software approach’, John Wiley & Sons, 2nd Edition 2005.

17EC3017 OPTICAL SIGNAL PROCESSING

Credits 3:0:0

Course Objectives:

- Familiarize the basic theory of light propagation, concept of spatial frequency etc.
- Learn the transform domain approach of different optical components like slit, lens, free space etc.
- Acquire knowledge about various spectral analysis tools, filters and spatial filters.
- Get a overall picture about the applications of acoustic-optical devices and heterodyne systems.

Course Outcomes:

- Understand basic concepts of light propagation, spatial frequency and Spectral analysis
- Develop optical modulators for various applications of light processing.
- Design spatial filters to clean up the output of lasers, removing aberrations in the beam due to imperfect, dirty, or damaged optics, or due to variations in the laser gain medium itself.
- Judge the characteristics of optical filters, modulators and detectors, design as well as conduct experiments in software and hardware, analyze the results to provide valid conclusions.

- Familiar with Design considerations of acousto-optic devices.
- Analysis and decision making skills based on the results of acousto-optic power spectrum analyzer.

Unit I - BASICS OF SIGNAL PROCESSING AND OPTICS: Characterization of a General signal, examples of signals, Spatial signal. Basic laws of geometrical optics, Refractions by mirrors, the lens formulas, General Imaging conditions, the optical invariant, Optical Aberrations.
Unit II - PHYSICAL OPTICS: The Fresnel Transforms, the Fourier transform, Examples of Fourier transforms, the inverse Fourier transform, Extended Fourier transform analysis, Maximum information capacity and optimum packing density, System coherence.
Unit III - SPECTRUM ANALYSIS AND SPATIAL FILTERING: Light sources, spatial light modulators, The detection process in Fourier domain, System performance parameters, Dynamic range. Some fundamentals of signal processing, Spatial Filters
Unit IV - BINARY SPATIAL FILTERS: Magnitude Spatial Filters, Phase Spatial Filters, Real valued Spatial Filters, Interferometric techniques for constructing Spatial Filters. Optical signal processor and filter generator, Applications for optical signal processing.
Unit V - ACOUSTO-OPTIC CELL SPATIAL LIGHT MODULATORS: Applications of acousto-optic devices. Basic Acousto-optic power spectrum analyzer. Heterodyne systems: Interference between two waves, the optical Radio.

References Books:

1. D. Casasent, "Optical data processing-Applications", Springer-Verlag, Berlin,
2. H.J. Caulfield, "Handbook of holography", Academic Press New York 1979
3. P.M. Dufffieux, "The Fourier Transform and its applications to Optics", John Wiley and sons
4. J. Horner ,"Optical Signal Processing ",Academic Press 1988
5. Joseph W. Goodman," Introduction to Fourier Optics", second edition Mc Graw Hill.
6. Francis T. S. Yu, Suganda Jutamulia, "Optical Signal Processing, Computing, and Neural Networks", Krieger Publishing Company; 2nd edition.
7. Anthony Vanderlugt ,"Optical signal processing" ,Wiley-Interscience
8. Hiroshi Ishikawa ,"Ultrafast All-Optical Signal Processing Devices",Wiley

17EC3018 ADVANCED DIGITAL IMAGE PROCESSING

Credits 3:0:0

Course Objectives:
- To understand the image fundamentals and mathematical transforms necessary for image processing
- To understand how image are analyzed to extract features of interest.
- To comprehend the concepts of image registration and image fusion

Course Outcomes:
Upon completion of the course, student will be able to
- Apply image processing techniques in both the spatial and frequency (Fourier) domains.
- Design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
- Conduct independent study and analysis of feature extraction techniques.
- Analyze the performance of an image processing task for a specific application
- Understand the advantages and limitations of various filters for image enhancement.
- Apply the knowledge gained for improving the resolution of images

Unit I - IMAGE PROCESSING FUNDAMENTALS: Fundamentals: Definition and Applications , steps in Digital Image Processing, Visual perception and structure of Human eye, Diigtal Image representation, Spatial and intensity resolution.
Unit II - IMAGE ENHANCEMENT: Image enhancement in spatial domain, Spatial filtering, 2D image transforms :DFT and its property, Cosine and sine transform, Hadamard and Haar transform, Image enhancement in frequency domain.
Unit III - MORPHOLOGICAL PROCESSING: Morphological image processing, Erosion and Dilation, Opening and Closing , Edge detection and model, Active contour, Texture.

Unit IV - REGISTRATION: Wavelet based Segmentation, Localized feature extraction shape, boundary, Moments and Texture descriptors, Registration –basics, Transformation functions , Resampling, Image fusion – pixel, Multiresolution and region based fusion
Unit V - 3D IMAGE PROCESSING: 3D image visualization , 3D Data sets, Volumetric display, Stereo Viewing , Ray tracing , Image processing in 3D, Measurements on 3D images.

Reference Books:

1. John C.Russ, "The Image Processing Handbook", CRC Press,2007.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 2008.
3. ArdeshirGoshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications",John Wiley and Sons,2005.
4. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, Inc., Second Edition, 2004.
5. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education,Inc., 2002.
6. Rick S.Blum, Zheng Liu,"Multisensor image fusion and its Applications",Taylor& Francis, 2006

17EC3019 MICROWAVE INTEGRATED CIRCUITS

Credits 3:0:0

Course Objectives:

- To study about the technology of microwave IC's and propagation of signals through microstrip transmission lines.
- To understand how analyzes of fields and microwave circuit design are performed.
- To learn coplanar MICs and design of microwave circuits like amplifiers, oscillators and mixers.

Course Outcomes:

The students will be able to:

- Discriminate various hybrid MIC fabrication technologies (Thick and Thin film technologies).
- Distinguish various fabrication processing steps of monolithic MICs.
- Apply the knowledge of microstrip transmission lines and their parameters in the design process.
- Analyze passive and non-passive reciprocal devices and their design.
- Develop various coplanar MICs for different applications.
- Design and discriminate various microwave circuits like amplifiers, oscillators and mixers.

Unit I - TECHNOLOGY OF HYBRID MICS & MONOLITHIC MICS: Hybrid MICs: Dielectric substrates – Thick film technology and materials – Thin film technology and materials – Methods of testing – Encapsulation of devices for MICs – Mounting of active devices. MMICs: Processes involved in fabrication – Epitaxial growth of semiconductor layer – Growth of dielectric layer – Diffusion-ion implantation – Electron beam technology.
Unit II - MICROSTRIP TRANSMISSION LINES: Strip lines – Formulas for propagation constant – Characteristic impedance – Attenuation – An approximate electrostatic solution. Slot Lines and Coplanar waveguides – Static TEM parameters and design of microstrip – High frequency dispersion effects in microstrip.
Unit III - ANALYSIS OF PASSIVE RECIPROCAL AND NON-RECIPROCAL MICROWAVE DEVICES: Passive reciprocal devices: Methods of analysis of passive reciprocal microwave devices – Even and Odd mode method – Eigen value method. Applications to microstrip directional couplers – Parallel coupled lines – Coupled microstrip design – Branch line couplers – Hybrid ring couplers – Wilkinson power dividers/combiners. Passive Non-Reciprocal Components: Ferromagnetic substrates for non-reciprocal devices – Design of microstrip circulators – Latching circulators – Isolators – Phase shifters.
Unit IV - COPLANAR MICs: Coplanar waveguides: Transmission properties – Discontinuities. Introduction to Coplanar MICs – Coplanar transistors – Coplanar switches – Coplanar microwave active filters, Coplanar electronic circulators – Coplanar frequency doublers.
Unit V - MICROWAVE CIRCUIT DESIGN: Microwave amplifier Design – Two port power gain, stability single stage transistor amplifier design, low noise amplifier design, broad band amplifier design, balanced and distributed amplifiers, design of class A amplifiers. Microwave Oscillator Design, negative resistance oscillator, transistor oscillators design, dielectric resonator oscillator design, oscillator phase noise, microwave mixer, single ended diode mixer, FET mixer, balanced mixer, image reject mixer, double balanced mixer.

Reference Books:

1. K.C.Gupta and Amarjitsingh , "Microwave Integrated Circuits", John Wiley and sons-Wiley Eastern Reprint, 2004.
2. R. K. Hoffmann, "Handbook of Microwave Integrated Circuits", 1st edition,Artech House, 1987.
3. I.Wolff, "Coplanar Microwave Integrated Circuits",1st edition, John Wiley and Sons, 2006.
4. David M.Pozar, "Microwave Engineering", 3rd edition,John Wiley and Sons, 2009.
5. Ravender Goyal, "Monolithic MIC: Technology & Design", Artech House, 1989.
6. C. Gentili, "Microwave Amplifiers and Oscillators", North Oxford Academic, 1986.
7. I.Kneppo, J.Fabian and M.Pavel, "Microwave Integrated Circuits",2nd edition, Kluwer Academic Publishers 2012.
8. U.L.Rohde and P.N.David, "RF / Microwave Circuit Design for Wireless Applications", John Wiley, 2004.

17EC3020 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Credits: 3:0:0

Course Objective:

- To familiarize with the fundamental of EMI/EMC required for electronics industry
- To understand the importance of shielding in cables
- To introduce PCB design techniques and testing standards for EMC compliances

Course Outcome:

The students will be able to:

- Design and test electronic products with acceptable radiations and susceptible to EMI
- Analyze cabling and grounding problems in high-frequency systems
- Analyze and simulate component placements in PCB board design to reduce EMI
- Design shielding techniques to prevent ESD and EMI in high-frequency systems
- Apply techniques to prevent crosstalk in high-frequency systems.
- Interpret EMC lab reports and certificates

Unit I - EMI/EMC CONCEPTS: EMI-EMC Definitions- Units of Parameters- Need for EMC and its importance in electronic product design - Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards. - Few case studies on EMC

Unit II - EMI COUPLING PRINCIPLES: Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; near field cable to cable coupling, cross talk; Field to cable coupling; Power mains and Power supply coupling

Unit III - EMI CONTROL TECHNIQUES: Shielding-Shielding Material-Shielding integrity at discontinuities, Filtering-Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding-Measurement of Ground resistance -system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control, EMI gaskets-Conductive Gaskets and Coatings.

Unit IV - EMC DESIGN OF PCB: EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits,Component selection and mounting; PCB trace impedance; Routing; Cross talk control-Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

Unit V - EMI MEASUREMENTS AND STANDARDS: Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN;
Military Standards-MIL461E/462 - Frequency assignment - Spectrum conversation, British VDE standards, Euro norms and standards in Japan- comparisons. EN Emission and Susceptibility standards and specifications.

Reference Books:

1. Xingcun Colin Toong, Advanced Materials and Design for Electromagnetic Interference Shielding , 3rd Edition, CRC Press-Taylor & Francis Group, 2009
2. J.L Normal Violette, Dionald R.J White, Michael F. Violette, Electromagnetic Compatibility Handbook, 1st Edition Reprint, Springer Science + Business Media, LLC, 2013
3. H. W. Ott, Electromagnetic Compatibility Engineering, 2nd Edition , John Wiley & Sons, 2011
4. C. R. Paul, Introduction to Electromagnetic Compatibility, 2nd Edition, Wiley India, 2010

5. K. L. Kaiser, Electromagnetic Compatibility Handbook, 1st edition, CRC Press, 2005.
6. David A. Weston Electromagnetic Compatibility: Methods, Analysis, Circuits and Measurements, 3rd Edition, CRC Press-Taylor & Francis Group, 2017.
7. V.P.Kodali, Engineering EMC Principles, Measurements and Technologies, 2nd Edition, IEEE Press, New York 2001.

17EC3021 RF SYSTEM DESIGN

Credits: 3:0:0

Course Objectives:

- To understand the fundamental parameter in RF wireless system transceiver architecture design
- To discuss the impedance matching techniques using smith chart for various RF subsystems like amplifiers, oscillators, mixers etc
- To learn RFIC design and implementation of RFICs using simulation tools

Course Outcomes:

After completion of the course, the students are able to

- Distinguish the RF system design parameters for various subsystem blocks level modeling
- Interpret Smith chart measurements related to impedance matching techniques
- Apply knowledge of basic RF Electronics for realizing RF System design and implementation
- Analyze the given specifications defined by wireless system standard in its physical layer
- Transform the system specification into the requirements for the RF front-end blocks for creating a new architecture.
- Design and simulate RF front-end as per given system specification for the required performance using software tools.

Unit I - CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES: CMOS: Introduction to MOSFET Physics - Noise: Thermal, Shot, Flicker, Popcorn noise Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link Transceiver Architectures: Receiver : Homodyne, Heterodyne, Image reject, Low IF Architectures - Transmitter: Direct up-conversion, Two step up-conversion.

Unit II - IMPEDANCE MATCHING AND AMPLIFIERS: S-parameters with Smith chart - Passive IC components – Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design Low Noise Amplifiers: Power match and Noise match-Single ended and Differential LNAs - Terminated with Resistors and Source Degeneration LNAs.

Unit III - Feedback Systems: Stability of feedback systems: Gain and phase margin, Root Locus techniques - Time and Frequency domain considerations - Compensation Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearisation Techniques - Efficiency boosting techniques - ACPR metric - Design Considerations

Unit IV - MIXERS AND OSCILLATORS: Mixer: characteristics - Non-linear based mixers: Quadratic mixers - Multiplier based mixers Single balanced and double balanced mixers – sub-sampling mixers Oscillators: Describing Functions, Colpitts oscillators - Resonators - Tuned Oscillators - Negative resistance oscillators - Phase noise

Unit V - RADIO FREQUENCY INTEGRATED CIRCUITS: Radio frequency Integrated Circuits: Transceiver architectures-Role of RFICs in Transceiver, Lower frequency design and RFIC design- design issues of RFICs in transceivers-Active/Passive device technologies for RFIC implementations-Modern RFIC chip sets for current wireless standards, Packaging techniques, High frequency measurement RFIC design issues : Noise, Linearity and distortion in RF circuits, dynamic range, Filtering issues, selectivity, and sensitivity and phase noise.

Reference Books:

1. T.Lee, “Design of CMOS RF Integrated Circuits”, Cambridge, Second Edition, 2004.
2. B.Razavi, “RF Microelectronics”, Pearson Education, Second Edition, 1997.
3. Jan Crols, MichielSteyaert, “CMOS Wireless Transceiver Design”, KluwerAcademic Publishers, First Edition 1997.
4. B.Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 14th reprint 2008.
5. John M. W. Rogers, John W. M. Rogers, Calvin Plett, “Radio Frequency Integrated Circuit Design”, Second Edition, Artech House, 2010

17EC3022 TELECOM NETWORK MANAGEMENT

Credits:3:0:0

Course Objective:

- To learn about the important concepts and issues related to network management.
- To manage LAN and wireless networks
- To analyze high speed networks and estimate their link performance

Course Outcomes:

The students will be able to

- Identify various aspects of Local Area Network management
- Recognize wireless network management using monitoring tools
- Estimate the link performance
- Analyze high speed networks
- Apply the network management and SNMP tools
- Describe network security aspects and mobility management

Unit I - LAN ADMINISTRATION: Introduction- Console and Agents- Automatic Software Distribution- Monitoring File Use- Virus scanning- Printer Management- Storage Management- Reporting Bindery Data- Process Scheduling- Console Text Viewer- Tracking Network Activity- Integrated Help Desk.
Managing the Wireless Networks– Introduction – Configuration Details- Mobile IP- Spanning Tree Protocol- Performance Monitoring- Applying Filters- Logs- Setting SNMP Traps- Virtual Networks- Managing TDM Systems.
Unit II - MANAGING LINK PERFORMANCE: Introduction- Digital Data Service- CSU Functionality- Carrier Testing Services- User Controlled Diagnostics- Fractional T1- Integrated Solutions- Integral Protocol Analyzers- SNMP for Management- Disaster Recovery- Service Level Management.
Unit III - MANAGING HIGH SPEED PACKET NETWORKS: Introduction – Frame Relay- Asynchronous Transfer Mode- IP Networks.
Unit IV - NETWORK MANAGEMENT SYSTEMS: Introduction- Management System Evolution- Management in the Wired World- The Mechanics of SNMP- Graphical SNMP Tools- SNMP on Wireless Networks- Telecommunications Management Networks- Open Source Management Tools.
Unit V - MANAGING NETWORK SECURITY: Introduction- Threat Assessment- Securing the Workplace- Securing the Network- Data Encryption- Virus Protection- Firewalls- Intrusion Detection Systems- Remote Access Security- Policy Based Security- Network Management System Security- Security Personnel- Security Training -Mobility Management in Wireless Networks.

Reference Books:

1. N J Muller, “LANs to WANs: The Complete Management Guide”, Artech House, 2003.
2. J W Mark & W. Zhuang, “Wireless Communications and Networking”, PHI, 2005.
3. Terplan, “Telecom Network Management”, PHI, 1998
4. Haojin Wang, “Telecommunication Network Management”, Mc Graw Hill, 1999.
5. Mani Subramanian, “Network Management : Principles and Practice”, 2nd Edition, Pearson Education, 2010.

17EC3023 RF MEMS

Credits: 3:0:0

Course Objective:

- Understand the simple linear and non-linear mechanical, electromagnetic and electromechanical models of RF MEMS structures..
- Identify the limitations of the RF MEMS technology for wireless applications
- Describe the working principles of the state-of-the-art RF-MEMS devices

Course Outcome:

The student will be able to

- recognize the advantages and limitations of RF-MEMS technology
- apply the Fabrication methods for MEMS for specific applications
- illustrate the working principles of the state-of-the-art RF-MEMS devices
- evaluate the merits and drawbacks of an RF-MEMS design

- design high-performance circuits and sub-systems using RF MEMS components
- design practical RF MEMS devices using analytical and numerical techniques.

Unit I - WIRELESS SYSTEMS AND ELEMENTS OF RF CIRCUIT DESIGN: Introduction on spheres of wireless activities, the home and office, the ground fixed/ mobile platform, the space platform, wireless standards, systems and architectures, wireless standards, conceptual wireless systems, wireless transceiver architectures, power and bandwidth-efficient wireless systems & challenges, MEMS based wireless appliances enable ubiquitous connectivity. Physical aspects of RF circuit design, skin effect, transmission lines on thin substrates, self-resonance frequency, quality factor packaging, practical aspects of RF circuit design, dc biasing, and impedance mismatch effects in RF MEMS.

Unit II - MICRO-FABRICATION AND ACTUATION MECHANISMS IN MEMS: Introduction to Microfabrication Techniques- Materials properties, Bulk and surface micromachining, Wet and dry etching, Thin-film depositions (LPCVD, Sputtering, Evaporation), other techniques (LIGA, Electroplating) Actuation Mechanisms in MEMS- Piezoelectric, Electrostatic, Thermal, Magnetic

Unit III - RF MEMS SWITCHES, INDUCTOR AND CAPACITOR: RF MEMS relays and switches. Switch parameters. Actuation mechanisms. Bistable relays and micro actuators. Dynamics of switching operation. MEMS inductors and capacitors. Micromachined inductor. Effect of inductor layout. Modeling and design issues of planar inductor.Gap tuning and area tuning capacitors, Dielectric tunable capacitors.

Unit IV - MICROMACHINED RF FILTERS, ANTENNAS AND MEMS PHASE SHIFTERS: Micromachined RF filters. Modeling of mechanical filters. Electrostatic comb drive. Micromechanical filters using comb drives. Electrostatic coupled beam structures. Micromachined antennas. Microstrip antennas – design parameters. Micromachining to improve performance. Reconfigurable antennas. MEMS phase shifters. Types. Limitations. Switched delay lines. Micromachined transmission lines. Coplan.ar lines. Micromachined directional coupler and mixer

Unit V - RF MEMS BASED CIRCUIT DESIGN AND CASE STUDIES: Phase shifters - fundamentals, X-Band RF MEMS Phase shifter for phased array applications, Ka-Band RF MEMS Phase shifter for radar systems applications, Film bulk acoustic wave filters - FBAR filter fundamentals, FBAR filter for PCS applications, RF MEMS filters - A Ka-Band millimeter-wave Micromachined tunable filter, A High-Q 8-MHz MEM Resonator filter, RF MEMS Oscillators - fundamentals, A 14-GHz MEM Oscillator, A Ka - Band Micromachined cavity oscillator, A 2.4 GHz MEMS based voltage controlled oscillator

Reference Books:

1. Vijay K. Varadanetal, RF MEMS and their Applications, Wiley-India, 2011.
2. H.J.D. Santos, RF MEMS Circuit Design for Wireless Communications, Artech House, 2002.
3. G.M.Rebeiz, RF MEMS Theory, Design, and Technology, Wiley, 2003.
4. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2006.
5. Charles P.Poole, Frank J.Owens, “Introduction to nanotechnology” John Wiley & sons, 2003.
6. Julian W.Gardner, Vijay K Varadhan, “Microsensors, MEMS and Smart devices”, John Wiley & sons, 2001.
7. Vijay Varadan, K. J. Vinoy, K. A. Jose, Wiley, "RF MEMS and Their Applications", 2002.
8. Hector J. De Los Santos, "Introduction to Microelectromechanical Microwave Systems, Second Edition", , Artech House, 2004.

17EC3024 NEURAL NETWORK FOR RF AND MICROWAVE DESIGN

Credits 3:0:0

Course Objective:

- To focus new, unconventional alternatives for conquering RF and microwave design and modelling problems using neural networks.
- To understand optimization using Neural Networks techniques.
- To understand Microstrip transmission line model.

Course Outcome:

Upon completion of the course, student will able to

- Employ various neural network structures to create microwave models.
- Analyze the neural network structures using various training algorithms.
- Relate RF and microwave design problems to possible solutions utilizing neural networks

- Evaluate how neural nets can be and "trained" for modeling various electromagnetic structures.
- Develop neural net models for RF and microwave components using MATLAB
- Perform optimization for Microwave designs

Unit I - NEURAL NETWORK STRUCTURES: Neural network modeling approach – Multilayer perception (MLP) – MP structure - Activation functions, effect bias – Neural feed forward –Universal approximation theorem – Back propagation -2D training process –Radial Basis function networks –structure –two step training of PBF networks – comparison of MLP and RBF networks –recurrent Neural Network.
Unit II - TRAINING OF NEURAL NETWORKS: Key issues in Neural Model Development –Data Generation –Data Splitting & scaling –initialization of neural model weight parameters – over learning and under learning – neural network training –Gradient based methods –Back propagation algorithm –training algorithms using gradient based optimization techniques.
Unit III - GENETIC ALGORITHMS FOR NEURAL NETWORK TRAINING: Optimization problem – Algorithms – The schema theorem –effect of crossover, Mutation – Building Block Hypothesis – Walsh Schema transform, chromosomal representation-fitness function –setting the GA parameters and operators – Normal, Mutation and crossover operations –Avoiding the loss of useful genetic material- Royal Road function –hitch hilling phenomenon –training neural networks.
Unit IV - MODELS FOR RF AND MICROWAVE COMPONENTS: Modeling procedure –selection of input and outputs –training data generation-error measures –models for mcirstrip transmission lines – microstrip via- to stripline interconnect –models for CPW transmission line –CPW continuities –CPW opens and short –CPW Symmetric T Junctions.
Unit V - DESIGN AND OPTIMIZATION USING NEURAL NETWORK MODELS: Optimization of Component structure –circuit optimization –CPW folded double stub filter –power divider –Multilayer circuit design and optimization -CPW patch antenna design –yield optimization.

Reference Books:

1. A.J.F. Van Rooji, L.C Jain, R.P. Johnson, “Neural Network Training Using Genetic Algorithms” World Scientific Pub, 1997.
2. Q.J Zhang, K.C. Gupta, “Neural Networks for RF and Microwave Design” Artech house 2000.
3. Laurene Fausett, Fundamentals of Neural Networks: Architectures, Algorithms, and Applications, Prentice Hall International, Inc., 1994.

17EC3025 SMART ANTENNAS

Credits: 3:0:0

Course Objectives:

- T o understand the evolution of antenna arrays for dynamic environments in wireless communications
- To learn the need for narrowband and broadband signal processing techniques.
- To provide in-depth knowledge on performance parameters direction of arrival estimation methods and diversity combining techniques combining

Course Outcomes:

The students will be able to

- suggest necessary signal processing techniques for allocated spectrum in dynamic environments.
- apply adaptive beamforming algorithm for specific applications
- analyse the performance metrics of spatial channel model
- interpret the diversity combining techniques at wireless receivers end
- evaluate the performance of single user and multi user signal processing techniques using software tools

Unit I - SMART ANTENNAS: Historical development of smart antennas- Antenna gain, Antenna Pattern, Antenna bore sight, Phased array antenna, power pattern, beam steered and weighted arrays, beam steered circular arrays, rectangular planar arrays- fixed beam arrays- retro directive arrays, degree of freedom, optimal antenna, adaptive antennas, smart antenna -key benefits of smart antenna technology, wide band smart antennas, Digital radio receiver techniques and software radio for smart antennas.
Unit II - NARROW AND BROAD BAND PROCESSING: Signal model conventional beamformer- null steering beamformer-optimal beamformer-Optimization using reference signal, beam space processing - Tapped delay line

structure, Partitioned realization, Derivative constrained processor, Digital beam forming, Broad band processing using DFT method.

Unit III - ADAPTIVE PROCESSING: Sample matrix inversion algorithm, unconstrained LMS algorithm, normalized LMS algorithm, Constrained LMS algorithm, Perturbation algorithms, neural network approach, Adaptive beam space processing - Implementation issues.
Unit IV - DIRECTION OF ARRIVAL ESTIMATION METHODS: Fundamentals of matrix algebra- array correlation matrix- AOA estimation methods- Spectral estimation methods- Bartlett method and Capon method, linear prediction method, Maximum Entropy method, Maximum Likelihood method, PHD method, Min-norm method, Eigen Structure methods, Music Algorithm -root Music and cyclic music algorithm, the ESPRIT algorithm
Unit V - DIVERSITY COMBINING: Spatial Diversity selection combiner - Switched diversity combiner – Equal gain combiner - Maximum ratio combiner - Optical combiner.

Reference Books:

1. T.S.Rappaport & J.C.Liberti, “Smart Antennas for Wireless Communication”, Springer, First Edition, 2008.
2. R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Springer, Second Edition, 2001.
3. Bronzel, “Smart Antennas”, John Wiley and Sons, First Edition, 2004
4. Lal Chand Godara, "Smart Antennas" CRC press, 2004
5. A. Balanis, "Antenna Theory: Analysis and Design", John Wiley and Sons, 2005

17EC3026 COMMUNICATION NETWORK SECURITY

Credits: 3:0:0
Course Objective:
- To learn about various data encryption standards and network attacks.
- To study about security mechanisms such as encryption algorithms and security services to recover the network from attacks.

Course Outcome:
Students will be able to;
- Apply their Engineering mathematical concepts for communication networks security.
- Identify network attacks; formulate methods to solve the encountered attacks.
- Analyze and interpret data.
- Design a better internet security system to detect and correct security violations that are involved in the transmission of information as per the needs and specifications.
- Demonstrate knowledge of professional and ethical responsibilities.
- Show the understanding of impact of engineering solutions of different encryption standards and security, on the society and also will be aware of contemporary issues.

Unit I - CONVENTIONAL ENCRYPTION: Introduction - Conventional encryption model - Steganography - Data Encryption Standard - block cipher - Encryption algorithms - confidentiality - Key distribution.
Unit II - PUBLIC KEY ENCRYPTION AND HASHING: Principles of public key cryptosystems - RSA algorithm - Diffie-Hellman Key Exchange- Elliptic curve cryptology - message authentification and Hash functions – Hash and Mac algorithms - Digital signatures.
Unit III - IP SECURITY: IP Security Overview - IP Security Architecture - Authentification Header - Security Payload - Security Associations - Key Management.
Unit IV - WEB SECURITY: Web security requirement - secure sockets layer - transport layer security - secure electronic Transaction - dual signature
Unit V - SYSTEM SECURITY: Intruders - Viruses - Worms - firewall design - Trusted systems - antivirus techniques – digital Immune systems.

Reference Book:

1. Stallings,W, "Cryptography and Network security", Principles and Practice, 3rd Edition, Prentice Hall, 2002.
2. Baldwin.R and Rivest.R."TheRC5,RC5-CBC,TC5-CBC-PAD and RC5-CT5 Algorithms,RFC2040",October 1996.

3. Charlie Kaufman, Radia Perlman, Mike Speciner, “Network Security”, Second Edition, Prentice Hall, 2002.

17EC3027 COMMUNICATION NETWORK ROUTING ALGORITHMS

Credits: 3:0:0

Course Objectives:

- To review the general routing concepts in circuit switching, packet switching networks and high speed networks
- To expose the students to the layered architecture of communication networks and the specific functionality of the network layer
- To enable the student to understand the basic principles of routing algorithms in conventional networks and evolving routing algorithms

Course Outcomes:

After completion of the course, students will be able to

- Understand general routing concepts in circuit switching, packet switching networks and Mobile Networks
- Estimate the performance of routing algorithms in conventional networks .
- Identify the type of networks and protocols for a given network scenario.
- Design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network.
- Implement different type of applications for mobile devices with latest network strategies.
- Conversant with the latest 3G/4G and WiMAX networks and its architecture.

Unit I - CIRCUIT SWITCHED NETWORKS: Basic classifications of routing, Routing in circuit switching networks - Routing in packet switching networks - Dynamic Non -Hierarchical Routing - Trunk Status Map Routing-Real Time Network Routing- Dynamic Alternative Routing - Routing strategies - Routing in ATM networks.

Unit II - PACKET SWITCHED NETWORKS: Routing in packet switching networks - Distance Vector Routing - Routing Information Protocol - Link State Routing - Open Shortest Path First Protocol (OSPF) - Interior Gateway routing protocols (IGRP) – Exterior Gateway Routing Protocol (EGRP) - Border Gateway Protocol (BGP)-Apple Talk Routing.

Unit III - MOBILE NETWORKS: Routing in Cellular Mobile Radio Communication networks-Mobile Network Architecture- Mobility management in cellular systems- Mobile IP -Connectionless Data service for cellular systems- Mobility and Routing in Cellular Digital Packet Data (CDPD) network, Packet Radio Routing-DARPA packet radio network- Routing algorithms for small, medium and large sized packet radio networks.

Unit IV - MOBILE AD-HOC NETWORKS: Table driven routing protocols and On-demand routing protocols, Desitination Sequenced Distance Vector (DSDV)-, Clusterhead Gateway Switch Routing protocol, Wireless Routing Protocol - Adhoc Ondemand Distance Vector protocol, Dynamic Source Routing protocol - Multicast routing – Link reversal routing - Temporally Ordered Routing Algorithm - Signal Stability Routing protocol .

Unit V - 4G CELLULAR COMMUNICATION: Introduction – 4G vision – 4G features and challenges – LTE Architecture – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, OFDM-MIMO systems, Adaptive Modulation and coding with time slot scheduler, Cognitive Radio.

Reference Books:

1. M.C.E. Perkins, "Ad Hoc Networking", Addison - Wesley Publication, Singapore, 2008.
2. S. Keshav, "An Engineering Approach to Computer Networking", Addison Wesley, 1st Edition, New Delhi, 2002.
3. C.K.Toh,” Ad Hoc Mobile Wireless Networks”, Pearson Education, New Delhi, 2007.
4. A.S. Tanenbaum, "Computer Networks", fifth edition, PHI, New Delhi, 2010.
5. Vijay Garg , “Wireless Communications and networking”, First Edition, Elsevier 2007
6. Jochen Schiller, “Mobile Communications”, Pearson Education, 8th Edition, New Delhi, 2008.
7. SteenStrub, “Routing in Communication Networks”, Prentice Hall International, New York, 1995.
8. Jack L. Burbank, Julia Andrusenko, Jared S. Everett, William T.M. Kasch, “Wireless Networking: Understanding Internetworking Challenges”, John Wiley & Sons Inc. 2013.

17EC3028 WIRELESS COMMUNICATION FOR SENSOR NETWORKS

Credits: 3:0:0

Course Objectives:

- To learn the architecture and protocols of wireless sensor networks.
- To understand the design issues in sensor networks.
- To introduce the tracking techniques, sensor database, energy management and security

Course Outcomes:

The students will be able to

- Recognize technologies and applications of wireless sensor networks
- Describe the architecture and protocols of wireless sensor networks.
- Choose suitable medium access protocols and radio hardware.
- Apply IEEE 802.15.4/ Zigbee/Bluetooth standards for Wireless Sensor Network application
- Illustrate tracking techniques and sensor database
- Analyze energy management and security in WSN applications.

Unit I - BASICS CONCEPTS OF SENSOR NETWORKS: Introduction – Difference between sensor networks and traditional data networks –Technical challenges in WSN - sensor node architecture - Functional architecture of sensor networks — Individual components of WSN -Sensor network node - Applications

Unit II - COMMUNICATION PROTOCOLS: Time synchronization protocols - Transport Layer protocol - Network layer protocol - Data link Protocol - medium access control - Requirements and design constraints for MAC for WSN - The S-MAC protocol – PEDAMACS - IEEE 802.15.4 standard and Zigbee - Error Control

Unit III - POSITIONING AND LOCATION TRACKING TECHNOLOGIES: Tracking scenario – Problem formulation – Sensing model –ToA, TDoA, and AoA Positioning by signal strength - positioning and location tracking algorithms –Trilateration -

Multilateration - Pattern matching - Nearest neighbor algorithms, location tracking - network based tracking, RADAR Sensors

Unit IV - SENSOR NETWORK DATA BASES: Sensor data base challenges - Querying the physical environment - High level data base Organization - Data aggregation - types of aggregation - Packet level aggregation - total aggregation - Geographic aggregation - selection of the best aggregation points - Problem with high data rate

Unit V - ENERGY MANAGEMENT AND SECURITY: Dynamic Power management:Idle power management - Active power management - Design challenges in energy efficient medium access control – IEEE 802.11- operation - power saving mode – merits - drawbacks implications in WSN, Bluetooth – operation - Merits – implications – Overview of load level energy management and energy efficient communication - Security: Security architecture - Cell based WSNs - Privacy of local information

Reference Books:

1. Mohammad Ilyas and Imad Mahgoub, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems" CRC Press 2009.
2. Feng Zhao, Leonidas J. Guibas, "Wireless Sensor Networks: An Information Processing Approach" Morgan Kaufmann Publishers 2004.
3. Michel Banatre, Pedro Jose Marron, Anibal Ollero and Adam Wolisz,"Cooperating
4. Embedded Systems and Wireless Sensor Networks", ISTE Ltd,2008.
5. Holger Karl and Andreas Willing, "Protocols and Architecture for Wireless Sensor Networks", Wiley, 2005.
6. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks: Technology, Protocols and Applications, WILEY , Second Edition (Indian) , 20144.

17EC3029 MOBILE COMMUNICATION NETWORKS

Credits 3:0:0

Course Objective:

- To understand the fundamentals of wireless communication.
- To know the essentials of Telecommunication system.
- To acquire knowledge on wireless networks and its layers.

Course Outcomes:
The students will be able to:
- summarize the concepts of wireless communication.
- explain digital cellular technology.
- analyze wireless networks.
- manipulate network layer protocols.
- practice transport layer protocols.
- describe the functions of application layer.

Unit I - WIRELESS COMMUNICATION FUNDAMENTALS: Introduction -Wireless transmission - Frequencies for radio transmission –Signals- Antennas- Signal Propagation - Multiplexing - Modulations - Spread spectrum – Media Access Control- **Space-division multiple access** - Frequency division multiple access - Time-division multiple access - Code Division Multiple Access - Cellular Wireless Networks.
Unit II - TELECOMMUNICATION SYSTEMS: Global System for Mobile communication - System Architecture - Protocols - Connection Establishment – Frequency Allocation - Routing - Handover- Security- General Packet Radio Service.
Unit Ill: WIRELESS NETWORKS: Wireless LAN - IEEE 802.11 Standards- Architecture- Services- High Performance Radio LAN -Ad hoc Network- Blue-Tooth.
Unit: IV NETWORK LAYER: Mobile IP- Dynamic Host Configuration Protocol- Routing- Destination-Sequenced Distance-Vector Routing- Dynamic Source Routing- Ad Hoc On-Demand Distance Vector- Zone Routing Protocol **-** Digital mobile radio
Unit V - TRANSPORT AND APPLICATION LAYERS: TCP over Wireless Networks - Indirect TCP - Snooping TCP - Mobile TCP – Fast Retransmit / Fast Recovery - Transmission/Timeout Freezing – Selective - Retransmission – Transaction Oriented TCP - Wireless Application Protocol - Wireless Application Protocol Architecture-Wireless Datagram Protocol **-** Wireless Transport Layer Security **-** Web Tools Platform **-** Wireless Session Protocol **-** Wireless Markup Language **-** Wireless Markup Language Script- Wireless Application Environment.

Reference Books:
1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2003.
2. William Stallings, 'Wireless Communications and Networks", Pearson Education, 2002.
3. Kaveh Pahlavan, Prasanth Krishnamoorthy, "Principles of Wireless Networks", First Edition, Pearson Education, 2003.
4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.
5. C.K.Toh, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.
6. Burkhardt, "Pervasive Computing", First Edition, Pearson Education, 2003.

17EC3030 HARDWARE DESCRIPTION LANGUAGES

Credits: 3:0:0

Course Objectives:
1. To know about the various Architecture styles in VHDL and Verilog.
2. To learn the circuit verification using VHDL and Verilog HDL
3. To get familiar with various Synthesis Techniques.

Course Outcomes:
After completion of the course, students will be able to
1. Understand basic terminologies and modeling types used in VHDL and Verilog HDL
2. Design and synthesis combinational circuits and sequential circuits using VHDL and Verilog HDL
3. Develop a digital circuit test bench using VHDL and Verilog HDL
4. Develop a VHDL package for digital circuit using VHDL
5. Design gates using Verilog HDL switch level modeling
6. Implement simple digital circuit application on FPGA using VHDL

Unit I - VHDL Overview – FPGA Design flow Process – Software tools - Xilinx Tool Flow – Libraries – Data objects - Data types – Data operators – Entities – Architectures. Basic Concurrent Statements – Signal assignment statements – Conditional Signal assignment – Selected signal assignment – Usage of Blocks in Dataflow modeling –

Implementations of different digital circuits in Dataflow modeling . Process – Delays – Basic Sequential Statements – if, if else statements, case statements – Loops– for loop, while loop, next, exit, null statements – Usage of Variables inside the process – Implementation of digital circuits using Sequential statements Multi Process statements.
Unit II - Component Declarations **–** Component Instantiation – Types of Component Instantiation- Examples – Packages with Components declaration & Instantiation –– Generics – Operator Overloading – Conversion functions – Attributes – File Concepts - Packages – Functions & Procedures – Predefined & User defined library implementations. FSM implementation – Moore & Mealy Machines – Implementations of Basic digital circuit using structural modeling – Test benches – Combinational & Sequential Test benches – Examples – Traffic Light Controller – Toll both controller.
Unit III - Design Methodology – Module – Ports – Basicconcepts – Operators – Number specification – Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multiway branches - Loops - Switch – Modeling elements – Implementation of Basic circuit using Dataflow & Behavioral Modeling
Unit IV - Component Assignments – Switch level modeling – Applications of all dataflow, behavioral and Structural modeling in FPGA – FSM Implementation – Test Benches.
Unit V - VHDL Synthesis: Synthesis basics-modeling a wire- modeling combinational logic- modelling sequential logic- Modeling Flip-flop-Flip-flop with Synchronous Preset and clear- Flip-flop with Asynchronous Preset and clear-Modeling a latch. Verilog Synthesis: Synthesis of combinational logic-synthesis of sequential logic with latches and flip flops- synthesis of explicit and implicit state machines- Synthesis of gated clocks and clock enables synthesis of Loops.

Reference Books:

1. J. Bhaskar, “A VHDL Primer”, PHI Learning, III Edition, 2009.
2. Bhasker, “A Verilog HDL Primer”, Star Galaxy Publishing, 2010
3. Samir Palnitkar, “Verilog HDL”, Pearson Education, 2004.
4. Charles H. Roth, Jr and Lizy Kurian John’s Digital Systems Design Using VHDL Cengage Learning 2^{nd} edition 2012.
5. Douglas L. Perry, “VHDL Programming by Example”, TATA McGRAW-HILL Edition,2003.
6. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL”, Pearson Education Asia, First India Reprint,2008.
7. Stephen Brown, "Fundamentals of Digital Logic Design with VHDL", Tata Mcgraw-Hill Publishing Company Limited, 2nd Edition ,2007.

17EC3031 DIGITAL SYSTEM AND ASIC DESIGN

Credit 3:0:0

Course objective:
- To design combinational and sequential circuits using CPLDs
- To understand the types of ASIC s and design flow.
- To acquire knowledge on Programmable ASICs and programmable ASIC logic cells.
- To study the concepts of Programmable ASIC Interconnect and Programmable ASIC design software.

Course outcome:
On successful completion of the Course, students can be able to
- Define steps to design combinational and sequential circuits.
- Describe steps to design combinational and sequential circuits using CPLDs.
- Discuss the types of ASICs, Combinational and Sequential Logic Cells.
- Demonstrate the Programmable ASICs and programmable ASIC logic cells.
- Illustrate Programmable ASIC Interconnect and Programmable ASIC design software.
- Apply the concepts of EDIF - CFI design representation.

Unit I - DIGITAL DESIGN: Design of combinational circuits - Adders, subtractors -multiplexers, demultiplexer decoders, encoders,code converters parity generators, magnitude comparators - Design of static hazard free and dynamic hazard free logic circuits - Mealy machine, Moore machine - Design of synchronous sequential logic circuits.
Unit II - DESIGN WITH PLDS: Design of asynchronous sequential logic circuits .Design of combinational circuits using PLDs- Design of combinational circuits using CPLD's - Design of sequential circuits using PLDs-Design of sequential circuits using CPLD's -ASM Chart.

Unit III INTRODUCTION TO ASICS: Types of ASICs- Design Flow- CMOS Design Rules- Combinational Logic Cells- Sequential Logic Cells-Logical Effort

Unit IV - PROGRAMMABLE ASICS, AND PROGRAMMABLE ASIC LOGIC ELLS: The Antifuse - static RAM -EPROM and EEPROM Technology - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX.

Unit V - PROGRAMMABLE ASIC INTERCONNECT AND PROGRAMMABLE ASIC DESIGN SOFTWARE: Actel ACT- Xilinx LCA- Xilinx EPLD- Altera MAX 5000 and 7000- Altera MAX 9000- Altera FLEX- Design Systems Logic Synthesis - The Halfgate ASIC.- Schematic Entry- PLA tools EDIF - CFI design representation.

References Books:

1. Morris Mano, "Digital Design", 3rd edition Prentice Hall Of India, 2002.
2. Palmer, J.E., Perlman, D.E., "Introduction to Digital Systems", Tata McGraw Hill, New Delhi, Reprint 1996.
3. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", PrenticeHall International, Inc., New Jersey, 1995.
4. Robert K Dueck, "Digital Design with CPLD applications and VHDL", Thomson Asia, 2002.
5. Michael John Sebastian Smith "Application specific integrated circuits." Addison, Wesly Longman Inc., 2006.
6. Kevin Skahill, "VHDL for Programmable Logic", Pearson Education, First Indian Reprint, 2004.
7. Farzad Nekoogar and Faranak Nekoogar, "From ASICs to SOCs: A Practical Approach", Prentice Hall PTR, 2003.

17EC3032 CMOS VLSI DESIGN

Credits 3:0:0

Course Objective:

- To develop a fundamental understanding in the design of CMOS VLSI circuits.
- To know the essentials of stick diagrams and Layouts.
- To impart the knowledge of arithmetic design and to apply the CMOS design concepts with learn the concepts in data path circuits.

Course outcome:

The students will be able to:

- Recognize the MOS transistor theory
- Summarize the qualitative analysis of MOSFET
- Demonstrate the CMOS design and apply in various combinational logic
- Analyze the performance of different types of Inverters
- Design Combinational and Sequential logic design
- Evaluate and develop the various Arithmetic logic blocks based on CMOS design

Unit I - MOS TRANSISTOR THEORY: MOS Transistor Theory: The Metal Oxide Semiconductor (MOS) Structure – The MOS System under External Bias – Structure and Operation of MOS Transistor (MOSFET) – Threshold Voltage-MOSFET Operation: A Qualitative View- MOSFET Current-Voltage Characteristics-Channel Length Modulation- Substrate Bias Effect- Measurement of Parameters-MOSFET Scaling and Small-Geometry Effects-MOSFET Capacitance: Oxide -related Capacitance-Junction Capacitance.

Unit II - CMOS DESIGN: CMOS Design- MOS Transistor Switches - MOS Transistor Switches -Design logic gates using CMOS devices- Stick Diagram- Layout-The Complementary CMOS inverter - DC Characteristics – nMOS Inverter- Resistive-load Inverter-The Static Behaviour of CMOS Inverter: Switching Threshold-Noise Margins-Performance of CMOS inverter: Dynamic behaviour: Computing the capacitance -Propagation delay: First Order Analysis.

Unit III - COMBINATIONAL LOGIC DESIGN: Combinational Logic Design: Static CMOS Design: Complementary CMOS-Ratioed Logic-Pass Transistor Logic- Dynamic CMOS Design : Basic Principles-Speed and Power Dissipation of Dynamic Logic-Signal Integrity Issues in Dynamic Design-Cascading Dynamic Gates.

Unit IV - SEQUENTIAL LOGIC DESIGN: Sequential Logic Design: Static Latches and Registers –Bi-stability Principle- Multiplexer based Latches-Master -Slave Edge- Triggered Register-Low -Voltage Static Latches- Dynamic Latches and Registers –Dynamic Transmission Gate Edge-triggered Registers-C^2MOS-A clock skew Insensitive

Approach-True Single Phase Clocked Register-Alternative Register Styles: Pulse Registers-Sense Amplifier based Registers –Pipelining: Latch-NORA-CMOS.

Unit V - ARITHMETIC BUILDING BLOCKS: Arithmetic Building Blocks: Binary Adder-Full Adder Circuit Design Considerations-Mirror Adder Design-Transmission Gate Based Adder -Manchestor Carry-Chain Adder-The Binary Adder: Logic Design Considerations -Carry-By Pass Adder-Linear Carry Select Adder-Square Root Carry Select Adder-Carry Lookahead adder-Array Multipliers – Carry Save Multipliers-Tree Multipliers -Shifters-Barrel Shifters.

Reference Books:

1. Kang ,Leblebigi "CMOS Digital IC Circuit Analysis & Design", McGraw Hill, 2003.
2. Jan.M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education, 2nd Edition 2003. '
3. Neil H.E. Weste, David Harris, Ayan Banerjee, "A Ciruits and Systems Perspective",Pearson Education India, 3rd Edition, 2006.
4. Kamran Eshraghian, Douglas A.Pucknell, Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems", Eastern Economy Prentice Hall of India, New Delhi, 2005.

17EC3033 ANALYSIS AND DESIGN OF ANALOG INTEGRATED CIRCUITS

Credits 3:0:0

Course Objective:

- To develop a fundamental understanding in the concepts of amplifiers
- To know the essentials of frequency response of amplifiers and the association of poles and nodes.
- To impart the knowledge of feedback analysis, stability and compensation.

Course Outcome:

The students will be able to:

- define the single stage amplifiers
- understand the knowledge of Differential amplifiers
- practice the characteristics of noise in amplifiers
- analyze different types of feedback concepts in amplifiers
- perform stability analysis
- design and develop various analog circuits for various applications

Unit I - SINGLE STAGE AMPLIFIERS: Single stage Amplifiers-Common source Stage: Common Source (CS)stage with resistive load-CS stage with Diode Connected Load-CS with Current source load- CS with Triode Load- CS stage with source degeneration-Source follower-Common Stage Stage-Cascode Stage: Folded Cascode-Choice of Device models.

Unit II - DIFFERENTIAL AMPLIFIERS AND CURRENT MIRRORS: Differential Amplifiers-Single Ended and Differential Operation- Basic Differential Pair: Qualitative Analysis-Quantitative Analysis-Common mode Response-Differential Pair with MOS Loads-Gilbert Cell-Passive and Active Current Mirrors-Basic Current Mirrors-Cascode Current Mirrors-Active current Mirrors: Large Signal Analysis-Small-Signal Analysis-Common-mode Properties.

Unit III: FREQUENCY RESPONSE OF AMPLIFIERS: Frequency response of amplifiers-Miller Effect-Association of Poles and Nodes-Common source stage-Source Followers-Common-Gate Stage- Cascode Stage-Differential pair-Noise-Statistical Characteristics of Noise: Noise Spectrum-Amplitude Distribution-Types of Noise: Thermal Noise ,Flicker Noise-Noise in Single-stage Amplifiers-Common Source Stage-Common-Gate Stage -Source Followers-Noise in Differential Pairs.

Unit IV - FEEDBACK TOPOLOGIES: Feedback-Properties of Feedback circuits-Types of Amplifiers-Feedback Topologies: Voltage-Voltage Feedback-Current-Voltage Feedback-Voltage-Current Feedback-Current Current Feedback-Effect of loading-Two-Port Network models-Loading in Voltage-Voltage Feedback- Loading in Current-Voltage Feedback - Loading in Voltage- Current Feedback- Loading in Current- Current Feedback - Operational Amplifiers -One stage op-amps-Two stage Op-amps-Gain boosting -Common-Mode Feedback-Input Range Limitations-Slew rate-Power supply Rejection.

Unit V - STABILITY AND FREQUENCY COMPENSATION: Stability and Frequency Compensation-Multipole Systems-Phase Margin-Frequency Compensation-Compensation of Two stage op-amps-Band gap Reference-temperature independent References: Negative TC Voltage-Positive TC Voltage-Band gap Reference-Phase -

Locked Loops-Simple PLL: Phase Detector-Basic PLL topology-Charge -Pump PLLs: Problem of Lock Acquisition-Phase/Frequency Detector and Charge Pump-Basic Charge -Pump PLL.

Reference Books:

1. BehzadRazavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2001
2. Willey M.C. Sansen, “Analog design essentials”, Springer, 2006.
3. Grebene, “Bipolar and MOS Analog Integrated circuit design”, John Wiley &sons,Inc., 2003.
4. Phillip E.Allen, DouglasR.Holberg, “CMOS Analog Circuit Design”, Second edition, Oxford University Press, 2002
5. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Fourth Edition, Wiley Student Edition, 2009.

17EC3034 VLSI TECHNOLOGY

Credits: 3:0:0

Course Objectives:

- To study the manufacturing concepts of VLSI devices.
- To build a chip with the design rules or layout rules.
- Fabrication process that allows this technology evolution is the minimum feature size that can be printed on the chip.

Course Outcomes:

The students will be able to:

- Understand the VLSI fabrication steps in detail.
- Illustrate various techniques followed in the industry for every fabrication process.
- Interpret various tools used for fabricating VLSI devices and Predict the design rules for fabrication.
- Identify the difficulties while fabricating the device and express the rectification
- Select the materials used for fabrication of devices
- Examine the application of technology customization for the chip design economically.

Unit I - CRYSTAL GROWTH AND EPITAXY: Introduction to VLSI fabrication, Crystal Growth – Electronic grade silicon, Czochralski Crystal Growing, Silicon Shaping ,Processing conditions; Epitaxy – Vapor Phase Epitaxy; Molecular Beam Epitaxy; Silicon on Insulators, epitaxial evaluation Silicon on Insulators, epitaxial evaluation.

Unit II - OXIDATION : Kinetics of silicon dioxide growth for thick and thin films;Thin oxides;Oxidation techniques and systems;Oxide properties, Redistribution of dopants at interface;Oxidation of Polysilicon and oxidation induced effects

Unit III - LITHOGRAPHY, ETCHING & DEPOSITION: Optical lithography-E-Beam lithography-X- Ray lithography -Ion Lithography-Reactive Plasma Etching-Introduction to Plasma Properties,Feature-size control and anisotropic etch mechanisms’Specific etch processes, Deposition Processes-Polysilicon Silicon di oxide, silicon nitride,Plasma assisted depositions,

Unit IV - DIFFUSION & ION IMPLANTATION: Models of Diffusion in solids’ Fick’s One Dimensional Diffusion equations, Atomic diffusion mechanisms, diffusivities of B,P, As and Sb Measurement techniques,iffusion in Polycrystalline silicon, SiO2 Diffusion enhancements and retardations,Ion implantation equipment,Annealing and shallow junctions,High energy implantation

Unit V - METALLIZATION AND VLSI PROCESS INTEGRATION: Metallization applications and choices,Physical Vapor deposition,Patterning,Metallization problems, NMOS IC technology CMOS IC technology,MOS memory IC technology Bipolar IC technology and IC fabrication VLSI Assembly technologies, Package Types, Packaging Design Considerations.

Reference Books:

1. S.M.Sze, “VLSI Technology”, McGraw Hill Second Edition. 1998.
2. James D Plummer, Michael D. Deal, Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and Modeling”, Prentice Hall India.2000.
3. Wai Kai Chen, “VLSI Technology” CRC Press, 2003.
4. Rajesh Agarwal and Dr.LaxmanSahoo, “VLSI Technology and Design”,Technical Publications Pune, 2008.

5. YasuoTarui, “VLSI Technology: Fundamentals and Applications”, 2011

17EC3035 SOLID STATE DEVICE MODELING AND SIMULATION

Credits: 3:0:0

Course objective:

- To understand the principles of various device modeling
- To Know about the physics of solid state device modeling and simulation.
- To know about the models and its effects behind semiconductor devices

Course outcome:

The students will be able to:

- Formulate new mathematical models for various devices.
- Learn the physics behind the semiconductor devices
- Deep understanding of PN Junction theory, heterojunctions and Contacts in the devices.
- Analyze the RF based modeling.
- Explore MOSFET and other semiconductor devices from semiconductor device perspective.
- Understand short channel effect and leakage mechanism in MOSFET devices.
- Advantages and applications of various SPICE models in the MOS devices.

Unit I - SEMICONDUCTOR DEVICE PHYSICS AND OPERATION: Band theory of solids, carrier transport mechanism, MOS capacitor - surface potential accumulation, depletion, inversion, electrostatic potential and charge distribution, threshold voltage, polysilicon work function, interface states and oxide traps, drain current model, sub-threshold characteristics.

Unit II - MOSFET RF MODELLING: Basic modeling, SPICE Level-1, 2 and 3 models, Short channel effects, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and A.C small signal modeling.

Unit III - NOISE MODELING: Noise sources in MOSFET, Flicker noise modeling, Thermal noise modeling, model for accurate distortion analysis, nonlinearities in CMOS devices and modeling, calculation of distortion in analog CMOS circuit.

Unit IV - THE BSIM4 MOSFET MODEL: Gate dielectric model, Enhanced model for effective DC and AC channel length and width, Threshold voltage model, Channel charge model, Mobility model, Source/drain resistance model, I-V model, gate tunneling current model, substrate current models, Capacitance models, High speed model, RF model, Noise model, Junction diode models , Layout-dependent parasitic model.

Unit V - OTHER MOSFET MODELS AND SIMULATION: The EKV model, model features, long channel drain current model, modeling second order effects of the drain current, modeling of charge storage effects, Non-quasi-static modeling, Noise model, temperature effects, MOS model 9, MOSAI model, PSP model and its simulations Influence of process variation, Modeling of device mismatch for Analog/RF Applications.

References Books:

1. TrondYtterdal, Yuhua Cheng and Tor A. Fjeldly, Wayne Wolf, “Device Modeling for Analog and RF CMOS Circuit Design”, John Wiley & Sons Ltd, (2003).
2. B. G. Streetman and S. Banarjee, “Solid State Electronic Devices”, Prentice-Hall of India Pvt. Ltd, New Delhi, India, (1995).
3. A. B. Bhattacharyya, “Compact MOSFET Models for VLSI Design”, John Wiley & Sons Inc., 2009.

17EC3036 LOW POWER VLSI DESIGN

Credits 3:0:0

Course Objective :

- To understand basic principles of low power concepts.
- To acquire knowledge on circuit and logic level power reduction techniques
- To design low power latches flipflops and SRAM devices.

Course Outcome:

On successful completion of the Course, students can be able to

- Describe the basic principles and need for low power VLSI chips.
- Define the various low power reduction techniques at circuit and logic level.

- Demonstrate the application of probabilistic power analysis in VLSI chip design.
- Illustrate the architecture and system level power reduction techniques.
- Develop low power SRAM chips
- Apply the of energy recovery concepts to design low power circuits and to design low power flipflops.

Unit I - SIMULATION POWER ANALYSIS: Need For Low Power VLSI Chips- Charging And Discharging Capacitance- Short Circuit Current- Leakage Current- Static Current- Basic Principles of Low Power Design- Gate Level Logic Simulation- Architectural Level Analysis- Probability and frequency - Probabilistic Power Analysis Techniques.
Unit II - CIRCUIT AND LOGIC LEVEL POWER ESTIMATION: Transistor and Gate Sizing- Equivalent Pin Ordering- Network Reconstructing and Reorganization- Gate Reorganization- Signal Gating - Logic Encoding- State Machine Encoding- Pre-Computation Logic- Power Reduction in Clock Networks- CMOS Floating Node- Low Power Bus- Delay Balancing.
Unit III - ARCHITECTURE AND SYSTEM LEVEL POWER ESTIMATION: Power and Performance Management- Switching Activity Reduction- Parallel Architecture- Flow Graph Transformation. Leakage Current in Deep Sub-Micrometer Transistors- Deep SubMicrometer Device Design Issues- Low Voltage Circuit Design Techniques- Multiple Supply Voltages.
Unit IV - SRAM ARCHITECTURES: MOS Static RAM- Memory Cell- Banked SRAM- Reducing Voltage Swing on Bit Lines- Reducing Power in the Write Driver and Sense Amplifier Circuits.
Unit V - ENERGY RECOVERY AND LOW POWER LATCHES AND FLIP FLOPS: Energy Recovery Circuit Design - Design with Partially Reversible Logic- Need for Low Power Latches and Flip Flops- Evolution of Latches and Flip Flops- Quality Measures for Latches and Flip Flops.

Reference Books:

1. Gary Yeap, “Practical Low Power Digital VLSI Design”, Kluwer academic publishers, 2001.
2. Kaushik Roy, Sharat prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley & Sons Inc., 2000.
3. Anantha Chadrasekaran and Robert Broderson, “Low Power CMOS Design”, Standard Publishers, 2000.
4. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, “CMOS/BiCMOS ULSI Low Voltage, Low Power”, Pearson edition, Second Indian reprint, 2003.

17EC3037 CAD FOR VLSI CIRCUITS

Credits: 3:0:0

Course Objective:
- To design the circuit using Floor planning, Placement and Routing concepts.
- To design and implement various algorithms onto FPGA.
- To verifySimulation and Synthesis process in the circuit design.

Course Outcome:
The students will be able to:
- Understand the basic VLSI design Automation Tools.
- Solve the Tractable and Intractable problems.
- Verify the VLSI design process through Simulation and Synthesis.
- Understand about Floor planning, Placement and Routing.
- Verify the Design Rule Check (DRC) in the circuit design.
- Implement the various algorithms onto FPGA applications.

Unit I – INTRODUCTION: Introduction to VLSI Methodologies – Types of ASICs – Design flow -VLSI Physical Design Automation – Fabrication process and its impact on Physical Design.
Unit II - AUTOMATION TOOLS AND GRAPH THEORY: A quick tour of VLSI Design Automation Tools – Data structures and Basic Algorithms - Algorithmic graph theory and computational complexity – Tractable and Intractable problems.
Unit III - SIMULATION AND SYNTHESIS: Simulation – Logic synthesis – Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis- Verification – High level synthesis – Compaction.Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation
Unit IV - CAD PHYSICAL DESIGN: Partitioning methods – floor planning – placement – global routing – detailed routing- circuit extraction –DRC.

Floor planning concepts - shape functions and floor plan sizing - Types of local routing problems Area routing - channel routing - global routing - algorithms for global routing.

Unit V - CAD IMPLEMENTATIONS IN FPGA: Physical Design Automation of FPGAs – MCMS – Implementation of various Algorithms using VHDL & Verilog onto FPGA's.

Reference Books:

1. N.A. Sherwari, "Algorithms for VLSI Physical Design Automation", John Wiley, 2003.
2. Sabih H. Gerez," Algorithms for VLSI design automation", John Wiley, 2004.
3. M.J.S.Smith, "Application – Specific Integrated Circuits", Addison, Wesly Longman Inc.,1997.

17EC3038 TESTING AND TESTABILITY

Credits 3:0:0

Course Objective:

- To develop a fundamental understanding in the concepts of testing combinational and sequential circuits
- To know the essentials of various fault simulation techniques
- To understand the difference between DFT and BIST

Course Outcome:

The students will be able to:

- recognize the basic difference between testing and verification
- understand the knowledge of modeling of faults
- utilize the test generation algorithms for generating test vectors
- analyze different types of methods to test sequential circuits
- perform modal analysis to fault simulation techniques
- design and develop various architectures for DFT and BIST.

Unit I - MOTIVATION OF TESTING: Role of Testing-Testing and Diagnosis-Testing at different Levels of Abstraction-Errors and Faults-Modeling and Simulation-Test Evaluation-Digital and Analog VLSI Testing-Failures and Faults-Modeling of Faults: Stuck-at faults-Bridging faults-Stuck-open faults-Delay Faults-Temporary Faults-Fault Detection and Redundancy-Fault Equivalence and Fault Location-Fault Dominance.

Unit II - TEST GENERATION ALGORITHMS: Test Generation algorithms-Test Generation For Combinational Logic Circuits-Fault Table-One-Dimensional Fault Sensitization-Boolean Difference-D-Algorithm-Test Generation for Sequential Logic Circuits: Testing of Sequential Circuits as Iterative Combinational circuits-State Table Verification-Designing checking experiments-Random Testing.

Unit III - FAULT SIMULATION TECHNIQUES: Fault Simulation Techniques -Simulation for Design Verification-Algorithms for Fault Simulation-Serial Fault Simulation- Parallel Fault Simulation-Deductive Fault Simulation -Concurrent Fault Simulation.

Unit IV - DESIGN FOR TESTABILITY: Design for Testability-Controllability and Observability-Ad Hoc Techniques-Scan-Path Techniques for testable sequential circuit design-Level sensitive Scan Design (LSSD): Clocked Hazard-free latches-LSSD Design Rules-Advantages of LSSD techniques-Random Access Scan Techniques-Partial Scan-Boundary Scan.

Unit V - BUILT-IN SELF TEST: Built-In Self Test-Test Pattern Generation for BIST: Exhaustive Testing-Pseudo exhaustive Pattern Generation-Pseudo random pattern Generator-Output Response Analysis: Transition Count-Syndrome Checking-Signature Analysis-BIST Architectures-Built-in Logic Observer- Specific BIST Architectures - CSBL-BEST-LOCST-STUMPS- CBIST-SST.

Reference Books:

1. Vishwani D. Agarwal,"Essential of Electronic testing for digital, memory and mixed signal circuits", Springer, 2000
2. Abramovici .M, Breuer , "Digital Systems Testing and Testable Design", Jaico Publishing House, 2000
3. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Cliffs, 1998.
4. ParagK.Lala, " Digital circuit Testing and Testability", Academic press, 1997
5. Abramovici .M, Breuer .M.A. and Friedman .A.D, "Digital Systems Testing and Testable Design", Wiley, 1994.

17EC3039 VLSI DIGITAL SIGNAL PROCESSING

Credits: 3:0:0

Course Objectives:

- To understand the various VLSI architectures for digital signal processing.
- To know the techniques of critical path and algorithmic strength reduction in the filter structures.
- To study the performance parameters, viz. area, speed and power.

Course Outcomes:

Students will be able to

- Recognize the technologies in VLSI based architectures.
- Distinguish path reduction methodologies for architectures.
- Solve algorithmic strength reduction methods and Filter Designing
- Model pipeline based architectures in the design.
- Synthesize area, speed and power in the architectures.
- Justify the efficient architectures for various DSP algorithms.

Unit I - INTRODUCTION: 6 Overview of DSP – FPGA Technology – DSP Technology requirements – Design Implementation.

Unit II - METHODS OF CRITICAL PATH REDUCTION 12 : Binary Adders – Binary Multipliers – Multiply-Accumulator (MAC) and sum of product (SOP) – Pipelining and parallel processing – retiming – unfolding – systolic architecture design.

Unit III - ALGORITHMIC STRENGTH REDUCTION METHODS AND RECURSIVE FILTER DESIGN: Fast convolution-pipelined and parallel processing of recursive and adaptive filters – fast IIR filters design.

Unit IV - DESIGN OF PIPELINED DIGITAL FILTERS: Designing FIR filters – Digital lattice filter structures – bit level arithmetic architecture – redundant arithmetic – scaling and round-off noise.

Unit V - SYNCHRONOUS ASYNCHRONOUS PIPELINING AND PROGRAMMABLE DSP: Numeric strength reduction – synchronous – wave and asynchronous pipelines – low power design – programmable DSPs – DSP architectural features/alternatives for high performance and low power. TOTAL: 45 PERIODS

Reference Books:

1. U. Meyer – Baese, "Digital Signal Processing with Field Programmable Arrays", Springer, Second Edition, Indian Reprint, 2007.
2. S.Y.Kuang, H.J. White house, T. Kailath, “VLSI and Modern Signal Processing”, Prentice Hall, 1995.
3. Keshab K.Parhi, “VLSI Digital Signal Processing Systems, Design and Implementation”, John Wiley, Indian Reprint, 2007.

17EC3040 ASIC DESIGN LABORATORY

Credits 0:0:2

Course Objectives:

- Design of Digital Circuits for synthesis and simulation using HDL and Schematic Entry.
- Design of various steps involved in Physical Design such as Placement, Routing, DRC, Parasitic Extraction and Layout.
- Design and analysis of Analog Circuits

Course Outcomes:

The students will be able to

- perform various analysis for combinational circuits using Tanner and Cadence EDA tools.
- design Bi-CMOS logic gates
- analyze and develop analog circuits using Tanner and Cadence EDA tools.
- perform analysis on sequential circuits using HDL Designer.
- examine and analyze the ASIC design flow process
- demonstrate the tools for their Projects and Research works.

List of Experiments:

1. Design and simulation of CMOS logic gates using Tanner EDA.
2. Design and simulation of half adder and full adder using Tanner EDA.
3. Design and simulation of BICMOS logic gates using Tanner EDA.
4. Design and simulation of emitter follower and differential amplifier using Tanner EDA.

5. Design and simulation of Clippers and Clampers using Tanner EDA
6. Design and simulation of Schmitt trigger and level shifters using Tanner EDA
7. Design and simulation of NMOS inveters and multiplexers using CADENCE
8. Design and simulation of switched capacitor circuits using LT-SPICE
9. Design and simulation of FSM using HDL Designer
10. Layout design for CMOS inverter, NAND Gate and NOR Gate using Tanner EDA or CADENCE
11. Design and simulation of full ASIC Design flow of an inverter using Mentor Graphics
12. Design and simulation of full ASIC Design flow of an inverter using CADENCE

17EC3041 HDL LABORATORY

Credits: 0:0:1

Course Objectives:

- To learn various VHDL modeling Verilog HDL modeling.
- To familiarize with VHDL sub program and packages technique.
- To have an understanding about transistor level modeling

Course Outcomes:

After completion of the course, students will be able to

- Design for combinational and sequential circuits using VHDL and Verilog HDL
- Develop package for digital circuits using VHDL
- Develop test bench for digital circuits using VHDL and Verilog HDL
- Design gates using transistor level modeling using Verilog HDL
- Synthesize the circuits after programming.
- Implement circuit on FPGA using VHDL and Verilog HDL.

List of experiments

1. Design and Simulate Combinational circuits in all three modeling .
2. Design and Simulate 4-bit adder in structural and behavioral modeling.
3. Design and Simulate sequential circuits using VHDL.
4. Design and Simulate State machine using VHDL.
5. Design and Simulate Traffic Light Controller using VHDL.
6. Design and simulation of combinational circuit test bench.
7. Design and Simulate ALU using Packages and user defined data type.
8. Design and Simulate Flip-flops using VHDL
9. Design and Simulate Combinational circuits using Verilog HDL
10. Design and Simulate Sequential circuits using Verilog HDL
11. Design and Simulate logic gates using Switch level modeling
12. FPGA implementation of combinational circuit using VHDL and Verilog HDL

17EC3042 SYSTEM ON CHIP DESIGN

Credits:3:0:0

Course Objectives:

- To design combinational and sequential logic networks.
- To learn optimization of power in combinational and sequential logic machines.
- To study the design principles of FPGA and PLA.
- To learn various floor planning methods for system design.

Course Outcomes:

After completion of the course, students will be able to

Understand Combinational logic function, Switch logic

- Do Power optimization, combinational and sequential logic testing
- Design system using various floor planning
- Develop a test bench for digital circuits
- Design gates using transistor level modeling
- Write Verilog programs for real time applications.

Unit I - LOGIC GATES: Introduction. Combinational Logic Functions. Static Complementary Gates. Switch Logic. Alternative Gate Circuits. Low-Power Gates. Delay Through Resistive Interconnect. Delay Through Inductive Interconnect. Objectives

Unit II - COMBINATIONAL LOGIC NETWORKS: Introduction. Standard Cell-Based Layout. Simulation. Combinational Network Delay. Logic and interconnect Design. Power Optimization. Switch Logic Networks. Combinational Logic Testing.

Unit III - SEQUENTIAL MACHINES: Introduction. Latches and Flip-Flops. Sequential Systems and Clocking Disciplines. Sequential System Design. Power Optimization. Design Validation. Sequential Testing.

Unit IV - SUBSYSTEM DESIGN: Introduction. Subsystem Design Principles. Combinational Shifters. Adders. ALUs. Multipliers. High-Density Memory. Field Programmable Gate Arrays. Programmable Logic Arrays. References. Problems.

Unit V - FLOOR-PLANNING: Introduction, Floor-planning Methods – Block Placement & Channel Definition, Global Routing, switchbox Routing, Power Distribution, Clock Distributions, Floor-planning Tips, Design Validation. Off-Chip Connections – Packages, The I/O Architecture, PAD Design.

Reference Books

1. Wayne Wolf, “Modern VLSI Design – System – on – Chip Design”, Prentice Hall, 3rd Edi tion,2008.
2. Wayne Wolf , “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008

17EC3043 RECONFIGURABLE COMPUTING

Credits:3:0:0

Course Objectives:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose the students to HDL programming , familiarize with the development environment and various placement and routing protocols
- To develop applications with FPGAs

Course Outcomes:

After completion of the course, students will be able to

- Identify the need for reconfigurable architectures
- Discuss the architecture of FPGAs
- Point out the salient features of different reconfigurable architectures
- Build basic modules using any HDL
- Develop applications using any HDL and appropriate tools
- Design and build an SoPC for a particular application

Unit I - DEVICE ARCHITECTURE: General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

Unit II - RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS: Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

Unit III - PROGRAMMING RECONFIGURABLE SYSTEMS: Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

Unit IV - MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS: The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

Unit V - APPLICATION DEVELOPMENT WITH FPGAS: Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

Reference Books:

1. Maya B. Gokhale and Paul S. Graham, “Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays”, Springer, 2005.

2. Scott Hauck and Andre Dehon (Eds.), "Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation", Elsevier / Morgan Kaufmann, 2008.
3. Christophe Bobda, "Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications", Springer, 2010.

17EC3044 IP BASED VLSI Design

Credits:3:0:0

Course Objectives:
- To learn about IC manufacturing and fabrication
- To analyse the combinational, sequential and subsystem design
- To study about different floor planning techniques and architecture design
- To have an introduction to IP design security

Course Outcomes:
After completion of the course, students will be able to
- Understand various CMOS technology, IC design techniques , IP based design and Fabrication process.
- Obtain standard cell based layout and logic testing
- Design static complementary gates and complementary gates
- Do subsystem design
- Get knowledge floor planning and architecture design
- Design security VLSI IP based protection application

Unit I - VLSI AND ITS FABRICATION: Introduction, IC manufacturing, CMOS technology, IC design techniques, IP based design, Fabrication process-Transistors, Wires and Via, Fabrication Theory reliability, Layout Design and tools.
Unit II - COMBINATIONAL LOGIC NETWORKS: Logic Gates: Combinational Logic Functions, Static Complementary Gates, Switch Logic, Alternate Gate circuits, Low power gates, Delay, Yield, Gates as IP, Combinational Logic Networks-Standard Cell based Layout, Combinational network delay, Logic and Interconnect design, Power optimization, Switch logic network, logic testing.
Unit III - SUBSYSTEM DESIGN: Sequential Machine-Latch and Flip flop, System design and Clocking, Performance analysis, power optimization, Design validation and testing; Subsystem Design-Combinational Shifter, Arithmetic Circuits, High Density memory, Image Sensors, FPGA,PLA, Buses and NoC, Data paths, Subsystems as IP.
Unit IV - FLOOR PLANNING AND ARCHITECTURE DESIGN: Floor planning-Floor planning methods, Global Interconnect, Floor plan design, Off-chip Connections Architecture Design- HDL, Register-Transfer Design, Pipelining, High Level Synthesis, Architecture for Low power, GALS systems, Architecture Testing, IP Components, Design Methodologies, Multiprocessor System-on-chip Design
Unit V - DESIGN SECURITY: IP in reuse based design, Constrained based IP protection, Protection of data and Privacy constrained based watermarking for VLSI IP based protection

Reference Books:
1. Wayne wolf, "Modern VLSI Design:IP-based Design", Pearson Education,2009.
2. Qu gang, Miodrag potkonjak, "Intellectual Property Protection in VLSI Designs: Theory and Practice", kluwer academic publishers,2003.

17EC3045 DESIGN OF SEMICONDUCTOR MEMORIES

Credits 3:0:0

Course Objective:
- To know the guidelines and design challenges in designing semiconductor memories.
- To know about the functionality of different types of memories and the methods of testing it.
- To understand the effects of radiation and reliability issues while designing application specific memories.
- To know about the advanced memory technologies.

Course Outcome:
The students will be able to
- Design the architecture of volatile and non volatile memories.

- Choose the type of memory for a specific application.
- Analyse different types of faults that occurs in memories.
- Provide solutions to test the memories.
- Illustrate various reliability and radiation effects that occur in memories.
- Comprehend the significance of technology development in memories.

Unit I - RANDOM ACCESS MEMORY TECHNOLOGIES: SRAM - Cell structures – MOS SRAM architectures **-** MOS SRAM cell and Peripheral Circuit Operation - SRAM Technologies **–** Bipolar, BiCMOS and SOI - Application Specific SRAMs - **DRAM –** Technology Development - DRAM cell theory - Advanced Cell structures - Soft error failures in DRAM - Application Specific DRAMs.
Unit II - NON VOLATILE MEMORIES: Masked Read only Memories (MROM) – Programmable ROM (PROM) – Erasable (UV) Programmable ROM (EPROM) - Floating Gate EPROM cell - One time Programmable EPROM (OTPEPROM) - Electrically Erasable PROM (EEPROM) - EEPROM Technology and Architecture - Non volatile SRAM - Flash memories - Flash Architectures.
Unit III - MEMORY FAULT MODELING AND TESTING: RAM Fault Modeling - RAM Electrical Testing – DC and AC Parametric Testing - Functional Testing – Pseudo Random Testing - Algorithms - IDDQ Fault Modeling and Testing - Application Specific Memory Testing.
Unit IV - SEMICONDUCTOR MEMORY RELIABILITY AND RADIATION EFFECTS: General Reliability Issues - RAM Failure Modes and Mechanism - Nonvolatile Memory Reliability **-** Radiation Effects: Single Event Phenomenon (SEP) - Radiation Hardening Techniques – Radiation Hardening Process and Design Issues - Radiation Hardened Memory Characteristics.
Unit V - ADVANCED MEMORY TECHNOLOGIES: Ferroelectric Random Access Memories (FRAMs) - Gallium Arsenide (GaAs) FRAMs – Analog Memories – Magneto resistive Random Access Memories (MRAMs) - Experimental Memory Devices – case study: Technology developments in semiconductor memories.

Reference Books:

1. Ashok K.Sharma, " Semiconductor Memories Technology, Testing and Reliability ", Wiley-IEEE Press, August 2002.
2. Ashok K.Sharma, “Advanced semiconductor memories –Architecture,design and applications
3. Wiley, 2002.
4. Santosh K.Kurinec and Krzysztof Iniewski, “Nanoscale Semiconductor Memories Technology and Applications”, CRC Press, Taylor & Francis Group, 2014.
5. Betty Prince, “ Emerging Memories: Technologies and trends”, Kluwer Academic publishers, 2002.
6. TegzeP.Haraszti, “CMOS Memory Circuits”, Kluwer Academic publishers, 2001.

17EC3046 HARDWARE DESIGN VERIFICATION TECHNIQUES

Credits 3:0:0

Course Objective:
- To understand the difference between verification and testing.
- To know about various verification strategies.
- To apply the verification concepts in various digital design.

Course outcome:
The students will be able to:
- differentiate between verification and testing
- understand the knowledge of writing test benches to verify circuits.
- utilize the verification plan in digital design
- analyze different types of verification levels
- perform output verification in self checking test benches
- perform verification in various digital design circuits

Unit I - FUNCTIONAL VERIFICATION APPROACHES: Functional Verification Approaches -Test bench-Importance of Verification-Formal Verification-Equivalence Checking-Model Checking- Functional Verification Approaches: Black-Box Verification White-Box Verification Grey-Box Verification-Testing Versus Verification: Scan Based Testing-Design for Verification- Verification and Design Reuse- Verification Tools: Linting Tools: Limitation of Linting Tools-Linting Verilog Source code-Linting VHDL Source code-Code Reviews.

Unit II - SIMULATORS: Simulators: Stimulus and Response-Event Driven Simulation-Cycle-based Simulation-Co-Simulators-Third Party Models: Hardware Modelers- Waveform Viewers-Code Coverage: Statement Coverage-Path Coverage-Expression Coverage-Issue Tracking: Issue-Grapevine System-The Post-It System- The Procedural System- Computerized System- Metrics :Code Related Metrics-Quality-Related Metrics-Interpreting Metrics
Unit III - VERIFICATION PLAN: Verification plan: Specifying the Verification-Defining the first-time Success- Levels of Verification: unit levels of verification -reusable components verification -ASIC and FPGA verification -System level verification-Board-level verification- Verification Strategies: Verifying the response-Random Verification- From Specification to features: Component level features-System-level features-Error Types.
Unit IV - FROM FEATURES TO TEST CASES: From features to test cases: Prioritize-Group into test cases-Design for Verification-From Test cases to test benches: Verifying Test Benches-Stimulus and Response- Simple Stimulus: Generating a Simple Waveform-Generating Synchronized Waveform-Aligning Waveforms in delta time-Generating Synchronous Delta Waveforms-Encapsulating Waveform Generation-Abstracting Waveform Generation.
Unit V - OUTPUT VERIFICATION: Output Verification –Self Checking Test Benches : Input and Output Vectors-Golden Vectors-Reusable Verification Components:eVC Reuse Requirements-eVC Architecture:DUT and eVC,BFM and Monitors-Clocks and Events-DUT Signals-Agent Details-Combining eVCs-Typical files in and eVC- Introduction to System Verilog-Verification of design using System Verilog.

Reference Books:

1. Janick Bergeron, "Writing Test Benches Functional Verification of HDL Models" Springer 2nd Edition Feb 2003.
2. Andreas Meyer, "Principles of Functional Verification" Elsevier Inc.,2004.
3. Amir Palnitkar, "Design Verification with e" Prentice Hall 1st Edition ,2003.

17EC3047 HIGH SPEED VLSI DESIGN

Credits 3:0:0

Course objective:

- To develop a fundamental understanding in the concepts of Non clocked and Clocked Logic Styles
- To know the essentials of Latching Strategies.
- To impart the knowledge in Asynchronous Clocking Techniques

Course Outcome:
The students will be able to:

- Recognize the characteristics of Non-Clocked and Clocked Logic Styles.
- Understand the knowledge of pass gate families
- Utilize the Domino logic style CMOS design
- Analyze different types of Domino logic styles.
- Analyze various Domino structures structures.
- Design and develop high speed CMOS VLSI design circuits.

Unit I - NON-CLOCKED AND CLOCKED LOGIC STYLES: Non-Clocked and Clocked Logic Styles Static CMOS Structure – DCVS Logic – Non-Clocked Pass-Gate Families – Single Rail Domino Logic Styles – Alternating-Polarity Domino Approaches – Dual-Rail Domino Structures – Latched Domino Structures – Clocked Pass-**Gate Logic.**
Unit II - CIRCUIT DESIGN MARGIN: Circuit Design Margin- Design Variability- Process Induced Variation – Design Induced Variation – Application Induced variation – Noise.
Unit III - LATCHING STRATEGIES: Latching Strategies Basic Latch Design – Latching Single-Ended Logic – Latching Differential Logic – Race Free Latches for Precharged Logic – Asynchronous Latch Techniques.
Unit IV - INTERFACE TECHNIQUES: Interface Techniques Signaling Standards – Chip-to-chip Communication Networks – ESD Protection – Driver Design Techniques – Receiver Design Techniques.
Unit V - CLOCKING STYLES: Clocking Styles Clock Jitter and Skew – Clock Generation – Clock Distribution – Single Phase Clocking – Multi Phase Clocking – Asynchronous Techniques.

Reference Books:

1. Kerry Bernstein & et.al, "High Speed CMOS Design Styles", Kluwer Academic Publishers, 2001.

2. Evan Sutherland, Bob Stroll, David Harris, “Logical Efforts, Designing Fast CMOS Circuits”, Kluwer Academic Publishers, 1999.

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17EC3048 ANALOG VLSI DESIGN

Credits: 3:0:0

Course objective:

- To develop a fundamental understanding in the concepts of device modeling.
- To know the essentials of analog systems including ADC and DAC.
- To impart the knowledge of circuit design and modeling and apply in CMOS amplifiers and Comparators.

Course Outcome:

The students will be able to:

- recognize the characteristics of MOS transistors
- understand the knowledge of circuit characteristics through device modeling
- utilize the analog design concepts in data converters
- analyze different types of amplifiers
- perform analysis in CMOS and Output amplifiers
- design and develop various CMOS amplifier and comparator and analyze the performance suing various EDA tools.

Unit I - DESIGN PROCESS FOR ANALOG INTEGRATED CIRCUITS: Design process for analog Integrated circuits-Approach to Device Modeling:MOS Models-dc MOSFET Model-Bipolar Models-dc BJT Model-Small Signal BJT Model-High Frequency BJT Model.

Unit II - ANALOG SYSTEMS: Analog Signal Processing-Digital-to-Analog Converters-Current Scaling D/A Converters-Voltage Scaling D/A Converters-Charge Scaling D/A Converters-Serial D/A Converter-Analog-to-Digital Converters-Serial A/D Converters-Successive Approximation A/D Converters-Parallel A/D Converters.

Unit III - CONTINUOUS TIME FILTERS: Continuous Time Filters- Low Pass Filters- High Pass Filters- Band Pass Filters-Switched Capacitor Circuits-Resistor Emulation-Design of a Parallel switched capacitor resistor emulation-Design of a series parallel capacitor resistor emulation- Sampling Switches: MOSFETs as Switches-Speed Considerations-Switched-Capacitor Amplifiers_ Unity-Gain Sampler/Buffer-Noninverting Amplifier-Switched Capacitor Integrator-Switched Capacitor Common Mode Feedback.

Unit IV - CMOS AMPLIFIERS CMOS Amplifiers: Active load Inverter-Performance of a current sink inverter-Push pull inverter-Differential Amplifiers: CMOS differential amplifier using a current mirror load- CMOS differential amplifier using a p-channel MOSFET-Current source load differential amplifier-Design of CMOS Differential amplifier with a current mirror load- Cascode amplifiers: Simple cascode amplifier-Design of a cascode amplifier-Current Amplifiers: Single-ended input current amplifier-Differential-input current amplifier.

Unit V - OUTPUT AMPLIFIERS: Output Amplifiers -Class A amplifiers-Design of a simple class A output stage-Push Pull common source amplifiers-High-Gain Amplifier Architectures: VCCS circuit-CCCS Circuit-CCVS Circuit-Comparators: Characterization of a comparator-Two stage open-loop comparator performance-Design of a two stage open-loop comparator-Non inverting autozeroing comparator-Inverting autozeroed comparator.

Reference Books:

1. Philip E. Allen, Douglas R. Halberg, “CMOS Analog Circuit Design”, Oxford University Press, 2nd Edition, 2003.
2. Randall L.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques for Analog and Digital Circuits”, McGraw Hill International Co, 1990.
3. BehzadRazavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2001
4. YannisTsividis, “Mixed Analog – Digital VLSI Device and Technology” World scientific publishing Co. Pvt. Ltd., 2002

17EC3049 CMOS MIXED SIGNAL CIRCUIT DESIGN

Credits: 3:1:0

Course Objectives:

- To impart knowledge on MOSFET models mixed signal design flow and data convertors.
- To analyze CMOS based switched capacitor circuits and CMOS analog circuits.
- To provide hands on using VLSI CAD tools to design and analyze mixed signal circuits.

Course Outcomes:

The students will be able to

- Acquire knowledge on the MOSFET models (nMOS and pMOS transistors)
- Design CMOS analog circuits to achieve performance specifications
- Analyze CMOS based switched capacitor circuits
- Apply VLSI CAD tools for design and analysis of mixed-signal circuits
- Synthesis on mixed-signal design flow
- Use VLSI circuits in various data convertor architectures .

Unit I - CURRENT SOURCES AND SINKS: The cascade connection, sensitivity and temperature analysis, transient response, layout of simple current mirror, matching in MOSFET mirrors, Other current Sources/Sinks.

Unit II - AMPLIFIERS: Gate drain connected loads, current sources loads, Noise and distortion.Feedback equation, properties of negative feedback and amplifer design, feedback topologies, amplifiers employing four types of feedback, Stability.The source coupled pair, the source cross coupled pair, Wide Swing differential amplifiers.Basic CMOS OPAMP Design, Operational Trans conductance amplifiers, Differential output op amp.

Unit III - NON LINEAR & SWITCHED CAPACITOR CIRCUITS: Basic CMOS Comparator Design, Adaptive Design, Analog Multipliers.Non idealities in switch capacitor, Switched capacitor architecture, Switched capacitor applications.

Unit IV - DATA CONVERTOR ARCHITECTURE & PERFORMANCE METRICS: Successive approximation ADC, Dual slope ADC, Flash ADC, Pipelined ADC, Hybrid ADC, High resolution ADC, DAC.

Unit V - FREQUENCY SYNTHESIZERS AND SYNCHRONIZATION: Basics of PLL, Analog PLL, Digital PLL, DLL. Mixed signal layout issues, interconnects and data transmission.

Reference Books:

1. CMOS Circuits Design, Layout and Simulation- Baker, Li, Boyce, 3rd edition., 2010, TMH.
2. Analog Integrated Circuit Design – David A. Johnes, Ken Martin, 1997, John & Wilney Sons.
3. Design of Analog CMOS Design- B.Razavi, MGH,2003, TMH
4. Analog MOS IC’s for signal processing – R.Gregorian, Gabor. C. Temes, John Wilney & Sons,1986.

17EC3050 VLSI CIRCUITS FOR BIOMEDICAL APPLICATIONS

Credits:3:0:0

Course Objectives:

- To impart knowledge on the basics of bio sensing units and implantable devices.
- To impart knowledge on the essentials of interface circuits.
- To design Interface circuits and CMOS VLSI circuits for bio medical applications.

Course Outcomes: The students will be able to

- Acquire knowledge on the basics of various bio sensing units
- Identify various implantable devices in bio medical applications
- Evaluate error coding techniques for wireless medical applications
- Analyze on the essentials of interface circuits
- Apply Interface circuits for implantable bio medical devices
- Design CMOS VLSI circuits for bio medical applications.

Unit I - INTRODUCTION: Circuits for Wireless Biosensing and Body Implants- Wireless Integrated Voltametric and Amperometric Biosensing.

Unit II - VISUAL CORTICAL NEUROPROSTHESIS: A SYSTEMS APPROACH: Circuits for Biomedical Implantable Devices. Towards Self-Powered Sensors and Circuits for Biomechanical Implants. RF Circuits for Wireless Medical Applications. Error-Correcting codes for In-Vivo Wireless Links.

Unit III - BIOSENSING INTERFACING CIRCUITS: Microneedles: A Solid-State Interface with the Human Body. Integrated Circuits for Neural Interfacing: Neuroelectrical Recording, Neurochemical Recording, and Neural Stimulation.
Unit IV - CIRCUITS FOR IMPLANTABLE NEURAL RECORDING AND STIMULATION: Neuromimetic Integrated Circuits. Interface Circuits for Amperometric Electrochemical Sensors. ADC Circuits for Biomedical Applications.
Unit V - CIRCUITS FOR MOLECULAR BIOLOGY: CMOS Circuit Design for Label-Free Medical Diagnostics. Silicon-Based Microfluidics for Nucleic Acid Analysis. Architectural Optimizations for Digital Microfluidic Biochips. Magnetotactic Bacteria as Functional Components in CMOS Microelectronic Systems.

Reference Books:

1. Krzysztof Iniewski**, "**VLSI Circuits for Biomedical Applications", Artech House, 2008.
2. Rahul Sarpeshkar, "Ultra Low Power Bioelectronics: Fundamentals, Biomedical Applications, and Bioinspired Systems", Cambridge University Press, 2010.
3. 3. E. Sanchez-Sinencio and A. G. Andreau "Low-voltage/Low-power Integrated Circuits and Systems ", Wiley,1998.

17EC3051 VLSI FOR WIRELESS COMMUNICATION

Credits: 3:0:0
Course Objectives:
- To impart knowledge on the design concepts of low noise amplifiers, mixers designed for wireless communication.
- To analyze and design PLL and VCO used in communication systems.
- To understand the concepts of CDMA in wireless communication.

Course Outcomes: The students will be able to
- Acquire knowledge on the basic concepts of communication.
- Analyze various mixer circuits in communication systems.
- Evaluation of gain, distortion and noise in various mixer circuits.
- Design various frequency synthesizer circuits in communication systems
- Realize various sub blocks in communication systems.
- Implement VLSI circuits in communication systems.

Unit I - COMPONENTS AND DEVICES: Classical Channel - Wireless Channel Description - Path Loss - Channel Model and Envelope Fading - Multipath Fading: Frequency Selective and Fast Fading - Non idealities and Design Parameters - Nonlinearity –Noise - Derivation of Noise Figure.
Integrated inductors, resistors, Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers.
Unit II - BALANCED MIXERS: Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer.
Unit III - SAMPLING MIXERS: Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer - Distortion in Single Ended Sampling Mixer - Intrinsic Noise in Single Ended Sampling Mixer - Extrinsic Noise in Single Ended Sampling Mixer.
Unit IV - FREQUENCY SYNTHESIZERS Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design -Example (DECT Application).
Unit V - SUB SYSTEMS & IMPLEMENTATION OF VLSI ARCHITECTURE: Data converters in communications, adaptive Filters, equalizers and transceivers. VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System- Application Example.

Reference Books:

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press, 2003.

4. Emad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design - Circuits and Systems”, Kluwer Academic Publishers, 2000.
5. Behzad Razavi, “Design of Analog CMOS Integrated Circuits” McGraw-Hill, 1999.
6. J. Crols and M. Steyaert, “CMOS Wireless Transceiver Design,” Boston, Kluwer Academic Pub., 1997.

17EC3052 DATA CONVERTERS

Credits 3:0:0

Course Objective

- To learn the various techniques & architectures of D/A Converters.
- To learn the various techniques & architectures of A/D Converters.
- To study about the S/H circuit and testing of A/D and D/A Converters

Course outcome

The students will be able to:

- recognize the characteristics of D/A converters and A/D Converters
- understand the knowledge of specifications of Data converters
- utilize the basic specifications in high speed data converters
- analyze different types of sample-and -hold amplifiers
- perform the analysis in delta sigma data converters
- design and test various A/D and D/A data converters.

Unit I - BASIC D/A AND A/D CONVERTER FUNCTION: Basic D/A and A/D converter function-Specifications of converters: Digital data coding-DC specifications: Accuracy-Nonlinearity-Offset-Temperature dependence-Supply voltage-Dynamic specifications: Signal-to-Noise Ratio-SFDR-ENOBs-Dynamic range-Required accuracy-Glitches-BER-Maximum sampling-rate-Power supply rejection ratio-Settling time-Acquisition time-Aperture time-Sample-to-hold step-Noise in sample-and -hold specifications-Figure of Merit.

Unit II - HIGH SPEED A/D CONVERTERS: High Speed A/D Converters : Design problems-Full-flash converter: Comparator input amplifier-Two-step flash converters: Twostep A/D Converter-Two-step capacitive MDAC A/D converter-Pipeline converter architecture: Single bit per stage sub-converter architecture-Multi bit pipeline converter-Sharing amplifiers in pipeline converters-High speed D/A converter architecture- Voltage weighting based architecture: Dual ladder 10-bit D/A converter-Data interleaved D/A converter

Unit III - HIGH RESOLUTION A/D CONVERTERS: High Resolution A/D Converters :Pulse width modulation D/A converters- Integrating D/A converters- Current weighting using ladder networks: R-2R ladder network-MOS only binary weighted current network-MOS R-2R implementation-Two-step current division network-MOS ladder network converter system-Weighted capacitor converter system-Monotonic by design operation: Voltage division operation-Current weighting operation-Current-to-voltage converter.

Unit IV - SAMPLE AND HOLD AMPLIFIERS: Sample and hold amplifiers: Basic Sample –and –Hold Configuration: Signal Bandwidth-Acquisition time-Aperture time accuracy-Differential sample-and-hold circuit-Sample clock bootstrapping-Integrating S/H Circuit- Switched Capacitor S/H circuit-MOS differential sample-and-hold circuit.

Unit V - SIGMA-DELTA A/D CONVERSION AND TESTING OF DATA CONVERTERS: Sigma-delta A/D conversion - General Filter Architectures: 1-bit Sigma-delta signal examples-Multi-bit Sigma-delta signal examples-Discussion of Basic Converter Architectures: First-order A/D converter-Second order A/D Converter-Multi Stage Sigma-Delta Converter (MASH)-DC Testing of D/A Converters: Temperature relations-Supply voltage dependence-Bit weight noise-Dynamic Testing of A/D Converters: Dynamic integral nonlinearity test-Spurious free dynamic range-Differential non linearity-Settling time measurement.

Reference Books:

1. Rudy van de Plassche, “CMOS Integrated Analog to Digital and Digital to Analog Converters”, Springer International Edition, Second Edition, 2007.
2. Jacob Baker. R, Harry W. Li, David E. Boyce, “CMOS Circuit Design, Layout and Simulation”, IEEE Press, Fifth Edition, 2003.
3. Randall L.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques for Analog and Digital Circuits”, McGraw Hill International Co, 1990.

17EC3053 SIGNAL INTEGRITY FOR HIGH SPEED DEVICES

Credits 3:0:0

Course Objective:

- To learn the fundamental and importance of signal integrity.
- To analyze and minimize cross talk in unbounded conductive media.
- To study about the different types of Di-Electric materials.
- To learn about differential cross talk and CMOS based transmission line model

Course Outcome:

Students will be able to

- implement signal integrity principles in the design of high speed circuits.
- analyze about electrostatics
- analyze about the different types of Di-Electric materials.
- Perform signal modal analysis
- implement ESSD protection Circuits.
- Design various high speed devices by considering the signal integrity issues suitable for various applications.

Unit I - SIGNAL INTEGRITY: The importance of signal integrity: Compting Power:Past and Future-Basics-A new realm of bus design- Electromagnetic fundamentals for signal integrity:Maxwell equations - Common vector operators: Vector-Dot Product-Cross Product-Vector and Scalar Fields-Flux-Gradient-Divergence-Curl-Wave propagations: Wave Equation-Relation between E and H and the Transverse Electromagnetic mode-Time-Harmonic Fields-Propagation of time harmonic plane Waves-

Unit II - ELECTROSTATICS: Electrostatics: Electrostatic Scalar Potential in Terms of an Electric Field-Energy in and Electric Field-Capacitance-Energy stored in a Capacitor-Magneto statics:Magnetic Vector Potential-Inductance- Energy in a Magnetic Field-Power flow and the poynting vector: time Averaged Values-Reflections of electromagnetic waves: Plane Wave incident on a perfect conductor-Palne wave Incident on a Lossless Dielectric

Unit III - MUTUAL INDUCTANCE AND CAPACITANCE: Mutual inductance and capacitance: Mutual Inductance-Mutual Capacitance-Field Solvers-Coupled wave equation: Wave Equation Revisited-Coupled Wave Equations-Coupled line analysis: Impedance and Velocity-Coupled Noise-Modal analysis: Modal Decomposition-Modal Impedance and Velocity-Reconstructing the Signal-Modal Analysis-Modal Analysis of Lossy Lines- Cross talk minimization

Unit IV - SIGNAL PROPAGATION: Signal propagation in unbounded conductive media: Propagation constant for conductive media=Skin Depth-Classic conductor model for transmission lines: DC Losses in conductors- Frequency-Dependent Resistance in Conductors - Frequency-Dependent Inductance-Power Loss in a Smooth Conductor

Unit V DI-ELECTRIC MATERIALS: Di-electric materials- Removal of common mode noise-Differential Cross talk-Virtual reference plane-Propagation of model voltages common terminology-Drawbacks of Differential signaling- Introduction- non ideal return paths-Vias-IO design consideration-Push-pull transmitter-CMOS receivers-ESSD protection circuits-On chip Termination.

Reference Books:

1. StephenHall,HowardL.Heck,“Advanced Signal Integrity for High-Speed Digital Designs”,Wiley Publishers,2009.
2. JamesEdgar Buchanan, “ Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS”,McGraw-Hill,1996

17EC3054 NANO SCALE FET

Credits: 3:0:0

Course Objective:

- To understand the concept of scaling in FET device
- To explain various nano structures, and nano materials.
- Study various types of nano scale devices.

Course Outcome:

The students will be able to:

- Understand the important of nano structures and scaling in FETs.

- Understand the concept and structure of Nano scale MOSFET and its various parameters.
- Understand the issues in scaling, interface issues in gate oxide and leakages.
- Deep understanding of compound materials and heterostructure devices.
- Understand the Novel structures such as Finfet, MODFET, MESFET etc..
- Understand various nano-structures such as SET, CNT, RTD etc..

Unit I - INTRODUCTION TO PHYSICS OF THE SOLID STATE NANO-STRUCTURES: Diversity in nanosytems-Evolving interfaces of nano structures, manipulating materials in the nano scale, Physical chemistry of solid surfaces, surface energy-electrostaic stabilize, DLVO theory-steric stabilization-Template based self-assembly of nano structures, Nano-Structures, Band theory of solids, carrier transport mechanism, Properties of Individual Nanoparticles, Metal Nanoclusters, Semiconducting Nanoparticles, Quantum Wells, Wires, And Dots

Unit II - NANO SCALE- MOSFET: Basic Concepts Of MOSFET – Capacitance-Voltage Characteristics – Threshold Voltage of MOS Capacitor – Flat-Band Voltage – Gate Oxide Charges And Transport Through Gate Oxide– Current-Voltage Relation of Long Channel MOSFETS – Drain Conductance – Transconductance – Drain Current Saturation – Body Effect – Drift- Diffusion Model – Sub-Threshold Conduction, Slope And Mobility Models in MOSFETS – Temperature Effect

Unit III - MOSFET-SCALING: MOS Scaling theory, Issues in scaling MOS transistors, Short- Channel Effects, – Charge Sharing Model – Narrow Width Effect – Channel Length Modulation – Hot Carrier Effects. Requirements for Non-classical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs High-k gate dielectrics. Integration issues of high-k. Interface states, bulk charge, band offset, stability, reliability.

Unit IV - SEMICONDUCTOR NANO-DEVICES: Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot. SOI - PDSOI and FDSOI, Ultrathin body SOI - double gate transistors. Vertical transistors - FinFET and Surround gate FET, Germanium Nano MOSFETs, Advantages of Germanium over Silicon, Compound semiconductors - material properties, Compound semiconductors, LDD MOSFET – VMOS, FAMOS – MESFET – Hetero structure MOSFETs and MODFET.

Unit V - OTHER NANOSTRUCTURES: Carbon Nano-tube, Carbon Molecules, Carbon Clusters, Fabrication, Structure, Electrical Properties, Vibrational Properties, Mechanical Properties, Applications of Carbon Nanotubes, Resonant Tunneling Transistor, Single-Electron Transistor (SET), Principle of the Single-Electron Transistor , The Coulomb Blockade, Performance of the Single-Electron Transistor, Technology, SET Circuit Design, Comparison Between FET and SET Circuit Designs**.**

Reference Books:

1. B. G. Streetman and S. Banarjee, "Solid State Electronic Devices", Prentice-Hall of India Pvt. Ltd, New Delhi, India, (1995).
2. Charles p. Poole, Frank J. O " Introduction to nano technology"Wiley Interscience , 2003.
3. Y. Taur and T. Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, 1998
4. W. Ranier, ―Nano Electronics and Information Technology‖, Wiley, (2003)

17EC3055 NANOSCALE DEVICES AND CIRCUIT DESIGN

Credits: 3:0:0

Course objective:

- To design the circuit in Nano scale level.
- Importance of Nano scale devices & it characteristics.

Course outcome:

The students will be able:

- To analyze the effects of leakage current and its control and reduction techniques in CMOS devices.
- To know the device technologies for sub 100nm CMOS.
- To comprehend the device scaling of single and multigate MOSFETs.
- To familiarize the low power design and voltage scaling issues in Nano scale devices.
- To gain knowledge on various nanoscale devices.
- To design CMOS circuit using non-classical devices.

Unit I - NANO SCALE SEMICONDUCTOR DEVICES: Leakage current mechanisms in nanoscale CMOS, leakage control and reduction techniques, process variations in devices and interconnects. Device technologies for sub 100nm CMOS: Silicidation and Cu-low k interconnects, strain silicon – biaxial stain and process induced strain; Metal-high k gate; Emerging CMOS technologies at 32nm scale and beyond – FINFETs, surround gate nanowire MOSFETs, heterostructure (III-V) and Si-Ge MOSFETs.

Unit II - MOS SCALING THEORY: Two dimensional scaling theory of single and multigate MOSFETs, generalized scale length, quantum confinement and tunneling in MOSFTEs, velocity saturation, carrier back scattering and injection velocity effects, scattering theory of MOSFETs.

Unit III - COMPOUND SEMICONDUCTOR HETERO-STRUCTURE GROWTH AND CHARACTERIZATION: Si and hetero-structure nanowire MOSFETs, carbon nanotube MOSFETs, quantum wells, quantum wires and quantum dots; Single electron transistors, resonant tunneling devices.

Unit IV - PERFORMANCE AND ISSUES OF CMOS LOGIC DESIGN: CMOS logic power and performance, voltage scaling issues; Introduction to low power design; Performance optimization for data paths.

Unit V - SEQUENTIAL CIRCITS: Statistical circuit design, variability reduction, design for manufacturing and design optimization; Sequential logic circuits, registers, timing and clock distribution, IO circuits and memory design and trends. Non-classical CMOS: CMOS circuit design using non-classical devices – FINFETs, nanowire, carbon nanotubes and tunnel devices.

Reference Books:

1. Lundstrom, M., “Nanoscale Transport: Device Physics, Modeling, and Simulation”, Springer. 2000
2. Maiti, C.K., Chattopadhyay, S. and Bera, L.K., “Strained-Si and Hetrostructure Field Effect Devices”, Taylor and Francis, 2007
3. Hanson, G.W., “Fundamentals of Nanoelectronics”, Pearson, India., 2008.
4. Wong, B.P., Mittal, A., Cao Y. and Starr, G., “Nano-CMOS Circuit and Physical Design”, Wiley, 2004
5. Lavagno, L., Scheffer, L. and Martin, G., “EDA for IC Implementation Circuit Design and Process Technology”, Taylor and Francis, 2005

17EC3056 PHOTONICS

Credits: 3:0:0

Course Objective:

- To introduce to the students the basic principles of Nanophotonics.
- To design and understand various types of photonics devices opertaions.
- To Visualize various photonics structures.

Course Outcomes:

The students will be able to:

- Acquainted with the concepts of Nanophotonics.
- Describe the effects of quantization on the optical properties of semiconductors and metals.
- Work on plasmonics based structures and its applications.
- Understand the importance of Quantum confined materials.
- Analyze the new approaches in Nano photonics.
- Visualization of photonics structures and its applications.

Unit I - INTRODUCTION: Photons and electrons: similarities and differences, freespace propagation. Confinement of photons and electrons. Propagation through a classically forbidden zone: tunneling. Localization under a periodic potential: Band gap. Cooperative effects for photons and electrons.Nanoscale optical interactions, axial and lateral nanoscopiclocalization.Nanoscale confinement of electronic interactions: Quantum confinement effects, nanoscale interaction dynamics, nanoscale electronic energy transfer. Cooperative emissions.

Unit II - QUANTUM CONFINEMENT STRUCTURES AND SUPER LATTICES: Inorganic semiconductors, quantum wells, quantum wires, quantum dots, quantum rings. Manifestation of quantum confinement: Optical properties nonlinear optical properties. Quantum confined stark effect. Dielectric confinement effect, superlattices.Core-shell quantum dots and quantum-dot-quantum wells. Quantum confined structures as Lasing media. Organic Quantum-confined structures

Unit III - PLASMONICS AND NANO-PARTICLES: Internal reflection and evanescent waves –plasmons and surface plasmon resonance –Attenuated Total reflection – Grating SPR coupling –Optical waveguide SPR coupling-SPR dependencies and materials –plasmonics and nanoparticles.

Unit IV - PHOTONIC CRYSTAL FABRICATION: Important features of photonic crystals-Presence of photonic band gap-anomalous group velocity dispersionMicrocavity-effects in Photonic Crystals-fabrication of photonic

Crystals-Dielectric mirrors and interference filtersphotonic crystal laser-PBC based LEDs-Photonic crystal fibers (PCFs)-Photonic crystal sensing.
Unit V - PHOTONIC MICROSCOPY: Near Field Optics-Aperture less near field optics-near field scanning optical microscopy (NSOM or SNOM)-SNOM based detection of plasmonic energy transport-SNOM based visualization of waveguide structures-SNOM in nanolithography-SNOM based optical data storage and recovery-generation of optical forces-optical trapping and manipulation of single molecules and cells in optical confinement-laser trapping and dissection for biological systems.

Reference Books:

1. H. Masuhara, S. Kawata and F. Tokunga, ―NanoBiophotoics", Elsevier Science, (2007).
2. B. E. A. Saleh and A. C. Teich, "Fundamentals of Photonics", John Wiley and Sons, NewYork, (1993).
3. P. N. Prasad, ―Introduction to Biophotonics", John Wiley and Sons, (2003).
4. M. Ohtsu, K. Kobayashi, T. Kawazoe and T. Yatsui, ―Principals of Nanophotonics (Optics and Optoelectronics)" University of Tokyo, Japan, (2003).
5. MotoichiOhtsu, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui and Makoto Naruse, Principles of Nanophotonics. New York, USA: CRC Press-Taylor & Francis Group, 2008.

17EC3057 ADVANCED EMBEDDED SYSTEMS

Credits: 3:0:0

Course Objective:

- To study the overview of Embedded System Architecture and characteristics of real time systems
- To focus on distributed Embedded Architecture, networks and its accessing protocols
- To understand about the design methodologies in hardware and software design.

Course Outcomes:

After completion of the course, students will be able to

- Learn about the peripherals and construct an embedded system hardware
- Develop software programs to control embedded system
- Validation and testing methodologies for embedded system
- Understands the usage of networks in embedded system
- Understands the architecture, programming, and interface requirements of a commercially 32-bit microprocessor
- Acquires clear understanding about CISC and RISC architectures

Unit I - EMBEDDED ARCHITECTURE: Embedded systems overview- processor technology – Characteristics and challenges of Embedded Computing Applications- processor and IC technology - Embedded system design process- Designing Hardware and Software Components- System Integration- Structural Description Behavioral Description- Design Example: Model Train Controller
Unit II - EMBEDDED PROCESSOR AND COMPUTING PLATFORM: Processing elements, single purpose processor design- general purpose processor design- ARM processor- processor and memory organization- Data operations- Memory organization- Data operations- Flow of Control- parallelism with instructions- CPU Bus configuration-Memory devices- Input/output devices- Component interfacing- designing with microprocessor development and debugging- Design Example : Alarm Clock.
Unit III - NETWORKS IN EMBEDDED SYSTEM: Distributed Embedded Architecture- Hardware and Software Architectures- Networks for embedded systems- I2C- CAN Bus- SHARC link ports- Ethernet- Myrinet- Internet- Network Based design- Communication Analysis- system performance Analysis -Hardware platform design-Allocation and scheduling- Design Example: Elevator Controller.
Unit IV - CHARACTERISTICS OF REAL TIME SYSTEM: Clock driven Approach- weighted round robin Approach- Priority driven Approach- Dynamic Versus Static systems- effective release times and deadlines Optimality of the Earliest deadline first (EDF) algorithm- challenges in validating timing constraints in priority driven systems- Off-line Versus On-line scheduling.
Unit V - SYSTEM DESIGN TECHNIQUES AND PERIPHERALS: Design Methodologies- Requirement Analysis- Specification System Analysis and Architecture Design- Quality Assurance- Design Example: Telephone PBX, Ink jet printer, Personal Digital Assistants, Set-top Boxes - Standard single purpose processor's peripherals Timers, Counters, Watch Dog Timers, UART, LCD Controllers, Motor controllers, ADC, RTC.

Reference Books:

1. Jonathan.W.Valvano, Embedded Microcomputer systems: Real Time Interfacing, Third edition, cengage learning,2012
2. Santanuchattopadhyay, Embedded system Design, PHI Learning Pvt. Ltd., 2010
3. Steave Heath, Embedded system Design, Second edition, 2003
4. Daniel D. Gajski, Samar. Abdi, Andreas. Gerstlauer Embedded system design: Modeling, synthesis and verification", Springer, 2009
5. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2001.
6. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/Software Introduction, Third edition, John Wiley & sons, 2010

17EC3058 WIRELESS AND OPTICAL NETWORKS

Credits: 3:0:0

Course Objectives:

- To expose the students the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.
- To introduce the students the important areas of communication networks and mainly optical networks.
- To enable the students to acquire a solid understanding of foundations of optical networks technologies, systems, networks issues as well as economic deployment considerations and also photonic switching.

Course Outcomes:

- To get a basic understanding of physical properties of optical networks.
- To get a profound understanding of optical switching methods and networking techniques, circuit, packet, hybrid, burst and flow.
- To get a basic understanding of optical components and optical node design.
- To be able to communicate, reason and creatively think about optical networks.
- To be able to design optical networks, taking both physical transmission properties and optical networking constraints into account.
- To be able to evaluate performance of optical packet switched nodes using discrete event simulation methods.

Unit I - OPTICAL SYSTEM COMPONENTS: Light propagation in optical fibers – Loss & bandwidth, System limitations, Nonlinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

Unit II - OPTICAL NETWORK ARCHITECTURES: Introduction to Optical Networks; SONET / SDH standards, Metropolitan Area Networks, Layered Architecture; Broadcast and Select Networks–Topologies for Broadcast Networks, Media Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

Unit III - WAVELENGTH ROUTING NETWORKS: The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength Assignment [RWA], Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

Unit IV - PACKET SWITCHING AND ACCESS NETWORKS: Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switchbased networks; Access Networks – Network Architecture overview, OTDM networks; Optical Access Network Architectures; Future Access Networks.

Unit V - NETWORK DESIGN AND MANAGEMENT: Transmission System Engineering – System model, Power penalty transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

Reference Books:

1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks : Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
2. Biswanath Mukherjee, "Optical Communication Networks", McGrawHill ©1997, First Edition.

3. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks : A Practical Perspective”, Harcourt Asia Pvt Ltd., Second Edition 2004.
4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.

17EC3059 VLSI DESIGN TECHNIQUES

Credits: 3:0:0

Course Objectives:

- Learn to construct CMOS logic circuits
- Understand CMOS technology, scaling, and design rules
- Characterize and design delay and power constrained CMOS circuits

Course Outcomes:

Students will be able to

- Define CMOS transistors
- Demonstrate CMOS based combinational and sequential logic
- Use layout design rules in CAD based circuits
- Examine the influence of delay, power, and size in CMOS circuits
- Design analog and digital CMOS circuits
- Appraise CMOS based ac and dc circuits for power sensitive applications

UNIT I - Introduction to CMOS circuits: MOS transistors, CMOS combinational logic gates, multiplexers, latches and flip-flops, CMOS fabrication and layout, VLSI design flow
UNIT II - MOS transistor theory: Ideal I-V and C-V characteristics, non ideal I-V effects, DC transfer characteristics, Switch level RC delay models
UNIT III - CMOS technologies: Layout design rules, CMOS process enhancement, Technology related CAD issues
UNIT IV - Circuit characterization and performance estimation: Delay estimation, Logical effort and transistor sizing, Power dissipation, Interconnect design margin, Reliability, Scaling
UNIT V - Combinational circuit design: Static CMOS, Ratioed circuits, Cascode voltage switch logic, Dynamic circuits, Pass transistor circuits

Text Books:

1. Neil H. E. Weste, D. Harris, “CMOS VLSI Design (3/e)”, Pearson, 2005
2. J.Rabey, M. Pedram,” Digital Integrated circuits (2/e)”, PHI, 2003

Reference Books:

1. D. Pucknell & K. Eshraghian, “Basic VLSI Design”, (3/e), PHI, 1996
2. Recent literature in Basics of VLSI Design techniques and trends

17EC3060 EMBEDDED SYSTEMS LABORATORY

Credits: 0:0:1

Course Objectives:

- To perform various mathematical and logical operations
- To learn interfacing of external circuits with ARM processor/Atmega microcontroller
- Expertise in Keil and Atmel studio software.

Course Outcomes:

After completion of the course, students will be able to

- Able to write Embedded C program for any applications
- Understand what is a microcontroller, microcomputer, embedded system.
- Understand key concepts of embedded systems like IO, timers, interrupts, interaction with peripheral devices
- Able to test an embedded system based on the test inputs provided
- Design and implement real time embedded systems using ARM processor and Atmega microcontroller
- Using Keil and Atmel Studio software for the project work.

List of Experiments

1. Interfacing LED using ATMEGA16

2. Interfacing LCD using ATMEGA16
3. Waveform generation (DAC) using ATMEGA16
4. ADC Interface with ATMEGA16
5. Stepper motor/DC motor interface using ARM LPC2148
6. LED/Switch interface using ARM LPC2148
7. 7segment display interfacing LED/Switch interface using ARM LPC2148

17EC3061 ADVANCED SIGNAL PROCESSING LABORATORY

Credits: 0:0:1

Course Objectives:
- To learn the power spectrum estimation methods by using Periodogram, Modified Periodogram, Barlett & Welch method.
- To study the system design (like filters) to remove the noise.

Course Outcome:
Upon completion the student will be able to
- Analyze the power spectrum of the signals.
- Design various digital filters for different applictions of signal processing.
- Develop algorithms for image processing applictions.
- Model a system to recognse the speech signals.
- Judge the practical implementation (both in haedware and software) issues

List of Experiments:
1. Power spectrum estimation
2. Multirate /Multistage System
3. Design and Realization of the adaptive filter using LMS/RLS algorithm (solved using steepest descent algorithm)
4. Quadrature mirror filter
5. DSP processor Based FIR filter design
6. DCT image compression technique

17EC3062 SCRIPTING LANGUAGES AND VERIFICATION

Credits 3:0:0
Course objective:
- To introduce various verification techniques
- To writing scripts for tool automation.
- To develop UVM testbench environment.

Course outcome:
The students will be able to:
- Understand the verification methodology of VLSI circuits.
- Develop scripts for VLSI design automation.
- Work in Testbench tools for VLSI Circuits.
- Execute Perl and TCL scripts of various applications.
- Design UVM testbench.
- Verify the logic designs for VLSI systems.

UNIT I - PERL Basics and Advanced Topics in PERL: History and Concepts of PERL - Scalar Data - Arrays and List Data - Control structures – Hashes - Basics I/O - Regular Expressions – Functions - Miscellaneous control structures - Formats. Directory access - File and Directory manipulation - Process Management - Packages and Modules.
UNIT II - TCL Basics and Advanced Topics in TCL - An Overview of TCL and Tk - Tcl Language syntax – Variables – Expressions – Lists - Control flow – procedures - Errors and exceptions - String manipulations. Accessing files- Processes. Applications - Controlling Tools - Basics of Tk.
UNIT III - System Verilog: Introduction to System Verilog – Literal values-data Types – Arrays - Data Declarations attributes-operators – expressions - procedural statements and control flow. Processes in System Verilog – Task and functions - assertions.

UNIT IV :Verification Techniques: Introduction to Verification - Testing Vs Verification - Verification Technologies – Functional Verification- Code coverage – Functional coverage. Testbench – Linear Testbench – Linear Random Testbench - Self-checking Testbench – Regression - RTL Formal Verification.
UNIT V - Universal Verification Methodology: Introduction to UVM - Verification components - Transaction level modeling - Developing reusable verification components - Using Verification components and functional coverage - Register classes.

Reference Books:

1. Larry Wall, Tom Christiansen, John Orwant, "Programming PERL", Oreilly Publications, Fourth Edition, 2012.
2. John K. Ousterhout, "Tcl and the Tk Toolkit", Addison-Wesley Publishing Company, Second Edition, 2008.
3. Ray Salmei, "The UVM Primer: A Step-by-Step Introduction to the Universal Verification Methodology" Boston Light Press; First edition, 2013.
4. Brent B. Welch and Ken Jones, "Practical Programming in Tcl and TK", Pearson Education, Fourth Edition, 2003.
5. Randal L, Schwartz Tom Phoenix, "Learning PERL", Oreilly Publications, Third Edition, 2000.
6. Christian B Spear, "SystemVerilog for Verification: A guide to learning the Testbench language features", Springer publications, Third Edition, 2012.
7. SystemVerilog 3.1 Accellera's Extensions to Verilog®, by Accellera Organization, 2003.
8. Janick Bergeron, "Writing Testbenches using SystemVerilog", Springer Science, First Edition, 2006.
9. Vanessa R. Copper, "Getting started with UVM: A Beginner's Guide", Verilab Publishing, First Edition, 2013.

17EC3063 ADVANCED DIGITAL SIGNAL PROCESSING

Credits:3:0:0

Course Objective:

- To have a good understanding of the fundamentals and applications of discrete-time signals and systems, including sampling, convolution, filtering, and discrete Fourier transforms.
- To be able to design digital filters, and perform spectral analysis on real signals using the discrete Fourier transform.
- To be familiar with some of the most important advanced signal processing techniques, including multi-rate signal processing.

Course Outcome:

- Acquire the knowledge & concepts of basic and multi-rate digital signal processing algorithms.
- Comprehends the discrete, time and frequency domain representation of real signals.
- Applies the basic concepts of time and frequency domain analysis for design of filters.
- Analyze the system representation in both time and transform domain.
- Design algorithms for practical implementation of Decimation, Interpolation and Filter banks.
- Evaluate optimal multirate signal processing structures.

Unit I - INTRODUCTION: Signals and their origin – Characterization and Classification of continuous time signals and Discrete time signals, Classification and properties of systems, Time domain characterization of DT system – Convolution – Difference equation
Unit II - DT SIGNALS IN TRANSFORM DOMAIN: Discrete Fourier Transforms (DFT) and its properties, Power and energy spectral density – Radix 2FFT, Computational advantages of FFT over DFT – Decimation in time FFT algorithm – Decimation – In Frequency FFT algorithm, Z – Transform and its properties – Inverse Z – transform.
Unit III - DESIGN OF IIR FILTERS: Block diagram Representation of digital filter – Basic IIR digital filter structures – Structure Realization – Preliminary consideration in digital filter design – Bilinear transformation
Unit IV - DESIGN OF FIR FILTERS: Basic FIR Filter Structure, Structure realization of FIR filter, FIR Filter design based on windowed Fourier series, Frequency sampling method, Equiripple linear phase FIR filter design, Window based FIR filter design Least square error FIR filter design
Unit V - MULTI – RATE DIGITAL SIGNAL PROCESSING: Mathematical description of change of sampling rate – Interpolation and Decimation – Direct digital domain approach – Decimation by an integer factor – Interpolation by an integer factor – Sampling rate conversion by a rational factor, Filter implementation for sampling rate

conversion, Direct form FIR structures, Polyphase filter structures, multistage implementation of multirate system – Application – Phase shifters – Audio sub band coding

Reference Books

1. John .G.Proakis, "Digital Signal Processing Principles, Algorithms and Applications", Addision Wesley, USA, 2006.
2. Sanjit .K. Mitra "Digital Signal Processing A Computer based approach", Tata McGraw, New Delhi, 2001. Department of Electronics and Instrumentation Engineering Page No.8-58
3. Emmanuel C.Ifeachor "Digital Signal Processing A Practical Approach", Addison– Wesley, California, 2002
4. Simon Haykin, "Signals and Systems", Wiley-India Edition, 2009 for the Introduction Chapter.

17EC3064 EMBEDDED IMAGE PROCESSING

Credits:3:0:0

Course Objective:

- To introduce the fundamentals of digital image processing
- To study the techniques for improving the quality of spoilt images and segmenting image components
- To deal with the compression of images to save storage space

Course Outcome:

- Describe different modalities and current techniques in image acquisition
- Classify how digital images are represented and stored efficiently depending on the desired quality, color depth, dynamics
- Apply the mathematical principles of digital image enhancement (contrast, gradients, noise).
- Analyze the concepts of feature detection and contour finding algorithms.
- Design and Analyze the constraints in image processing when dealing with larger data sets (efficient storage and compression schemes).
- Compare the knowledge primarily obtained by studying examples and cases in the field of biomedical imaging to other engineering disciplines.

Unit I - DIGITAL IMAGE FUNDAMENTALS: Fundamental steps in Digital Image processing-Components of an Image Processing Systems-Light and the Electromagnetic Spectrum-Examples of fields that use Digital Image Processing- Visual Perception-Image sensing and Acquisition-Image sampling and Quantization-Imaging Geometry- Basic relationships between pixels.

Unit II - IMAGE ENHANCEMENT IN SPATIAL AND FREQUENCY DOMAIN

Basic Gray Level Transformations-Histogram Processing-Arithmetic and Logic Operations- Smoothing Spatial filters- Sharpening Spatial filters-Introduction to Frequency and the Frequency Domain-Smoothing Frequency Domain Filters-Sharpening Frequency filters

Unit III - IMAGE MORPHOLOGY AND SEGMENTATION

Dilation and Erosion-Opening and Closing-Hit-or-Miss Transformation-Basic Morphological Algorithms-Detection of Discontinuities-Edge linking and Boundary detection-Thresholding-Region based Segmentation-Use of Motion in Segmentation.

Unit IV - IMAGE REPRESENTATION, DESCRIPTION AND OBJECT RECOGNITION

Representation Approaches-Boundary Descriptors: Shape Numbers, Fourier Descriptors, Statistical Moments-Regional Descriptors: Topological Descriptors-Texture: Statistical, Structural and Spectral Approaches-Relational Descriptors. Patterns and Pattern Classes-Matching-Recognition based on Decision-Theoretic Methods: Optimum Statistical Classifiers-Structural Methods: Matching Shape Numbers, String Matching, Syntactic Recognition of Strings, and Syntactic Recognition of Trees.

Unit V - IMAGE PROCESSING IN OPEN CV

Basics of PYTHON Programming Syntax and Style – Python Objects– Dictionaries – comparison with C programming on Conditionals and Loops – Files – Input and Output – Errors and Exceptions –Functions – Modules – Classes and OOP – Execution Environment- image processing functions using python

Reference Books

1. Rafael C. Gonzalez, Richard E. Woods "Digital Image Processing" Third Edition, illustrated, revised Published by Prentice Hall, 2007, ISBN 013168728X, 9780131687288

2. Pratt, W.K “Digital Image Processing, 3rd ed., John Wiley & Sons, New York, 2002.
3. Atam P.Dhawan, ‘Medical Image Analysis’, Wiley Interscience Publication, NJ, USA2003
4. Kavyan Najarian and Robert Splerstor,” Biomedical signals and Image processing”,CRC Taylor and Francis,New York,2006
5. Anil. K. Jain, ‘Fundamentals of Digital Image Processing’, Pearson education, Indian Reprint 2003

17EC3065 SOFTWARE FOR EMBEDDED SYSTEMS

Credits:3:0:0

Course Objective:

- To study the programming software used in embedded systems.
- To study the object oriented analysis and design for real time systems.
- To study the development activities of real time system using programming languages.

Course Outcome:

- Define the build process and basic need of embedded programming.
- Summarize the embedded C programming concepts for software design.
- Demonstrate the object oriented concepts for real time system design.
- Illustrate the Real Time system behaviour in UML.
- Outline the different principles for modelling the behaviour of real time systems.
- Design an embedded software based real time system for real time applications.

Unit I - LOW LEVEL PROGRAMMING IN C AND ASSEMBLY: C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

Unit II - EMBEDDED C PROGRAMMING TOOL CHAIN and HOST-TARGET SETUP: Adding Structure to ‘C’ Code, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism -Creating loop timeouts - Creating hardware timeouts, Getting embedded software into a target system.

Unit III - OBJECT ORIENTED ANALYSIS: Introduction to real time system and objects- Model based development-Object orientation with UML-UML Diagrams and Notations, Requirement analysis of Real Time system-Use cases- Filling out details of use cases- Defining object structure- Connecting the Object Model with the Use Case Model. Key Strategies for Object Identification

Unit IV - UNIFIED MODELING LANGUAGE: Object State Behaviour - UML State charts - Role of Scenarios in the Definition of Behaviour -Timing Diagrams - Sequence Diagrams - Event Hierarchies - Types and Strategies of Operations- Architectural Design in UML Concurrency Design - Representing Tasks - System Task Diagram - Concurrent State Diagrams - Threads. Mechanistic Design - Simple Patterns.

Unit V - APPLICATIONS: Multi threaded applications – assembling embedded applications – polled waiting loop and interrupt driven I/O – pre emptive kernels and shared resources - system timer-client server computing, Basics of Python Programming for embedded applications

Text Book:

1. Bruce Powel Douglas, “Real-Time UML, Second Edition: Developing Efficient Objects for Embedded Systems (The Addison-Wesley Object Technology Series)”, 2 edition (2000),Addison-Wesley.
2. Daniel W. Lewis, “Fundamentals of Embedded Software where C and Assembly meet” PHI 2002.

Reference Book:

1. Peter Coad, Edward Yourdon, “ Object Oriented Analysis, First Indian Reprint 2001
2. Simon Bennett , Steve Mcrobb, Ray Farmer, “Object Oriented Systems Analysis And Design Using Uml, Second Edition
3. Phillip A. Laplante , “Real Time Systems Design And Analysis, Third Edition Second Reprint 2001.

17EC3066 EMBEDDED LINUX

Credits:3:0:0

Course Objective:

- To expose the students to the fundamentals of Linux operating system.
- To impart the technology in embedded concept.
- To introduce the embedded implementation.

Course Outcome:

The student will be able to

- Estimate the efficiency of different types of scheduling algorithms and gain in-depth knowledge on the working of Linux systems
- Prioritise the work on Linux system and to locate additional utilities, configurations and maintenance.
- Demonstrate a working knowledge of board support package and embedded file system concepts pertaining to system administration.
- Efficiently use of embedded environment.
- Select the embedded drivers and port mapping for particular application
- Formulate the programming techniques for embedded application.

Unit I - Fundamentals of Operating Systems - Overview of operating systems – Process and threads – Processes and Programs – Programmer view of processes – OS View of processes – Threads - Scheduling – Non preemptive and preemptive scheduling – Real Time Scheduling

Unit II - Linux Fundamentals - Introduction to Linux – Basic Linux commands and concepts – Logging in - Shells - Basic text editing - Linux File System - Processes and threads in Linux - Inter process communication – Linux System calls

Unit III - Introduction to Embedded Linux - Introduction – Embedded Linux Distributions - Architecture - Linux kernel architecture - User space – linux startup sequence – GNU cross platform Tool chain.

Unit IV - Board Support Package and Embedded Storage - Inclusion of BSP in kernel build procedure - The bootloader Interface – Memory Map – Interrupt Management – PCI Subsystem – Timers – UART – Power Management –Memory Technology Device (MTD) –MTD Architecture - MTD Block and character devices – Optimizing storage space

Unit V - Embedded Drivers and Application Porting - Linux serial driver – Ethernet driver – I2C subsystem – USB gadgets – Watchdog timer – Kernel Modules – Application porting roadmap - Programming with pthreads – Operting System Porting Layer – Kernel API Driver - Case studies - RT Linux – uClinux

Reference Books

1. Dhananjay M. Dhamdhere, “Operating Systems A concept based Approach”, Tata Mcgraw-Hill, New Delhi, 2010.
2. Matthias Kalle Dalheimer, Matt Welsh, “Running Linux”, O’Reilly, U.K, 2005.
3. Mark Mitchell, Jeffrey Oldham and Alex Samuel “Advanced Linux
4. Programming” New Riders, USA, 2001.
5. P. Raghavan ,Amol Lad , Sriram Neelakandan, “Embedded Linux System Design and Development”, Auerbach Publications. London, 2016.
6. Karim Yaghmour, “Building Embedded Linux Systems”, O'Reilly, UK, 2010.
7. Daniel P.Bovet, Marco Cesati “Understanding the Linux kernel”, Shroff publishers & distributors Pvt Ltd, 2009,

17EC3067 DISTRIBUTED EMBEDDED COMPUTING

Credits:3:0:0

Course Objectives:

- To expose the students to the fundamentals of Network communication technologies.
- To teach the fundamentals of Internet
- To study on Java based Networking
- To introduce network routing Agents

Course Outcomes:

- Acquire the knowledge & concepts of internet

- Comprehends the embedded computing architecture
- Applies the concepts of web technology for embedded system.
- Analyze the real time problems and solve using embedded java programming.
- Develop webpage design for real time applications
- Evaluate mobile robotics structure

Unit I - INTERNET INFRASTRUCTURE: Broad Band Transmission facilities –OpenInterconnection standards –Local Area Networks – Wide Area Networks –Network management – Network Security – Cluster computers.
Unit II - INTERNET CONCEPTS: Capabilities and limitations of the internet -– Interfacing Internet server applications to corporate databases HTML and XML Web page design through programming and the use of active components.
Unit III - EMBEDDED JAVA: Introduction to Embedded Java and J2ME - embedded java concepts -IO streaming – Object serialization – Networking – Threading – RMI – multicasting – distributed databases –– Smart Card basics – Java card technology overview – Java card objects – Java card applets – Web Technology for Embedded Systems.
Unit IV - EMBEDDED AGENT: Introduction to the embedded agents – Embedded agent design criteria – Behaviour based, Functionality based embedded agents – Agent co-ordination mechanisms and benchmarks embedded-agent. Case study: Mobile robots.
Unit V - EMBEDDED COMPUTING ARCHITECTURE Synthesis of the information technologies of distributed embedded systems – analog/digital co-design – optimizing functional distribution in complex system design – validation and fast prototyping of multiprocessor system-on-chip – a new dynamic scheduling algorithm for real-time multiprocessor systems.

References:
1. Dietel & Dietel, "JAVA how to program", Prentice Hall 1999.
2. Sape Mullender, "Distributed Systems", Addison-Wesley, 1993.
3. George Coulouris and Jean Dollimore, "Distributed Systems – concepts and
4. design",Addison –Wesley 1988.
5. "Architecture and Design of Distributed Embedded Systems", edited by Bernd
6. Kleinjohann C-lab, Universitat Paderborn, Germany, Kluwer AcademicPub, Boston, April 2001,
7. 248 pp.
8. Wigglesworth,"Java Programming Advanced Topics,Cengage,2010
9. Mclaughlin,"Java & XML,O'reilly,2006.

17EC3068 WIRELESS AND MOBILE COMMUNICATION

Credits:3:0:0

Course Objectives:
- To expose the students to the fundamentals of wireless communication technologies.
- To teach the fundamentals of wireless mobile network protocols
- To study on wireless network topologies, network routing protocols
- To introduce the basis for classification of commercial family of wireless communication
- Technologies

Course Outcome:
- Recognize different wireless transmission
- Design simple embedded application using python programming
- describe different mobile network architectures
- develop an application with mobile network
- identify different layers in protocols
- apply wireless technology in embedded design

Unit I – INTRODUCTION: Wireless Transmission – signal propagation – Free space and two ray models – spread spectrum – Satellite Networks – Capacity Allocation – FDMA –TDMA- SDMA – DAMA
Unit II - MOBILE NETWORKS: Cellular Wireless Networks – GSM – Architecture – Protocols – Connection Establishment – Frequency Allocation – – Handover – Security – GPRA.
Unit III - WIRELESS NETWORKS: Wireless LAN – IEEE 802.11 Standard-Architecture – Services – Hiper LAN, Bluetooth

Unit IV – ROUTING: Mobile IP- SIP – DHCP – AdHoc Networks – Proactive and Reactive Routing Protocols – Multicast Routing - WSN routing – LEACH- SPIN- PEGASIS
Unit V - TRANSPORT AND APPLICATION LAYERS: TCP over Adhoc Networks – WAP – Architecture – WWW Programming Model – WDP – WTLS – WTP – WSP – WAE – WTA Architecture – WML – WML scripts.

References

1. Jochen Schiller, " Mobile communications", PHI/Pearson Education, Second Edition, 2003.
2. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks' PHI/Pearson Education, 2003
3. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004.
4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile computing", Springer, New york, 2003.
5. C.K.Toh, " AdHoc mobile wireless networks", Prentice Hall, Inc, 2002.
6. Charles E. Perkins, " Adhoc Networking", Addison-Wesley, 2001.
7. William Stallings, " Wireless communications and Networks", PHI/Pearson Education, 2002.

17EC3069 EMBEDDED OPEN SOURCE SOFTWARE

Credits:3:0:0
Course Objectives:

- Define open source software
- Identify and discuss various software licensing models
- Understand the motivation, theory, strengths and weaknesses of open source software.
- Become familiar with Linux, MySQL, PHP, Python, Apache and other Tools and technologies.

Course Outcomes:

- Recognize different terminologies in open source
- Design simple embedded application using python programming
- describe different tool syntax for programming
- develop an application with webserver technology
- identify different error and debugging techniques
- apply the concept of scheduling in embedded design

Unit I – INTRODUCTION: Open Source Terminologies: Open Source Software, Freeware, Shareware, Proprietary Software - Introduction to Open sources - Need of Open Sources - Advantages of Open Sources - Application of Open Sources. Open source operating systems: LINUX: Introduction - General Overview – Kernel Mode and user mode - Process - Advanced Concepts - Scheduling - Personalities- Cloning - Signals -Development with Linux.
Unit II - OPEN SOURCE DATABASE: MySQL: Introduction - Setting up account - Starting, terminating and writing your own SQL programs - Record selection Technology - Working with strings - Date and Time - Sorting Query Results -Generating Summary - Working with metadata - Using sequences - MySQL and Web.
Unit III - OPEN SOURCE PROGRAMMING LANGUAGES: PHP: Introduction - Programming in web environment - variables - constants - data types - operators -Statements - Functions - Arrays - OOP - String Manipulation and regular expression - File handling and data storage - PHP and SQL database - PHP and LDAP - PHP Connectivity - Sending and receiving E-mails - Debugging and error handling - Security - Templates.
Unit IV – PYTHON: Syntax and Style - Python Objects - Numbers - Sequences - Strings - Lists and Tuples - Dictionaries -Conditionals and Loops - Files - Input and Output - Errors and Exceptions - Functions - Modules -Classes and OOP - Execution Environment.
Unit V - OPEN SOURCE WEB SERVER, TOOLS AND TECHNOLOGIES: General Overview of Web Server - Case Study: Apache Web server - Working with Web Server - Configuring and using Apache Web services - Case Study: Apache Tomcat - Open Source IDE - Modeling Tools - Mozilla Firefox - Wikipedia - Eclipse.

References:

1. Remy Card, Eric Dumas and Frank Mevel, "The Linux Kernel Book", Wiley Publications, 2003
2. Steve Suchring, "MySQL Bible", John Wiley, 2002
3. Rasmus Lerdorf and Levin Tatroe, "Programming PHP", O'Reilly, 2002
4. Wesley J. Chun, "Core Phython Programming", Prentice Hall, 2001

5. Martin C. Brown, “Perl: The Complete Reference”, 2nd Edition, Tata McGraw-HillPublishing Company Limited, Indian Reprint 2009.
6. Steven Holzner, “PHP: The Complete Reference”, 2nd Edition, Tata McGraw-HillPublishing Company Limited, Indian Reprint 2009.
7. Vikram Vaswani, “MYSQL: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
8. Vivek Chopra, Sing Li, Jeff genender, “Professional Apache Tomcat 6”, Wiley India, 2007

17EC3070 ELECTRONIC PRODUCT DESIGN

Credits :3:0:0

Course Objectives:

- To expose the students to the fundamentals of product development process.
- To teach the fundamentals of system design
- To study on electronic packaging, quality in design process

Course Outcome:

- Recognize different terminologies in product development process.
- Design simple embedded application using python programming
- describe concepts in system design
- develop an electronic portable product
- identify different packaging available for electronic products
- apply concept of quality control in embedded design products

Unit I - INTRODUCTION: The basic product development process-product planning-design and engineering-procurement manufacturing -functionality-performance-user interface-form factor- battery life- cost- time to market (TTM)- reliability marketing and distribution-service and support.
Unit II - SYSTEM DESIGN: Top down design-product concept-innovation-creativity- validation -communication-product requirements system architecture development-trade-off analysis-cost modeling-circuit design-physical and mechanical design-Tolerance
and reliability.
Unit III - ELECTRONIC PACKAGING: IC packaging: Leaded package, TABITCP package-COB, flip-chip, BGA, CSP-Discrete components-Board to board connectors-substrates-Escape routing-PCA/module design metrics-Electronic packaging metrics- I/O hardware : buttons, switches, dials and touch screens, speakers , microphones, antennas, and external connectors.
Unit IV - MECHANICAL DESIGN : Housings-EMI shielding-Thermal management: High level thermal analysis, thermal issues in notebook computers-mechanical integration-DFMA analysis.
QUALITY IN THE DESIGN PROCESS: Quality control -quality assurance-quality functional deployment-assignment matrices checklist- quality in the design process-concurrent design-risk analysis-quality in production.
Unit V - PORTABLE ELECTRONICS: Digital and analog processing: microprocessor, logic devices, microcontrollers, DSP, analog devices, sensors, wireless communication, system memory and mass storage-Displays: Display technologies-LCD-micro display-pen input-power sources- Battery technologies: Ni-Cd, alkaline, Ni-MH ,lithium ion, lithium polymer, photovoltaic cells, fuel cells-product implementation-high level power analysis-Case study**:** Cellular phones-portable PCs-Personal digital assistants-digital imaging products.

References:

1. Tony Ward and James Angus, ”Electronic Product Design”, Chapman and Hall publications,1996.
2. Bert Haskell, “ Portable Electronics Product Design and Development: For Cellular Phones, PDAs, Digital Cameras, Personal Electronics and More”, McGraw-HILL, 2004.

17EC3071 EMBEDDED SYSTEM NETWORKS

Credits:3:0:0

Course Objectives

- To expose the students to the fundamentals of CAN bus
- To teach the fundamentals of embedded security
- To study on protocols for embedded systems

Course Outcome

- recall the concept of bus access and arbitration
- Design simple embedded application using python programming
- describe concepts in can physical layer
- analyze various embedded security systems.
- identify an embedded application with networks
- apply embedded client-server mechanism in embedded design

Unit I - THE CAN BUS: Introduction – Concepts of Bus Access and Arbitration – Error Processing and Management – Definition of the CAN Protocol ISO 11898-1 – Error Properties, Detection and Processing – Framing.

Unit II - THE CAN PHYSICAL LAYER:
Introduction – Signal Propagation – Bit Synchronization – Network Speed and Range – High Speed CAN – Low Speed CAN – CAN Components – Event-Triggered and Time-Triggered Protocols - CAN Applications**:** Application Layers and Development Tools for CAN

Unit III - USB: Introduction **–** Types of USB Transfers: Control Transfer – Bulk Transfer – Interrupt Transfer – Isochronous Transfer – Introduction to the Enumeration Process – Introduction to USB Development Tools

Unit IV - EMBEDDED SECURITY: Introduction – Access Control and Origins of Security Theory – Introduction to Cryptography, Data Integration and Authentication – Networked Embedded Systems and Resource Constraints – Embedded Security Design

Unit V - TCP/IP FOR EMBEDDED SYSTEMS: Introduction – Embedded SMTP Client – Embedded SMTP Server – Case Studies: IP Security Camera – Vending Machine – Internet Radio – Ethernet Gateway

References:

1. Dominique Paret, “Multiplexed Networks for Embedded Systems”, Wiley, 2007
2. Timothy Stapko, “Practical Embedded Security”, Elsevier, 2008
3. John Hyde, “USB Design by Example”, Intel University Press, 2001
4. Jan, Axelson, “USB Complete”, Lake View Research, 2005
5. Edward Insam, “TCP/IP Embedded Internet Applications”, Elsevier, 2003
6. Tim Jones, “TCP/IP Application Layer Protocols for Embedded Systems”, Charles River Media, 2002.

17EC3072 SPEECH AND AUDIO SIGNAL PROCESSING

Credits 3:0:0

Course objectives:

- To study the analysis of various M-band filter banks for audio coding
- To learn various transform coders for audio coding.
- To study the speech processing methods in time and frequency domain

Course outcomes :

At the end of the course, the students will be able to:

- Describe the mechanics of speech and audio
- Analyze the quality measurement of speech
- Employ filter banks for coders
- Familiarize with time and frequency domain in codeing
- Distinguish various transform coders in speech
- Adopt speech processing methods for practical applications

Unit I - MECHANICS OF SPEECH AND AUDIO: Introduction - Review Of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non simultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

Unit II - TIME-FREQUENCY ANALYSIS: Introduction -Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree- Structured QMF and CQF M-band Banks - Cosine Modulated “Pseudo QMF” M-band Banks - Cosine

Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Preecho Control Strategies.
Unit III - AUDIO CODING AND TRANSFORM CODERS: Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4Audio Coding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.
Unit IV - TIME AND FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING: Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods
Unit V - LINEAR PREDICTIVE ANALYSIS OF SPEECH: Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP

References:

1. Digital Audio Signal Processing, Second Edition, UdoZölzer, A John Wiley& sons Ltd Publications,2008
2. Applications of Digital Signal Processing to Audio and Acoustics, Mark Kahrs, Karlheinz Brandenburg, Kluwer Academic Publishers New York, Boston, Dordrecht, London , Moscow,2002
3. Digital Processing of Speech signals – L.R.Rabiner and R.W.Schaffer - Prentice Hall –1978

17EC3073 BIOLOGICAL SIGNAL PROCESSING

Credits 3:0:0

Course objectives:
- To introduce the characteristics of different biosignals
- To discuss linear and non-linear filtering techniques to extract desired information
- To introduce techniques for automated classification and decision making to aid diagnosis

Course outcomes:
- Analyze signals in time series domain & estimate the spectrum
- Understand the significance of wavelet detection applied in biosignal processing.
- Extract the features using multivariate component analysis.
- Apply the classification techniques in biological signals
- Relate neural network with bio signals
- Describe prediction models for bio signal analysis

Unit I - INTRODUCTION: Signal, System and Spectrum Characteristics of dynamic biomedical signals, cross-spectral density and coherence function.
UNIT II - TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION: Cepstrum and homomorphism filtering.Linear prediction models, Application in Heart rate variability
UNIT III - TIME FREQUENCY AND MULTIVARIATE ANALYSIS: PCG signals, Biosignal Classification and Recognition ,Time frequency representation, spectrogram
UNIT IV - ANALYSIS: Wavelet analysis – Data reduction techniques, Multivariate component analysis,
UNIT V - CLASSIFICATION: Back propagation, neural network based classification.

References:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, 'Biomedical Signal Analysis-A case study approach', Wiley-Interscience/IEEE Press, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, 'Digital Signal processing- A Practical Approach' Pearson education Ltd., 2002
5. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000

17EC3074 MEDICAL IMAGE PROCESSING

Credits 3:0:0

Courseobjectives:

- To understand 2D and 3D image reconstruction techniques.
- To gain sound knowledge about CT, MRI, nuclear and ultrasound imaging.
- To realize the factors those affect the quality of medical images**.**

CourseOutcomes:

The students will be able to

- analyze the physiological events associated with the human system.
- describe the influences of artifacts in image quality
- identification of new developments in health care system
- employ reconstruction and segmentation algorithms
- interpret medical imaging devices
- relate the concepts with its practical uses.

Unit I - INTRODUCTION: Acquisition of Images, rectilinear scanner, Emission computed Tomography multiple crystal scintillation cameras, Image Reconstruction from Projections in Two dimensions, Radon Transform, Projection Theorem

Unit II - MEDICAL IMAGING DEVICES: Xrays – film, digital, C-arm, Iso-Carm, Fluoroscopy, CT, MRI and protocols, Functional imaging: fMRI, SPECT, PET,Image quality Digital fluoroscopy, cinefluorography.

Unit III - IMAGING RECONSTRUCTION ALGORITHMS: Magnetic Resonance Imaging and Spectroscopy-Fundamentals - tissue contrast in MRI – angiography, spectrography. Ultra sound, Neuro magnetic Imaging, Quality control, Origin of Doppler shift – Limitations of Doppler systems

Unit IV - SEGMENTATION METHODS: Manual methods, Thresholding and classification - Non-parametric optimal thresholding- Parametric optimal thresholding- Minimum distance methods- Maximum likelihood methods- Edge-based techniques

Unit V - IMAGE FUSION: Basics of registration - Rigid registration techniques- Deformable registration techniques-Uses

References:

1. William R. Hendee, E. Russell Ritenour, "Medical Imaging Physics":A John Wiley & sons, Inc., Publication, Fourth Edition 2002.
2. Geoff Dougherty, "Medical Image Processing: Techniques and Applications", Springer,2011.
3. Z.H. Cho., J-oie, P. Jones and Manbir Singh, "Foundations of Medical Imaging", John Wiley and sons,1993.
4. Avinash C. Kak, Malcolm Shaney, Principles of Computerized Tomographic Imaging,IEEE Press, Newyork-1998.

17EC3075 VLSI DIGITAL SIGNAL PROCESSING

Credits 3:0:0

Course Objectives:

- To integrates VLSI architecture theory and algorithms.
- To address various architectures at the implementation level, and presents several approaches to analysis, estimation, and reduction of power consumption.
- To explain how to design high-speed, low-area, and low-power VLSI systems for broad range of DSP applications.

Course outcomes:

At the end of the course, students will be able to:

- apply several optimization techniques to improve implementations of DSP algorithms.
- optimize design in terms of area, speed and power
- incorporate pipeline based architectures in the design.
- modify the existing or new DSP architectures suitable for VLSI for high speed networks

- design new DSP architectures for low area applications
- analyze VLSI architectures

Unit I - Iteration Bound & Pipelining / Parallel Processing: Introduction to DSP systems- representations of DSP Algorithms- loop bound and iteration bound- algorithms for computing iteration bound- iteration bound for MRDFG- pipelining and parallel processing of FIR filters- pipelining and parallel processing for low power applications.
Unit II - Retiming & Unfolding: Definition and properties of retiming -solving system inequalities- retiming techniquesalgorithm and properties of unfolding -applications-Algorithmic strength reduction in filters and transforms- parallel FIR filters- fast FIR algorithms.
Unit III - Systolic Array & Fast Convolution Algorithm: Design Methodology- FIR systolic Arrays- Selection of Scheduling Vector- Cook-Toom Algorithm-Winograd Algorithm- Iterated Convolution – Cyclic Convolution-
Unit IV - Scaling And Round Off Noise: State Variable Description of digital filters- Scaling and roundoff noise computation- Bit level arithmetic architectures- parallel multipliers- bit serial multipliers- Canonic Signed Digit Arithmetic- distributed arithmetic
Unit V - Numerical Strength Reducing Techniques: Redundant Arithmetic- Redundant Number Representations-Carry Free Radix-2 Addition And Subtraction-Hybrid Radix 4 Addition- Data Format Conversion- Redundant To Nonredundant Converter- Subexpression Elimination- Multiple Constant Multiplication- Subexpression Sharing In Digital Filters- Additive and Multiplicative Number Splitting- Synchronous Pipeling And Clocking Styles-Wave Pipelining- Asynchronous Pipeling- Signal Transition Graphs.

References

1. Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and implementation", Wiley, Interscience, 2007.
2. U. Meyer Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004.
3. Mohammed Isamail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994
4. Jose E. France, YannisTsividis,"Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
5. S.Y.Kuang, H.J. White house, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall,1995.

17EC3076 ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING

Credits 3:0:0

Courseobjectives:

- To study about the aspects of clinical engineering
- To study about the various aspects of electronics used in hospitals
- Know the importance of calibration of medical devices

Course outcomes:

The students will be have the

- ability to specify the type of networking facility to be provided in the hospital
- capability to identify the electromagnetic effects on medical devices
- make the devices electromagnetically compatible
- ability to specify the type of optic sensor for physiological measurement
- analyze medical standards related to devices
- apply the concepts in medicine

Unit I - Medical standards and recalibration: Need for Standardization, Hospital design, Hospital safetyRegulations, Management and Legal aspects.
Unit II - Network topologies: LAN components,network operating system,planning and installing LAN in hospital set up-Fibre
Unit III - Sensors in hospital management: Optic Sensors for Measuring Physiological Parameters – Application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities- principles of smart sensors.

Unit IV - EMI and EMC: EMI and EMC Applied to Hospital Equipment's- Techniques and methods adopted for testing in hospitals.
Unit V - Virtual Reality Application: Human Factorsand Human Perception, Computer graphics principles used in VR,Existing tools Tracking- Applications of Virtual Reality in Medicine

References:

1. Syed Amin Tabish "Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001
2. Jacob Kline, "Handbook of Biomedical Engineering", Academe press INC ,Sandiego 1981.
3. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech House 3rd Edition, 1986.
4. Eric Udd, "Fibre Optic Sensors and Introduction for engineers and scientists",WileyInterscience Publication, New Delhi, 1991.
5. SK Basandia, Local Area Network,Golgotia Publishing Pvt. Ltd., New Delhi, 1995
6. R.C.Goyal,'Hospital administration and human resource management', 4th edition, Prentice Hall of India, New Delhi, 2006.

17EC3077COMPUTER BASED MEDICAL INSTRUMENTATION

Credits 3:0:0

Courseobjectives:

- To teach PC hardware and its related interfacing
- To understand the basics of computerized data acquisition and programming.
- To provide knowledge about biometrics and network security

Courseoutcomes:

The students will have knowledge on

- Understand hardware behind data acquisition
- Analyze the scope of virtual reality in health care
- Develop an insight knowledge about the biometrics
- apply the features of network security
- evaluate computer based medical equipments
- compare and contrast with the traditional techniques

Unit I - Computer Architecture overview: Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply (BIOS, DOS) interaction, Functional and Architecture Block diagram of a PC, Processors and Memory.
Unit II - Processors: 80X86 Processors, Architectures and Memory management,Peripheral Interfacing and Controllers
Unit III - Memory: RAM ,SDRAM and RDRAM, Cache memory,ROM and its types, Flash memory, I/O slots,Serial andParallel ports,USB, FireWire port.
Unit IV - Computerised Data Acquisition: Programming - in C, DSP in Medical applications, CAD In Medical Instrumentation - FPGA Design Logics, Instrumentation in LAB view, Multisim Simulation with bio amplifiers
Unit V - Applications: Mixed signal SoC applications in biomedical applications

References:

1. RamachandraLele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005 19
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005

17EC3078 MEDICAL SIGNAL PROCESSING

Credits: 3:0:0

Course Objective

- To introduce the basic concepts of Bio signal Processing
- To learn about the filtering techniques used in Medical Signal Processing
- To understand the Applications of Signal Processing for Diagnosis.

Course Outcome:

- Classify the nature of Bio signals and their Electrical Characteristics.
- Analyze the Bio Signal Processing Techniques and Pattern Recognition
- Illustrate the Techniques for Data Compression
- Design Digital Filters for Biomedical Applications
- Choose suitable algorithms for Signal Processing and Analysis
- Develop systems for Biosignal Acquisition and Analysis

Unit I - Introduction to biomedical signals & processing techniques: Origin, nature and acquisition of bio-signals Examples of biomedical signals-EEG, EMG,ECG, VMG, VAG, evoked potentials, Event Related Potentials, Speech Signal, Bioacoustic signals - Sampling and aliasing , Signal reconstruction, Signal conversion systems, convolution - Correlation - , FFT -decimation in time algorithm, Decimation in Frequency algorithm

Unit II - Analysis of Biosignals : Cardiological Signal Processing - Methods in Recording ECG , Waves and Intervals of ECG - ECG Data Acquisition , ECG Parameters and Their Estimation - ECG QRS Detection Technique - Template Matching Technique - Differentiation Based QRS Detection Technique - Simple QRS width Detection Algorithm - High Speed QRS detection Algorithm - Estimation of R-R Interval - Estimation of ST Segment - Analysis of PCG signal - Analysis of EMG signal and EEG Signal

Unit III - Filtering and Noise Cancellation: Random Noise, Structured Noise, and Physiological NoiseTime domain filtering – Synchronous averaging, Moving average filters, Frequency domain filters – Design of Butterworth filters- optimal filtering, Adaptive noise cancellation-LMS and RLS algorithms in adaptive filtering – Application: Motion Artifacts in ECG, Powerline Interference in ECG, Maternal Interference in ECG

Unit IV - Data Reduction Techniques: Data Reduction Techniques - Data Compression , Need for Data Compression -Direct Data Compression Techniques - Tolerance Comparison Compression - Polynomial Predictors - zero order predictor, Run Length Coding - First Order Predictor - Zero Order Interpolator - First Order Interpolator - Direct ECG Data compression Techniques by Turning Point Algorithm - Peak Picking Compression and Cycle to Cycle compression

Unit V - Application : Adaptive Segmentation of ECG and PCG signals - Time varying analysis of heart rate variability - Detection of Coronary Artery Disease - Analysis of Ectopic ECG beats

Reference Books:

1. RangarajM.Rangayyan, Biomedical signal analysis, John Wiley &Sons.Inc. 2002
2. Monson H.Hayes ,Statistical Digital signal processing, John Wiley &Sons.Inc 1996
3. Arnon Cohen, Biomedical Signal Processing Vol I and II, CRC Press Inc., Boca Ralon, Florida, 1988.
4. Biomedical Signal Processing: Principles and Techniques, D.C.Reddy, Tata McGraw-Hill Education, Third reprint 2007.
5. Sanjit K.Mitra "Digital Signal Processing", A Computer Based Approach", Tata McGraw-Hill, New Delhi, fourth edition 2011.
6. John G. Proakis and Dimitris G.Manolakis, "Digital SignalProcessing, Algorithms and Applications", PHI of India Ltd., New Delhi, fourth Edition, 2007.

17MT2001 TECHNICAL WRITING FOR ELECTRONIC MEDIA

Credits: 3:0:0

Course objective:

- To define the basics of Script writing and apply them in creative productions.
- To construct effective scripts that will comply to the stringent norms of the media industry
- To breakdown scripts of productions that have impacted the audience over the years.

Course outcome:
The students will be able to:

- Identify different types of scripts based on genre.
- Infer meanings and terminologies used in script.
- Apply story writing and scripting skills to their own productions
- Illustrate their ideas through storyboards
- Develop shooting scripts and compose shots and angles creatively
- Interpret the emotions that are being conveyed through choice of colors, lights and angles.

Unit I - Introduction- questions to ask before writing the script- Visual treatment - Script - Three act structure- Building your story - Maintaining suspense - Confrontation - Resolution
Unit II - Lyric writing - Music composing - Finding inspiration - Good practices for music production - Listening
Unit III - Adapting for screen - Narration - Dialogues - Character development - Storyboards - Lighting - Color theory - Props - Sets - Identifying sponsors - Producers
Unit IV - Basic Camera shots - Basic Camera Angles - Basic Camera Movements - Single camera production - Multi camera production - Indoor production - Outdoor production - Film - Digital technology
Unit V - Legal issues - permissions - Casting - Hiring - Insurance - Safety - Fire hazards - Storage - Scheduling - Location scouting - Transport -

Text Book

1. Syd Field, "Screenplay- The foundation of screenwriting", Edition 1, Dell Publishing Company, 1979.
2. David Trottier, "The Screenwriter's Bible: A Complete Guide to Writing, Formatting, and Selling Your Script", Edition1 , Silman-James Press, 2005.

Reference Books

1. Steven Katz "Film Directing: Cinematic Motion " Focal Press publishers, 2004.
2. Antony Friedman "Writing for media" ,Focal press, 2006.
3. Blain Brown "Cinematography- Theory and Practice" - Focal Press
4. Paul Wheeler , "Digital Cinematography", Focal Press, 2001

17MT2002 DIGITAL COMPOSITING

Credits: 3:1:0

Course objective:

- To understand the basic working of the human perception system and camera parameters to better do compositing.
- To examine the various tools of compositing and choose the right tool for the application.
- Help the student visualize and comprehend the current state of the VFX industry.

Course outcome:
The students will be able to:

- Make better choices when making technical and creative decisions using the understanding of human perception and camera parameters.
- Manipulate image data using mathematical formulae to obtain the required result.
- Compare the feature set available in various software and select the optimal set required.
- Stabilize and get measureable data from images for use in Post Production.
- Separate foreground and background and reconstruct the image using another background.
- Compose a realistic image from various 2D and 3D source elements.

Unit I - Introduction: History and Evolution of Compositing, Basics of Human perception, Camera Basics, Digital representation of visual information - Image Generation, Pixels, Components, Channels, Spatial Resolution, HDRI, Colour Models, Colour Management.
Unit II - Manipulations: Basic Image Manipulations using single and multi operators, Spatial filters and working, Geometric transformations, Expression Language, Masks, Pre-multiplied images, Morphing, Motion Blur.
Unit III - Standards: Analog and Digital Film formats – Analog and Digital Television Formats- Aspect Ratio and Format Conversion Pipeline, UI, Dope Sheet, Curve editor.

Unit IV - Rotoscopy, Automated keying techniques- Luma, Chroma, Difference keying, Keylight, Primatte, Ultimatte, Matte Backgrounds, Retiming techniques-optical flow analysis - Image tracking and stabilization-Camera Tracking, Lighting parameters, Camera Parameters.
Unit V - Interactive Color and lighting, Light wrapping, Relighting, Shadows, digital color matching, spill suppression, Atmosphere, camera characteristics, Digital Intermediary, Matching Film Grain and sensor Noise, Multi-pass Compositing, Deep Compositing, Stereoscopy, Focus.

Text Book

1. Ron Brinkmann, The Art and Science of Digital Compositing, second edition, Morgan Kaufmann, 2008.
2. Ron Ganbar, "Nuke 101: Professional Compositing and Visual Effects", First Edition, Peachpit Press, 2011.

Reference Books

1. Steve Wright, Digital Compositing for Film and Video, Focal Press, 2006
2. Dough Kelly, Digital Composting in-Depth, Coriolis, 2000.

17MT2003 AUDIO ENGINEERING

Credits: 3:0:0
Course objective:

- To develop a theoretical and practical understanding of the fundamentals of audio engineering
- To enhance problem solving skills in the field of audio engineering.
- To develop practical and creative approaches to setup Live Sound/ Studio Recording.

Course outcome:
The students will be able to:

- Identify different audio equipments in a signal chain.
- Review audio equipments available currently.
- Demonstrate skills to use industry standard audio products.
- Analyze the specifications of particular audio equipment.
- Visualize and develop a complete signal chain for a Live Sound Reinforcement/ Studio Production.
- Estimate the cost incurred in Live Sound/ Studio setup.

Unit I - Simple Harmonic Motion and the sine wave, Sound in Media, Wavelength and Frequency, Complex Waves, Octaves, Spectrum, Electrical, Mechanical and Acoustical Analogs, Sound Levels and the Decibels, Sound in the Free Field, The Perception of Sound, Signals, Speech, Music and Noise.
Unit II - Microphone Fundamentals, Classification of Microphones, Dynamic Microphones, Condenser Microphones, Special Purpose Microphones, Different Microphones Specifications, Miking Techniques, Application Information/ Accessories, Microphone Selection.
Unit III - Methods of Acoustic Transduction, Low frequency drivers and enclosures, High frequency drivers and horns, Crossovers, Loudspeaker Specification, Amplifier Power rating, Frequency response and Power bandwidth, Slew rate, THD and Bridged operation, Considerations in choosing an Amplifier, Matching Amplifier and loudspeaker.
Unit IV - Split line and Inline Mixers, Mixing Console, Understanding analog console specification, Signal Processors: General Discussion, Dynamic range processors, Equalizers and filters, Application – Mixers, Application – Signal Processors.
Unit V - Analog and Digital Information, Analog to Digital Conversion, Digital to Analog conversion, Basic MIDI principles, MIDI messages, MIDI control

Text Book

1. F.Alton Everest, Ken C Pohlmann, "Master Handbook of Acoustics", McGraw Hill, Sixth Edition, 2015.
2. Francis Rumsey, "Desktop Audio Technology", Elseiver, 1st edition, 2004.
3. Gary Davis, Ralph Jones, "YAMAHA LSR Handbook", 2nd Edition, 1990.

Reference Books

1. Stanley R. ALten, Audio in Media, Wadsworth, 2005.
2. Michael Talbot-Smith, Sound Engineering Explained, Focal Press, 2002.
3. IAN R. SINCLAIR, Audio and Hi-Fi Handbook, Newnes, 1998.
4. Zach Price, "Beginners guide to Computer based Music Production", 2004.
5. Jay Rose, "Audio Post Production for Digital Audio", 2002.

17MT2004 AUDIO ENGINEERING AND PRODUCTION LAB

Credits: 0:0:2
Co-requisite: 17MT2003 - Audio Engineering

Course objective:

- To learn the skills to rightly handle various audio equipments used in the studio.
- To learn the art of recording quality sound using appropriate audio equipments.
- To learn how to playback and edit a particular audio recorded using DAW.

Course outcome:
The students will be able to:

- Choose the right microphones for a specific type of recording.
- Demonstrate skills to handle and use audio equipments in the right way.
- Experiment with different miking techniques.
- Inspect the signal flow in a studio or Live Sound installations.
- Modify the different characteristics of a recorded audio.
- Evaluate the quality of a recorded audio.

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester

17MT2005 GRAPHICS AND ANIMATION

Credits: 3:0:0

Course objective:

- To understand the basic working and the technical concepts of the graphical system
- To examine the various geometrical transformations
- Help the student visualize and comprehend the graphic tools to create two dimensional computer animation.

Course outcome:
The students will be able to:

- Outline the two dimensional graphic production process
- Classify the various algorithms for generating graphical components
- Demonstrate skills to use industry standard graphical productions.
- Experiment with different light sources based on visible surface determination
- Setup an graphical production.
- Discriminate two and three dimensional graphical production.

Unit I - Basic Principles of Two Dimension Graphics: Raster versus vector graphics- Basic geometric objects-Geometric transformations-Homogenous coordinates- Applications of transformations-Geometric transformations in java 2D-Animation and movements based on transformations- Interpolators for continuous changes- implementations of interpolators in Java 2D-Single or double precision
Unit II - Drawing lines and curves: Lines and pixel graphics-The midpoint algorithm for lines- Structural algorithms-Pixel densities and line styles-Line clipping-Midpoint algorithm for circles- Drawing arbitrary curves- Antialiasing- Drawing thick lines-Filling areas-Buffered images in java 2D-Displaying text-Text in java 2D-Grey images and intensities-Colour Model-Colour Interpolation with java 2D.
Unit III - Basic Principles of Three-Dimensional Graphics: Geometric transformations-The scenegraph- Elementary geometric objects in java 3D-The scenegraph in java 3DAnimations and moving objects- Projections in Java 3D-Modelling Three dimensional objects-Three Dimensional objects and their surfaces-Topological notions-Modelling techniques-Surface Modeling with polygons in java 3D-importing geometric objects in to java3D-Parametric curves and freedom surfacesnormal vectors for surfaces
Unit IV - Visible Surface Determination: Clipping volumes- Algorithms for visible surface determination- Image precision techniques-Priority algorithms- Illumination and shading- Light sources- Light sources in java 3D-Reflection- Shading in java 3D- Shading- Shadows- Transparency- Textures- Textures in java 3D- The radiosity model- Ray tracing.

Unit V - Special Effects and Virtual Reality: Fog and particle systems- Fog in Java 3D- Dynamic surfaces- Interaction-Interaction in Java 3D-Collision detection-Collision detention in Java 3DSound effects-Sound effects in Java 3D- stereoscopic viewing

Text Book

1. Frank Klawonn, Introduction to Computer Graphics Using Java 2D and 3D, Springer, 2008.

Reference Books

1. Rick Parent, Computer Animation Algorithms and Techniques, Morgan Kaufmann publishers, 2002.
2. F.S.Hill,jr ,Computer graphics using Open GL,Prentice Hall of India,2006.
3. Peter Shirley, et al, Fundaments of Computer Graphics, AK Peters Ltd, 2005.
4. Issac Victor Kerlow, The Art of 3D Computer Animation and Effects, John Wiley, 2004.

17MT2006 GRAPHICS AND ANIMATION LAB

Credits:0:0:2

Co-requisite: 17MT2005 GRAPHICS AND ANIMATION

Course objective:

- The course provides knowledge on two dimensional graphical animations
- This course helps students to analyze the project and use various animation techniques.
- The course helps students to upgrade and equip with latest trends in two dimensional animation.

Course outcome:

The students will be able to:

- Define basics concepts of two dimensional animation.
- Classify the different types of animation.
- Demonstrate their understanding of frame by frame and interpolation based animations.
- Experiment with the geometrical transformations in two dimension
- Reconstruct complex character animation movements
- Interpret the pose set into realistic character movements through various interfacing techniques.

Course Description:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2007 WEB DESIGNING

Credits: 3:0:0

Course objective:

- To understand and use HTML tags for designing web pages.
- To learn Java-script for developing dynamic pages.

Course outcome:

The students will be able to:

- To evaluate the basic and advanced features in Server side scripting.
- Create a complete webpage with responsive feature
- Experiment about HTML programming and designing a web page
- To practice basic web pages using HTML, HTML5 and CSS.
- To Recognize the JavaScript program as an aid for web design.
- To reproduce the unique design problems involved in web design.

Unit I - HTML: Introduction – Editors – Basic structure – Elements – Attributes – Headings – Paragraphs – Styles – Formatting - Comments – Colors – Links – Images – Tables – Lists –Classes – Iframes – Forms

Unit II - HTML 5 & CSS : Introduction – HTML 5 Elements – Semantics – Canvas - HTML Audio – HTML Video – HTML Media – HTML API – CSS – Backgrounds – Borders – Margins – Padding – Box Model – CSS responsive – CSS 3

Unit III - BOOTSTRAP: Introduction - Grid Basics- Typography – buttons – pagination – panels – dropdowns – carousel – popover - Tooltip

Unit IV - JAVASCRIPT: Introduction – keywords – Data types – Variables – Operators – Comments – Arrays – Expressions – Control Structures – Functions (calling a function, returning values, integrating function & HTML) - JSON

Unit V - SERVER SIDE SCRIPTING: SQL – SQL database – SQL Functions - PHP – PHP variables – PHP Forms – MySql database - ASP – ASP VB function

Text Book

1. H.M. Deitel, P.J. Deitel, “Internet & World Wide Web – How to program”, 3rd Ed. Prentice Hall, 2003.Author, “Book”, Publisher, Year of Publishing
2. Thomas A. Powell, “HTML: The Complete Reference”, McGraw Hill, 2001.

Reference Books

1. Danny Goodman, Michael Morison, Paul Novitski, “Java Script Bible”, Wiley Publication, 7th Edition Author, “Book”, Publisher, Year of Publishing
2. David Crowder and Rhona Crowder,“Web Design with HTML/Flash/Javascript & Ecommerce BIBLE”, Wiley DreamTech India Pvt. Ltd,2001
3. Luke welling and Laura Thomson “PHP and MYSQL web development”, III Edition,, 2005

17MT2008 DIGITAL TELEVISION ENGINEERING

Credits: 3:0:0

Course objective:

- To overview the current and emerging trends in digital television.
- To understand the different propagation channels in digital television transmission.
- To apply the concepts in design of real-time broadcast television setup.

Course outcome:

The students will be able to:

- Observe the principles in digital television systems.
- Review the advantages of digital over analogue televisions.
- Discover the new advancements in digital television broadcast.
- Compare and contrast various types of television standards.
- Find a robust prorogation medium for television signals.
- Evaluate the performance of the optimum medium.

Unit I - Introduction to Digital Television: Shannon’s Information Theorem - Digitizing a Video Signal - Measuring and Compressing Digital Video Signals - Digital Video Broadcasting -Picture and Sound Quality - MPEG-4: HDTV Compression

Unit II - Digital TV by Satellite: SatellitePositions and Power - Finding the Satellite - Positioning the Dish - Low Noise Block Converters (LNBs) - The Satellite Receiver -Modulating Digital Signals -Error Protection and Transmitted Bitrate -Dish Size - Multi-Satellite Antennas -Installing Multi-Focus Antennas - Optimizing Parabolic Antennas

Unit III - DIGITAL TV BY CABLE: The Headend: The Heart of the Cable TV Network - Channel Capacity -The MATV (Master Antenna TV) Network - UHF Coaxial Networks - Coaxial Cable TV Networks - Hybrid Fiber Coaxial Networks (HFC) -Digital Cable Television - SMATV, Satellite MATV Systems - Terrestrial Digital TV Signals in Coaxial Cable Systems

Unit IV - DIGITAL TV BY TERRESTRIAL TRANSMITTERS: Antennas for Terrestrial TV Reception - Digital Terrestrial TV - Multi-Directional Antenna Systems -Indoor Antennas -Digital Terrestrial Receivers -DVB-T Receivers -Terrestrial TV for Mobile Devices; DVB-H

Unit V - DIGITAL TV BY BROADBAND: Broadband IPTV –Internet TV - Software Media Player Options - Internet Via Satellite - Digital Receivers - Digital TV with Interactive Services - Digital Receiver Firmware - The Application Interface - The API of the Future - The Media Gateway Dream -The Media Terminal

Text Book

1. Lars-Ingemar Lundstrom,“Understanding Digital Television-An Introduction to DVB Systems with Satellie, Cable, Broadband and Terrestrial TV Distribution, Focal Press; 1 edition (august 30, 2006).

Reference Books

1. Michael Robin, Michael Poulin “Digital Television Fundamentals”, McGraw Hill 2nd Edition 2000.
2. Gerald W.Collins, “Digital Television Transmission”, John Wiley & Sons 2001
3. Marcelo S. Alencar, “Digital television Systems”, Cambridge University Press 2009.
4. Walter Fisher. “ Digital Video And Audio Broadcasting Technology”, Springer 2nd Edition 2008.

17MT2009 INTRODUCTION TO 3D ANIMATION

Credits: 3:0:0
Pre-requisite: 17MT2005 GRAPHICS AND ANIMATION
Course objective:

- The course provides knowledge and understanding about various three dimensional animation process
- This course helps students to understand the concepts of modeling, texturing, lighting and animation
- The course provides details information about advanced strategies of animating human character.

Course outcome:
The students will be able to:

- Relate the various 3D software's
- Identify the efficient modeling techniques
- Apply lighting to modeled objects
- Experiment various lighting techniques
- Develop a plan for architectural modeling
- Evaluate the rendering process.

Unit I - Pre Production: Introduction – Principles of Animation - Storyboarding: Preliminary, Presentation and Production – character and model design - sound design –technical tests –Production scheduling
Unit II - Modeling Basics: Introduction –polygonal modeling –splines and patches –coordinate systems –viewing windows – Geometric primitives –transformations –common modeling techniques –hierarchies –booleans and trims.
Unit III - Rendering Basics: The camera –Lights –Surface characteristics –shading algorithms –rendering algorithms –background images –Surface texture mapping –solid texture mapping –final rendering.
Unit IV - Animation Basics: Introduction –Key framing –interpolations –parameter curve editing –dope sheet editing –forward kinematics –inverse kinematics –motion plans –shape deformations –camera animation –animating lights and surface properties –pose based animation.
Unit V - Retouching and Post Production Techniques: Virtual sculpting –hair and fur –texturing polygons –Rendering algorithms –cloth dynamics – Facial animation- compositing –Editing.

Text Book

1. Michael O'Rourke, "Principles of Three – Dimensional Computer animation", 3rd edition,W.W. Norton & company, 2003.

Reference Books

1. John Vince, "Essential Computer Animation", Springer UK , FirstEdition 2000.
2. John Edgar Park, "Understanding 3D animation using Maya", Springer Science & business Media. Inc, 2005.
3. Marcia Kuperberg, Martin W. Bowman, "Guide To Computer Animation", Focal press ,2002.

17MT2010 DIGITAL PHOTOGRAPHY

Credits: 3:0:0
Course objective:

- To define the basics of photography and apply them in creative productions.
- To compose effective frames that will comply to the various rules of composition.
- To evaluate the quality of their own photographs and appraise the works of other photographers that have impacted the audience over the years.

Course outcome:
The students will be able to:

- Define basics concepts of photography.
- Classify the different types of camera technologies.
- Demonstrate their understanding of composition and framing through photographs.
- Experiment with the modes of operation of a camera and use lights creatively.
- Reconstruct complex lighting set-ups by observing various images and paintings.
- Interpret the emotions that are being conveyed through choice of colors, lights and angles.

Unit I - Introduction to photography - History & development of photography - Types of camera and usage - Photographic film - Digital still camera - Types of DSLRs - Working with digital camera - Components of a digital camera - Camera modes and operation - Resolution
Unit II - Types of lenses and use - Focal Length - Aperture - Depth of Field - Shutter - Shutter speed - ISO - Exposure - Exposure triangle
Unit III - Photo Composition - Techniques of photo composition - Rule of thirds - Angle of view - Types of lights - Lighting - 3 point lighting - Low key - High key - Flash - Flash modes and flash accessories - Tripods - Filters - Color theory - Props - Sets
Unit IV - Setup for digital imaging - Desktop computer components - Data storage and transfer - Software for digital process - Image editor - File formats - Photo printers & types - Printing paper & types - Digital technology
Unit V - Portraiture - Inspirational portrait techniques - Architectural photography- Product-Fashion-Travel- Environmental- Action - Aerial - Macro - panoramic -Sports - Indoor photography - Outdoor photography - Photography project - Photography assignments - Photo power point presentation - Photo documentary - Photo essay - Designing a small budget studio - Equipments and budget

Text Book

1. Rick Sammons , "Complete Guide to Digital Photography 2.0", W. W. Norton & Company; Pap/Cdr edition (22 December 2003)
2. Barbara London , "Photography" ,12th Edition, Pearson, 2016

Reference Books

1. David D Busch, "Mastering Digital SLR Photography", Premier Press, 2004
2. Ralph F Jacobson, "The Manual of Photography", 8^{th} edition, Focal Press, 1988
3. Julie Adair King ,"Digital Photo Projects for dummies", Wiley Publishing inc, 2007

17MT2011 PHOTOGRAPHY LAB

Credits: 0:0:2
Co-requisite: 17MT2010 DIGITAL PHOTOGRAPHY

Course objective:

- To define the basics of photography and apply them in creative productions.
- To compose effective frames that will comply to the various rules of composition.
- To evaluate the quality of their own photographs and appraise the works of other photographers that have impacted the audience over the years.

Course outcome:
The students will be able to:

- Define basics concepts of photography.
- Classify the different types of camera technologies.
- Demonstrate their understanding of composition and framing through photographs.
- Experiment with the modes of operation of a camera and use lights creatively.
- Reconstruct complex lighting set-ups by observing various images and paintings.
- Interpret the emotions that are being conveyed through choice of colors, lights and angles.

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2013 - VIDEO POST PRODUCTION LAB

Credits: 0:0:2
Pre-requisite: 17MT2001 – Technical Writing for Electronic Media
Course objective:

- The course provides knowledge on storytelling
- This course helps students to analyze the project and use various Post Production techniques
- The course helps students to upgrade and equip with latest trends in technology used for video editing and other post production techniques.

Course outcome:
The students will be able to:

- Reproduce the knowledge of editing concepts and their principles in application.

- Analyze footage contents and apply the principles of post-production techniques.
- Classify the content as per the genre and apply the principles of editing
- Examine the flow of storytelling in the Final product or project.
- Simplify storytelling as per the perspective of audience.
- Evaluate the software tools required for given project.
- Effective storyteller and expert in editing tools(software and hardware) as per market standards

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2014 VISUAL EFFECTS LAB

Credits: 0:0:2
Pre-requisite: 17MT2009 INTRODUCTION TO 3D ANIMATION

Course objective:
- To experiment with the basic underlying Visual Effects.
- Apply rotoscopy or keying techniques to separate images.
- To track 2D features, find camera parameters and integrate different footage together.
- To use various techniques to remap the timing of the footage.

Course outcome:
The students will be able to:
- Understand the basic User Interface and grasp the working of any VFX software.
- Apply the various roto and keying techniques to separate the foreground from background.
- Analyze the given footage and apply appropriate colour grading and correction on them.
- Choose appropriate tracking features and get a good track(2D and 3D) for bringing in camera synced Element.
- Remap the time parameters of the footage to speed up or slow the footage.
- Use compositing techniques to seamlessly construct a New Image from other images.

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2015 WEB DESIGNING LAB

Credits: 0:0:2

Course Objectives:
- To learn creation of web pages, scripting objects, application and special objects.
- To understand the usage of databases.
- To experiment with interactivity in web pages.

Course Outcomes:
- Evaluate a website with a server side scripting
- Enable to create a commercial website
- Choose the designing language for the web content
- Extend the support to front end & back end scripting
- Compute the different web designing language
- Reproduce the responsive web design page

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2016 VISUAL DESIGN LAB

Credits: 0:0:2

Course objective:

- To understand the principles of design.
- To ensure effective usage of principles of design.
- To enrich the skill level of graphic design through the topic.

Course outcome:

The students will be able to:

- The students would apply principles of design appropriately.
- The study would enrich student's creative component.
- It helps the students to increase their designing skills
- The quality of projects will be better owing to a better understanding of the text forms.
- The students will be able to visualize and demonstrate an idea and express it
- The students will be able to demonstrate an understanding of principles of design and colors and apply them effectively to various assignments.

Course Description:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2017 THEORIES OF GAME PRODUCTION

Credits: 3:0:0

Course objective:

- This course aims at providing detailed knowledge about various stages involved in game production
- Providing an overview on digital video games from production to marketing stage

Course outcome:

The students will be able to:

- Outline the basic concepts of protocols followed in a game industry
- Formulate and interpret legal contracts on games
- Understand contributions of various teams and units involved in game production
- Identify and construct game play mechanics and programming structures
- Formulate life cycle of a complete video game and add dynamics to it
- illustrate and predict the budget required and marketing strategies involved in game production

Unit I Game and gaming Industry: Platform, game modes, game industry review, game concept basics, pitching a game to publishers, legal contracts-types and developments

Unit II Game production overview: production cycle, testing, role of- game producer, art director, Asset -Engineering-Design-Audio-QAC

Unit III Game Concept: Motivation- target audience-SWOT analysis, defining concept, game settings, game play mechanics, I/UX, game programming basics, risk analysis-project kickoff

Unit IV Game requirements and Production cycle: game features, deliverables, tools and pipelining, documentation, design production cycle, art production cycle, Engineering production cycle

Unit V Localization, Testing and Marketing: Language assets, schedule and budget, testing-plans, cycles, external testing, Marketing-packaging, marketing assets,PR

Text Book

1. Heather Maxwell Chandler, Rafael Chandler, Fundamentals of Game Development, Jones & Bartlett Learning, 2011.

Reference Books

1. Heather Maxwell Chandler, The Game Production Handbook, Jones & Bartlett Publishers, 2013
2. Erik Bethke, Game Development and Production, Wordware Publishing, Inc., 2003
3. Steven Conway, Jennifer deWinter, Video Game Policy: Production, Distribution, and Consumption, Routledge, 2015

17MT2018 MOBILE APPLICATION AND GAMING LAB

Credits: 0:0:2

Course Objectives:

- The course provides knowledge on implementing 2d/3d games on Mobile device.
- This course helps students to understand the steps involved and dynamics behind developing a game for mobile environment using their sensors.

Course Outcomes

The students will be able to:

- Inherit capability of creating 2d/3d games on mobile interface
- Apply their skills on concepts like creating UI elements and make them intractable with the game.
- Construct game modalities using specific sensors integrated with smart phone
- Formulate the design of suitable game environment using unity3d and flash animate
- Estimate and experiment various concepts of gestures and controlling game using them.

Course Description:

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2019 3D ANIMATION LAB

Credits: 0:0:2

Course objective:

- The course provides knowledge and understanding about various three dimensional animation process
- This course helps students to understand the concepts of modeling, texturing, lighting and animation
- The course provides details information about advanced strategies of animating human character.

Course outcome:

The students will be able to:

- Relate the various 3D software's
- Identify the efficient modeling techniques
- Apply lighting to modeled objects
- Experiment various lighting techniques
- Develop a plan for architectural modeling
- Evaluate the rendering process.

Course Description:

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2020 STUDIO ACOUSTICS

Credits: 3:0:0

Pre-requisite: 17MT2003 AUDIO ENGINEERING

Course objective:

- To understand how sound waves travel in free fields and in enclosed places.
- To learn how human sound perception and Psychoacoustics affect room design.
- To learn how to calculate and predict reflections, reverberation times, and room modes.
- To understand the acoustics of auditoriums and concert halls.

Course outcome:

The students will be able to:

- Recognize the need for acoustic treatment in a specific environment.
- Demonstrate the skills to perform acoustical measurements and site surveys, and choose construction materials.
- Employ their theoretical knowledge to design and build effective studios.
- Examine the acoustic treatments installed/ done and give their review or comments about the same.
- Design, build and install treatment modules to optimize early reflections, reverberations and diffusions.

- Evaluate the total requirements of a studio and come up with cost effective plans and specifications.

Unit I - Reflection, Diffraction, Refraction, Diffusion, Comb-Filter Effects, Reverberation, Absorption
Unit II - Modal Resonances, Schroeder Diffusers, Adjustable Acoustics, Sound Isolation and Site Selection, Sound Isolation: Walls, Floors, Ceilings, Windows, Doors
Unit III - Acoustics of Listening Rooms and Home Theaters, Acoustics of Home Studios, Acoustics of Small Recording Studios
Unit IV - Acoustics of Large Recording Studios, Acoustics of Control Rooms, Acoustics of Large Halls, Acoustics of Audio/ Video Rooms
Unit V - Acoustical Distortion, Room Acoustics Measurement Software, Room Optimizer

Text Book

1. F.Alton Everest, Ken C Pohlmann, "Master Handbook of Acoustics", McGraw Hill, Sixth Edition, 2015.

Reference Books

1. Philip Newell, Recording Studio Design, Focal Press, 2008.
2. Ken Pohlmann, Handbook of Sound Studio Construction: Rooms for Recording and Listening, McGraw Hill, 2012
3. William M. Hartmann, Principles of Musical Acoustics, Springer, 2013
4. Oswald Leroy & Mack A. Breazeale, Physical Acoustics: Fundamentals and Applications, Springer 2012

17MT2021 MEDIA LAWS AND ETHICS

Credits: 3:0:0

Course objective:

- To learn in detail about the Media Laws in India
- To study the Civil law related to media and to learn the code of ethics to be followed during broadcasting.

Course outcome:

The students will be able to:

- To comprehend the concept of Indian Constitution
- To understand the media laws and ethics to be followed while broadcasting
- To identify the cyber laws in India
- To illustrate how to sustain ethical information in the media field
- To relate how to grip civil and criminal law in the field of media
- To analyze the journalistic ethics in mass media.

Unit I - Overview of the Indian constitution - Fundamental Rights - Duties of citizens - Directive principles of state policy - Functions of Executive - Judiciary , Legislative, Powers and Privileges of Parliament - Provisions for declaring Emergency - Provision for amending the constitution - Freedom of the press and restrictions – Centre and state relations.
Unit II - PRB Act 1867 - the press(objectionable matters)Act 1957 - The News Paper (prices and Pages)Act 1956 - Defense of India Act - Delivery of Books and Newspaper (public libraries)Act - Press Council Act - Cable TV Networks (regulations)Act - The Cinematographic Act 1952 - Drugs and magic remedies Act.
Unit III - Laws of Libel and defamation - Contempt of courts Act 1971 and contempt of Legislative - Copy right Act and IPR - Trade Mark Act and patents Act - Right to Information and Official Secrets Act - Autonomy and Prasar Bharati Act - Broadcasting Bill.
Unit IV - Recommendations of Press Commission I and II - Mac Bridge Report - Press council guide to Journalistic ethics - Self regulation and code of ethics - censorship and control of the press - press ownership and monopolies - various committees of broadcasting - Broadcasting policies Act regarding to working journalists.
Unit V - Nature and scope of cyber laws - The right to Publish and right to privacy - Digital signature Piracy - Domain name registration issues - convergences bill - Media council and media ombudsman in the world - New IT Law IT 2000.

Text Book:

1. Basu, Law of the Press in India, Practice Hall of India.
2. Basu, Introduction to Indian Constitution, Practice hall of India.
3. R.K Ravindran, Press in the Indian Constitution, Indian Publishers.

4. Radha Krishna Murthi , Indian Press Laws.

Reference Book:

1. Na. Vijayshankar, Cyber laws in India, Citizen's India
2. Hamelink cess-J.Ehics of cyber Space, Sage
3. Philip Patterson, Lee Wilking, Media ethics , Issues capes MC Graw Hill

17MT2022 STREAMING MEDIA

Credits: 3:0:0

Course objective:

- The course provides knowledge and understanding about installing and working on streaming servers.
- This course helps students to understand the concepts of audio and video compression techniques, codecs required for live streaming
- The course provides details information about live streaming, web-casting with digitl rights and their distribution

Course outcome:

The students will be able to:

- Inherit capability of choosing appropriate codecs required for streaming audio and video files
- Apply their skills on concepts like creating web based streaming player and their meta-files.
- Construct Streaming modalities based on audio/video
- Formulate the design of suitable system for live streaming and webcasting
- Estimate and experiment various concepts of live streaming techniques and their distribution in the fields of Education, Entertainment etc

Unit I Streaming Overview: Installing Media Encoder, Encoding audio and video files, streaming media basics, Streaming media industry, Media Player, Installing new media player.

Unit II Audio and Video Tools: Pre-production planning, Audio-video tools, hardware and software requirements, fundamentals of audio-video production, Audio-video theory related to streaming media, moving audio-video to streaming, choosing right codec, Encoding audio-video

Unit III IP networks and Compression Techniques: Network layers, audio compression-analog compression, ear and psychoacoustics, lossy compression, codecs, video compression-DCT, compression codecs, MPEG compression. streaming architecture, server architecture, server deployment

Unit IV Streaming media files and Distribution: Editing streaming media files, Embedding events, Streaming server, Web servers v/s Media servers, meta-files, linking and dynamically creating meta-files, Embedding streams in web pages-HTML coding, testing embedded player code.

Unit V Live streaming and webcasting: P2P streaming, open source tools, Live webcasting v/s streaming video, streaming high-definition video, streaming on portable devices, Digital Rights, Case studies- Government, Media and Entertainment, Broadcasting, Education.

Text Book

1. Joe Follansbee, Hands-on Guide to Streaming Media: An Introduction to Delivering On-demand Media, Taylor & Francis, 2006.
2. David Austerberry, The Technology of Video and Audio Streaming, Taylor & Francis, 2005.

Reference Books

1. Tobias Künkel, Streaming Media: Technologies, Standards, Applications, Wiley, 2003.
2. Gregory C. Demetriades, Streaming Media: Building and Implementing a Complete Streaming System, John Wiley & Sons, 2003.
3. Michael Topic, Streaming Media Demystified, McGraw Hill Professional, 2002

17MT2023 - VIDEO EDITING

Credits: 3:0:0

Pre-requisite: 17MT2001 – Technical Writing for Electronic Media

Course objective:

- The course provides knowledge on storytelling
- This course helps students to analyze the project and use various editing techniques

- The course helps students to upgrade and equip with latest trends in technology used for video editing

Course outcome:

The students will be able to:

- Reproduce the knowledge of editing concepts and their principles in application.
- Analyze footage contents and apply the principles of editing
- Classify the content as per the genre and apply the principles of editing
- Examine the flow of storytelling in the edited footage
- Simplify storytelling as per the perspective of audience
- Evaluate the software tools required for given project.
- Effective storyteller and expert in editing tools(software and hardware) as per market standards

Unit I - Role of Editor, Linear and Non-linear Editing- on-line and off-line editing- in cam edit- Matching actions- Continuity- Matching Tone- Cut in - Cut away- Jump cut- compression and expansion of time- Cross cutting- Circular and Non-Linear cutting- Axial cut- Intensity: The Close up- Suspense: The Extreme Long Shot & Point of view shot. Different types of Transition: Cut, L- cut, Jump Cut, Match Cut, Form Cut, dissolve, wipes, fade in & out.

Unit II - Griffith dramatic emphasis- Kuleshov contribution Juxtaposition- Pudovkin constructive editing- relational editing- Eisenstein Montage theory- The Rule of Six by Walter Murch- Why do cuts work? By Walter Murch- Editing for Narrative Clarity- Editing for Dramatic Emphasis

Unit III - Time -Rhythm –Pace - Editing for the Genre: Action, Dialog, Comedy, Documentary- Storytelling with colors- Experiments in editing: Alfred Hitchcock, David Lean, Christopher Nolan- Importance of Sound and Audio in Editing- Cases studies on Oscars for best film editing.

Unit IV - Logging and capture- batch capture- capture settings- scratch disk- toolbar- Timeline: Layered & Magnetic Timeline - Canvas- Viewer- Safe area- Video and audio layers- Transitions- Video and Audio filters- Keying- Chroma settings- Export options- EDL- various compression ratios- various Video and Audio formats.

Unit V - Online editing: Grammar of Editing, basic signal flow & Features of Video Switcher - New Technologies in editing- Proxy media files- Importance of Metadata- Virtual Reality Editing- Collaborating Editing in Real-Time- different software's.

Text Book

1. Ken Dancyger, "The Technique of Film and Video Editing: History, Theory, and Practice", 5 edition, Focal Press, 2011.
2. Walter Murch, "In the Blink of an Eye: A Perspective on Film Editing", 2 Edition, Silman-James Press,U.S., 2001.
3. Karen Pearlman, "Cutting Rhythms: Shaping the Film Edit", 1 edition, Focal Press, 2009.

Reference Books

1. Karel Reisz & Gavin Millar, The Technique of Film Editing, 2nd Edition, Focal Press, 2010.
2. Roy Thompson & Christopher Bowen, Grammar of the Edit, 2nd Edition, Focal Press, 2009.
3. Morris & Patrick, Nonlinear Editing: Media Mannel, 1st Edition, Focal Press, 1999

17MT2024 - PRINCIPLES OF CINEMATOGRAPHY

Credits: 3:0:0

Course objective:

- To make the students about the basics of Cinematography.
- To impart knowledge to the students on the aesthetics of Cinematography.
- To keep the students updated with the techniques in cinematography.

Course outcome:

The students will be able to:

- The students will master the time tested concept of applying cinematography in their production techniques.
- The students will get trained to industry standards.
- The students can able to understand and work in the field of Cinematography.
- Students will practice the skills of cinematography
- Students can able to review the cinematography techniques used in films
- Students can operate the functions in a camera

Unit I - Camera Angle: Introduction – Scene – Shot – Sequence – Types of Camera angles – Subject size – Subject angle – Camera height – Scene Requirements
Unit II - Continuity: Cinematic Time and Space – Filming the action – Filming techniques- Triple take technique – Directional continuity – Action Axis – Static screen Direction – Bridging Time and Space – Transitional Devices
Unit III - Cutting : Introduction – Types of Film Editing – Compilation cutting –Cross cutting – how to use cross cutting – cutting on action – cutting and continuity – cutting and composition – loose camera shots – Editorial Requirements
Unit IV - Close Ups : Close up size – Over the shoulder close ups – types of close ups – how to cut away close ups – close up choice – close up camera angle – close up tempo – close up camera set ups – close ups for sequence opener – close ups for transition
Unit V - Composition : Still vs motion picture – compositional rules – compositional language – balance – types of balance –unity- eye scan – image placement – dynamic composition

Text Book

1. Joseph V. Mascelli, "The 5Cs of Cinematography", Silman-James Press, 2001.
2. Ivan Cury, "Directing & Producing for Television", Focal Press, 2007.

Reference Books

1. Dan Ablan, "Cinematography and Directing", New Riders, 2000.
2. "Cinematographer's Field Guide", Kodak Entertainment Imaging, 2000.
3. Sonja Schenk & Ben Long, "The Digital Filmmaking Handbook", Course Technology, 2012.

17MT2025 ADVERTISING

Credits: 3:0:0

Course objective:

- To introduce the students to the advertising world and brief them on various stages involved in the process of producing & launching digital media advertisements.
- To make the students learn the types of advertising and creative strategies to build ad for the existing competitive world.

Course outcome:

The students will be able to:

- To apply the advertising concepts practically.
- To criticize the different types of advertisement campaigns.
- To illustrate various advertising and marketing strategies with respect to various media industry.
- To identify the latest terminologies used in advertising industry.
- To summarize the Advertising and PR relations.
- To describe the role of advertising in the society.

Unit I Understanding advertising today-The foundations of advertising –Types of Advertising – The advertiser Agency Partnership-The advertising Environment.
Unit II Audience Definition, Research, and Planning – Audience analysis and buyer behavior – Segmentation, Targeting and Positioning- Advertising Research- Objectives, Strategy and Plans- Intercultural and International Advertising.
Unit III The Creative Process – Creativity, Creative Strategy and Copywriting – Art Production – Print Production – Electronic Production.
Unit IV Media Choice- Media Objectives, strategy and planning –print media – electronic media - direct marketing and out of home advertising- Putting the campaign together- Sales promotion and supplementary media – public relations and special communications- local advertising –from plan to results: The complete campaign.
Unit V Public relations – evolution and growth, definition and relevance of PR role – Mass media & PR; PR in Government, public and private sectors; PR and corporate Communications writing for PR - PR ethics and regulations.

Text Book:

1. Fundamentals of Advertising', Otto Kleppner, Prentice Hall, New Jersey, 2000.
2. Courtland L. Bovee , Advertising Excellence : McGraw –Hill Inc. Publications,2001.

Reference Book:

1. The Practice of Advertising' Norman Hart, Heinemann Pub. London, 2000
2. Advertising worldwide Marieke de Mooij, Prentice Hall, UK, 2000
3. Advertising Management concepts and cases' M. Mohan, Tata Mc Graw Hill, 2008

17MT2026 - DIGITAL MUSIC

Credits: 3:0:0
Pre-requisite: 17MT2003 AUDIO ENGINEERING

Course objective:

- To learn analyzing music via mathematical models.
- The course provides knowledge on techniques and concepts involved in producing music using algorithms and system models.
- This course is designed to give students a broad-based exposure to musical notes and analyzing musical instruments mathematically.

Course outcome:
The students will be able to:

- develop simple algorithms for producing music.
- understand the mathematical approaches behind music production.
- Explore latest technologies and the tools used in Digital music.
- Apply algorithms in music synthesis and acoustic modeling.
- Learn various Effects creation process.
- Create vsti's and vste's.

Unit I - Introduction - Waves and Harmonics - Sound, The human ear, sine waves - Harmonic motion, Vibrating strings - Fourier's theory of harmonic analysis .
Unit II - Mathematician's Guide to the Orchestra - Wave equation for strings, Initial conditions, bowed string, Wind instruments, The drum, horn, THE BELL, Acoustics: Consonance and dissonance and Scales and temperament
Unit III - Pythagorean scale, the cycle of fifths, Eitz's notation
Unit IV - Digital Music: WAV AND MP3 FILES, MIDI Synthesis, the Yamaha DX7 and FM synthesis, C Sound,
Unit V - FM synthesis using CSound, Simple FM instruments.

Text Book

1. Dave Benson, Music: A Mathematical Offering, Cambridge University Press,2006.
2. Emile D Menache "The Desktop Studio: A Guide to Computer-based Audio Production", Hal Leonard Corporation, 2002.

Reference Books

1. Miller Puckette, The Theory and Technique of Electronic Music, World Scientific Publishing Co., 2007.
2. John Fauvel , Raymond Flood, Robin Wilson, "Music and Mathematics: From Pythagoras to Fractals", Oxford University Press, 2006.
3. David Wright, "Mathematics and Music", Library of Congress Publications, 2009.

17MT2027 - COMPUTER BASED MUSIC PRODUCTION

Credits: 3:0:0
Pre-requisite: 17MT2003 AUDIO ENGINEERING

Course objective:

- The students will appreciate the basics in the functioning of digital audio workstation.
- The students will be exposed to the use MIDI and digital audio tools in music production.

Course outcome:
The students will be able to:

- Creatively aware of the skills in music production.
- Learn the digital tools used in music production.
- Explore latest technologies and the digital tools used in music production
- Understand the various stages of Music Production.

- Learn various Effects creation process.
- Use vsti's and vste's.

Unit I - Introduction to DAW: Hardware and software needed, Mac & PC platform for DAW
Unit II - Hardware and software set up
for music production : PCI cards - USB – Fire Wire/ i link - PCMCIA Cards
Unit III - Audio interfaces - MIDI interface types and features – Sound Card Driver installation basics - Surface controller setup
Unit IV - MIDI - MIDI implementation charts - Creating a new song/MIDI file - Recording types-Common MIDI Recording Problems and their Solutions - Analog and Digital audio recording
Unit V - Basic track recording - dubbing - Wet vs Dry recording –Virtual MIDI instruments - Preparing tracks for audio editing-Mixing, Mastering and Archiving

Text Book

1. Zack Price, "Beginner's guide to computer based music production", Cherry lane music Company, 2004.
2. Martin Russ, "Sound Synthesis and Sampling", Third Edition, Focal Press, 2009

Reference Books

1. Francis Rumsey, Tim McCormick, "Sound and Recording: An Introduction", Fifth edition, Focal Press, 2006
2. Andrea Pejrolo, "Creative sequencing techniques for Music Production", Focal Press, 2005.
3. Emile D Menache "The Desktop Studio: A Guide to Computer-based Audio Production", Hal Leonard Corporation, 2002.

17MT2028 COMPUTER BASED MUSIC PRODUCTION LAB

Credits: 0:0:2
Co-requisite: 17MT2027 - COMPUTER BASED MUSIC PRODUCTION

Course objective:

- The students will appreciate the basics in the functioning of digital audio workstation.
- The students will be exposed to the use MIDI and digital audio tools in music production.
- The Students will be exposed to the various Effects creation process.

Course outcome:
The students will be able to:

- Creatively aware of the skills in music production.
- Learn the digital tools used in music production.
- Explore latest technologies and the digital tools used in music production
- Understand the various stages of Music Production.
- Learn various Effects creation process.
- Use vsti's and vste's.

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2029 LIVE SOUND REINFORCEMENT LAB

Credits: 0:0:2

Course objective:

- The course portrays how indoor & outdoor public address system functions in different environments.
- The behavior of sound in varied situations and the techniques for efficiently handling sound to give the best speech & music performance are discussed.
- Details on microphones, audio amplifiers & loudspeakers are provided with minimum amount of technicalities that are just sufficient for the students of this course.

Course outcome:
The students will be able to:

- plan and execute a sound reinforcement system for a variety of occasions.

- deliver good quality audio to the audience by choosing the right equipments & tweaking the listening area for optimum presentation of sound.
- know the functions of each equipment in the audio chain so that they will be able to guide the subordinates while rigging the system.
- Creatively aware of the skills in Live sound Reinforcement.
- Explore latest technologies and the digital tools used in Live sound Reinforcement.
- Understand the various stages of Live sound Reinforcement.

Course Description:

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2030 ARTIFICIAL INTELLIGENCE FOR GAMES

Credits: 3:0:0

Course objective:

- To impart knowledge about the fundamentals of intelligent behavior and decision making games
- To cover a wide range of artificial intelligence (AI) techniques to design games.

Course outcome:

The students will be able to:

- understand the basic concepts of decision making by machines in games
- apply the AI techniques for designing games
- Experiment and interpret the behavior of game objects having different types of AI on any Game Engine
- identify and investigate a particular game scenario and integrate AI based on specific game genres.
- visualize and simulate AI on game engines
- integrate AI with decision making capabilities for inspecting behavior of kinematic game objects

Unit I – Introduction: Artificial Intelligence, Model of game AI, The kind of AI in games, speed and memory,AI engine, using AI in Game Engines, Action combat AI, Motor racing AI
Unit II – Movement: Basics of movement algorithms, Input Axes in Game Engines, Rigid bodies and their properties , kinetic movement algorithms, steering behaviors.
Unit III – Prediction: Predicting physics, jumping, coordinating jump activity in Game Engines with gravity, coordinated movement, motor control, movement in third dimension, FPC, TPC
Unit IV - Path finding: Implementing sensors, Path finding graph, dijkstra, A*, problem, - Algorithm, pseudocode, data structures and interfaces, avoid obstacles, follow player game object, Navigation Mesh, baking.
Unit V - Fuzzy Logic: Introduction to fuzzy logic, Fuzzy logic decision making, fuzzy state machines, creating state machine behaviors in Unity3D-setting up player- setting up enemy.

Text Book

1. Ian Millington , Artificial Intelligence for Games, Morgan Kaufmann Publishers, 2006.
2. Ray Barrera, Aung Sithu Kyaw, Clifford Peters, Unity AI Game Programming, 2nd Edition Packt Publishing Ltd, 2015

Reference Books

1. Marco Gonzalo, Marco Antonio Gómez-Martín, Artificial Intelligence for Computer Games, Springer Science & Business Media, 2011
2. David M. Bourg, Glenn Seemann , AI for Game Developers, O'Reilly Media, Inc., 2004
3. Guy W. Lecky-Thompson, AI and Artificial Life in Video Games, Cengage Learning, 2008

17MT2031 - GAME DESIGN

Credits: 3:0:0
Pre-requisite: 17MT2017 Theories of Game Production

Course objective:

- The course provides knowledge on understanding the aesthetics and pre-requisites required for game designing.
- This course helps students to understand and utilize physics and mathematical concepts required for game environments and game development.

Course outcome:
The students will be able to:

- infer and inherit capability of designing 2D /3Dgames.
- apply their skills on concepts like camera movement and dynamics of game designing
- design and develop 2D/3D games on various platforms.
- identify and construct design game objects and provide them behavioral characteristics to interact in game environment.
- formulate the design of suitable game environment and skyboxes
- design various 3D menu, cut scenes and UI elements

Unit I – Introduction: Game play and game data, designers and development process, modeling factor, fudge factor, logic and scripting languages
Unit II - Game mechanics design: scale, graphical interfaces, terrain features, movement rates and algorithms, regulating movements, game statistics for movements, Items, characters and combat
Unit III - Implementing the design: storytelling, designing playfields, interface design, dialogues, 2d/3d maps, POV
Unit IV - 2D Game Design: sprite designing, background designing, UI designing, designing and implementing physics for 2d game objects, collisions, threading , scripting
Unit V - 3D Game design: 3 C's in 3D game designing, designing and importing 3D game object in 3D game engine, designing skyboxes, icon designing, 3D movement, collisions, designing cut scenes, designing for 3D game menu, introduction to 3d UI element designing.

Text Book

1. Michael Moore, Basics of Game Design, CRC Press, 2016
2. Scott Rogers, "Level Up! The Guide to Great Video Game Design", John Wiley Publishers, 2010.

Reference Books

1. Jonathan S. Harbour, "Advanced 2D Game Development", PTR Publishers, 2009.
2. Ernest Adams, "Fundamentals of Game Design", Pearson Education, 2012.
3. Jesse Schell, "The Art of Game Design: A book of lenses", Morgan Kauffman Publishers, 2008.

17MT2032 VR TECHNOLOGIES AND APPLICATIONS

Credits: 3:0:0

Course objective:

- The course provides knowledge on understanding the aesthetics and pre-requisites required for designing and developing a VR environment.
- This course helps students to understand the dynamics behind VR and its implementations

Course outcome:
The students will be able to:

- inherit capability of creating an VR environment
- apply their skills on concepts like creating UI elements and make them intractable with VR camera.
- construct VR modalities using specific sensors infer to their integration
- formulate the design of suitable VR game environment using unity3d
- estimate and experiment various concepts of physics and their interaction with VR camera using unity3d

Unit I - Introduction to Virtual Reality: virtual environment, virtual presence, VR system, human perception, motor and cognitive systems, basic applications.
Unit II - Dynamics of Virtual Environment: DOF, translational and rotational transformations, pose and displacement, dynamic models of VR- equations of motion, inertia, momentum, collision detection, computation of body movements.
Unit III - Tracking and Modalities: Pose sensor- mechanical, ultrasonic, optical, video metric, radio frequency and electromagnetic, motion tracking, physical input devices, Modalities- visual, Audio, Haptic
Unit IV - Interaction with Virtual Environment: Manipulations with virtual environments, navigations in virtual environments, interaction with other users, interactive computer game, Interactive educational methods
Unit V - VR and Unity3d: Starting Unity project, setting up project files for VR integration, creating UI elements for VR interaction, gaze based control, move around, jump, using 360 degrees, physics and environment-FPS

Text Book

1. Matjaz Mihelj, Domen Novak, Samo Beguš, Virtual Reality Technology and Applications, Springer Science & Business Media, 2013
2. Jonathan Linowes, Unity Virtual Reality Projects, Packt Publishing Ltd, 2015.

Reference Books

1. Jean-Marc Gauthier , Building Interactive Worlds in 3D, Taylor & Francis, 2013.
2. Jason Jerald, The VR Book: Human-Centered Design for Virtual Reality, Morgan & Claypool, 2015.
3. Philippe Fuchs, Guillaume Moreau, Pascal Guitton, Virtual Reality: Concepts and Technologies, CRC Press, 2011

14MT2033 GAME PRODUCTION LAB

Credits: 0:0:2

Course objective:

- The course provides knowledge on understanding the aesthetics and pre-requisites required for game designing.
- This course helps students to understand and utilize physics and mathematical concepts required for game environments and game development.

Course outcome:

The students will be able to:

- infer and inherit capability of designing 2D /3Dgames.
- apply their skills on concepts like camera movement and dynamics of game designing
- design and develop 2D/3D games on various platforms.
- identify and construct design game objects and provide them behavioral characteristics to interact in game environment.
- formulate the design of suitable game environment and skyboxes
- design various 3D menu, cut scenes and UI elements

Course Description:

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

14MT2034 ADVANCED ANIMATION LAB

Credits: 0:0:2
Pre-requisite: 17MT2009 Introduction 3D animation

Course objective:

- To experiment with crown simulation techniques.
- To construct characters and rig them for animation.
- To try simulating pyrotechnic and fluid effects.

Course outcome:

The students will be able to:

- Make better models from 2D reference images.
- Build complex rigs to animate human and animal character face animation.
- Build Fluid simulations to render sea effects and other liquid effects.
- Build Complex Walk cycles of Human and animals.
- Generate procedural terrain Models.
- Generate crowd simulations and test crowd behaviour.

Course Description:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2035 ANIMATRONICS

Credits: 3:0:0

Course objective:

- Analyze, design and evaluate electronic components and systems using state-of-the-art tools.
- Apply modern smart sensor technology to communicate with animation and gaming world.
- Analyze and design animatronics prototypes.

Course outcome:

The students will be able to:

- Analyze design and behavior of animatronics characters in movies
- Classify and identify various kinds of sensors required for controlling an animation.
- Interpret and compute the sensor data acquisition and interfacing with specific microcontrollers
- Choose and modify appropriate sensors required for controlling an animation.
- Estimate the behavior of animated objects using different sensors
- Create, design and develop an animatronics prototype on smart phone using mobile sensors

Unit I - Overview: Introduction to Animatronics, Top 7 Animatronics beasties in movies- Jaws, Jurassic Park, Aliens, Terminator, Gremlins, King-Kong and Extra-Terrestrial.
Unit II - Sensors and Actuators: Role of sensors and actuators, human sensory systems, Control System Architecture, Instrumentation process, Data Acquisition hardware, Signal Conditioning and filtering.
Unit III - Microcontroller Interfacing: Theoretical Analysis, operating principles, Time to Digital conversion, direct resistive sensor to microcontroller interfaces, direct capacitive sensor to microcontroller interfaces, Design issues of Microcontroller interfacing
Unit IV - Sensor Data Processing: General input-output classification, Microcontroller data processing-Temperature sensor, Pressure Sensors, Flow sensors, potentiometers, electromagnetic sensors, piezo-electric sensors, intelligent sensors, Fiber optics sensors, ultrasonic sensors.
Unit V - Animation using Electronic sensors: Architecture meets Robotics and gaming, Sensors as input devices-Kinect sensor, Smart phone sensors controlling animation in mobiles- Accelerometer sensor, location sensors, proximity sensors.

Text Books

1. Clarence W. de Silva, Sensors and Actuators: Engineering System Instrumentation, Second Edition, CRC Press, 2015
2. Gourab Sen Gupta Embedded Microcontroller Interfacing, Springer Science & Business Media, 2010.
3. Ferran Reverter, Ramón Pallás Areny , Direct Sensor-to-microcontroller Interface Circuits: Design and Characterization, Marcombo, 2005
4. Ram n Pall s-Areny, John G. Webster, Sensors and Signal Conditioning, John Wiley & Sons, 2012
5. Greg Milette, Adam Stroud, Professional Android Sensor Programming, John Wiley & Sons, 2012
6. Francisco R. Ortega, Fatemeh Abyarjoo, Armando Barreto, Naphtali Rishe, Malek Adjouadi, Interaction Design for 3D User Interfaces, CRC Press, 2016

Reference Books

1. Christian Berger, Mohammad Reza Mousavi, Rafael Wisniewski, Cyber Physical Systems. Design, Modeling, and Evaluation, Springer, 2017
2. John Vetelino, Aravind Reghu, Introduction to Sensors, Packt Publishing Ltd, 2016.
3. Varun Nagpal, Android Sensor Programming By Example, Packt PublishingLtd, 2016

17MT2036 LIVE MULTI - CAMERA PRODUCTION LAB

Credits: 0:0:2
Pre-requisite: 17MT2012- Video Production Lab

Course objective:

- To experiment video production on a multiple camera setup.
- To set up the equipments according to signal flow.
- To broadcast the programme as a live stream .

Course outcome:
The students will be able to:
- Recall the principles in multi camera production.
- Review the requirements in a multi camera setup.
- Practice their skills in multi camera switching and recording.
- Experiment on various techniques in multi camera setup.
- Setup the hardware and software requirements of a live broadcast.
- Evaluate the quality of the production with broadcast quality programmes.

Course Description:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/ Director and notify it at the beginning of each semester.

17MT2037 BROADCAST TECHNOLOGY

Credits: 3:0:0

Course objective:
- To overview the latest updates in the broadcast technology.
- To understand the various mediums in broadcasting.
- To apply the concepts in designing a broadcast setup.

Course outcome:
The students will be able to:
- Observe the principles in broadcasting systems.
- Review the functional requirements in a broadcast house.
- Discover the new advancements in broadcasting networks.
- Compare and contrast various types of broadcasting systems.
- Find a robust broadcast system for media applications.
- Evaluate the system based on standard parameters.

Unit I - Introduction to Broadcast Technology: Quantities - Units – Formulas and calculations – Analogue/Digital Circuits – Information systems – Error Correction – Cables and Fibers – TCP/IP Networking – SAN NAS Technologies – Telco – Color Displays – Colorimetry.
Unit II - Broadcast Systems and Standards: Audio Systems - TV Standards – Color Encoding – Time code – Sound Sync – VBI data – Interfaces – File Formats – DVB/HDTV standards – ATSC/PSIP - Sound origination – Optic systems – Camcoders – VTR – Standard Conversion.
Unit III - Studio Production Systems: Television studio – Camera and Mounts – Lighting – Talk back and Communication – Mixers – Visual Effects – Editing – Telecines – Sound Recording – Editing – Mixing – Surround Sound – Routers and matrices – MAM systems – News Room Systems.
Unit IV - Outside Broadcast Systems: Outside broadcast vehicles – Mobile control rooms – Microwave links for OB and ENG – Electronic News Gathering and Electronic Field Production – Power generators and Electrical systems for outdoor Broadcast – Battery Systems.
Unit V - Transmission Systems: RF propagation – Thermionics – Power Grid- Linear Grid Tubes – Transposers – Terrestrial Planning – Satellite Services – Microwave radio delay – Uplink Terminals – Intercity links – Switching Centers – Transmitter Power equipment – Towers and antennas.

Text Book
1. E.P.J. Tozer,“ Broadcast Engineer's Reference Book, Focal Press, (2012).

Reference Books
1. Jerry C. Whitaker, “Standard Handbook of Broadcast Engineering”, McGraw-Hill Education, 11-Feb-2005.
2. Skip Pizzi, Graham Jones, “A Broadcast Engineering Tutorial for Non-Engineers”, Focal Press; 4 edition (March 29, 2014)
3. Edmund A. Williams, “National Association of Broadcasters Engineering Handbook”, Taylor & Francis, 2012.
4. Patrick S. Finnegan, “Broadcast engineering & maintenance handbook”, G/L Tab Books, 6 Aug 2011.

17MT2038 AUDIO SIGNAL PROCESSING

Credits: 3:0:0

Pre-requisite: 17MT2003 AUDIO ENGINEERING

Course Objective:

- To impart basic knowledge about digital signal processing
- To understand Digital (IIR and FIR) filter design procedures.
- To know about the finite word length effects and PDSPs.

Course Outcome:

The students will be able to:

- Outline the audio signal processing concepts.
- Analyze the quantization techniques.
- Apply various transformations for various signal processors.
- Relate the signal processing concepts practically with the help of Audio Filters
- Compare and select the processors suitable for a specific application.
- Design and develop algorithms for audio signal processing applications.

Unit I - Sampling and Quantization: Sampling: Sampling theorem, Sampling rate conversion: Upsampling and Anti-imaging Filtering, Downsampling and Anti-aliasing Filtering Contents, Synchronous Conversion, Asynchronous Conversion, Interpolation Methods.

Quantization: Signal Quantization, Dither, Quantization levels, Spectrum shaping of Quantization, Number Representation.

Unit II - A-D/D-A Conversion: Nyquist Sampling, Oversampling, Delta-Sigma Modulation, Digital Signal Processors, Digital Audio Interfaces: Single-processor Systems, Multi-processor Systems.

Unit III - Equalizers: Recursive Audio Filters: Parametric Filter Structure, Quantization Effects, Nonrecursive Audio Filters: Basics of Fast Convolution, Fast Convolution of Long Sequences, Filter Design by Frequency Sampling , Multi-complementary Filter Bank

Unit IV - Room Simulation: Reverberation, Room Acoustics, Model-based Room Impulse response, Measurement of Room Impulse Response, Simulation of Room Impulse Response, Early Reflections, Subsequent Reverberation, Approximation of Room Impulse Response

Unit V - Dynamic Range Control: Basics, Dynamic Behaviour: Level Measurement, Gain Factor Smoothing, Time Constants

Implementation: Limiter, Compressor, Expander, Noise Gate, Combination System

Realization Aspects: Sampling rate Reduction, Curve Approximation, Stereo Processing

Text Book

1.Udo Zolzer, “Digital Audio Signal Processing”, Second Edition, John Wiley&Sons, Ltd,2008.

Reference Books

1. Emmanuel C. Ifeacher and Barrie W. Jervis, “Digital Signal Processing – A Practical Approach”, Wesley Longman Ltd., 2nd Edition, 2004.
2. SanjitK.Mitra, “Digital Signal Processing - A Computer Based Approach”, Tata McGraw-Hill,New Delhi, 2nd Edition, 2001
3. Johny R. Johnson, “Introduction to Digital Signal Processing”, PHI, 2006
4. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, “Digital Signal Processing”, McGraw Hill International, 2007
5. Venkatramani B, M. Bhaskar, ‘Digital Signal Processors Architecture, Programming and Applications’, Tata McGraw– Hill Publishing Company Limited, New Delhi, 2002.

17MT2039 - PHOTOGRAPHY THEORY AND PRACTICE

Credits: 3:0:0

Course objective:

- To define the basics of photography.
- To describe the creative use of framing and composition.
- To apply the knowledge gained in exposure setting to creative photographs and evaluate progress in conceptual understanding in photography.

Course outcome:
The students will be able to:

- Define basics concepts of photography.
- Classify the different types of cameras.
- Demonstrate their understanding of composition and framing through photographs.
- Experiment with the modes of operation of a camera.
- Compare their works with works of art made by professionals and identify areas of improvement.
- Plan for capturing a properly exposed picture.

Unit I - Introduction to photography - History & development of photography - Types of camera and usage - Photographic film - Digital still camera - Types of DSLRs - Working with digital camera - Camera modes and operation
Unit II - Types of lenses and use - Focal Length - Aperture - Depth of Field - Shutter - Shutter speed - ISO - Exposure - Exposure triangle
Unit III - Photo Composition - Techniques of photo composition - Rule of thirds - Angle of view - Types of lights - Lighting - 3 point lighting - Flash - Flash modes and flash accessories - Tripods - Filters - Color theory - Props - Sets
Unit IV - Portraiture - Inspirational portrait techniques - Architectural photography- Product-Fashion-Travel- Environmental- Action - Aerial - Macro - panoramic -Sports - Indoor photography - Outdoor photography
Unit V - Photography project - Photography assignments - Photo power point presentation - Photo documentary - Photo essay - Designing a small budget studio - Equipments and budget

Text Book

1. Rick Sammons , "Complete Guide to Digital Photography 2.0", W. W. Norton & Company; Pap/Cdr edition (22 December 2003)
2. Barbara London , "Photography" ,12th Edition, Pearson, 2016

Reference Books

1. David D Busch, "Mastering Digital SLR Photography", Premier Press, 2004
2. Ralph F Jacobson, "The Manual of Photography", 8th edition, Focal Press, 1988
3. Julie Adair King ,"Digital Photo Projects for dummies", Wiley Publishing inc, 2007

17MT2040 -ELECTRONIC MEDIA MANAGEMENT

Credits: 3:0:0

Course objective:

- To appraise the students with the elements in media management.
- To explore the qualities of a media manager.
- To keep the students updated with the latest techniques in media management

Course outcome:
The students will be able to:

- Indentify various managerial aspects in making a media house run.
- Estimate and plan the expenses of a media broadcast house.
- Prepare an action plan for the functioning of various levels in a house.
- Analyze on various case studies and implement a robust method.
- Develop a new strategy in managing the various levels in a house.
- Evaluate the effectiveness of the strategic plans implemented in house.

Unit I - Broadcast station management: Management Defined - Evolution of Management Thought - Management Levels - Management Functions - Management Roles - Management Skills - Influences on Management.
Unit II - Financial management: The Accounting Function - Planning Financial Records - Preparing Financial Statements - Cost Controls - Monitoring Financial Progress.
Unit III - Human resource management: The Functions of Human Resource Management- Human Resource Management and Trade Unions - Human Resource Management and the Law.
Unit IV - Broadcast programming: The Audience - The Program Department - The Program Manager- Radio Station Programming - Television Station Programming - Programming the Network Affiliate - Independent Station - Station Representative - Children and the Community.

Unit V - Broadcast promotion and sales: The Promotion and Marketing Director - The Promotion Plan - Audience Promotion - Sales Promotion - The Sales Department - The General Sales Manager - Time Sales - Research and Sales.

Text Book

1. Peter K. Pringle, Michael F. Starr, “Electronic Media Management”, Focal Press, 2006.

Reference Books

1. B. K. Chaturvedi, “Media Management” Global Vision Pub House, 2009
2. Promotion & Marketing for Broadcasting Cable of the web by Eastman, Susantylen
3. Consumer Behavior by Leon G. Schiffman and Leslie Lazar Kanuk, Prentice Hall India
4. Essentials of Management by Harold Koonz and Heinz Weihrich, Mac Graw Hills, 2001

LIST OF COURSES

Sl. No.	Course Code	Name of the Course	Credits
1	15EC3001	Augmented Reality	3:0:0
2	16EC1001	Electronics for Every Day Life	3:0:0
3	16EC3001	Biological Effects of Microwaves	3:0:0
4	16EC3002	Software Defined Radio	3:0:0
5	16EC3003	Advanced Computer Communication	3:0:0
6	16EC3004	Telecom Network Management	3:0:0
7	16EC3005	Machine Learning Methods	3:0:0
8	16EC3006	Medical Image Analysis	3:0:0
9	16EC3007	Applied Signal Processing Lab	0:0:2
10	16EC3008	Flexible Electronics	3:0:0
REVISED VERSION COURSES			
Sub.Code	**Version**	**Subject**	**Credits**
14EC1001	1.1	Basic Electronics Engineering	3:0:0
14EC2001	1.1	Digital Electronics	3:1:0
14EC2002	1.1	Electron Devices	3:0:0
14EC2003	1.1	Signals and Systems	3:1:0
14EC2004	1.1	Digital Electronics Lab	0:0:2
14EC2005	1.1	Electron Devices and Circuits lab	0:0:2
14EC2006	1.1	Electronic Circuits	3:0:0
14EC2007	1.1	Transmission Lines and Wave guides	3:1:0
14EC2008	1.1	Linear Integrated Circuits	3:0:0
14EC2009	1.1	Microprocessor and Interfacing techniques	3:0:0
14EC2010	1.1	Linear Integrated Circuits Lab	0:0:2
14EC2011	1.1	Microprocessor lab	0:0:1
14EC2012	1.1	Pulse and Wave Shaping Circuits	3:0:0
14EC2013	1.1	Communication Theory and Systems	3:0:0
14EC2014	1.1	Digital Signal Processing	3:1:0
14EC2015	1.1	Microcontroller and its Applications	3:0:0
14EC2016	1.1	CAD for Electronics Engineers	3:0:0
14EC2017	1.1	Electronics and Communication Lab	0:0:2
14EC2018	1.1	Digital Signal Processing Lab	0:0:2
14EC2019	1.1	Microcontroller lab	0:0:1
14EC2020	1.1	Antenna Theory and Wave propagation	3:1:0
14EC2021	1.1	Digital Communication	3:1:0
14EC2022	1.1	Microwave and Optical Communication	3:0:0
14EC2023	1.1	Advanced Communication Lab	0:0:2
14EC2024	1.1	Microwave and Optical Communication Lab	0:0:2
14EC2025	1.1	Computer Communication	3:0:0
14EC2026	1.1	Advanced Microprocessor Architecture	3:0:0
14EC2029	1.1	Embedded System Design	3:0:0
14EC2030	1.1	ARM Processors	3:0:0
14EC2031	1.1	ARM Lab	0:0:2
14EC2032	1.1	Testing for Embedded System	3:0:0

14EC2033	1.1	Embedded lab	0:0:2
14EC2034	1.1	Fault Tolerant Techniques	3:0:0
14EC2035	1.1	PCB Design Lab	0:0:2
14EC2037	1.1	Telecommunication Switching Networks	3:0:0
14EC2038	1.1	Cellular Mobile Communication	3:0:0
14EC2039	1.1	Mobile Computing	3:0:0
14EC2041	1.1	High Speed Network	3:0:0
14EC2042	1.1	Routing Algorithms for Wireless Mobile networks	3:0:0
14EC2043	1.1	Advanced Digital Communication Systems	3:0:0
14EC2044	1.1	Fundamentals of Wireless Communication	3:0:0
14EC2046	1.1	Optoelectronics	3:0:0
14EC2047	1.1	Solid State Microwave Devices	3:0:0
14EC2048	1.1	Fiber Optic Communication	3:0:0
14EC2049	1.1	Radar Communication	3:0:0
14EC2050	1.1	Basics of Satellite Communication	3:0:0
14EC2051	1.1	RF Circuit Design	3:0:0
14EC2052	1.1	Antenna Design Lab	0:0:2
14EC2053	1.1	Advanced Wireless lab	0:0:2
14EC2054	1.1	Bio-Medical Signal Processing	3:0:0
14EC2055	1.1	Adaptive Signal Processing	3:0:0
14EC2056	1.1	Wavelet Techniques	3:0:0
14EC2058	1.1	Neural Networks and Fuzzy Systems	3:0:0
14EC2059	1.1	Optimization Techniques	3:0:0
14EC2060	1.1	Multimedia Compression Techniques	3:0:0
14EC2061	1.1	Soft Computing	3:0:0
14EC2062	1.1	Machine Learning Algorithms for Image Processing	3:0:0
14EC2065	1.1	Information Theory and Coding	3:0:0
14EC2066	1.1	Digital System Design	3:0:0
14EC2067	1.1	VerilogHDL	3:0:0
14EC2068	1.1	VHDL	3:0:0
14EC2069	1.1	VLSI Design	3:0:0
14EC2070	1.1	ASIC Design	3:0:0
14EC2071	1.1	VLSI Subsystem Design	3:0:0
14EC2072	1.1	Analysis and Design of Digital IC	3:0:0
14EC2073	1.1	Low power techniques in VLSI Design	3:0:0
14EC2074	1.1	VLSI Fabrication Techniques	3:0:0
14EC2075	1.1	Nano electronics	3:0:0
14EC2076	1.1	VHDL Lab	0:0:2
14EC2077	1.1	Verilog Lab	0:0:2
14EC2078	1.1	IC Design Lab	0:0:2
14EC2079	1.1	Microprocessors and Microcontrollers	3:1:0
14EC2080	1.1	Communication Engineering	3:0:0
14EC2081	1.1	Monolithic Microwave Integrated Circuits	3:0:0
14EC2082	1.1	Semi Conductor Device Modelling	3:0:0

14EC2083	1.1	Verification of VLSI Circuits	3:0:0
14EC2084	1.1	Design of Analog CMOS IC	3:0:0
14EC2085	1.1	CAD for VLSI Design	3:0:0
14EC2086	1.1	Testing of VLSI Circuits	3:0:0
14EC2087	1.1	Micro Electro Mechanical Systems	3:0:0
14EC2088	1.1	Microprocessor and Microcontroller Lab	0:0:2
14EC2090	1.1	Fundamentals of Electronics	3:0:0
14EC2091	1.1	Electron Devices and Instrumentation	3:0:0
14EC2092	1.1	Electron Devices and Instrumentation lab	0:0:2
14EC3001	1.1	Statistical Digital Signal Processing	3:0:0
14EC3002	1.1	Advanced Embedded Systems	3:0:0
14EC3003	1.1	Computational Intelligence and Optimization Techniques	3:0:0
14EC3004	1.1	Hardware Description Languages	3:0:0
14EC3005	1.1	Advanced Digital Image Processing	3:0:0
14EC3007	1.1	Wireless and Optical Networks	3:0:0
14EC3008	1.1	VLSI Design Techniques	3:0:0
14EC3009	1.1	HDL Lab	0:0:1
14EC3010	1.1	Data Compression Techniques	3:0:0
14EC3011	1.1	Optical Networks and Photonic Switching	3:0:0
14EC3012	1.1	Modern Digital Communication Techniques	3:0:0
14EC3013	1.1	Wireless Communication Networks	3:0:0
14EC3014	1.1	Advanced Radiation Systems	3:0:0
14EC3015	1.1	Satellite Communication	3:0:0
14EC3016	1.1	Error Control Coding	3:0:0
14EC3017	1.1	Communication Lab – I	0:0:2
14EC3018	1.1	Communication Lab – II	0:0:2
14EC3019	1.1	Digital System and ASIC Design	3:0:0
14EC3020	1.1	CMOS VLSI Design	3:0:0
14EC3021	1.1	Analysis and Design of Analog Integrated Circuits	3:0:0
14EC3022	1.1	VLSI Technology	3:0:0
14EC3023	1.1	Solid State Device Modeling and Simulation	3:0:0
14EC3024	1.1	Low Power VLSI Design	3:0:0
14EC3025	1.1	CAD for VLSI Circuits	3:0:0
14EC3026	1.1	Testing And Testability	3:0:0
14EC3027	1.1	VLSI Digital Signal Processing	3:0:0
14EC3028	1.1	ASIC Design Laboratory	0:0:2
14EC3029	1.1	Speech and Audio Signal Processing	3:0:0
14EC3030	1.1	Biological Signal Processing	3:0:0
14EC3031	1.1	Medical Image Processing	3:0:0
14EC3033	1.1	Advances in Electronics Applied to Hospital Engineering	3:0:0
14EC3034	1.1	Computer based Medical Instrumentation	3:0:0
14EC3035	1.1	Digital Communication Receivers	3:0:0
14EC3036	1.1	Detection and Estimation Theory	3:0:0
14EC3037	1.1	DSP Architecture and Programming	3:0:0

14EC3038	1.1	Global Positioning System	3:0:0
14EC3039	1.1	Optical Signal Processing	3:0:0
14EC3040	1.1	Microwave Integrated Circuits	3:0:0
14EC3041	1.1	Electromagnetic Interference and Compatibility	3:0:0
14EC3042	1.1	RF System Design	3:0:0
14EC3043	1.1	RF MEMS	3:0:0
14EC3044	1.1	Neural Network for RF and Microwave Design	3:0:0
14EC3045	1.1	Smart Antennas	3:0:0
14EC3046	1.1	Communication Network Security	3:0:0
14EC3047	1.1	Communication Network Routing Algorithms	3:0:0
14EC3049	1.1	Mobile Communication Networks	3:0:0
14EC3050	1.1	System On –Chip Design	3:0:0
14EC3051	1.1	Reconfigurable Computing	3:0:0
14EC3052	1.1	IP Based VLSI Design	3:0:0
14EC3053	1.1	Design of Semiconductor Memories	3:0:0
14EC3054	1.1	Hardware Design Verification Techniques	3:0:0
14EC3055	1.1	High Speed VLSI Design	3:0:0
14EC3056	1.1	Analog VLSI Design	3:0:0
14EC3057	1.1	CMOS Mixed Signal Circuit Design	3:0:0
14EC3058	1.1	VLSI Circuits for Bio-Medical Applications	3:0:0
14EC3059	1.1	VLSI for Wireless Communication	3:0:0
14EC3060	1.1	Data Converters	3:0:0
14EC3061	1.1	Signal Integrity for High Speed Devices	3:0:0
14EC3062	1.1	Nanoscale FET	3:0:0
14EC3063	1.1	Nanoscale Devices and Circuit Design	3:0:0
14EC3064	1.1	Photonics	3:0:0
14EC3067	1.1	Embedded systems lab	0:0:1

15EC3001 AUGMENTED REALITY

Credits 3:0:0

Course Objective

- To understand the concepts of augmented reality.
- To be able to select the hardware and software required for the augmented reality application.
- To be able to understand the method of interaction between real and virtual world.

Course outcomes

On completion of the course, students will be able to

- Analyze the use of the concepts of Augmented reality to various applications.
- Illustrate an Augmented Reality system.
- Model a simple Augmented reality system.

Course Description

Augmented reality –Visualization techniques – Mobile Projection Interfaces for Augmented Reality Applications - Interactive volume segmentation and visualization in augmented reality –Sampling and reconstructing presence in multiple shared spaces – Markerless tracking – Enhancing interactivity – Referencing patterns – Navigation techniques in Augemented and Mixed reality

References

1. Borko Furht, 'Handbook of Augmented Reality', Springer, 2011.
2. Alan B Craig, "Understanding Augmented Reality: Concepts and Applications", Morgan Kauffman, 2013.
3. Oliver Bimber and Ramesh Raskar, 'Spatial Augmented Reality', A K Peters, 2005.
4. Rui Wang, 'Augmented Reality with Kinect', PACKT Publishing, 2013.

16EC1001 ELECTRONICS FOR EVERY DAY LIFE

Credits 3:0:0

Course Objective:

- To impart the characteristic features of various electronic devices.
- To understand the basic concepts of cellular communication.
- To impart the significance of electronics in daily life.

Course Outcome:

On completion of the course the students will be able to

- Design simple electronic circuits.
- Design digital circuits
- Develop models for smart cities.

Course Description:

Electron Devices: Passive components, PN and Zener diodes, Transistors, Special diodes
Digital Systems: Logic gates – Digital Circuits-Combinational and Sequential circuits ,various storage devices
Embedded systems: Introduction to embedded systems, automotive electronics, health care gadgets
Communication: Communication Technologies 2G-5G, Wi-Fi , Bluetooth, GPS
IoT: Digital India, Smart Buildings, Smart Transport, Smart Health Care.

Reference Books:

1. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.
2. Thomas Floyd, “Digital Fundamentals”, Prentice Hall, 10th Edition, 2011.
3. Rappaport T.S, “Wireless Communication” Pearson Education, 2003.
4. Rajkamal- Embedded systems-Architecture, programming and design-Second edition,Tata McgrawHill
5. R. S. Khandpur, “Handbook of Biomedical Instrumentation”, McGrawHill, 2012.
6. Dr. Ovidiu Vermesan, Dr. Peter Friess, “Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems”, River Publishers 2013.

16EC2001 FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

Credits: 3:0:0

Course Objectives:

- To learn the fundamental concepts of Image processing techniques
- To gain knowledge about the various segmentation algorithms in image processing
- To gain an insight on the various compression and morphological techniques in image processing

Course Outcomes:

After completion of the course, students will be able to

- Develop Simple Algorithms For Image Processing Using Fundamental Concepts.
- Apply The Segmentation Algorithms For Real-Time Applications
- Analyze the various compression techniques available for 2-D images

Course Description:

Fundamentals of Image Processing: Fundamental steps and applications of digital image processing - Spatial & Gray-Level resolution – Introduction to Two dimensional discrete Fourier Transform – Color Fundamentals - Basic gray level transformations – Point Detection-Line Detection-Edge Detection - Image Compression models – Variable Length Coding: Huffman Coding-Arithmetic coding - LZW Coding - Morphological Image Processing.

References:

1. Rafael C.Gonzalez and Richard E. Woods, “Digital Image Processing”, PHI 2nd Edition, 2002.
2. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 9th Edition, Indian Reprint, 2002
3. William, K.Pratt, “Digital Image Processing”, John Wiley and Sons, 3rd Edition,2002
4. Wilhelm Burger and Mark J. Burge, “Principles of Digital Image Processing: Fundamental Techniques”, Springer, 1st Edition, 2nd Reprint, 2009.

16EC2002 INTERNET OF THINGS FOR COMMUNICATION ENGINEERING

Credits: 3:0:0

Course Objectives:

- To provide in depth knowledge in the basics, architecture and layering analysis of various protocols in IoT
- To comprehend on the various networks and development platforms in IoT
- To provide the various IoT applications

Course Outcomes:

After completion of the course, students will be able to

- Have in depth knowledge in the basics, architecture and layering analysis of various protocols in IoT

- Understand the various networks and development platforms in IoT
- Familiarize the various IoT applications.

Course Decription:

IoT Architecture: History of IoT, M2M – Machine to Machine, Web of Things, IoT protocols. Applications: Remote Monitoring & Sensing, Remote Controlling, performance analysis - architecture The Layering concepts - IoT Communication Pattern - IoT protocol Architecture.
The IoT Networking Core : Technologies involved in IoT Development: Data transfer referred with OSI Model, IP Addressing, Data transfer & Network Topologies. Applications: IoT applications – IoT in homesecurity, industries, IoT electronic equipments.

References:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers 2013.
2. Jean-Philippe Vasseur, Adam Dunkels , "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kuffmann Publishers, 2010.
3. Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning, "The Internet of Things: From RFID to the Next-Generation Pervasive Network", ed. 2008.
4. Vijay Madisetti , Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)" , 2014.
5. Adrian McEwen , Hakim Cassimally , "Designing the Internet of Things" , Wiley,2013.

16EC2003 RECENT TRENDS IN WIRELESS COMMUNICATION

Credits 3:0:0

Course Objectives:

- To introduce the fundamentals of wireless sensor networks and adhoc networks
- To learn the Architecture of IoT
- To introduce the basics of Software defined radio and Cognitive radio networks

Course Outcomes:

After completion of the course, students will be able to

- Learn about the fundamentals of wireless sensor networks and adhoc networks
- Understand the Architecture of IoT
- Familiarize with the basics of Software defined radio and Cognitive radio networks

Course Description:

Wireless adhoc and sensor Networks : Introduction to Adhoc/sensor networks - unique constrains and challenges - MAC protocols - Issues in designing MAC protocols- routing protocols-issues in routing protocols Internet of things (IoT): IoT vision - conceptual frame work of IoT - Architecture - Role of RFID in IoT-applications of IoT - Ubiquitous computing- Applications Software defined radio and Cognitive radio networks : Heterodyne Architecture of SDR - Multichannel modulation - wideband RF processing - Introduction to Cognitive radio concept-Spectrum sensing-spectrum sharing - Spectrum sharing - cognitive radio and flexible spectrum usage for health care.

References:

1. Xiang-Yang Li, "Wireless Ad Hoc and Sensor Networks Theory and Applications", Cambridge University press, 2008
2. Markus Dillinger , Kambiz Madani , Nancy Alonistioti, "Software Defined Radio: Architectures, Systems and Functions" Wiley Series in Software Radio, 2003.

3. Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning, “The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems”, CRC press, 2008.
4. Alexander M. Wyglinski , Maziar Nekovee , Thomas Y. Hou, “Cognitive Radio Communications and Networks: Principles and Practice”, 2009.

16EC2004 ELECTRON DEVICES AND CIRCUITS

Credits 3:0:0

Course Objectives:
- To know about various electron devices and their characteristics
- To learn about various amplifier circuits
- To know the design of oscillator circuits.

Course Outcomes:
After completion of the course, students will be able to
- Understand the characteristics of various electron devices
- Design various amplifier circuits
- Gain understanding on design of oscillators

PN Junction diode – Zener diode – BJT – JFET – MOSFET – Biasing of BJT – BJT and MOSFET amplifiers – cascaded amplifier – differential amplifier – tuned amplifier – power amplifiers – oscillators

References:
1. Robert Boylestad and Louis Nashelsky, “Electronic Devices & Circuit Theory”, 9th Pearson Education Edition, 2009.
2. V.K.Metha,“Principles of Electronics”,Chand Publications,2008.
3. Millman &Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 3rd Edition, 2010.
4. Malvino.A P, “Electronic Principles”, McGraw Hill International, 7th Edition 2006.
5. David .A .Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2010.

16EC2005 LINEAR AND DIGITAL IC LAB

Credits 0:0:2
Co-requisite: 14EC2001 Digital Electronics, 14EC2008 Linear Integrated Circuits

Course Objectives:
- To design basic circuits using IC741.
- To design different multi vibrators and oscillators using IC741 and IC555.
- To design combinational and sequential circuits using logic gates

Course Outcomes:
After completion of the course, students will be able to
- Design basic circuits using IC741.
- Design different multi vibrators and oscillators using IC741 and IC555.
- Design and implement basic combinational and sequential circuits using logic gates.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

16EC2006 DIGITAL ELECTRONICS AND ELECTRONIC CIRCUITS LAB

Credits 0:0:1
Co-requisite: 14EC2001 Digital Electronics, 14EC2006 Electronic Circuits

Course Objectives:
- To design combinational and sequential circuits using logic circuits
- To design and implement multivibrator circuits using BJT
- To design and implement clippers and clampers using BJT

Course Outcomes:
After completion of the course, students will be able to
- Design basic combinational and sequential circuits using logic circuits
- Design and implement multivibrator circuits using BJT
- Design and implement clippers and clampers using BJT

Experiments
The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

16EC2007 LINEAR IC AND DIGITAL COMMUNICATION LAB

Credits 0:0:1
Co-requisite: 14EC2021 Digital Communication, 14EC2008 Linear Integrated Circuits

Course Objectives:
- To design basic circuits using IC741.
- To design different multi vibrators and oscillators using IC741 and IC555.
- To analyze the performance of different digital modulation techniques.

Course Outcomes:
After completion of the course, students will be able to
- Design basic circuits using IC741.
- Design different multi vibrators and oscillators using IC741 and IC555.
- Analyze the performance of different digital modulation techniques.

Experiments
The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

16EC3001 BIOLOGICAL EFFECTS OF MICROWAVES

Credits 3:0:0

Course Objectives:
- To study about different types of radiations
- To learn to analyze the characteristics of microwaves and their interaction with living systems
- To learn RF/Microwave radiation exposure standards

Course Outcomes:
After completion of the course, students will be able to
- Understand the types of radiations
- Learn the various effects of microwaves on various biological systems.
- Know the RF/Microwave radiation exposure standards

Course Description:
Types of Radiations - EM spectrum - Typical equipments generating microwaves - Characteristics of microwaves and their interaction with living systems - Effects of microwaves on various systems - Health status of personnel occupationally exposed to microwaves and the symptoms of microwave overexposure - a survey - Safe exposure limits, control and prevention of health hazards - RF/Microwave Radiation exposure standards

References:

1. Martino Gandolfo, “Biological Effects and Dosimetry of Nonionizing Radiation”, Springer, reprint, 2012.
2. Peter Stavroulakis, “Biological Effects of Electromagnetic Fields”, Springer, 2003.
3. Frank S. Barnes , Ben Greenebaum, “Handbook of Biological effects of Electromagnetic Fields”, CRC Press, 2006.
4. Ronald Kitchen, “RF and Microwave Radiation Safety”, Newnes, 2nd Edition, 2001.
5. B. Jon Klauenberg, Martino Grandolfo, David N. Erwin, “Radiofrequency Radiation Standards: Biological Effects, Dosimetry, Epidemiology, and Public Health Policy”, Springer, 1995.

16EC3002 SOFTWARE DEFINED RADIO

Credits: 3:0:0

Course Objectives:
- To know the SDR concepts and implementation details
- To understand the design of SDR for a specific purpose
- To know the challenges in SDR

Course Outcomes:
After completion of the course, students will be able to
- Conceptualize the SDR and implementation details
- Design SDR for a specific application
- Identify the challenges in the maintenance of SDR

Course Description:
Introduction to software defined radio – A traditional hardware radio architecture – Signal processing hardware history – A basic software defined radio architecture – 2G, Hybrid radio architecture - Basic software defined radio block diagram - RF system design – Analog-to-Digital and Digital-to-Analog Conversion - Digital Frequency up and down converters - Signal processing hardware components - SDR requirements for processing power - DSP Devices - DSP compilers - Reconfigurable processors - Software architecture and components - Major software, Hardware, Specific software architecture - Smart Antennas using software radio - Phased antenna array theory - Applying software radio principles to antenna systems - Smart antenna architectures.

References:

1. Paul Burns, “Software Defined Radio for 3G”, Artech House, 2002.
2. Tony J Rouphael, “RF and DSP for SDR”, Elsevier Newnes Press, 2008.
3. Jouko Vanakka, “Digital Synthesizers and Transmitter for Software Radio”, Springer, 2005.
4. P Kenington, “RF and Baseband Techniques for Software Defined Radio”, Artech House, 2005.
5. Markus Dillinger, “Software Defined Radio,Architecture, Systems and Functions”, Wiley, 2003.

16EC3003 ADVANCED COMPUTER COMMUNICATION

Credits: 3:0:0

Course Objectives:

- To study and analyze the MAC layer protocols
- To understand the routing algorithms for data networks
- To know about IPv6

Course Outcomes:

After completion of the course, students will be able to

- Analyze the MAC layer protocols
- Implement the routing algorithms for data networks
- Understand the concepts in IPv6

Course Description:

Access Methods - Pure ALOHA, Slotted ALOHA, CSMA,CSMA/CD,CSMA/CA - Routing - Network layer routing, Least cost path algorithms, Non Least cost path algorithms, Intra domain routing protocols, Inter domain routing protocols, Congestion control at network layer - Logical Addressing - IPv4 Addresses, IPv6 Addresses - Internet Protocol - Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Transport and end-to-end protocols, Mobile transport protocols, Performance evaluation of TCP protocol - Wireless networks and Mobile IP, Infrastructure of wireless networks, Wireless Mesh Networks, Bluetooth networks, Wi-Max, and RFID - ATM - Traffic control, Connection admission control, Usage parameter control -Virtual scheduling algorithm

.

References:

1. William Stallings, "Data and Computer Communication", Pearson, 2011.
2. Behrouz A. Forouzan, "Data Communication and Networking", McGraw-Hill, 2013.
3. Andrew S. Tanenbaum, "Computer Networks", Prentice Hall, 2011.
4. James F. Kurose, Keith W.Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education, 2010.
5. S.Keshav, "An Engineering Approach to Computer Networking", Pearson Education, 2003.

16EC3004 TELECOM NETWORK MANAGEMENT

Credits: 3:0:0

Course Objectives:

- To manage LAN and wireless networks using monitoring tools
- Understand the high speed networks and estimate their link performance.
- To know about the SNMP tools.

Course Outcomes:

After completion of the course, students will be able to

- Manage LAN and wireless networks using monitoring tools
- Analyse high speed networks and estimate the link performance
- Use the network management and SNMP tools

Course Description:

LAN Administration – Console and Agents - Virus scanning - Printer management - Storage management - Managing the wireless networks – Configuration details - Mobile IP - Spanning tree protocol - Virtual networks - Managing TDM systems, Managing link performance – Digital data service - Carrier testing services - User controlled diagnostics - Fractional T1 - Integrated solutions - Integral protocol analyzers - Disaster recovery - Managing high speed packet networks - Network management systems - Management in the wired world - The mechanics of SNMP - Graphical SNMP tools - SNMP on wireless networks - Telecommunications management networks - Managing network security - Threat assessment - Securing the workplace - Securing the network - Virus protection

References:

1. N J Muller, "LANs to WANs: The Complete Management Guide", Artech House, 2003.
2. J W Mark & W. Zhuang, "Wireless Communications and Networking", PHI, 2005.
3. Terplan, "Telecom Network Management", PHI, 1998.
4. Haojin Wang, "Telecommunications Network Management", Mc Graw Hill, 1999.
5. Mani Subramanian, "Network Management : Principles and practice", 2^{nd} Edition, Pearson education, 2010.

16EC3005 MACHINE LEARNING METHODS

Credits 3:0:0

Course Objectives:

- Learn various machine learning techniques.
- Solve problems using machine learning algorithms.
- Know the applications of machine learning.

Course Outcomes:

After completion of the course, students will be able to

- Exhibit Knowledge About Machine Learning.
- Comprehend And Analyze The Performance Of Machine Learning Algorithms. .
- Apply machine learning concepts for real world problems.

Course Description:

Supervised learning – Unsupervised learning– Probabilistic learning: Gaussian mixture models, nearest neighbor methods – Support vector machines: optimal separation, kernels, SVM algorithm – Learning with trees: decision trees, CART – Ensemble learning: boosting, bagging, random forests – Graphical model: Bayesian network, Markov random fields, hidden Markov models – Reinforcement learning: Example, Markov decision processes - Optimization and Search: exhaustive search, greedy search, hill climbing, simulated annealing and genetic algorithm.

References:

1. Stephen Marsland, "Machine learning: An Algorithmic Perspective", CRC Press, 2015.
2. M. Mohri, M. Rostamizadeh, A. Talwalkar, "Foundations of Machine Learning", MIT Press, 2012.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
4. EthemAlpaydin, "Introduction to Machine Learning", 3^{rd} Edition, MIT Press, 2014.
5. S. Shalev-Shwartz, S. Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2014.
6. Jason Bell, "Machine Learning: Hand-On for Developers and Technical Professionals", Wiley, 2015.

16EC3006 MEDICAL IMAGE ANALYSIS

Credits 3:0:0

Course Objectives:
- Understand the principles of medical imaging systems.
- Learn the implications of methods in processing medical images.
- Know the various fields in medical image processing.

Course Outcomes:
After completion of the course, students will be able to
- Exhibit knowledge about various medical imaging modalities.
- Analyze methods towards solving problemsusing medical images.
- Identify the developments in various domains of medical image processing.

Course Description:
Medical imaging fundamentals: system, images and modalities - medical image noise removal: non local mean, nonlinear anisotropic diffusion filtering, total variation, wavelet denoising and sparse image denoising - medical image segmentation: region based, deformable models and statistical methods: GMM, PNP, MLP - medical image registration: feature and voxel based, medical image interpolation.

References:

1. Klaus D. Toennies, "Guide to Medical Image Analysis: Methods and Algorithms", Springer, 2012
2. A.P. Dhawan, "Medical Image Analysis", IEEE Press, 2011.
3. Geoff Dougherty, "Medical Image Processing: Techniques and Applications", Springer, 2011.
4. Isaac N. Bankman, "Handbook of Medical Imaging Processing and Analysis, Academic Press, 2009.
5. Meyer-Base, V. Schmid, "Pattern Recognition and Signal Analysis in Medical Imaging", Academic Press, 2014
6. J. V. Hanjal, D. J. Hawkes and D. L.G Hill, "Medical Image Registration", 2001
7. M. A. Haidekker, "Advanced Biomedical Image Analysis", 2011
8. G. R. Sinha, B.C. Patel, "Medical Image Processing: Concepts and Applications", PHI Learning, 2014.

16EC3007 APPLIED SIGNAL PROCESSING LAB

Credits 0:0:2
Co-requisite: 14EC3029 Speech and Audio Signal Processing
14EC3030 Biological Signal Processing
14EC3031 Medical Image Processing

Course Objectives:
- Better understanding on Audio,Speech and Image/Video processing fundamentals.
- To implement various Audio, Speech and Image/Video processing algorithms.
- To learn about MATLAB: Signal processing and Computer vision system tool boxes.

Course Outcomes:
After completion of the course, students will be able to
- Design and test 1-D, 2-D and 3-D signal processing algorithms
- Take up real time projects in the signal processing area
- Expertise in MATLAB: Signal processing and Computer vision system tool boxes.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

16EC3008 FLEXIBLE ELECTRONICS

Credits: 3:0:0

Course Objectives:

- To realizing the importance of flexible materials in electronics.
- To gain in depth knowledge of flexible devices in electronics.
- To learn various applications of flexible electronics.

Course Outcomes:

After completion of the course, students will be able to

- Understand the importance of flexible materials
- Familiarize various types of flexible devices
- Gain knowledge to develop the applications of flexible electronics

Course Description

Overview of flexible electronics – Theory of thin film structures – Low temperature dielectrics - Low temperature thin films transistors – Amorphous silicon - Flexible backplane and display application- Flexible transition metal oxide electronics and imprint technology – Materials and novel pattern methods – sensors and actuators – organic and polymeric TFTs – structural property of flexible materials – carbon nano tubes for thin film transistors.

References:

1. William.S.Wong, Alberto Salleo, “Flexible Electronics: Materials and Applications”, Springer publishers, 2009.
2. S.Logothetidis, “Hand Book of Flexible Organic Electronics”, Elsevier, 2015.
3. Mario Caironi,Yong-Young Noh, “Large Area and Flexible Electronics”, Wiley –VCH Verilag, 2015.

14EC1001 BASIC ELECTRONICS ENGINEERING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To impart the basic knowledge about the passive components.
- To know about the fundamentals of electronics and some electronic devices.
- To get the knowledge about the various analog communication techniques.

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge of how passive electronic devices work and their main applications.
- Analyze the function of active electronics devices and basic digital system.
- Gain knowledge of analog communication system design and applications.

Course Description:

Introduction to passive components and semiconductor- Types of Resistors - Types of capacitors - Types of inductors - N type & P type semiconductor - PN junction diode - Half wave rectifier, Zener diode - Bipolar Junction Transistor - Field Effect Transistors (JFET, MOSFET) - UJT. Number system - Boolean algebra – logic gates - karnaugh map (4 variables), combinational circuit - Basic block of communication system - need for modulation - types of analog modulation - AM and FM signal - Block diagram of AM and FM transmitter - Superhetrodyne receiver - Principle of Television - Satellite communication - Radar System - Fiber optic communication - ISDN

References
1. Robert Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Pearson Education Edition, 2009.
2. Muthusubramanian , R, Salivahanan S, Muraleedharan K.A, "Basic Electrical Electronics & Computer Engineering" Tata Mc.Graw Hill, 2009
3. Anokh Singh, "Principles of Communication Engineering" S.Chand Co., 2001
4. V.K.Metha,"Principles of Electronics",Chand Publications,2008.

14EC2001 DIGITAL ELECTRONICS

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:
- To learn about number systems, binary codes and the basic postulates of Boolean algebra.
- To study formal procedures for the analysis and design of combinational and sequential circuits
- To learn the implementation of digital circuits in programmable logic devices and about different logic families.

Course Outcomes:
After completion of the course, students will be able to
- Understands number systems, binary codes and the basic postulates of Boolean algebra.
- Acquire knowledge to design various combinational and sequential circuits.
- Gains better understanding in the implementation of digital circuits in programmable logic devices and about different logic families.

Course Description:
Number Systems - Postulates & Theorems of Boolean Algebra - Canonical Forms - Simplification of Logic Functions using Karnaugh map - QuineMcclusky method -Combinational Logic Circuits – Implementation of Logical Functions using Multiplexers -Flipflops - Design of Synchronous sequential circuits – Synchronous and Asynchronous Counters-Design of Synchronous Counters – Shift Registers – Basic Structure of PLDs – Logic Families (CMOS-TTL-ECL).

References:
1. M.Morris Mano, "Digital Design", 4th Edition, Pearson publisher,2011.
2. Thomas Floyd, "Digital Fundamentals", Prentice Hall, 10th Edition, 2011.
3. Jain R.P, "Modern Digital Electronics", 4th Edition, Tata Mcgraw Hill, 2010
4. Charles.H.Roth," Fundamentals of logic design",4th Edition, Jaico publishing house, 2006.
5. V.K. Puri, "Digital Electronics: Circuits and Systems", Tata McGraw Hill, First Edition, 2006.

14EC2002 ELECTRON DEVICES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the mechanisms of current flow in semiconductors.
- To familiarize on the principle of operation, capabilities and limitation of fundamental semiconductor devices and its practical application.
- To analyze various circuits based on semiconductor devices.

Course Outcomes:
After completion of the course, students will be able to
- Understand the mechanisms of current flow in semiconductors.

- Familiarize with the principle of operation, capabilities and limitation of fundamental semiconductor devices and its practical application.
- Acquire understanding on functions and characteristics of various devices.

Course Description:
Semiconductor in Equilibrium: Charge carriers in semiconductors, Extrinsic semiconductors - Charge neutrality, position of Fermi energy level - carrier transport phenomena - Carrier generation and recombination - Continuity equation - Quasi Fermi energy levels-PN junctions : basic structure, applied bias - PN junction diode : PN junction current, small signal model of the PN junction - BJT: Bipolar transistor action, Ebers-moll model - static characteristics of transistors - JFET : JFET concepts, JFET characteristics - MOSFET : structure and Characteristics - SCR - DIAC - TRIAC - Zener diode - Tunnel diodes - LED - plasma display and LCD display.

References :

1. Donald A. Neamen, “Semiconductor Physics and Devices”, Tata McGraw Hill, 4th Edition, 2012.
2. Millman &Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 3rd Edition, 2010.
3. Malvino.A P, “Electronic Principles”, McGraw Hill International, 7th Edition 2006.
4. David .A .Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2010.
5. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Pearson new International Education, 2013.

14EC2003 SIGNALS AND SYSTEMS

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:
- To impart the basic knowledge about discrete and continuous time signals and systems.
- To know about the frequency analysis of continuous time signals and systems using CTFT and Laplace transform.
- To understand the sampling process and frequency analysis of discrete time signals and systems using DTFT and Z transform.

Course Outcomes:
After completion of the course, students will be able to
- Gain knowledge about discrete and continuous time signals and systems.
- Acquire knowledge about the frequency analysis of continuous time signals and systems using CTFT and Laplace transform
- Familiarized on the sampling process and frequency analysis of discrete time signals and systems using DTFT and Z transform.

Course Description:
Classification of Continuous-time signals & Discrete-time signals. Properties of Continuous-time systems and Discrete time systems. Continuous linear time-invariant systems & Discrete linear shift-invariant systems, impulse response: differential equations and difference equations, convolution integral and sum. System analysis and frequency response using CT Fourier transform & Laplace transform. Sampling, System analysis and frequency response using DT Fourier transform and Z transform.

References:

1. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, “Signals & Systems”, 2nd Edition, PHI, New Delhi, Reprint 2009.

2. Simon Haykin and Barry Van Veen, “ Signals & Systems ”, 2nd Edition, John Wiley and Sons Inc., 2005
3. Samir S Solimon and Srinath M.D., “Continuous and Discrete Signals and Systems”, 2nd Edition, PHI, 2003.
4. Rodger E Zaimer and William H Tranter, “Signals & Systems – Continuous and Discrete”, McMillan Publishing Company, 4th Edition, III Reprint, 2002.
5. B.P. Lathi, Signal Processing and Linear Systems, Oxford University Press, Incorporated, 2009.
6. Steven T. Karris , “Signals and Systems with MATLAB Computing and Simulink Modelling”, Orchard Publications,4th Edition 2008

14EC2004 DIGITAL ELECTRONICS LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2001 Digital Electronics.

Course Objectives:
- To learn the basic characteristics of all logic gates.
- To design combinational circuits.
- To design sequential circuits.

Course Outcomes:
After completion of the course, students will be able to
- Understands the basic characteristics of all logic gates.
- Design combinational circuits.
- Design sequential circuits.

List of experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2005 ELECTRON DEVICES AND CIRCUITS LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2002 - Electron Devices
14EE2001 - Electric Circuits & Networks.

Course Objectives:
- To understand the characteristics of diodes, FET and UJT.
- To design rectifiers, amplifiers, oscillators and regulators.
- To understand the basic Network theorems

Course Outcomes:
After completion of the course, students will be able to
- Understand the characteristics of diodes, FET and UJT.
- Design rectifiers, amplifiers, oscillators and regulators.
- Understand the basic Network theorems.

List of experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2006 ELECTRONIC CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To know about the design and analysis of power supplies and transistor biasing networks.
- To understand the design and analysis of power amplifiers and feedback amplifiers.
- To know about the design and understand the working of oscillators and tuned amplifiers.

Course Outcomes:

After completion of the course, students will be able to

- Understand to design and construct simple power supplies and transistor biasing networks.
- Familiarized with design and analysis of power amplifier and feedback amplifiers.
- Gain better idea about oscillators and tuned amplifiers.

Course Description :

Rectifier - rectifier parameters - Capacitor and inductor filters - series and shunt regulator- Short circuit and over load protection - Transistor Biasing circuits - small scale modelling of FET - FET biasing circuits - Single stage Amplifier - RC coupled and Transformer coupled amplifiers - Power amplifiers: Class A, AB, B and D - Feedback circuits - Differential amplifier - Barkhausen criterion - RC and LC Oscillators - Crystal Oscillators - Tuned amplifiers - Multivibrators.

References:

1. Millman .J. &Halkias.C , "Electronic Devices And Circuits", Tata McGraw Hill, 3rd Edition 2010.
2. Mathur S.P, Kulshrestha D.C., Chanda P.R., "Electronic Devices Applications and Integrated Circuits, Umesh Publications, 3rd Edition ,2004.
3. Malvino A.P., "Electronic Principles", McGraw Hill International, 7th Edition 2005.
4. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory", PHI, 11th Pearson new International Education,2013.
5. David.A.Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2010.

14EC2007 TRANSMISSION LINES AND WAVEGUIDES

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:

- To understand the fundamental concepts of transmission lines and waveguides.
- To understand the essentials of impedance matching and to calculate the impedance and admittance using the Smith chart.
- To understand mode analysis in waveguides and to apply basic electromagnetic concepts with Microwave resonators.

Course Outcomes:

After completion of the course, students will be able to

- Understand the characteristics of transmission lines.
- Acquire knowledge on impedance matching and also to calculate the impedance and admittance using the Smith chart.
- Acquire knowledge in the propagation modes of waveguides and understand the basic electromagnetic concepts with Microwave resonators.

Course Description:

Transmission Line: Fundamentals - Types - General Solution of the transmission line - T and ∏ - sections equivalent to lines - Waveform distortion - Loading - Matching - The Line at Radio Frequencies: Voltages and currents on the dissipationless line - Travelling and Standing waves - One eighth wave line - Quarter wave line - Half wave line - Circle diagram - Smith diagram and its applications - Single stub matching and double stub matching - Uniform plane wave: Waves between parallel planes of perfect conductors - Propagation of wave - Characteristics of parallel waveguide - Rectangular Waveguides: Modal propagation in rectangular waveguide - Characteristics of rectangular waveguide - Circular Wave Guides and Resonators - Microstripline - Stripline - Slot lines - Coplanar Waveguide - Fin line.

References:

1. J.D. Ryder, "Networks, Lines and Fields", 2nd Edition, PHI, New Delhi, 2009.
2. R.E. Collin, "Foundations for Microwave Engineering", McGraw-Hill, 2009.
3. David M. Pozar, "Microwave Engineering", 4th Edition, John Wiley 2013.
4. E.C. Jordan and K.G.Balmain, "Electro Magnetic Waves and Radiating System", 2nd Edition, PHI Learning, New Delhi, 2011.
5. David K.Cheng, "Field and Waves in Electromagnetism", New International edition, Pearson Education, 2013.

14EC2008 LINEAR INTEGRATED CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn IC 741 and its applications.
- To learn IC 555 and its applications.
- To learn about the ICs used in voltage regulators, PLL, ADC, DAC & to get knowledge about IC fabrication.

Course Outcome:

After completion of the course, students will be able to

- Design circuits using IC741.
- Acquire knowledge on IC 555 and its applications.
- Understand ICs used in voltage regulators, PLL, ADC & DAC & to acquire knowledge on IC fabrication.

Course Description:

Op-amp Basics - Characteristics of Op-amp - Applications - Comparators - Multivibrators - Oscillators - Active Filters - 555 Timers (Astable and Monostable operation) - Applications of 555 Timers - Voltage Regulators using IC723 - PLL - ADC - DAC - IC Fabrication (Diode, BJT, FET)

References:

1. Roy Choudhury.D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 4th Edition 2010.
2. Gayakwad.A.R., "Op-Amps & Linear IC's", PHI, 4th Edition, 2004
3. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & Linear Integrated Circuits", PHI 6th Edition, 2001.
4. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", TMH, 4th edition, 2015.
5. Millman & Halkias , "Integrated Electronics", Mc Graw Hill, 2nd edition 2010.

14EC2009 MICROPROCESSOR AND INTERFACING TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To impart the basic concepts of 8085 and 8086 microprocessors.
- To impart the basic concepts of Pentium Processors and Embedded C.
- To introduce interfacing chips, programmable peripheral chip and applications.

Course Outcomes:

After completion of the course, students will be able to

- Understands the concepts of 8085, 8086 and Pentium processors.
- Acquires programming skills in 8085 and 8086.
- Understands the interfacing concepts, Memory and I/O Interfacing and design of microprocessor based system.

Course Description:

Study of 8085 processor and 8086 - Architecture – Instruction set - Addressing Modes - Maximum and Minimum Mode - Memory and I/O interfacing - Introduction to Pentium Processors and Embedded C - Case studies (any five applications involving 8085 and 8086) – Microprocessor based System design.

References

1. Ramesh Gaonkar "Microprocessor Architecture, Programming & Applications with 8085", PENRAM International, 6th Edition, 2013.
2. D.V. Hall "Microprocessors and Interfacing" McGraw Hill Education (India) Private Limited, 3rd Edition, 2012.
3. Rafiquzzaman.M."Microprocessor Theory and Applications - Intel and Motorola", PHI, 2007.
4. Walter A. Triebel, Avatar Singh, "The 8088 & 8086 Microprocessor, Program, Interfacing, Software, Hardware and Applications" Prentice Hall of India, Fourth Edition, 2007.
5. Barry B. Brey, "The Intel Microprocessors Architecture, Programming and Interfacing" 8th Edition, Pearson Education, 2009.
6. Daniel W. Lewis, "Fundamentals of Embedded Software: Where C and Assembly Meet" Prentice Hall, 2003.

14EC2010 LINEAR INTEGRATED CIRCUITS LAB

Credits: 0:0:2 **(Version 1.1)**

Co-Requisite: 14EC2008 Linear Integrated Circuits.

Course Objectives:

- To design basic circuits using IC741.
- To design different multi vibrators and oscillators using IC741 and IC555.
- To design and simulate the circuits.

Course Outcomes:

After completion of the course, students will be able to

- Design basic circuits using IC741.
- Design different multi vibrators and oscillators using IC741 and IC555.
- Perform software simulation of the circuits.

List of experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2011 MICROPROCESSOR LAB

Credits: 0:0:1 **(Version 1.1)**

Co-requisite: 14EC2009 Microprocessor and Interfacing Techniques

Course Objectives:

- To develop assembly level programming skills.
- To design interfacing circuits for various applications.
- To develop the programming skills to design microprocessor based applications.

Course Outcomes:

After completion of the course, students will be able to

- Develop assembly level programming skills.
- Design interfacing circuits for various applications.
- Design microprocessor based applications.

List of experiments

- The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2012 PULSE AND WAVE SHAPING CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To design various linear and non-linear wave shaping circuits.
- To design various multivibrators and triggering circuits.
- To impart knowledge about the different time based generators and Blocking Oscillators.

Course Outcomes:

After completion of the course, students will be able to

- Understand to design various linear and non-linear wave shaping circuits.
- Understand to design various multivibrators and triggering circuits.
- Gain knowledge about various time based generators and blocking Oscillators.

Course Description:

High pass and low pass RC circuits - attenuators - clippers - clamper - Bistable Multivibrator - Triggering methods - Design - Schmitt Trigger - Applications - Monostable Multivibrator - Astable Multi vibrator - General feature of a time base signal - exponential circuit - Miller and Bootstrap time base generators- Blocking Oscillators - Sampling gates.

References:

1. Millman&Taub, "Pulse Digital and Switching Waveforms", McGraw Hill, 3rd Edition 2011.
2. Suryaprakash Rao Mothiki, "Pulse and Digital Circuits", McGraw Hill, 3 rd Edition 2010.
3. Thomas L. Floyd, "Electronic Devices", 9th Edition, Pearson Education, 2011.
4. David A Bell, "Solid State Pulse Circuits", PHI, Fourth Edition, 2005.
5. Millman.J&Halkias. C, " Electronic Devices & Circuits", Tata McGraw Hill, 2007.

14EC2013 COMMUNICATION THEORY AND SYSTEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To impart the basic concepts of communication system, transmitter and receiver.
- To understand analog modulation and demodulation techniques.
- To analyze the adverse effect of noise on signals.

Course Outcomes:
After completion of the course, students will be able to
- Understand the basic concepts of communication system, transmitter and receiver.
- Acquire knowledge on different modulation and demodulation techniques.
- Analyze the influence of noise on communications signals.

Course Description:
Communication system block diagram - Need for modulation, Need for wireless communication - Types of modulation - Amplitude modulation, Double sideband suppressed carrier system, Single sideband suppressed carrier system, AM power calculation, AM with a complex wave, Low level and High level modulation - AM generation and detection - Double sideband suppressed carrier - generation and detection - Vestigial side band - Frequency modulation: FM generation and Detection - Phase modulation - AM Transmitter, AM Receiver - SSB Transmitter, ISB Transmitter, FM Transmitter, FM Receiver - Noise and Interference analysis: Signal to Noise Ratio calculation of AM, DSB-SC and SSB-SC, Signal to Noise Ratio calculation of FM Receiver.

References:

1. Anokh Singh, A.K.Chhabra,"Principles of Communication Engineering", S.Chand Co.,7th Edition, 2013.
2. Dennis Roddy & John Coolen, "Electronic Communication", Pearson Education Limited, 4th Edition, 2012.
3. G.Kennedy, "Electronic Communication Systems", McGraw Hill, 5th Edition, 2012.
4. Taub and Schilling , "Principles of Communication Systems", McGraw Hill, 3rd Edition, 2008.
5. Simon Haykins, Michael Moher, "Communication Systems", John Wiley & Sons, New Jersey, 5th Edition, 2009.

14EC2014 DIGITAL SIGNAL PROCESSING

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:
- To impart basic knowledge about digital signal processing.
- To understand Digital (IIR and FIR) filter design procedures.
- To know about the finite word length effects and PDSPs.

Course Outcomes:
After completion of the course, students will be able to
- Understand the importance and basics of digital signal processing.
- Understand Digital (IIR and FIR) filter design procedures.
- Apply the signal processing concepts practically with the help of finite word length effects and PDSPs.

Course Description:
Circular Convolution and sectioned convolution, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations-

Impulse Invariant and Bilinear Transformation. Design of FIR Digital filters: Window method, frequency sampling Method. Effect of finite register length in DSP. Adaptive Filter: Basics of Wiener and LMS – PDSPs. Applications of DSP – Case studies.

References:

1. John G Proakis and Manolakis, “Digital Signal Processing Principles, Algorithms and Applications”, Pearson, 4th Edition, 2007.
2. Emmanuel C. Ifeacher and Barrie W. Jervis, “Digital Signal Processing – A Practical Approach”, Wesley Longman Ltd., 2nd Edition, 2004.
3. Sanjit K.Mitra, “Digital Signal Processing - A Computer Based Approach”, Tata McGraw-Hill, New Delhi, 2nd Edition, 2001.
4. Johny R. Johnson, “ Introduction to Digital Signal Processing”, PHI, 2006.
5. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, “Digital Signal Processing”, McGraw Hill International, 2007.
6. Venkatramani B, M. Bhaskar, “Digital Signal Processors Architecture, Programming and Applications”, Tata McGraw – Hill Publishing Company Limited, New Delhi, 2002.

14EC2015 MICROCONTROLLER AND ITS APPLICATIONS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the basic concepts of 8-bit microcontroller (8031&8051) and 8-bit PIC microcontroller.
- To interface the peripheral devices to the microcontrollers.
- To write assembly language programs and Embedded C in 8031&8051 and PIC.

Course Outcomes:

After completion of the course, students will be able to

- Understand the basic concepts of 8-bit microcontroller (8031&8051) and 8-bit PIC microcontroller.
- Gain knowledge to interface the peripheral devices to the microcontrollers.
- Acquire programming skills in 8031 & 8051 and PIC.

Course Description:

Organization of 8031 and 8051 microcontrollers - I/O ports - External memory - Interrupts - Assembly language programming - Counter and Timers – Serial data input and output- PIC - Program memory - CPU Registers - Register file structure - Block diagram of PIC18Fxx - I/O Ports - Timers 0, 1 and 2 features - Interrupt Logic - Serial Peripheral Interface - I^2C Bus – ADC – UART - PIC family parts. Simple applications - Keyboard interfacing – ADC - Sensor interfacing and Signal conditioning. (Zigbee Module, GSM Module, GPS Module- Interfacing with Controller)- Interface with latest chip (RTC)

References

1. Kenneth J.Ayala, “The 8051 Microcontroller Architecture, Programming & Applications” Penram International publishing,2008.
2. Muhammad Ali Mazidi, J.G.Mazidi, R.D.Mckinlay, “The 8051 Microcontroller and Embedded Systems Using Assembly and C” 2nd Edition Prentice Hall-2008.
3. John B Peatman, “Design with PIC Micro Controllers”, Pearson Education India Series, New Delhi, 2005.
4. 4.Muhammad Ali Mazidi, Rolin McKinlay, Danny cause, “PIC Microcontroller and
5. Embedded Systems”, 1st Edition Pearson India, 2008

6. Rafiquzzaman.M. " Microcontroller Theory and Applications with the PIC18F" 1st Edition, Wiley Publisher, 2011.
7. Ajay V Deshmukh, "Microcontrollers: Theory and Applications" Tata McGraw Hill, Sixth Reprint 2007.
8. Michael J.Pont, "Embedded C", 1st Edition Pearson India, 2007

14EC2016 CAD FOR ELECTRONICS ENGINEERS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To provide an introduction to the fundamentals of Computer-Aided Design tools for the modelling, design, analysis, test, and verification of digital systems, Xilinx, LabVIEW, MATLAB and PCB design.
- To design, code and test programs that meet requirements expressed by engineers. This includes a basic understanding of top-down design.
- To illustrate the role of computer programming in solving engineering problems.

Course Outcomes:

After completion of the course, students will be able to

- Working familiarity with GUI and advanced features in MATLAB.
- Do graphical code that can solve the engineering problems – LabVIEW & PCB
- Have a working familiarity with XILINX

Course Description:

XILINX: Introduction- Programming basics (Verilog)- Data types and operators - Different types of modelling - Control statements - loop statements-decision statements - User defined functions - Switch level modelling – Logic level synthesis in Verilog – Floor Planning – Routing; **Introduction to MATLAB:** SIMULINK- Sampling- Analog modulation-Pass band Digital transmission – GUI in MATLAB; **LabVIEW:-**Build VI-Create Sub VI- arrays manipulation, loops and case structures; **PCB:** Design using eagle-circuit schematic design – PCB layout design - CAD modelling in PCB; **Advanced MATLAB:** Classes and Objects – Constructors – Inheritance – Cell arrays & Structure arrays - Sorting and Searching.

References::

1. C. F. Van Loan and K.-Y. D. Fan. , "Insight Through Computing: A Matlab Introduction to Computational Science and Engineering" , SIAM Publication, 2009.
2. Brian R. Hunt,Ronald L. Lipsman,Jonathan M. Rosenberg, "A Guide to MATLAB, for Beginners and Experienced Users"
3. G.DeMicheli," Synthesis and Optimization of Digital Circuits", McGraw-Hill, 1994.
4. T.R. Padmanaban,"Design through Verilog HDL", Wiley Interscience, IEEE Press, 2004.
5. Won.Y.Yang, Yong.S.Cho, Won.G.Jeon., Jeong.W.Lee, Jong.H.Paik, Jaekwon Kim, Mi-Hyun Lee, Kyu. I.Lee, Kyung.W.Park, Kyung.S.Woo, "MATLAB/Simulink for Digital Communication", Hongrung Publishing, 2012.

14EC2017 ELECTRONICS AND COMMUNICATION LAB

Credits: 0:0:2 **(Version 1.1)**

Co-requisite: 14EC2012 Pulse and Wave Shaping Circuits,
14EC2013 Communication Theory and Systems

Course Objectives:

- To design wave shaping circuits.
- To design multivibrator circuits.

- To analyze the different types of modulation and demodulation techniques.

Course Outcomes:
After completion of the course, students will be able to

- Design various wave shaping circuits.
- Design various multivibrator circuits.
- Analyze the different types of modulation and demodulation techniques.

Experiments: The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2018 DIGITAL SIGNAL PROCESSING LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2014 Digital Signal Processing

Course Objectives:

- To gain knowledge in DSP applications like FIR,IIR filters and FFT
- To gain knowledge on ADSP BS533
- To gain knowledge on Texas instrument TMS320C6416/6713 DSK.

Course Outcomes:
After completion of the course, students will be able to

- Apply the knowledge in real time DSP applications like FIR,IIR filters and FFT
- Gain practical knowledge on ADSP BS533 and apply in signal processing applications.
- Gain practical knowledge on Texas instrument TMS320C6416 /6713 DSK and apply in signal processing applications.

Experiments: The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2019 MICROCONTROLLER LAB

Credits: 0:0:1 **(Version 1.1)**
Co-requisite: 14EC2015 Microcontroller and Its Applications

Course Objectives:

- To impart knowledge about programming using microcontrollers.
- To improve the programming skills.
- To develop the skills in designing application oriented projects.

Course Outcomes:
After completion of the course, students will be able to

- Perform assembly level programming and Embedded C.
- Improve the programming skills.
- Develop skills in designing projects and get confidence to work in core companies.

Experiments:
The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2020 ANTENNA THEORY AND WAVE PROPAGATION

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:

- To understand fundamental parameters in an antenna.
- To analyse the radiation pattern of an antenna types
- To familiarise on various antenna types and wave propagation.

Course Outcomes:

After completion of the course, students will be able to

- Acquire knowledge on the basic terminology and parameters in an antenna.
- Obtain the field distributions of different kinds of antenna
- Design antenna with patterns and concepts of radio wave propagation

Course Description:

Review of antenna theory - dipoles, monopole and loop antennas - linear and planar arrays - array synthesis - phased arrays - helical antennas - radiation from apertures - aperture distribution- horn and parabolic dish antennas - Yagi - Uda and log-periodic antennas-microstrip antennas and arrays - Dielectric Antennas - Ground Wave - Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction-Wave propagation in complex environments, Tropospheric Propagation, Tropospheric scatter. Ionospheric propagation: Structure of ionosphere, Sky waves, skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects of earth's magnetic fields, Faraday rotation, Whistlers.

References:

1. J.D. Karus, "Antennas theory and its application", McGraw Hill, 2007.
2. E.C.Jordan and Balmain, "Electromagnetic waves and Radiating Systems", Pearson Education / PHI, 2006
3. Balanis, "Antenna Theory - Analysis and Design", John wiley, 2010(reprint)
4. R.E. Collin, "Antennas and Radiowave Propagation", McGraw Hill, 1985.

14EC2021 DIGITAL COMMUNICATION

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:

- To study the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To learn various base band transmission schemes
- To understand various coding and spread spectrum techniques.

Course Outcomes:

After completion of the course, students will be able to

- Understand various base band transmission schemes
- Analyze the spectral characteristics of band pass signalling schemes.
- Acquire knowledge on error control coding and spread spectrum techniques.

Course Description:

Basic building blocks of Digital communication System - Analog versus Digital communication - Sampling - Quantization - PCM - Delta modulation - ISI and Nyquist criterion - Phase shift keying schemes - Generation, detection, signal space diagram, bit error probability and power spectra - QAM, MSK -

Source Coding - Shannon's Theorem - Linear block code, cyclic and convolutional code generation - Spread spectrum techniques

References

1. Bernard Sklar, "Digital Communications, Fundamentals and Applications" Pearson Education Asia, 2nd Edition, 2009.
2. Simon Haykins, "Digital Communication" John Wiley, 4th Edition, 2006 (Reprint 2010).
3. Taub& Schilling, "Principles of Digital Communication" Tata McGraw-Hill 28th Reprint, 2003.
4. J.G.Proakis, "Digital Communication", 5th Edition, Tata MC Graw Hill Company, 2001.
5. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd edition, Oxford University Press 2007.

14EC2022 MICROWAVE AND OPTICAL COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the various microwave components.
- To know about the operation of microwave vacuum tubes and solid state devices.
- To get familiarized with the optical transmitter and receiver.

Course Outcomes:

After completion of the course, students will be able to

- Study the characteristics of various microwave components and to implement various applications.
- Analyze the difference between microwave vacuum tube and solid state devices through its operation and working principles.
- Understand various types of optical transmitters and receivers and also understand the concept of optical fiber and its applications.

Course Description:

Microwave passive devices with scattering matrix - Microwave vacuum tube devices and microwave solid state devices - mechanism of operation and applications - microwave amplifiers: parametric and Travelling Wave Tube Amplifier - Microwave Diodes: GUNN, IMPATT, TRAPATT, BARITT - microwave power measurements

Optical communication: types of fibers and its effects - types of optical transmitters and receivers with mode of operation and applications.

References:

1. Samuel.Y.Liao, "Microwave Devices and Circuits", Prentice Hall of India, 3rd Edition, 2008.
2. Keiser.G., "Optical Fiber Communications", McGraw Hill, 3rd edition, 2000.
3. Annapurna Das, Sisir K. Das, "Microwave Engineering", Tata McGraw Hill., 3rd Edition, 2001.
4. Gower.J, "Optical Communication Systems", Prentice Hall, 2nd edition, 2001.
5. John Senior, "Optical Communications" Prentice Hall India, 3rd Edition, 2009.

14EC2023 ADVANCED COMMUNICATION LAB

Credits: 0:0:2 **(Version 1.1)**

Co-requisite: 14EC2020 Antenna Theory and Wave Propagation,
14EC2021 Digital Communication

Course Objectives:
- To determine the radiation pattern of different antenna.
- To analyze the characteristics of different transmission lines.
- To analyze the performance of different digital modulation techniques.

Course Outcomes:

After completion of the course, students will be able to
- Determine the radiation pattern of different antenna.
- Analyze the characteristics of different transmission lines.
- Analyze the performance of different digital modulation techniques.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2024 MICROWAVE AND OPTICAL COMMUNICATION LAB

Credits: 0:0:2 **(Version 1.1)**

Co-requisite: 14EC2022 Microwave and Optical Communication

Course Objectives:
- To learn the characteristics of microwave sources.
- To analysis scattering parameters, VSWR, Coupling of microwave signals.
- To gain knowledge in optical sources and detectors, transmission of signals through optical fiber.

Course Outcomes:

After completion of the course, students will be able to
- Understand the characteristics of microwave sources.
- Understand about Coupling of Microwave signals.
- Understand optical sources and detectors, transmission of signals through optical fiber

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2025 COMPUTER COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand protocol architecture for wired and wireless network.
- To familiarize with different local area networks.
- To understand routing, transport and application layer protocols.

Course Outcomes:

After completion of the course, students will be able to
- Understand protocol architecture for wired and wireless network.
- Familiarize on different local area networks.

- Understand routing, transport and application layer protocols.

Course Description:
Protocols - OSI model – TCP / IP protocol suite - Transmission media - Switching - Modem -Data link control - Wired LANS - Wireless LANS – ATM - Logical addressing - Internet Protocols - IPv4 - IP addressing – Subnetting - IPv6 - Routing protocols - UDP - TCP - SCTP -Congestion Control – Quality of services - Domain Name System (DNS) – E-mail – SMTP - FTP – WWW – HTTP.

References:

1. Behrouz A. Foruzan,“Data Communication and Networking”, Tata McGraw-Hill, 4th Edition, 2006.
2. Andrew S. Tannenbaum, “Computer Networks”, Pearson Education, 5th Edition, 2011.
3. Wayne Tomasi,“Introduction to Data Communication and Networking”, Pearson Education, 2007.
4. William Stallings,“Data and Computer Communication”, Eighth Edition, Pearson Education, 2007.
5. Fred Halsall,“Multimedia Communications, Applications Networks Protocols and Standards”, Pearson Education, Asia 2002.

14EC2026 ADVANCED MICROPROCESSOR ARCHITECTURE

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To impart knowledge in advanced microprocessors
- To impart knowledge of multiprocessors
- To train the students towards various architectures of advanced microprocessors

Course Outcomes:
After completion of the course, students will be able to
- Acquired Knowledge on the different types of advanced microprocessors
- Gained knowledge on the various techniques employed in various architectures
- Use the knowledge gained to select suitable microprocessor for practical application

Course Description:
Fundamentals of Computer Design - Instruction-Pipelining - Difficulties In Implementing Pipelines - Extending the Pipeline to Handle Multicycle Operations - Instruction Set Design And Pipelining - Parallel Computer Models And Instruction Level Parallelism-Issues in The Memory Hierarchy Design - Multiprocessors-Advanced Processors - CISC Scalar Processors, RISC Scalar Processors, Superscalar Processors, VLIW Architectures, Vector And Symbolic Processors

References:

1. Kai Hwang, “Advanced computer architecture”, McGraw Hill Education, 2nd Edition, 2010.
2. D. A. Patterson and J. L. Hennessey, “Computer organization and design,” Morgan Kaufmann Publication, 5th Edition, 2014.
3. J.P.Hayes, “Computer Architecture and organization”, MGH,1998.
4. Harvey G.Cragon, “Memory System and Pipelined processors”, Narosa Publication,1998.
5. Mano, M M., "Computer system Architecture", Prentice Hall of India, 3rd Edition, 2001.

14EC2029 EMBEDDED SYSTEM DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the basic concepts of Embedded System.
- To acquire Knowledge in practical embedded system, basic programming languages and tools.
- To explore the potential areas utilizing embedded processors in practical systems

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge about the hardware requirements using Embedded System
- Do basic programming using Software tools of embedded system
- Acquire knowledge to design an embedded project

Course Description:

Introduction to Embedded Systems- Embedded Design Life cycle- Programming embedded systems in C - Hardware Interfacing Techniques with embedded C programming - Serial Communication, RTC and EEPROM interface, Relay, Stepper and DC motor; Software Development tools and Programming Techniques – IDE - Timer Programming - Serial port programming - Getting Embedded Software into Target System Debug Kernels, Real Time Operating System

References:

1. Arnold Berger, "Embedded System Design: An Introduction to Processes, Tools, and Techniques", CMP Books, 2001.
2. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems", Second Edition, Prentice Hall, Inc.2006.
3. David E Simon, "An Embedded Software Primer", Pearson Education Asia, 2006.
4. Rajkamal, "Embedded Systems: Architecture, Programming and Design", Tata McGraw Hill, 2003.
5. Wayne Wolf, "Computers as Components", Morgan Kaufmann Publishers, 2005.
6. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", Second Edition, Tata McGraw-Hill Edition, 2001.

14EC2030 ARM PROCESSORS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To impart basic knowledge about architecture of ARM processor.
- To get familiarized with the instruction sets in ARM processors
- To explore the necessity of ARM processors in real time applications

Course Outcomes:

After completion of the course, students will be able to

- Understand the architecture of ARM Processors.
- Knowledge of software needed for ARM.
- Understand the application of ARM processors for a variety of real time applications.

Course Description:

CISC AND RISC Architecture– Block diagram-Introduction to ARM7/ARM9 and ARM extensions – Pipelines – Memory - Architecture – Memory interfacing – Bus architecture Programming in assembly language (ALP) – The **ARM** instruction set – Introduction to ARM thumb – Thumb Programmes model –

ARM/Thumb inter working- Data Types- Abstraction in software Design–Expressions – Loops – Functions and Procedures – Conditional Statements –Use of Memory. Memory Size and Speed – On Chip Memory – Caches – Cache Design–Protection Unit Registers – ARM Protection Unit – CP15 MMU Registers –ARM MMU Architecture Synchronization–Context Switching Input and Output. DSP and embedded Applications.

References:

1. SteveFurber, "ARM System on Chip Architecture", Addison Wesley Professional, Second Edition, Aug 2000.
2. Andrew NSloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide, Designing and Optimizing System Software", Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, "Design of System on a Chip: Devices and Components", Springer FirstEdition, July 2004.
4. Jason Andrews, "Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)", Newnes, Aug 2004.
5. Rashinkar P, Paterson and Singh L, "System on a Chip Verification – Methodologies and Techniques", Kluwer Academic Publishers, 2001.

14EC2031 ARM LAB

Credits: 0:0:2 **(Version 1.1)**

Co-Requisite: 14EC2030 ARM Processors

Course Objectives:

- To explore the necessity of ARM Processor in practical applications
- To improve the programming skills
- To encourage the students to have innovative ideas of their own

Course Outcomes:

After completion of the course, students will be able to

- Use ARM processor for real time applications.
- Improved programming skills
- Understand the need for ARM processor in practical applications

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2032 TESTING FOR EMBEDDED SYSTEM

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To expose students to various techniques of testing for embedded system
- To impart knowledge about testing in embedded system.
- To explore the potential areas in Embedded system.

Course Outcomes:

After completion of the course, students will be able to

- Obtain in depth knowledge in various testing techniques of embedded system.
- Obtain in depth knowledge in various testing techniques of embedded system.
- Understand different types of faults.

Course Description:
Physical faults and their modeling- Fault equivalence and dominance- fault collapsing- Fault simulation: parallel, deductive and concurrent techniques; critical path tracing- Test generation for combinational circuits: Boolean difference, D-algorithm, Podem, etc. Exhaustive, random and weighted test pattern generation; aliasing and its effect on fault coverage. PLA testing: cross-point fault model, test generation, easily testable designs. Memory testing: permanent, intermittent and pattern-sensitive faults; test generation. Delay faults and hazards; test generation techniques. Test pattern generation for sequential circuits: time-frame expansion method, ad-hoc and structures techniques scan path and LSSD, boundary scan. Built-in self-test techniques. Testing issues in embedded core based systems.

References:

1. N. K. Jha and S. Gupta, "Testing of Digital Systems", Cambridge University Press,2003
2. M. L. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing", Kluwer Academic Publishers,2000
3. M. Abramovici, M. A. Breuer and A. D. Friedman, "Digital Systems Testing and Testable Design", Wiley-IEEE Press,1994
4. P. H. Bardell, W. H. McAnney and J. Savir, "Built-in Test for VLSI: Pseudorandom Techniques", Wiley Interscience,1987.
5. P. K. Lala, "Fault Tolerant and Fault Testable Hardware Design", Prentice-Hall,1985.
6. A. Krstic and K-T Cheng, "Delay Fault Testing for VLSI Circuits", Kluwer Academic Publishers,1998.

14EC2033 EMBEDDED LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2029 Embedded System Design

Course Objectives:
- To develop programming skills in Embedded C
- To understand interfacing concepts in Embedded C programming
- To test a embedded system based on test inputs provided

Course Outcomes:
After completion of the course, students will be able to
- Able to write an Embedded C program
- Able to incorporate interfacing concepts in the Embedded C program
- Able to test an embedded system based on the test inputs provided

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2034 FAULT TOLERANT TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To teach the basic principles, concepts of fault tolerant strategies
- To impart knowledge about fault tolerance in distributive system
- To provide understanding about different fault tolerant scheduling algorithms

Course Outcomes:
After completion of the course, students will be able to
- Gain knowledge about the different evaluation techniques and about fault tolerance in real time systems

- Use different tools like HIMAP for analyzing evaluation techniques
- Create understanding of the fundamental concepts of fault-tolerance

Course Description:
Dependability concepts - dependability measures - classification of faults and failures; Fault tolerant strategies- Fault detection and recovery; Fault tolerant design techniques-Hardware, software redundancy and information redundancy Fault tolerance in distributed systems- check pointing and recovery, stable storage and RAID architectures, and data replication and resiliency. Dependability evaluation techniques and tools - Fault trees, Markov chains; HIMAP tool. Analysis of fault tolerant hardware and software architectures. Fault tolerance in real-time systems - Time-space tradeoff, fault tolerant scheduling algorithms

References:

1. Palmer,J.E., Perlman, D.E., "Introduction to Digital Systems", McGraw Hill Book Company, International Student Edition, 1993.
2. Nelson, V.P., Nagale H.T., Carroll, B.D., and Irwin J.D., "Digital Logic Circuit Analysis and Design", Prentice Hall International, Inc., New Jersey, 1995.
3. John V. Oldfield and Richard C.Dorf, "Field Programmable Gate Arrays: Reconfigurable Logic for Rapid Prototyping and Implementation of Digital Systems", John Wiley, 1995.
4. D.K.Pradhan, "Fault Tolerant Computing - Theory and Techniques" Vol.I & II, Prentice Hall, 1986
5. "Programmable Logic Devices Databook and Design Guide" National Semiconductors, 1989
6. Navabi, Z., "VHDL : Analysis and Modelling of Digital Systems", Prentice Hall Inc., 1989.
7. David Pellerin, Douglas Taylor, "VHDL Made Easy" Prentice Hall Inc., 1997.

14EC2035 PCB DESIGN LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2001 Digital Electronics

Course Objectives:
- To familiarize the design of simple circuits using PCB
- To improve the knowledge on circuits design
- To encourage the students to have innovative ideas of their own

Course Outcomes:
After completion of the course, students will be able to
- Emulate PCBs for simple electronic circuits.
- Gain knowledge in electronic circuit design
- Design electronic circuit for practical applications.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2037 TELECOMMUNICATION SWITCHING NETWORKS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the fundamentals of a telecom switching office, such as digital multiplexing, digital switching and digital subscriber access.
- To gain knowledge on the mathematical model for the analysis of telecommunication traffic.
- To learn ISDN, DSL / ADSL, and fiber optic systems in subscriber loop.

Course Outcomes:

After completion of the course, students will be able to

- Understand the fundamentals of a telecom switching office, such as digital multiplexing, digital switching and digital subscriber access.
- Acquire knowledge on the mathematical model for the analysis of telecommunication traffic.
- Learn ISDN, DSL / ADSL, and fiber optic systems in subscriber loop.

Course Description:

Multiplexing - FDM – TDM - Digital Transmission and Multiplexing - SONET/SDH : SONET Multiplexing overview, SONET optical standards - SONET networks – SONET rings. Digital Switching - Space Division Switching, Time Division Switching - STS Switching, TST Switching, Digital Cross - Connect Systems - Network Synchronization Control and Management -Timing Recovery - Timing Inaccuracies - Network Synchronization, Network Control, Network Management. Digital Subscriber Access - ISDN U Interface, ISDN D Channel Protocol - High-Data - Rate Digital Subscriber Loops - Digital Loop Carrier Systems -Voice band Modems. Traffic Analysis - Traffic Characterization - Network Blocking Probabilities-Delay Systems.

References:

1. J. Bellamy, “Digital Telephony”, John Wiley, 3rd Edition, 2003.
2. R.A.Thomson, “Telephone Switching Systems”, Artech House Publishers, 2000.
3. W. Stalling, “ Data and Computer Communications” Prentice Hall, .2007
4. T.N.Saadawi, M.H.Ammar, A.E.Hakeem, “Fundamentals of Telecommunication Networks”, Wiley Interscience, 1994.
5. W.D. Reeve, “Subscriber Loop Signaling and Transmission Hand book”, IEEE Press(Telecomm Handbook Series), 1995.
6. Viswanathan. T., “Telecommunication Switching System and Networks”, Prentice Hall of India Ltd., 1994.

14EC2038 CELLULAR MOBILE COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the state of art techniques in wireless communication.
- To learn the fundamental and emerging trends in Mobile Communication, wireless network/protocol architecture and broadcast system.
- To analyze the various wireless protocol architecture.

Course Outcomes:

After completion of the course, students will be able to

- Understand the state of art techniques in wireless communication.
- Learn the fundamental and emerging trends in Mobile Communication, wireless network/protocol architecture and broadcast system.
- Analyze the various wireless protocol architectures.

Course Description:
Wireless Transmission - Signal Propagation - Multiplexing and Modulation - Cellular System -Multiple Access Techniques - Evolution of mobile communication and radio system – cellular concept – frequency reuse – channel assignment – co-channel interference – hand off –interference & system capacity - Telecommunication and basics of Satellite System- Broadcast System and Radio transmission concepts - Wireless ATM services and functions – Routing Protocol

References:

1. William Y. Lee, "Cellular Mobile Communication, Analog And Digital", Tata Mc GrawHill, 1998.
2. Rappaport T.S, "Wireless Communication" Pearson Education, 2003.
3. Jochen Schiller, "Mobile Communications", Addison Wesley Publishers, 2003.
4. Yi-Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architecture",John Wiley and Sons, New Delhi, 2nd Edition, 2001.
5. Feher K., "Wireless Digital Communications", Prentice Hall of India Pvt. Ltd., New Delhi,1999.

14EC2039 MOBILE COMPUTING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To familiarize with the basics of various mobile standards and generation.
- To understand the basics concepts of 4G Networks
- To understand the basic concepts of 4G mobile application development.

Course Outcomes:
After completion of the course, students will be able to
- Understand the various mobile standards and generation.
- Acquire knowledge on basics concepts of 4G Networks
- Understand the basic concepts of 4G mobile application development.

Course Description:
Standards for voice oriented data communication - Standards for data and voice Communication- Mobile computing architecture - data dissemination - mobility management - Walsh codes - IS-95 CDMA One System – WCDMA 3G standards - CDMA2000 3G standards -OFDM - packet delivery and handover management - location management – registration - tunneling and encapsulation - route optimization - super 3G and Pre-4G-3GPP LTE and Wi Max 802.16e standard - features of 4G - LTE advanced and advanced Wi Max 802.16m - mobile computing novel applications – limitations - mobile application languages-XML and JAVA, mobile application development platforms.

References:

1. Raj Kamal, "Mobile Computing", Oxford University Press, Second edition, 2012.
2. Kumkum Garg, "Mobile Computing- Theory and Practice", Pearson, 2010.
3. William Y.Lee, "Cellular Mobile Communication, Analog and Digital" Tata McGraw Hill, 1998.
4. Rappaport T.S, "Wireless Communication" Pearson Education, 2003.
5. Yi-Bing Lin and Imrich Chlamtac, "Wireless and Mobile Network Architecture", John Wiley and Sons, New Delhi, 2nd Edition, 2001.

14EC2041 HIGH SPEED NETWORK

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To gain knowledge on ATM and Frame relay.
- To acquire knowledge on the survey of developments in High Speed Networks.
- To understand and analyze the techniques involved to support real-time traffic and congestion control.

Course Outcomes:
After completion of the course, students will be able to
- Familiar on ATM and Frame relay.
- Understand the developments in High Speed Networks.
- Synthesize protocols for quality of service (QoS) to different applications.

Course Description:
Frame relay networks – asynchronous transfer mode – architecture, logical connection – cell and service categories – High Speed LANs : fast Ethernet and gigabit Ethernet - fiber channel – Wireless LANs: applications and architecture of 802.11 - queuing analysis - queuing models – Single Server Queues – traffic management – congestion control in packet switching networks – frame relay congestion control - TCP flow control – TCP congestion control – retransmission – timer management – exponential RTO back off – KARN's Algorithm – performance of TCP over ATM - ABR traffic management – ABR rate control - RM cell formats - ABR capacity allocations - RSVP – goals, characteristics, data flow, operations, protocol mechanisms – Multiprotocol Label Switching – operations, label stacking, protocol details – RTP – protocol architecture.

References:

1. William Stallings, "High Speed Networks and Internet", Pearson Education, Second Edition, 2002.
2. Warland, Pravin Varaiya, "High Performance Communication Networks", Second Edition, Jean Harcourt Asia Pvt. Ltd., 2001.
3. IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN Architecture", CISCO Press, Volume 1 & 2, 2012.
4. Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004.
5. William Stallings, "ISDN and Broadband ISDN with Frame Relay and ATM", Pearson Education, Fourth edition, 2001.

14EC2042 ROUTING ALGORITHMS FOR WIRELESS MOBILE NETWORK

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To provide in depth knowledge on the design of routing algorithm.
- To understand and analyze the various topologies based routing algorithms.
- To design an efficient routing algorithm for a highly dynamic wireless environment.

Course Outcomes:
After completion of the course, students will be able to
- Familiar with the design of routing algorithms.
- Synthesize the various topologies based routing algorithms.
- Design an effective routing algorithm for a highly dynamic wireless environment.

Course Description:
Introduction to routing in mobile networks- routing strategies – choices – types - Power aware routing metrics - Dominating set based routing - Geometric routing - Delaunay triangulation -Self organized routing - Tree based multicast routing protocol - Mesh based multicast routing protocol - Energy efficient multicasting - Routing in Hybrid Wireless Networks - Preferred ring based routing schemes for load balancing - Clustering - Performance metrics and analysis – Graphs - sub graphs – topology - Planar graph - Directed graph - Critical transmission range - transmission range based topology – RNG – LMST – DLEDSR - network synthesis – presentation.

References:

1. Ivan Stojmenovic, "Hand book of Wireless Networks and Mobile Computing", John Wiley & Sons, Inc, 2003
2. Siva Ram Murthy. C and Manoj. B.S, "Ad Hoc Wireless Networks: Architectures and protocols", Prentice Hall PTR, 2004.
3. Miguel Labrador, Pedro Wightman, "Topology Control in Wireless Sensor Networks-with a companion tool for Teaching and Research" Springer Science, 2009.
4. Sudip Misra, Issac Woungang, Subhas Chandra Misra, "Guide to Wireless Ad Hoc Networks", Springer Verlag London Ltd, 2009.
5. Iti Saha Misra, "Wireless Communications and Networks – 3G and Beyond", Tata McGraw Hill, 2013.

14EC2043 ADVANCED DIGITAL COMMUNICATION SYSTEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objective:
- To understand basic concepts of coherent and non-coherent receivers
- To learn band limited channels.
- To understand the performance of various equalizers.

Course Outcomes
After completion of the course, students will be able to
- Design optimal coherent and non-coherent receiver
- Acquire knowledge on various types of channels.
- Analyze the performance of various equalizers.

Course Description:
Digital Baseband transmission - Coherent receivers - Optimum receivers in WGN - IQ modulation & demodulation - Non coherent receivers in random phase channels - MFSK receivers - Partially coherent receivers - Bandlimited channels and Digital Modulation - Communication Channel properties- baseband equivalent channel - Subscriber loop channel - line of sight radio channel - mobile radio channel - WLAN channel - HF Channel - Optical fibre Channel - channel with ISI as a finite state machine - equalizer - types - adaptive equalization algorithms - equalizers for MIMO systems - PLL for continuous signals - PLL for sampled signals - Maximum likelihood carrier phase estimation.

References:

1. Krzysztof Wesolowski , "Introduction to Digital Communication Systems", John Wiley & Sons, Ltd, 2009 (Reprint 2012).
2. Taub& Schilling, "Principles of Digital Communication", Tata McGraw-Hill, 28th Reprint, 2003.
3. Bernard Sklar, "Digital Communications, Fundamentals and Applications" Pearson Education Asia, 2nd Edition, 2009.

4. Upmanynu Madhow, "Fundamentals of Digital Communication", Cambridge University Press, 2009.
5. John.B. Anderson, "Digital Transmission Engineering", Wiley India Pvt. Ltd, 2012.

14EC2044 FUNDAMENTALS OF WIRELESS COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To introduce the concepts and history of wireless communication
- To know about the various propagation methods and channel models
- To enhance the understanding of channel models and capacity analysis

Course Outcomes:
After completion of the course, students will be able to
- Learn the concepts and history of wireless communication.
- Acquire knowledge about the various propagation methods and channel models
- Have an enhanced understanding of channel models and capacity analysis

Course Description:
Overview of Wireless systems - History of wireless communications - wireless vision - technical issues - current wireless systems - wireless spectrum - Methods for spectrum allocation - spectrum allocations for existing systems - Cellular design fundamentals - path loss and shadowing - free space path loss – Two ray model - simplified path loss - shadow fading - outage probability - Statistical multipath channel models - time varying channel impulse - Narrowband fading models - level crossing rate and average fade duration - Wideband fading models - power delay profile - coherence bandwidth - Doppler power spectrum and channel coherence - capacity of wireless channels - selective fading channels

References:
1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 5th Edition, 2015.
2. William C Y Lee, "Mobile Communications Engineering, Theory and Applications", McGraw Hill International Editions, 2nd Edition, 1998.
3. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia, New Delhi, 2nd Edition, 2002
4. David Tse and Pramod Viswanath,"Fundamentals of Wireless Communication", Prentice Hall, 2nd Edition, 2005.
5. Vijay K Garg," Wireless Communications and Networking", Elsevier-Morgan Kaufmann Publishers, Reprint 2013.

14EC2046 OPTOELECTRONICS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To gain knowledge on the basics of solid state physics and understand the nature and characteristics.
- To gain knowledge on principle of solar cells, optical detection mechanism, modulation techniques.
- To understand the optical switching and optoelectronic integrated circuits in transmitters and receivers.

Course Outcomes:
After completion of the course, students will be able to
- Acquire fundamental understanding of the basic physics behind optoelectronic devices

- Acquire detailed knowledge of solar cells and optoelectronic modulation and switching devices.
- Develop basic understanding of optoelectronic integrated circuits.

Course Description:
Elements of Light and Solid State Physics - Display Devices and Lasers-terminologies and technical concepts - Optical Detection Devices - Photo Conductors – Performance - Solar Cells -Optoelectronic Modulators - Optical Switching and Logic Devices - Optoelectronic Integrated Circuits – transmitters - Receivers and Guided wave devices

References:

1. J. Wilson and J. Haukes, "Opto Electronics –An Introduction", Prentice Hall India, Second Edition, 2003.
2. Pallab Bhattacharya, "Semiconductor Optoelectronic Devices", Prentice Hall India, Second Edition, 2002.
3. Jasprit Singh, "Opto Electronics – As Introduction to materials and devices", McGraw Hill International Edition, 1998.
4. John Gowar, "Optical Communication System", Prentice Hall India, Second Edition, 2002.
5. John. M. Senior, "Optical Fibre Communication", Pearson Education, Third Edition, 2010.

14EC2047 SOLID STATE MICROWAVE DEVICES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To model and analyze semiconductors operating at microwave frequency
- To design and analyze various microwave amplifier and oscillator using circle diagram.
- To construct microwave phase shifter, switches and mixers using diode and transistor.

Course Outcomes:
After completion of the course, students will be able to
- Knowledge in modeling microwave devices with respect to design parameters
- Designing of microwave amplifier and oscillator circuits using solid state devices
- Understanding of microwave passive component design using two terminal devices and transistors

Course Description:
Amplifiers - Microwave semiconductor devices and models; Power gain equations, stability, impedance matching, constant gain and noise figure circles; Small signal, low noise, high-power and broadband amplifier designs; Oscillators - One port, two port, YIG dielectric and Gunn-diode oscillators; Two terminal microwave devices and circuits; PIN diodes and uses as switches, phase shifters and limiters; varactor diodes, IMPATT and TRAPATT devices, transferred electron devices; Microwave BJTs. GaAs FETs, low noise and power GaAs FETs and their applications. Microwave mixers.

References

1. S.Y. Liao, "Microwave Circuit Analysis and Amplifier Design", Prentice Hall, 1987
2. G.D. Vendelin, A.M. Pavio, U.L. Rohde, "Microwave Circuit Design, Using Linear and Nonlinear Techniques", John Wiley, 1990.
3. Y. Konishi, "Microwave Integrated Circuits", Marcel Dekker, 1991.
4. Samuel.Y.Liao, "Microwave Devices and Circuits", Prentice Hall of India Pvt. Ltd., 3rd Edition, 5^{th} Reprinting, 2000.
5. Collin. R.E, "Foundation of Microwave Engineering", McGraw - Hill, II Edition, 1992.

6. Annapurna Das, Sisir K. Das, “Microwave Engineering”, Tata McGraw - Hill Co., Ltd., 1st Edition, Reprint 2001.

14EC2048 FIBER OPTIC COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn optical laws, definitions, optical fiber structures
- To gain knowledge on signal degradation, power launching and coupling in optical fibers.
- To study the operation of various optical sources and detectors

Course Outcomes:

After completion of the course, students will be able to

- Acquire knowledge in optical laws, definitions, optical fiber structures
- Gain knowledge on signal degradation, power launching and coupling in optical fibers.
- Learn the operation of various optical sources and detectors .

Course Description:

Introduction to vector nature of light, propagation of light through cylindrical dielectric rod, Ray model, wave model-types of optical fibers - Modal analysis - Signal degradation - dispersion and attenuation. Fabrication - measurement techniques - OTDR. Sources - LEDs and Lasers - Detectors – pin detectors, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.; Optical switches - coupled mode analysis of directional couplers, electro-optic switches. Non-linear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication. Optical amplifiers - EDFA, Raman amplifier and WDM systems.

References:

1. J.Keiser, “Fiber Optic Communication”, McGraw-Hill, 2nd Ed. 1992.
2. J.E. Midwinter, “Optical fiber for Transmission”, John Wiley, 1979.
3. T. Tamir, “Integrated Optics”, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
4. S.E. Miller and A.G. Chynoweth, eds., “Optical Fibres Telecommunications”, Academic Press, 1979.
5. G.Agrawal, “Non-linear Fiber Optics”, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, “Fiber Optic Communication Systems”, John Wiley and sons, 1992.

14EC2049 RADAR COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the principles of Radar.
- To understand the propagation of radio waves
- To understand the importance of radar communication in navigation.

Course Outcomes:

After completion of the course, students will be able to

- Understand the principles of Radar.
- Understand the propagation of radio waves
- Understand the importance of radar communication in navigation.

Course Description:

Basic radar - Block diagram of radar and operation - radar frequencies - applications - radar equation - detection of signals in noise - Receiver noise and Signal-to-Noise Ratio - probability density functions - probabilities of detection and false alarm - Integration of Radar pulses - radar cross section of targets – fluctuations - transmitter power - pulse repetition frequency - Antenna parameters - system losses - Doppler and MTI Radar - delay Line cancellers - staggered pulse repetition frequencies - Doppler filter banks - digital MTI processing - moving target detector - Limitations - MTI from a moving platform - Pulse Doppler radar - tracking - types - Propagation - standard and nonstandard propagation - radar antennas - radar transmitters - radar receivers - navigation methods - radio direction finding and types - radio ranges - hyperbolic systems of navigation (Loran and Decca)

References:

1. Merrill I. Skolnik," Introduction to Radar Systems", Tata McGraw-Hill, 3rd Edition, 2001.
2. Prof. A.K.Sen and Dr. A.B. Bhattacharya, "Radar Systems and Radio aids to Navigation", Khanna Publishers, sixth Edition, 2006.
3. J.C. Toomay, "Principles of Radar", Prentice Hall of India, third Edition, 2010.
4. N.S.Nagaraja, "Elements of Electronic Navigation Systems", TMH, 2nd Edition, 2001
5. Peyton Z. Peebles, "Radar Principles", John Wiley, first Edition, 2004.

14EC2050 BASICS OF SATELLITE COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the function of spacecraft subsystems and its performance.
- To learn orbital mechanics formula and tools to spacecraft mission design.
- To understand launch systems and their effect on satellite and payload design.

Course Outcomes:

After completion of the course, students will be able to

- Acquire knowledge on the functions of spacecraft subsystems and its performance.
- Apply orbital mechanics formula and tools to spacecraft mission design.
- Analyze the satellite and payload design.

Course Description:

Elements of orbital mechanics - Equations of motion – Tracking and orbit determination-Orbital Correction/control-Satellite launch systems-Multistage rocket launchers and their performance -Elements of communication satellite design - Spacecraft subsystems - Reliability considerations -Spacecraft integration Multiple access techniques - FDMA, TDMA, CDMA - Random access techniques - Satellite onboard processing-Satellite link design: Performance requirements and standards-Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite -based personal communication-Earth station design-Configuration-Antenna and tracking systems-Satellite broadcasting.

References:

1. Dennis Roddy, "Satellite Communication", Fourth Edition, McGraw-Hill, 2009.
2. John G. Proakis, Masound Salehi, "Communication System Engineering", Pearson Education Asia, Seventh Edition, 2011.
3. Simon Haykin, "Communication Systems", Wiley, 5th Edition, 2009.
4. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, 'Satellite Communication Systems Engineering', Prentice Hall, 2nd Edition, 2007.

5. M. Richharia, “Satellite Communication Systems-Design Principles”, Macmillan, 2nd Edition, 2003.
6. Michael Olorunfunmi Kolawale, “Satellite Communciation Engineering”, CRC Press, Second Edition, 2014.
7. T.Pratt, C.W.Bostain, “Satellite Communication”, Wiley India, Student-Second Edition, 2008.
8. Tri T ha, “Digital Satellite Communciation”, Tata McGraw Hill, Special Indian Edition, 2009.

14EC2051 RF CIRCUIT DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To learn the fundamentals of transmission line analysis and matching networks
- To study the RF modeling of diodes and transistors
- To study BJT and FET biasing networks

Course Outcome:
After completion of the course, students will be able to
- Acquire knowledge on fundamentals of RF circuit design
- Understand RF modeling of diodes and transistors
- Understand the importance of biasing networks in RF circuits

Course Description:
High frequency Resistors, Capacitor and Inductors –Transmission Line Analysis: Line equation, Micro strip line -Matching by Discrete Components - Design of two-component matching network, Design of T and matching network-Matching by micro strip line -Design of matching network - Design of stub matching - Components: RF Diode, RF Bipolar junction Transistor, RF field effect transistor - Modeling: Diode model, Transistor model, and FET model - Measurement of AC parameters of BJT and FET - Classes of operation and efficiency of Amplifiers - BJT biasing network - FET biasing networks.

References:
1. Reinhold Ludwig Pavel Bretchko, “RF Circuit Design” Pearson Education Asia Publication, Second Edition, 2001.
2. Matthew M. Radmanesh,“Radio Frequency and Microwave Electronics illustrated”, Pearson Education Asia, 1st Edition, 2001.
3. Peter. P Kenington, “High linearity RF Amplifier Design”, Artech House First Edition 2002.
4. Joseph. J. Carr, “Secrets of RF Circuit Design”, McGraw Hill Publishers, Third Edition, 2000.
5. Ulrich L. Rohde and David P. NewKirk, “RF / Microwave Circuit Design”, John Wiley & Sons USA First Edition, 2000
6. Roland E. Best, “Phase -Locked Loops: Design, simulation and applications”, McGraw Hill Publishers, Fifth Edition, 2003.

14EC2052 ANTENNA DESIGN LAB

Credits: 0:0:2 **(Version 1.1)**
Co-requisite: 14EC2020 Antenna Theory and Wave Propagation

Course Objectives:
- To learn the different types of antenna and its parameters.
- To develop skills on FEKO software- CAD Modeling.
- To understand microstrip lines circuits and MMICs.

Course Outcomes:
After completion of the course, students will be able to

- Acquire knowledge on the importance of antenna parameters.
- Model antenna in CAD - FEKO Tool.
- Analyze microstrip line circuits and different types of MMICs.

List of experiments

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2053 ADVANCED WIRELESS LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2038 Cellular Mobile Communication

Course Objectives:

- To simulate and study wireless fading channels and high level modulation schemes.
- To implement receiver equalizers and OFDM system.
- To implement high speed channel coders for WiMAX environment.

Course Outcomes:
After completion of the course, students will be able to

- Implement fading channels and M-ary modulation schemes for performance improvement.
- Learn all high speed filter algorithms for fast data recovery.
- Understand WiMAX infrastructure through implementation.

List of experiments

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2054 BIO MEDICAL SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the theoretical and practical aspects of Bio-medical signal processing.
- To have a better idea about biomedical devices.
- To get familiarized with the concept of wavelets and time frequency models.

Course Outcomes:
After completion of the course, students will be able to

- Learn concepts like prediction techniques and filtering.
- Understand adaptive signal processing and wavelets.
- Apply their knowledge for ECG, EEG and EMG signal processing applications.

Course Description:
Sources of bioelectric potential, resting & action potential, propagation of action potentials in nerves; ECG: Pre-processing, wave form recognition, automated diagnosis based on decision theory, EEG: Evoked responses, averaging techniques, Pattern recognition in EEG waves, EMG: Wave pattern studies, biofeedback. application of signal processing techniques such as linear prediction, lattice -filtering & adaptive signal processing; Introduction to wavelets & time frequency models and their applications to heart sounds, Fetal ECG & vesicular sound signals; Signal processing techniques for detection of pathologies in speech production system.

References:
1. E.N. Bruce, “Biomedical Signal Processing and Signal Modelling”, John Wiley and Sons, 2001.
2. W. J. Tompkins, “Biomedical Signal Processing”, Prentice Hall, 1995.
3. M. Akay, “Wavelets and Time frequency methods for Biomedical Signal Processing”, IEEE Press, 1995.
4. L. Rabinar, “Digital Processing of Speech Signals” Prentice Hall, 1978.
5. A.C. Guyton, “Human Physiology” Prism International, 1991.

14EC2055 ADAPTIVE SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To know the theoretical and practical aspects of adaptive signal processing and learning algorithms.
- To get the knowledge about the estimation theory and optimum filtering.
- To impart knowledge on linear adaptive signal processing, nonlinear adaptive signal processing, and blind adaptive techniques.

Course Outcomes:
After completion of the course, students will be able to
- Get an idea about the adaptive signal processing.
- Apply their knowledge in radar, sonar, geophysics and communication (spread spectrum techniques) applications.
- Apply their knowledge in real time applications.

Course Description:
Linear and non-linear estimation theory - Signal modelling- Optimal estimation- Constrained linear estimation- Adaptive filtering as an extension of the linear optimum filtering - Adaptive algorithms: Steepest descent algorithm- Stochastic gradient algorithm - Least Mean Square adaptation Algorithm - Normalised Least Mean Square Algorithm - Blind adaptive filtering- adaptive equalization and echo cancellation - adaptive lattice filters.

References:
1. S. Haykin, “Adaptive Filter Theory”, Pearson, 5th edition, 2014.
2. B. Widrow and S.D. Stearns, “Adaptive Signal Processing”, Pearson, 2009.
3. Ali H. Sayed, “Fundamentals of Adaptive Filtering”, John Wiley, 2003.
4. D. Manolakis, V. Ingle, S. Kogan, “Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing”, Artech House, 2005
5. J. Triechler, C. Johnson, M. Larimore, “Theory and Design of Adaptive Filters”, Prentice-Hall, 1995.
6. P. Diniz, Kluwer, “Adaptive Filtering: Algorithms and Practical Implementation”, Springer Science, 3rd edition, 2008.

14EC2056 WAVELET TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To provide the practical understanding of wavelet transforms.
- To understand the properties of wavelet transforms.
- To impart the knowledge on the concept of multi resolution transforms.

Course Outcomes:

After completion of the course, students will be able to

- Understand where Fourier transform fails and where wavelet transform is preferable.
- Identify which wavelet transform is a suitable for a particular application.
- Understand wavelet based analysis of multi scale phenomenon.

Course Description:

Continuous wavelets and Short Time Fourier Transform - Designing orthogonal wavelet systems - Discrete wavelets and relation to filter banks - Computing and plotting scaling and wavelet functions - Biorthogonal wavelets - Designing of wavelets using frequency domain approach - Wavelet packet analysis - M Band wavelets- Multiresolution transforms.

References:

1. K.P.Soman, K.I. Ramachandran and N.G. Resmi,"Insight into Wavelets from theory to practice", PHI Learning Private Limited, 2011.
2. Rao R.M and Bopardikar A.S., "Wavelet Transforms : Introduction to Theory and Applications", Pearson Education Asia, Pvt Ltd. 2008.
3. Strang G. and Nguyen T., "Wavelet Filter Banks", Wellessley Camebridge Press,1997.
4. Mallet S., "Wavelet Signal Processing", Academic Press, 1999.
5. I.Daubechies, "Ten lectures on wavelets", SIAM,1992.

14EC2058 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To impart knowledge on the fundamentals of Neural network .
- To gain understanding about Fuzzy logic.
- To get familiarized with the different architectures involved in Neural networks

Course Outcomes:

After completion of the course, students will be able to

- Apply the concepts of Neural Network and Fuzzy logic in practical applications
- Confidence to use the concept of Neural networks in medical field.
- Use the knowledge gained by practical application in companies

Course Description:

Artificial neural network – Applications - architectures- Training - McCulloch-Pitt Neuron-Backpropogation neural network - Hebb Net - Perceptron - Adaline, Associative neural network – Maxnet - Mexican hat - Hamming net - Kohonen Self_Organizing Maps, Linear Vector Quantization - Counter propagation - Adaptive Resonance Theory - Fuzzy logic basics - Defuzzification methods - Rule based systems - Applications of Fuzzy logic.

References

1. Laurence Fausett, "Fundamentals of Neural Networks, Architecture, Algorithm and Applications", Prentice-Hall, Inc, Pearson Education Asia , 4th Edition , 2008
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Mc.Graw Hill International Editions, Wiley India Pvt Ltd, 3rd Edition , 2010.
3. Phillip D. Wasserman, "Neural Computing theory and practice, Van Nostrand Reinhold", New York, 1989.
4. Jacek M. Zurada, "Introduction to Artificial Neural Networks", Jaico Publishing House, 10th Edition ,1999.
5. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic – Theory and Applications", Printice Hall of India, 2008.
6. Limin Fu, "Neural Networks in Computer Intelligence", McGraw Hill, 4th Edition, 2004.

14EC2059 OPTIMIZATION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the fundamentals of optimization techniques.
- To get the knowledge about the linear programming, unconstrained optimization, constrained optimization.
- To know about convergence and line search

Course Outcomes:

After completion of the course, students will be able to

- Apply the optimization techniques to solve optimization problems in real-time applications.
- Form novel optimization algorithm.
- Analyse the pros and cons of existing algorithms.

Course Description:

Matrix factorizations – Sets and sequences. Linear programming and simplex method - Weierstrass' theorem - Karush Kuhn Tucker optimality conditions, algorithms, convergence. Unconstrained optimization - Line search methods - method of multidimensional search - steepest descent methods. Newton's method - modifications to Newton's method - trust region methods - conjugate gradient methods - quasi-Newton's methods. Constrained optimization, penalty and barrier function methods - augmented Lagrangian methods - polynomial time algorithm for linear programming - successive linear programming - successive quadratic programming - Ant colony & PSO techniques.

References:

1. R. Fletcher, "Practical Optimization", John Wiley & Sons, New York, 2nd Edition, 2013.
2. M.S.Bazaraa, H.D.Sherali and C.Shetty, "Non-linear Programming: Theory and Algorithms", John Wiley and Sons, New York, 2013.
3. S.S Rao, "Engineering Optimization: Theory and Practices", 3rd Edition, New Age Int. (P) Ltd. Publishers, New Delhi, 2004.
4. E.K.P. Chong and S. H. Zak , "An Introduction to Optimization", John Wiley & Sons, New York, 2013.
5. A.L.Peressimi, F.E.Sullivan, J.J.Jr. Uhl, "Mathematics of Non-linear Programming", Springer, New York, 2012.

14EC2060 MULTIMEDIA COMPRESSION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the characterization of speech and image waveforms.
- To learn about the various compression techniques for text data, audio, image and video signals.
- To know about the speech and video coding standards.

Course Outcomes:

After completion of the course, students will be able to

- Understand the compression techniques
- Develop efficient algorithms for compression
- Use the knowledge gained in real time applications in the media industry

Course Description:

Fundamental concepts in text, digital audio, image, and video - need for compression - information theory & source models - quantization - vector quantization theory: LGB algorithm – Huffman & Adaptive Huffmann Coding - Arithmetic coding - Lempel-Ziv coding - Predictive Coding – DPCM - MPEG audio standard - Transform Coding - Subband coding - JPEG Standard - EZW, SPIHT coders - Video coding standards: MPEG standard-H.261 Standard.

References:

1. Khalid Sayood, "Introduction to Data Compression", The Morgan Kaufmann Series in Multimedia Information and Systems, 4th Edition,Newnes, 2012.
2. David Solomon, "Data Compression, The Complete Reference", Springer Verlag, New York INC, 2nd edition, Springer, 2012.
3. Peter Symes, "Digital Video Compression", McGraw Hill Pub., 2004.
4. Mark Nelson, "Data compression", BPB Publishers, New Delhi, 1998.
5. Ze-Nian Li, Mark S.Drew, J.Liu, "Fundamentals of Multimedia", PHI, Springer, 2014.
6. Yun A Shi, Huifang Sun, "Image & Video compression for Multimedia Engineering, Fundamentals,Algorithms & Standards", CRC Press, 2008.

14EC2061 SOFT COMPUTING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn about artificial neural networks and Fuzzy systems.
- To impart knowledge on Neuro Fuzzy modeling.
- To acquire knowledge about Genetic Algorithm.

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge on concepts of soft computing techniques.
- Apply soft computing techniques to solve various problems.
- Solve research oriented problems.

Course Description:

Artificial Neural Networks - Basic concepts - Supervised neural networks Unsupervised neural networks –Applications -Fuzzy Systems - Fuzzy sets - Fuzzy functions – Fuzzy rules - Fuzzy classification-Fuzzy control methods -Neuro-Fuzzy Modeling – Adaptive Neuro Fuzzy based inference systems – CART algorithm – Data clustering algorithms - Genetic Algorithm –Fundamentals – crossover operators - reproduction operators - simulated annealing-Random search-Downhill simplex search-Applications.

References:

1. Laurene Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Pearson Education India, 2006.
2. TimothyJ Ross, "Fuzzy logic with Engineering Applications", John Wiley and Sons, 2009.
3. S.Rajasekaran and G A VijayalakshmiPai, "Neural Networks, FuzzyLogic and Genetic Algorithm:Synthesis and Applications", Prentice Hall, India, 2003.
4. Jang J.S.R., Sun C.T and Mizutani E, "Neuro Fuzzy and Soft Computing: A Computational Approach to Learning Machine Intelligence", Prentice Hall, 1997.
5. Jacek M. Zurada, "Introduction to Artificial Neural Networks", Jaico Publishing House, 1997.
6. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic –Theory and Applications", Printice Hall of India, 2002.

14EC2062 MACHINE LEARNING ALGORITHMS FOR IMAGE PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the fundamental pattern recognition techniques for signal & image processing applications
- To gain understanding on different estimation techniques
- To get familiarized with the use of neural networks in pattern recognition.

Course Outcomes:

After completion of the course, students will be able to

- Apply these techniques to solve recognition problems in real-time applications
- Develop novel pattern recognition algorithm.
- Analyze the pros and cons of existing algorithms.

Course Description:

Overview of Pattern Recognition-Introduction to Statistical Pattern Recognition-Parametric &Non Parametric Approaches for Pattern Recognition - Maximum Likelihood Estimation -Bayesian Parameter Estimation-Nonparametric Estimation – Direct Estimation of Probabilities –Direct Classification using the Training Set - Nearest Neighbour Rule – NNR Approach-Linear Discriminant Functions – Fisher's Linear Discriminant-Linear Separability – Design of Linear Classifiers – Introduction to Support Vector Machines - Neural Network Structures for Pattern Recognition Applications – Neural Network Based Pattern Associator – Unsupervised Learning in Neural Pattern Recognition

References:

1. Robert Schalkoff, "Pattern Recognition-Statistical, Structural and Neural Approaches", John Wiley & sons, Inc, New York, 2005.
2. Earl Gose, R.Johnsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Limited, 1999.
3. Rojer Jang, T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice Hall of India Private Limited, 2003.
4. Duda, R. O., Hart, P. E., and Stork, D. G, "Pattern Classification", 2nd edition, John Wiley & Sons, NewYork,2001.
5. Tou and Gonzales, "Pattern Recognition Principles", Wesley Publication Company, London, 1974.

14EC2065 INFORMATION THEORY AND CODING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the basics of information theory
- To calculate channel capacity of discrete channel
- To apply various coding techniques to calculate the bit-rate and error probabilities.

Course Outcome:

After completion of the course, students will be able to

- Understand the basics of information theory
- Gain knowledge to calculate channel capacity of discrete channel
- Analyze and apply coding techniques and to calculate the bit-rate and error probabilities.

Course Description:

Information - Entropy - Mutual information, entropy for discrete ensembles, Shannon's noiseless coding theorem, Encoding of discrete sources - Markov sources: Shannon's noisy coding theorem and converse for discrete channels, Channel capacity and bounds for discrete channels - Algebraic Coding Theory - Introduction to finite fields - construction of finite fields and its properties - Convolutional code generator functions - Distance properties and error bounds - soft input output decoding - Convolutional coding in Mobile applications - Turbo codes - LDPC codes - Product Codes - Concatenated Convolutional Codes - Space Time Codes-Spatial Channels - Orthogonal Space Time Block Codes - Spatial Multiplexing

References:

1. Andre Neubauer, Jurgen Freudenberger, Volker Kuhn, "Coding theory: Algorithms, Architectures and Applications" John Wiley & Sons Ltd, Reprint 2012.
2. Robert. H. Morelos- Zaragoza, "The Art of Error Correcting Coding", Second Edition, John Wiley & Sons Ltd, Reprint 2013.
3. Tom Richardson, Rudiger Urbanke, "Modern Coding Theory" Cambridge University Press, 2009.
4. W. Cary Huffman and Vera Pless, "Fundamentals of Error Correcting Codes", Cambridge University Press, Reprint 2010
5. Simon Haykins, "Digital Communications", John Wiley, 1st edition, Reprint, 2004.
6. N. Abramson, "Information and Coding", McGraw Hill, 1963.

14EC2066 DIGITAL SYSTEM DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn sequential circuit design.
- To design sequential circuits in various modes.
- To learn about the different design methodologies involved in PLDs

Course Outcomes:

After completion of the course, students will be able to

- Acquire knowledge to design digital circuits.
- Know the architectures of various families of PLD's.
- Gain knowledge about different design tools involved in PLDs and design using them

Course Description:

Review of Combinational Logic Circuits: Shannon's expansion theorem- Sequential Logic Circuits: Mealy machine - Moore machine - State diagrams - State table minimization –State assignments - Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode - Programmable Logic Devices-Programmable Logic Element (PLE), Programmable Logic Array (PLA), Programmable Array Logic (PAL), Design of state machine using Algorithmic State Machines (ASM) chart as a design tool - CPLDS - Structure of Complex PLD's (CPLD) - Design of combinational and sequential circuits using CPLD's.

References:

1. Charles H.Roth, “Digital system Design using VHDL”, Nelson Engineering; 2nd Revised edition , 29 April 2007
2. James E. Palmer, David E. Perlman, “Introduction to Digital Systems ", Tata McGraw Hill, 1996.
3. Robert Dueck , “Digital design with CPLD applications and VHDL ”, Thomson ,2004
4. Bob Zeidman , “Designing with CPLDs and FPGAs “, CMP ,2002
5. Neil H.E. Weste, David Harrisayan Banerjee “Principles of CMOS VLSI Design : A Systems Perspective”, Pearson Education India,2nd Edition ,2002.

14EC2067 VERILOG HDL

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn various Verilog Programming Techniques.
- To understand different steps involved in Verilog Programming
- Knowledge about different types of modelling

Course Outcomes:

After completion of the course, students will be able to

- Understand basic terminologies involved in Verilog HDL
- Write program using Verilog HDL to design digital circuits
- Write program for real time applications and using test bench concept

Course Description:

Design Methodology – Module – Ports – Basic concepts – Operators – Number specification – Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multi way branches - Loops - Switch – Modeling elements – Implementation of Basic circuit using Dataflow & Behavioral Modeling - Component Assignments – Switch level modeling – Applications of all dataflow, behavioral and Structural modeling in FPGA – FSM Implementation – Test Benches

References:

1. Samir Palnitkar, “Verilog HDL”, Pearson Publication”, II Edition. 2003.
2. M.D. Ciletti, “Advanced Digital Design with the VERILOG HDL” PHI, 2008.
3. I.Bhaskar, “A VHDL Synthesis Primer”, BS Publications,III edition, 2004.
4. SadiqM.Sait, Habib Youssef, “VLSI Physical Design Automation”, World Scientific Publishing, 1998
5. M. Morris Mano,Micheal ciletti “Digital Design : With an Introduction to Verilog HDL” Pearson, 5th Edition, 2013.

14EC2068 VHDL

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn various VHDL modeling techniques.
- To familiarize with VHDL sub program and packages techniques.
- To have an understanding about generics and modeling delays

Course Outcomes:

After completion of the course, students will be able to

- Understand basic terminologies and modeling types used in VHDL
- Write program to design digital circuits
- Write program for using test bench and generic concepts

Course Description:

Design flow process –Software tools – Data objects - Data types – Data operators – Entities and Architectures Concurrent signal assignment – conditional signal assignment - selected signal assignment - concurrent and sequential statements – Data flow, Behavioral Modeling. Structural Modeling Component declaration and instantiation.– Test bench – Examples – CPU- Traffic light controller Functions – Procedures – Packages – Libraries – Attributes – Operator Overloading – Generics – Modeling Delays

References:

1. J. Bhaskar, "A VHDL Primer", PHI Learning, III Edition, 2009.
2. Douglas L. Perry, "VHDL Programming by Example", TATA McGRAW-HILL Edition,2003.
3. Sadiq M.Sait, Habib Youssef, "VLSI Physical Design Automation", World Scientific Publishing,1998
4. Stephen Brown, "Fundamentals of Digital Logic Design with VHDL", Tata Mcgraw-Hill Publishing Company Limited, 2nd Edition ,2007.

14EC2069 VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study about the MOS Transistor and its characteristics.
- To get familiarized with stick diagrams and Layout design.
- To understand the CMOS logic design styles, latches and registers.

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge on MOS Transistor structure and its characteristics.
- Gain knowledge on design rules and layout.
- Understand CMOS circuit design using the various logic styles.

Course Description:

VLSI Design Process- MOS Transistor Structure-Transistor Operation- I_{ds} Vs V_{ds} Characteristics-MOS Transistor Threshold Voltage- Small signal AC Characteristics-NMOS Fabrication-CMOS Fabrication-NMOS Inverter-Pull-up to Pull-down ratio of an NMOS Inverter-CMOS Inverter-Latch up in CMOS Circuits- Stick Diagrams-NMOS and CMOS Design style- λ based design rules/NMOS,CMOS Inverters, NAND,NOR gates- Sheet resistance – Area Capacitance -CMOS logic styles-Static Latches and Registers-Dynamic Latches and Registers.

References:

1. Pucknell Eshraghian "Basic VLSI Design", PHI of India Ltd.,Third Edition,2004
2. Neil H. E. Weste,DavidHarrisayan Banerjee "Principles of CMOS VLSI Design : A Systems Perspective", ,Pearson Education India,2nd Edition ,2002.
3. CMOS Digital Integrated Circuits Analysis and Design, " Sung-Mo-Kang,Yusuf Leblebici",Tata Mc Graw-Hill Third Edition,2003.
4. N.A. Sherwari, "Algorithms for VLSI Physical Design Automation", John Wiley, Third Edition,2003.
5. Jan.M.Rabaey, Ananthachandrakasan and Borivoje Nikolic, **"**Digital Integrated Circuits –A Design Perspective", Pearson Education, 2nd Edition 2003.

14EC2070 ASIC DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study different types of programmable ASICs
- To know about ASIC interconnects
- To gain understanding on the Physical design of ASICs.

Course Outcomes:

After completion of the course, students will be able to

- Understand the complete design flow of ASICs.
- Gain knowledge about the internal architecture of ASIC.
- Understand different types of programmable ASIC

Course Description:

Types of ASICS - Design Flow - Logical Effort - Programmable ASIC: Antifuse - Static RAM - EPROM and EEPROM - Programmable ASIC Logic Cells: ACT 1, ACT 2 and ACT 3 -- Xilinx XC 4000 – Altera MAX 5000/7000 - Xilinx I/O Block - Programmable ASIC Interconnect: Actel ACT – Xilinx LCA – Xilinx EPLD – Altera FLEX – Low level design entry: Schematic entry - EDIF – Floor Planning and Placement – Routing.

References:

1. M.J.S.Smith, "Application Specific Integrated Circuits", Pearson Education Asia , 2006.
1. S.D. Brown R.J. Francis, J.Rox, Z.G. Urumesic, "Field Programmable Gate Arrays", Kluwer Academic Publishers, 2007.
2. Neil H. E. Weste, David Harrisayan Banerjee, "Principles of CMOS VLSI Design : A Systems Perspective", Pearson Education India, 4^{th} Edition, 2011.
3. Sadiq M.Sait, Habib Youssef, "VLSI Physical Design Automation", World Scientific Publishing, 2004.
4. G.D.Micheli, "Synthesis and optimization of Digital circuits", Tata McGraw Hill, 2012.

14EC2071 VLSI SUBSYSTEM DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To know the design challenges and guidelines for digital circuit design
- To understand the design and implementation of complex digital circuits
- To understand control logic implementation of PLA and ROM

Course Outcomes:
After completion of the course, students will be able to
- Gain knowledge of circuit and system view together
- Design high performance digital circuits.
- Familiarize with control logic implementation of PLA and ROM

Course Description:
Design Strategies - Structured Strategies - Design Methods - Basic of Digital Circuits - Data path Operations - Binary Adders and Subtractors - Carry Look Ahead - Various Multipliers: Array, Wallace Tree, Serial multipliers - Parity Generators - Comparators – Clocking Strategies-Two phase and Four phase clocking - Binary Synchronous and Asynchronous Counters – Shifters - Memory Elements: Memory Core - Memory Peripheral Circuit – RAM – ROM – CAM - Serial Access Memory - Control: FSM Design Procedure - Control Logic Implementation - PLA, ROM Control Implementation.

References:

1. Wayne Wolf, "Modern VLSI Design System On Chip" , Pearson Education, 3rd Edition, 2006.
2. Jan.M.Rabaey, Anantha Chandra Kasan and Borivoje Nikolic, "Digital Integrated Circuits –A Design Perspective", Pearson Education, 2nd Edition, Reprint, 2014.
3. Neil H.E. Weste, Kamran Eshraghian , "Principles of VLSI Design - A Ciruits and Systems Perspective", Pearson Education India, 4th Edition, 2011
4. Kamran Eshraghian, Douglas A.Pucknell, Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems", Eastern Economy Prentice Hall of India, New Delhi, 1st Edition, 2006
5. John.P.Uyemura, "Introduction to VLSI Circuit Systems", John Wiley & Sons Inc, 2004.

14EC2072 ANALYSIS AND DESIGN OF DIGITAL IC

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To study the basic concepts of MOS transistor
- To study about the different delay models
- To know various circuit design processes and design any Combinational Logic Circuits or Sequential Logic Circuits.

Course Outcomes:
After completion of the course, students will be able to
- Design circuits using different CMOS styles
- Analyze various CMOS structures.
- Understanding the characteristics of CMOS logic style

Course Description:
Physical Structure of MOS Transistors-MOS Transistor Switches - Resistance Estimation- CMOS Inverter - DC Characteristics - Switching Characteristics: Analytic Delay Models-Empirical Delay Models-Gate Delays - CMOS Gate Transistor sizing - Static CMOS Design: Complementary CMOS - Ratioed Logic - Pass - Transistor Logic-Dynamic CMOS Design: Dynamic Logic- Domino Logic-np - CMOS-Designing Sequential Logic Design :Static Latches and Registers – Dynamic Latches and Registers

References

1. Kang ,Leblebbici "CMOS Digital IC Circuit Analysis & Design", McGraw Hill, 3rd Edition 2003.

2. Jan.M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, “Digital Integrated Circuits – A Design Perspective”, Pearson Education, 2nd Edition 2003.
3. Neil H E West and Kamran Eshranghian, “Principles of CMOS VLSI Design : A System Perspective”, Addison Wesley, 4th edition, 2011.
4. Anantha Chadrakasan and Robert Broderson, “Low Power CMOS Design”, Standard Publishers, 2000.
5. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, “CMOS/BiCMOS ULSI Low Voltage, Low Power”, Pearson Edition, Second Indian reprint, 2003

14EC2073 LOW POWER TECHNIQUES IN VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the concepts on different levels of power estimation
- To learn the fundamentals of optimization techniques
- To have an idea about Low voltage circuit design techniques

Course Outcomes:

After completion of the course, students will be able to

- Knowledge in low power techniques
- Know the fundamentals of optimization techniques.
- Understand the problems associated with micrometer device design.

Course Description:

Introduction- Gate Level Logic Simulation- Architectural Level Analysis- Circuit and logic level power optimization techniques- Special Techniques-Architecture and system- Leakage Current in Deep Sub-Micrometer Transistors- Deep Sub- Micrometer Device Design Issues - Low Voltage Circuit Design Techniques - SRAM Architecture- Energy Recovery Circuit Design.

References:

1. Gary yeap, “Practical Low Power Digital VLSI Design”, Kluwer academic publishers, 2001.
2. Kaushik Roy, Sharatprasad, “Low Power CMOS VLSI Circuit Design”, John Wiley & Sons Inc., 2000.
3. Anantha Chadrakasan and Robert Broderson, “Low Power CMOS Design”, Standard Publishers, 2000.
4. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, “CMOS/BiCMOS ULSI Low Voltage, Low Power”, Pearson edition, Second Indian reprint, 2003
5. Sung-Mo (Steve) Kang, Yusuf Leblebici,Leblebigi “CMOS Digital IC Circuit Analysis & Design”, McGraw Hill, 2003.
6. Jan.M.Rabaey, Anantha Chandrakasan, BorivojeNikolic, “Digital Integrated Circuits – A Design Perspective”, Pearson Education, 2nd Edition 2003.

14EC2074 VLSI FABRICATION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- Knowledge about device fabrication process of BJT and MOSFET.
- Knowledge about ECL and I^2L circuits.
- Familiar with different device technologies.

Course Outcomes:
After completion of the course, students will be able to

- Design VLSI circuits following technological constraints.
- Understand steps associated with fabrication techniques.
- Familiarize with cutting edge technologies like that of MESFET.

Course Description:
Introduction to VLSI fabrication - BJT and CMOS Fabrication Process a Brief Overview -Clean Room and Safety Requirements - Silicon Crystal Growth, Epitaxy - VPE and MBE.Oxidation and Diffusion,Oxidation: Silicon Dioxide Growth for Thick and Thin Films: Solid State Diffusion Modelling and Technology - Diffusion Systems - Ion Implantation Modeling and Technology – Damage Annealing – Masking during Implantation.Lithography and Etching: Basic Process Explaining Lithography – Positive and Negative Resist and their Comparison –Light Sources. Optical Lithography - X-ray Lithography – E-beam Lithography. Wet Chemical Etching- Dry Etching, Plasma Etching System. Deposition Techniques: Physical Vapor Deposition – Thermal Evaporation and Sputtering – Metallization, Chemical Vapor Deposition Techniques: CVD Techniques for Deposition of Polysilicon, Silicon Dioxide, Silicon Nitride.Integrated Device Fabrication: BJT fabrication – Isolation techniques; Junction Isolation, LOCOS, Trench Isolation – Realization of ECL and I^2L Circuits. MOSFET Fabrication– CMOS Fabrication – Latch-up in CMOS – Bi-CMOS Technology – MESFET Technology, VLSI Assembly and Packaging.

References:

1. S. A. Campbell, "The Science and Engineering of Microelectronic Fabrication" 2nd Edition, Oxford University Press, 2011.
2. G. S. May and S. M. Sze, " Fundamentals of Semiconductor Fabrication", John Wiley Inc., 2004.
3. C.Y. Chang and S.M.Sze (Ed), "ULSI Technology", McGraw Hill Companies Inc, 1996.
4. S.M. Sze (Ed), "VLSI Technology", 2nd Edition, McGraw Hill, 1988.
5. S.K. Ghandhi, "VLSI Fabrication Principles", 2nd Edition, John Wiley Inc., New york reprint 2004.

14EC2075 NANO ELECTRONICS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To impart knowledge about the basic concepts of nano electronic devices.
- To recognize the necessity of Carbon nano tubes in electronics.
- To know about the applications of nano electronics.

Course Outcomes:
After completion of the course, students will be able to

- Understand the concepts of nano regime such as coloumb blockade electron tunneling and the necessity of nano devices.
- Know the domains in which nano devices play a major role and are inevitable.
- Widen their knowledge about Spintronic devices

Course Description:
Introduction - CMOS Scaling - limits to scaling - system integration limits (interconnect issues etc.) - The nanoscale MOSFET - Vertical MOSFETs - Resonant Tunneling Transistors - Single electron transistors - Optoelectronic and Spintronic devices - Molecular electronics involving single molecules as electronic devices - transport in molecular structures - molecular systems as alternatives to conventional electronics - molecular interconnects - Carbon nanotube electronics - bandstructure& transport – devices - applications.

References:

1. Karl Goser, Peter Glosekotter, Jan Dienstuhl, "Nanoelectronics and Nanosystems", Springer, 2013.
2. C.P. Poole Jr., F.J. Owens ,"Introduction to Nanotechnology," ,Wiley 2003.
3. Waser Ranier, "Nanoelectronics and Information Technology (Advanced Electronic Materials and Novel Devices)", WaserRanier, Wiley-VCH, 2012.
4. K.E. Drexler , "Nanosystems", Wiley, 1992.
5. John H. Davies, "The Physics of Low-Dimensional Semiconductors", Cambridge University Press, 1998.

14EC2076 VHDL LAB

Credits: 0:0:2 **(Version 1.1)**
Co-requisite:14EC2068 VHDL

Course Objectives:

- To learn various VHDL modeling.
- To familiarize with VHDL sub program and packages technique.
- To have an understanding about generics and modeling delays

Course Outcomes:

After completion of the course, students will be able to

- Write VHDL Program for combinational and sequential circuits.
- Write VHDL programs for real time applications
- Synthesize the circuits after programming.

List of experiments

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2077 VERILOG LAB

Credits: 0:0:2 **(Version 1.1)**
Co-requisite: 14EC2067 Verilog HDL

Course Objectives:

- To learn various Verilog programming techniques.
- To understand different steps involved in Verilog programming.
- Knowledge about different types of modeling.

Course Outcomes:

After completion of the course, students will be able to

- Write Verilog Program for combinational and sequential circuits.
- Write Verilog programs for real time applications.
- Understand various modeling types and their significance

List of experiments

- The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2078 IC DESIGN LAB

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC2070 ASIC Design

Course Objectives:
- To study different types of programmable ASICs
- To know about ASIC interconnects
- To gain understanding on the Physical design of ASICs.

Course Outcomes:
After completion of the course, students will be able to
- The student will be able to design a system using CAD tools for ASIC.
- Knowledge in the complete design flow of ASICs
- Confidence in using ASICs for real time applications

List of experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2079 MICROPROCESSORS AND MICROCONTROLLERS

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:
- To learn the basic concepts of 8085 Microprocessor.
- To understand the basic concepts of 8051 Microcontroller.
- To accumulate the knowledge of interfacing microcontroller to memory and External devices.

Course Outcomes:
After completion of the course, students will be able to
- Gain knowledge on basic concepts of 8085 Microprocessor and its Programming.
- Acquire basic concepts and programming skills in microcontroller.
- Interface microcontroller to memory and external devices.

Course Description:
Functional Block of 8085 Microprocessor - Timing and control signals - Instruction set - Assembly language programs - Timing Diagram. Architecture of 8051 Microcontroller - Instruction cycle - Instruction fetching and execution - Instruction set and programming - I/O Ports - Timer - Interrupt and serial programming - Interrupt priority in 8051 - 8051 interfacing to external memory - 8051 interfacing with different external devices and Motors.

References:

1. Krishna Kant," Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096", PHI Learning Pvt Ltd, New Delhi, 1st Edition, 2010.
2. Ramesh Gaonkar "Microprocessor Architecture, Programming & Applications with 8085", PENRAM International, 6th Edition, 2013.
3. Myke Predko," Programming customizing the 8051 Microcontroller", Tata McGraw Hill Publications, New Delhi, 1st Edition 2007.
4. Muhammad Ali Mazidi, J.G.Mazidi, R.D.Mckinlay, "The 8051 Microcontroller and Embedded Systems Using Assembly and C" Second Edition Prentice Hall-2008.
5. Kenneth J. Ayala, "8051 Microcontroller", Cengage Learning, New Delhi, 3rd Edition, 2007.

14EC2080 COMMUNICATION ENGINEERING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- Learn the basic principles, concepts and types of communication systems.
- Understand the various design issues in a communication system.
- Gain knowledge about communication medium and television.

Course Outcomes:
After completion of the course, students will be able to
- Understand the basic concepts of communication system, transmitter and receiver.
- Acquire knowledge on different modulation and demodulation techniques.
- Understand various digital and fiber optic communication techniques.

Course Description:
Communication system block diagram - Types of modulation - Amplitude Modulation (AM), Frequency Modulation (FM), Phase Modulation (PM) - AM and FM modulators and demodulators - AM and FM transmitter and receiver - Effects of noise in AM and FM systems - Digital Communication Systems - PAM, PPM, PDM, PCM, Delta modulation, Digital modulation and demodulation systems - Data Transmission - Twisted pair and coaxial cables, Fiber optics - Sources and detectors - Multiplexing - TDM, WDM and FDM - Television - Scanning process, Transmitter & Receiver, Introduction to LCD and LED televisions.

References:

1. Anokh Singh, A.K.Chhabra, "Principles of Communication Engineering", S.Chand Co.,7th Edition, 2013.
2. Wayne Tomasi, "Electronic Communication Systems: Fundamentals Through Advanced", Pearson Education, Arizona, 5th Edition 2012.
3. William Schweber, "Electronic Communication Systems - A Complete Course", Prentice Hall International, New Jersey, 4th Edition, 2002.
4. G.Kennedy, "Electronic Communication Systems", Tata McGraw-Hill Education India Private Limited, 5th Edition, 2012.
5. Simon Haykins, Michael Moher, "Communication Systems", John Wiley & Sons, New Jersey, 5th Edition, 2009.
6. Taub and Schilling, "Principles of Communication Systems", Tata McGraw-Hill Education India Private Limited, 3rd Edition, 2008.

14EC2081 MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To study the different technologies of microwave integrated circuits.
- To learn the technologies of microwave integrated circuits.
- To analyze the micro strip line.
- To design and fabricate different lumped elements and non-reciprocal components.

Course Outcomes:
After completion of the course, students will be able to
- Familiarize with the technologies of microwave integrated circuits.
- Able to analyze the micro strip line.
- Able to design and fabricate different lumped elements and nonreciprocal components.

Course Description:
Introduction to microwave integrated circuits: Active and passive components. Analysis of microstrip lines: variational method, conformal transformation, numerical analysis; losses in microstrip lines; Slot line and Coupled lines; Design of power dividers and combiners, directional couplers, hybrid couplers, filters.;Microstrip lines on ferrite and garnet substrates; Isolators and circulators; Lumped elements in MICs.;Technology of MICs: Monolithic and hybrid substrates; thin and thick film technologies, computer aided design.

References:

1. Leo Young and H. Sobol, Ed. Advances in Microwaves, Vol.2, Academic Press Inc., 1974.
2. B.Bhatand ,"Stripline-like transmission lines for MICs", John Wiley, 1989.
3. T.K. Ishii, "Handbook of Microwave Technology", vol. I, Academic Press, 1995.
4. Annapurna Das, Sisir K. Das,"Microwave Engineering"–Tata McGraw- Hill,2000.
5. Gupta,K.C, and Amarjit singh ,"Microwave Integrated Circuits" –John Wileyand sons –Wiley Eastern Reprint, 1978.
6. I.Hoffmann, R.K, "Handbook of Microwave Integrated Circuits" –Artec House, 1987.

14EC2082 SEMICONDUCTOR DEVICE MODELLING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To learn the physics behind the semiconductor devices.
- To analyze the BJT, MOSFET from the design perspective through various models.
- To be familiarized with MOSFET SPICE models

Course Outcomes:
After completion of the course, students will be able to
- Have clear understanding of physics of semiconductor devices will help the students in learning the advanced semiconductor devices
- Analyze devices using various models
- Design the SPICE model with all possible circuit parasitic elements for MOSFET devices

Course Description:
Semiconductor Physics Semiconductor Materials and Structure - Band Structures – Electron-Hole Statistics – Carrier Mobility and Conductivity– Carrier Diffusion– Avalanche Multiplication - P-N Junction Theory – Built-In Potential – P-N Electrostatics –Current-Voltage Relation In P-N Junction – Diffusion Capacitance – Diode Equivalent Circuit – Breakdown Voltage – Junction Curvature Effect – Transient Behavior BJT Device Analysis - BJT Current- Voltage Relation – Current Gain – Band Gap Narrowing – Auger Recombination – Early Effect – Punch-Through In BJT – Breakdown Voltage In BJT – Small Signal Equivalent Circuit – Cut-Off Frequency – Switching Behavior. MOSFET analysis models – large and small signal characteristics - MOSFET SPICE model.

References:

1. S. M. Sze, "Semiconductor Devices: Pioneering Papers", World Scientific Publishing Company, 1st edition, 1991.
2. Daniel Foty, "MOSFET Modeling with SPICE, Principles and Practices", Prentice Hall, 1st edition, 1997.
3. H. C. de Graff and Francois M. Klaassen, "Compact Transistor Modelling for Circuit Design", Springer, 2013.
4. Ian E. Getreu, "Modeling the Bipolar Transistor", Elsevier Science Ltd, 1978.

5. P.E.Gray et al., “Physical Electronics and Circuit Models for Transistors”, John Wiley &Sons, 1st edition, 1964.

14EC2083 VERIFICATION OF VLSI CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the difference between verification and testing.
- To know about verification tools and plan.
- To learn about architecting test benches.

Course Outcomes:

After completion of the course, students will be able to

- Know the difference between verification and testing
- Write test benches to verify circuits**.**
- Do self checking test benches and reusable verification components

Course Description:

Functional Verification Approaches-Testing Versus Verification - Verification and Design Reuse - Linting Tools-Simulators - Third Party Models - Waveform Viewers - Code Coverage-Issue- Tracking Metrics - Verification plan-Levels of Verification-Verification Strategies –Specification Features – Test cases - Test Benches - Simple Stimulus - Output Verification – Self Checking Test Benches Reusable Verification Components – VHDL and Verilog Implementation.

References:

1. Janick Bergeron, “Writing Test Benches Functional Verification of HDL Models” Springer, 2nd Edition, 2003.
2. Andreas Meyer, “Principles of Functional Verification” Newnes , Oct 2003.
3. Amu Samir Palnitkar, “Design Verification with e” Prentice Hall 1stEdition,2003.
4. D. P. Foty, “MOSFET Modeling with SPICE, Principles and Practices”, Prentice HallPTR, 1997.
5. N.A. Sherwari, “Algorithms for VLSI Physical Design Automation”, Springer, 2013.

14EC2084 DESIGN OF ANALOG CMOS IC

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn about various types of CMOS amplifiers
- To understand the concepts of Filters
- To be familiar with Digital to Analog Converters and Analog to Digital Converters.

Course Outcomes:

After completion of the course, students will be able to

- Understand the concepts of amplifiers and their elements.
- Design filters for various circuits
- Familiarize with Digital to Analog Converters and Analog to Digital Converters.

Course Description:

Switches- active resistors- current source and sink - Amplifiers: Differential Amplifiers- Cascode Amplifiers - Current Amplifiers-Output Amplifiers- Low pass filters - High pass filters – Band Pass filters – Analog Systems: Digital-to- Analog Converters- Analog-To Digital Converters.

References:

1. Philip E. Allen, Douglas R. Holberg, “CMOS Analog Circuit Design”, Oxford University Press,3rd Edition, 2011.
2. Randall.L.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques forAnalog and Digital Circuits”, McGraw Hill companies, 1989.
3. YannisTsividis, “Mixed Analog–Digital VLSI Device and Technology”, World Scientific publishing Company., 2002.
4. Neil H. E. Weste, David Money Harris, “Principles of CMOS VLSI Design: A Systems Perspective”, Pearson Education India,4th Edition,2010.
5. Sadiq.M.Sait, Habib Youssef, “VLSI Physical Design Automation”, World Scientific Publishing,1999.

14EC2085 CAD FOR VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To provide knowledge about CAD Algorithm, placement and routing.
- Understanding of simulation based algorithms
- To gain knowledge on synthesis and MCMs.

Course Outcomes:

After completion of the course, students will be able to
- Acquire knowledge of CAD Algorithm, placement, routing,simulation,synthesis and MCMs is expected.
- Design VLSI devices using CAD.
- Understand the simulation based algorithms

Course Description:

Role of CAD tools in the VLSI Design process - Data Structures - Complexity Issues- Graph algorithms, Genetic algorithm- Simulated Annealing - Event driven, Switch level and Circuit simulation - CAD algorithms - logic synthesis - Technology independent and dependent logic optimization - Partitioning -KL, FM algorithms- Placement – Simulation based algorithms-Partitioning based algorithms - Floor planning - Global routing – Grid routing - detailed routing –over the cell routing.

References:

1. N.A. Sherwari, “Algorithms for VLSI Physical Design Automation”, Springer, 2013.
2. S.M.Sait, H.Youssef, “VLSI Physical Design Automation”, World scientific, 1999.
3. Sabih. H. Gerez “Algorithms for VLSI Design Automation” Wiley India Private Limited, 2006.
4. G.D.Micheli, “Synthesis and optimization of Digital circuits”, Tata McGraw Hill, 2003.
5. D. P. Foty, “MOSFET Modeling with SPICE, Principles and Practices”, Prentice HallPTR, 1997.

14EC2086 TESTING OF VLSI CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the methods of testing combinational and sequential circuits.
- To know about various fault simulation techniques.
- To understand the difference between DFT and BIST

Course Outcomes:

After completion of the course, students will be able to
- Have the knowledge to test any VLSI circuits

- Decide which testing method to be applied for a Device under Test (DUT)
- Understand BIST architectures

Course Description:
Motivation for testing - Fault models - Test generation algorithms for combinational logic circuits - Functional testing – Fault model based testing- Time frame expansion – Fault simulation techniques - Key testability concepts – Ad Hoc design for Testability – scan based design - Signature analysis - Compression techniques - Built-in self-test –Architectures.

References:
1. Vishwani D. Agarwal "Essential of Electronic testing for digital, memory and mixed signal circuits", Springer,2013.
2. Abramovici .M, Breuer .M.A. and Friedman .A.D, "Digital Systems Testing and Testable Design", Wiley,2001.
3. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Englewood Cliffs, 1998.
4. Parag.K.Lala, "Digital circuit testing and testability", Academic press, 1997.
5. S.M. Sze (Ed), "VLSI Technology", 2ndEdition, McGraw Hill, 2003.

14EC2087 MICRO ELECTRO MECHANICAL SYSTEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To learn about the engineering science of MEMS, materials used in MEMS and the concept of Micro fabrication and Micro machining.
- To learn about the various sensors and actuators used in MEMS devices.
- To learn about applications of MEMS in various fields.

Course Outcomes:
After completion of the course, students will be able to
- Understand the engineering science of MEMS, materials used in MEMS and the concept of micromachining and microfabrication
- Select the suitable sensors & actuators for MEMS devices.
- Understand the use of MEMS in electronic, photonic and medical devices

Course Description:
Historical Background – Engineering Science for Microsystems - Design and Fabrications-Materials for MEMS: Silicon& its compounds - Quartz, - Microfabrication and Micromachining: Bulk Micromachining Surface - Micromachining Microsensors: inertial, thermal, optical, chemical and biological Microactuators: Electrostatic, thermal - 3-D electromagnetic actuators and sensors, RF/ Electronics devices, Optical/ Photonic devices, Medical devices

References:
1. Tai-Ran Hsu, "MEMS & Microsystems Design & Manufacture", Tata McGraw Hill, 2002.
2. Stephen D. Senturia, "Microsystem Design" by, Kluwer Academic Publishers, 2001.
3. Marc Madou, "Fundamentals of Microfabrication", CRC Press, 1997.
4. Gregory.T.Kovacs, "Micromachined Transducers Sourcebook", WCB/McGraw-Hill, Boston 1998.
5. M.-H. Bao, "Micromechanical Transducers: Pressure Sensors, Accelerometers, and Gyroscopes", Elsevier, New York, 2000.

6. John H. Davies, “The Physics of Low-Dimensional Semiconductors”, Cambridge University Press, 1998.

14EC2088 MICROPROCESSOR AND MICROCONTROLLER LAB

Credits: 0:0:2 **(Version 1.1)**
Co-requisite: 14EC2079 Microprocessors and Microcontrollers

Course Objectives:
- To enable the students to understand the programming techniques of Microprocessor.
- To enable the students to understand the programming techniques of Microcontrollers.
- To design suitable control application using Microcontrollers.

Course Outcomes:
After completion of the course, students will be able to
- Improve the programming skills in Microprocessor and Microcontroller.
- Design hardware and software requirements for an application using Microprocessor.
- Design hardware and software requirements for an application using Microcontroller.

Experiments:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2090 FUNDAMENTALS OF ELECTRONICS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To impart the basic knowledge about the principle of semiconductor devices.
- To understand the basic digital system and electronic instruments.
- To get the knowledge about the various analog communication techniques

Course Outcomes:
After completion of the course, students will be able to
- Analyze the working principle of active semiconductor devices.
- Gain knowledge about various electronic instruments.
- Gain knowledge of analog communication system design.

Course Description:
Introduction to Semiconductor - semiconductor devices: diode, transistor, FET, MOSFET, UJT- basic op-amp applications- Integrated circuits - transistor as an amplifier and a switch – oscillator principles - Digital System – Semiconductor memory – Microprocessor - transducers – signal conditioning unit – telemetry circuits – virtual instrumentation– Measuring instruments – communication system - modulation & demodulation techniques – antenna principle – Introduction to Noise- radio receiver & transmitter Satellite communication – Fibre optics –Micro and Nano electronics.

References:
1. Muthusubramanian R, Salivahanan S, “Basic Electrical Electronics & Computer Engineering “Tata Mc.Graw Hill, 2005.
2. Robert Boylestad, “Electronic Devices & Circuit Theory”, Tenth Edition, Pearson Education, 2010.

3. A.K.Sawney, “ A course in Electrical and Electronic Measurements and Instrumentation”, Dhanpat Rai &Co, 19th Edition, 2011.
4. V.K.Metha.”Principles of Electronics”,Chand Publications,2014 reprint, Edition 2009.
5. Anokh Singh, “Principles of Communication Engineering” S.Chand Co., 2001
6. Tai-Ran Hsu, “MEMS & Microsystems Design & Manufacture”, Tata McGraw Hill,2002

14EC2091 ELECTRON DEVICES AND INSTRUMENTATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the mechanisms of current flow in semi conductors.
- To understand the diode operation and switching characteristics
- To know about the measuring and analysis techniques.

Course Outcomes:

After completion of the course, students will be able to

- Familiarized with the principle of operation, capabilities and limitation of various electronic devices.
- Design practical circuits and to analyze various components with the instruments.
- Give better idea to design own electronics projects for general applications

Course Description:

Intrinsic And Extrinsic Semiconductors - Theory of PN Diodes - Open circuit junction – Forward And Reverse Characteristics - Diode Equation- Applications: Half wave rectifier, full wave rectifier, Bridge rectifier – Hall Effect - Theory of FET, UJT and Thyristor - Special Semiconductor Devices – LED – LCD – optocouplers – Gunn diodes - Varactor diode – Transducers - Digital Instruments - Digital Voltmeters and Multimeters, - Data Display and Recording System - Computer Controlled Test System - Microprocessor based measurements.

References::

1. Millman & Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2007.
2. Malvino A P, “Electronic Principles”, , McGraw Hill International, 7th Edition 2006.
3. Rangan C.S., "Instrumentation Devices and Systems", Tata McGraw Hill, Second Edition, 1998.
4. W.D. Cooper, A.D. Helfrick, “Electronic Instrumentation and Measurement Techniques”, 3rd Edition.
5. Robert Boylestad and Louis Nashelsky, “Electronic Devices & Circuit Theory”, 9th Pearson Education Edition, 2009.
6. Muthusubramanian R, Salivahanan S, Muraleedharan Ka , “Basic Electrical Electronics & Computer Engineering “Tata Mc.Graw Hill, 2005.

14EC2092 ELECTRON DEVICES AND INSTRUMENTATION LAB

Credits: 0:0:2 **(Version 1.1)**

Co-requisite: 14EC2091 Electron Devices and Instrumentation

Course Objectives:

- To learn practically about different Electron Devices and its operation.
- To learn about the Instrument handling and its analysis
- To learn the simulation of various electronics circuits

Course Outcomes:

After completion of the course, students will be able to

- Understand the device characteristics and help them to develop experimental skills.

- Do various analyses with electronic instruments.
- Simulate and analyze various circuit by using PSPICE .

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3001 STATISTICAL DIGITAL SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the concepts of signal processing and analyze the statistical properties of signals.
- To estimate the spectrum using Parametric and Non Parametric methods.
- To design filters and multi-rate systems.

Course Outcomes:

After completion of the course, students will be able to

- Generate the various special types of random processes in communication receivers.
- Estimate / Evaluate the Power Spectrum.
- Design digital filters and multi-rate signal processing systems.

Course Description:

Discrete Random Processes - Energy- Power Spectral Density - Parseval's Theorem – Wiener Khintchine Relation – Periodogram - Sum Decomposition Theorem-Discrete Random Signal Processing using linear system - Parametric and Non-Parametric Spectrum Estimation Methods -Wiener, Kalman Filtering, Levinson-Durban Algorithms, Least Square Method, Adaptive Filtering, Non-stationary Signal Analysis, Wigner-Ville Distribution, Multi-rate Signal Processing - Single and multistage realization - Poly phase realization-Wavelet Analysis.

References

1. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Reprint, 2013.
2. John G.Proakis, DimitrisG.Manolakis, "Digital Signal Processing", Prentice Hall of India, 4th Edition, 2007.
3. P.P Vaithyanathan, "Multirate systems and filter Banks", Prentice Hall of India, 2008.
4. Emmanuel C. Ifeacher and Barrie W. Jervis, "Digital Signal Processing – A Practical Approach", Wesley Longman Ltd., 2nd Edition, 2004.
5. Yanwei Wang, Jian Li, Petre Stoica, "Spectral Analysis of Signals: The missing data case", Morgan and Claypool Publishers, 1st Edition, 2005.
6. S. Haykin, "Adaptive filter theory", Prentice Hall, 2005.
7. B. Widrow and S.D. Stearns, "Adaptive signal processing", Pearson Education Asia, 2009.

14EC3002 ADVANCED EMBEDDED SYSTEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the overview of embedded system architecture
- Focus on distributed embedded architecture and its accessing protocols
- Understand about the design methodologies in hardware and software design.

Course Outcomes:

After completion of the course, students will be able to

- Construct embedded system hardware
- Develop software programs to control embedded system
- Outline validation and testing methodologies for embedded system

Course Description:

Embedded systems overview - processor technology - Automation-synthesis- Verification. Processing elements - Single and general purpose processor design - Programme's view and development environment – ASIPs -- Memory – types, hierarchy, caches, advanced RAM. Interfacing - I/O addressing, interrupts, DMA - Arbitration- Multilevel bus architectures- protocols- Standard single purpose processor's peripherals. Design and development of latest Embedded systems using Embedded C.

References:

1. Frank Vahid and Tony Givargis, "Embedded System Design: A unified Hardware/Software Introduction", 3rd Edition, John Wiley & sons, 2010
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computing System Design", Morgan Kaufman Publishers, 2008.
3. Jonathan.W.Valvano, "Embedded Microcomputer systems: Real Time Interfacing", 3rd Edition, Cengage learning, 2012
4. Santanuchattopadhyay, "Embedded system Design", PHI Learning Pvt. Ltd., 2010
5. Steve Heath, "Embedded System Design", Second Edition, 2003
6. Daniel D. Gajski, Samar. Abdi, Andreas. Gerstlauer, "Embedded system design: Modeling, Synthesis and Verification", Springer, 2009
7. Raj Kamal, "Embedded Systems: Architecure, Programming and Design", 2nd Edition, TMH New Delhi, 2008.

14EC3003 COMPUTATIONAL INTELLIGENCE AND OPTIMIZATION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To introduce the computational methods inspired by human brain and nature.
- To comprehend the applications of computing and optimization techniques.
- To gain insight on computing and optimizations in solving real world problems.

Course Outcomes:

After completion of the course, students will be able to

- Understand the concepts of neural networks, fuzzy systems and optimization algorithms.
- Analyze the performance of various computing and optimization techniques.
- Application of computational intelligence techniques to classification, pattern recognition, prediction, rule extraction, and optimization problems

Course Description:

Neural Networks: Supervised and Unsupervised neural networks - Fuzzy Logic System: Fuzzy set operators, Fuzzy if-then rules, fuzzy reasoning, Adaptive Neuro-Fuzzy Inference System (ANFIS) - Evolutionary Computation: Basics and applications of Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization, Honey Bee Social Foraging Algorithms, Bacterial Foraging Optimization Algorithm

References:

1. D.J.C. MacKay, "Information theory, Pattern Recognition and Neural Networks, Learning Algorithms", Cambridge University Press, 2009
2. Laurene V. Fausett, "Fundamentals of neural networks: architectures, algorithms and applications", Pearson Education, 2004.
3. Nello Cristianini, John Shawe-Taylor, "An Introduction to Support Vector Machines and Other Kernel-based Learning Methods", Cambridge University Press, 2000
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-fuzzy and soft computing: a computational approach to learning and machine intelligence", Prentice Hall of India, 2004.
5. S.N. Sivanandam, S.N. Deepa, "Introduction to Genetic Algorithms", Springer, 2008.
6. Kenneth A DeJong, "Evolutionary Computation A Unified Approach", MIT Press, 2006.
7. Marco Dorigo and Thomas Stutzle, "Ant Colony optimization", Prentice Hall of India, 2004.
8. Andries P. Engelbrecht, "Fundamentals of Computational Swarm Intelligence", Wiley, 2005

14EC3004 HARDWARE DESCRIPTION LANGUAGES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To know about the various Architecture styles in VHDL and Verilog.
- To learn the circuit verification using VHDL and Verilog HDL
- To get familiar with various Synthesis Techniques.

Course Outcomes:

After completion of the course, students will be able to

- Write programs in VHDL and Verilog HDL for modeling digital electronic circuits.
- Verify the circuits using Test Bench .
- Synthesis the circuits after programming for implementation.

Course Description:

Basic Concepts - Verilog Operators- Data types- Number specification- System tasks and compiler directives- Modules and ports- Gate-level Modeling, Dataflow Modeling- Behavioral Modeling-example for each modeling - test bench- Tasks and Functions – examples - Useful modeling techniques - Timing and delays - Switch level modeling - User defined primitives- Basic Concepts: VHDL-Data Objects- Data Types, Operators- Concurrent and Sequential Assignment Statements- Different Styles of Modeling- Simple Examples-test bench- Procedure and functions – Examples - Packages - Generic constants and statements – Examples -Component and configuration - Introduction to synthesis - Verilog synthesis - Modeling tips for Verilog logic synthesis- Combinational and Sequential logic synthesis using VHDL - VHDL modeling restrictions.

References

1. Samir Palnitkar, "Verilog HDL", Pearson Education, 2004.
2. Douglas L. Perry, "VHDL Programming by Example", TATA McGRAW-HILL Edition,2003.
3. Bhasker, "A Verilog HDL Primer", Star Galaxy Publishing, 2010
4. Michael D. Ciletti, "Advanced Digital Design with the Verilog HDL", Pearson Education Asia, First India Reprint,2008
5. Morris Mano, M.; Michael D. Ciletti, "Digital Design with an Introduction to Verilog HDL"
6. Stephen Brown, "Fundamentals of Digital Logic Design with VHDL", Tata Mcgraw-Hill Publishing Company Limited, 2nd Edition ,2007
7. Bhasker J. "VHDL Primer", Pearson Education,2012

14EC3005 ADVANCED DIGITAL IMAGE PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- Understand the advanced concepts in digital image processing
- Analyze various 2D and 3D image processing methods
- Know the application areas of digital image processing

Course Outcomes:

After completion of the course, students will be able to

- Exhibit knowledge about advancement in the field of digital image processing.
- Apply analytical skills towards solving digital image processing problems.
- Suggest the possible improvements for image processing applications.

Course Description:

Review of image processing fundamentals - 2D Image transforms - Image enhancement: spatial and frequency domain - Morphological image processing - Image segmentation: Edge, Active contour, Texture, Model-based, Atlas and Wavelets - Feature extraction: shape, boundary, Moments and Texture - Introduction to image registration and fusion - 3D image visualization and processing - Measurements on 3D images.

References

1. John C. Russ, F. Brent Neal, "The Image Processing Handbook", CRC Press, 2015.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", 3rd Edition, Academic Press, (2012).
3. A. Ardeshir Goshtasby, "Image Registration: Principles, Tools and Methods", Springer, 2012.
4. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, Second Edition, 2010.
5. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall Inc, 2004.
6. H.B. Mitchell, "Image Fusion: Theories, Techniques and Applications", Springer-Verlag, 2010
7. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill, 2009

14EC3007 WIRELESS AND OPTICAL NETWORKS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the fundamentals of wireless networks.
- To learn the concepts of optical networks.
- To give adequate exposure to the emerging technologies and their potential impact.

Course Outcomes:

After completion of the course, students will be able to

- Understand the architecture and the functionalities of 3G networks.
- Understand the concepts and different interworking schemes
- Explore the functionalities of Hybrid wireless – optical networks

Course Description:

Access Technologies : Hybrid fiber coax, Cable Modem, WLAN, IEEE 802.11, WiMAX / 802.16, Optical Access Networks - Overview of 3G, 3GPP Network, 4G technologies - Software defined radio - Cognitive radio - IMS architecture, ABWAS, MVNO, LTE, Internetworking- Session Mobility - Internetworking architecture for WLAN and GPRS, LMDS, MMDS - PON Architectures - Protocols and

Scheduling Algorithms - Hybrid Optical –Wireless Access Network Architecture -Radio Over fiber architectures.

References:

1. KavehPahlavan and Prashant Krishnamurthy, “Principle of Wireless network- A Unified Approach”, Prentice Hall, 2006.
2. Clint Smith and Daniel Collins, “3G Wireless Networks”, Tata Mcgraw Hill, 2nd Edition, 2007.
3. Vijay K. Garg, “Wireless Communication and Networking”, Elsevier, 2007.
4. Moray Rumney, “LTE and the Evolution to 4G Wireless Design and Measurement Challenges”, Agilent Technologies, 2009.
5. Leonid G. Kazovsky, Ning Cheng, Wei-Tao Shaw, David Gutierrez, Shing-Wa Wong, “Broadband Optical Access Networks”, John Wiley and Sons, New Jersey, 2011.
6. Uyless D. Black, “Optical Networks: Third Generation Transport Systems”, Prentice Hall PTR, 2007.

14EC3008 VLSI DESIGN TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the concepts of MOS transistor and its AC characteristics.
- To know the fabrication process of CMOS technology and its layout design rules
- To know the concepts of static, dynamic CMOS design and its performance estimation.

Course Outcomes:
After completion of the course, students will be able to
- understand the working of MOS transistor
- obtain layout of basic CMOS based design
- know the performance and characteristics of Static and Dynamic CMOS design and basics of testing

Course Description:
MOS transistor theory - MOS models and small signal AC characteristics - CMOS technologies and Layout design rules- Latch up in CMOS circuits - CMOS process enhancements - CAD issues - Fabrication and packaging - NMOS and CMOS Inverters - Transmission gates - Static CMOS design - Dynamic CMOS design - Circuit characterization and performance estimation - VLSI system components - Circuits and system level physical design - Basics of CMOS testing.

References:

1. Neil H.E. Weste and Kamran Eshraghian, "Fundamentals of CMOS VLSI Design", Pearson Education South Asia,2011.
2. John P.Uyemura “Introduction to VLSI Circuits and Systems”, Wiley-India, 2006.
3. Ming-Bo Lin, "Introduction to VLSI Design - A logic, Circuit and System Perspective” CRC Press, 2012.
4. W.Wolf, Modern VLSI Design- System on chip design, 3rd Edition, Pearson publication, 2004

14EC3009 HDL LAB

Credits: 0:0:1 **(Version 1.1)**
Co-requisite: 14EC3004 Hardware Description Languages

Course Objectives:
- To design and analyze the performance of Digital systems

- To design any Digital circuit using Verilog and VHDL
- To learn about the Xilinx software tools.

Course Outcomes:

After completion of the course, students will be able to

- Design and analyze the performance of Digital systems
- Design and implement any digital circuit using Verilog and VHDL
- Use Xilinx software tools

The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3010 DATA COMPRESSION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To explore the special features and representations of different data types.
- To analyze different compression techniques for text data and audio signals
- To analyze various compression techniques for image and video signals

Course Outcomes:

After completion of the course, students will be able to

- Implement the various compression techniques in text and audio.
- Apply various compression techniques on image and video data.
- To develop efficient compression techniques for multimedia data.

Course Description:

Introduction, Special features of Multimedia - Storage requirements for multimedia applications - Lossy& Lossless compression techniques - vector quantization - LBZ algorithm - Text Compression - Compression techniques - Arithmetic coding, Shannon - Fanon coding - LZW family algorithms - Audio Compression- Audio compression techniques - Wavelet based compression - SPIHT, EZW, Video Compression - Video compression techniques and standards- Motion estimation and compensation techniques.

References:

1. Khalid Sayood, "Introduction to Data Compression", Morgan Kauffman, 4th Edition, 2012.
2. David Salomon, Giovonni Motta, "Data Compression – The Complete Reference", Springer Verlag, 5th Edition, 2010.
3. Yun Q. Shi, Huifang Sun, Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms and Standards, CRC Press, 2nd Edition, 2008.
4. Mark Nelson, "The Data Compression book", BPB Publishers, 1st Edition, 2008.
5. Ze-Nian Li, Mark S Drew and J Liu, "Fundamentals of Multimedia", Springer Science & Business Media, 2014.

14EC3011 OPTICAL NETWORKS AND PHOTONIC SWITCHING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn various components of optical networks.
- To learn various generations of optical networks.
- To study the importance of Photonic Packet Switching

Course Outcomes:
After completion of the course, students will be able to

- Understand the components of optical networks
- Know various generations of broadcast optical Networks.
- Acquire knowledge on Photonic Packet Switching

Course Description:
Network evolution - Optical Components – First generation networks – Multiplexing techniques - Single channel and multiple channel protocols – Wavelength routed networks – All optical circuit and packet switching - Protection and restoration.

References:

1. Biswanth Mukherjee, “Optical Network Series”, Springer, 2006
2. Rajiv Ramaswamy, Kumar N. Sivaranjan and Galen H. Sasaki, "Optical Networks – A practical perspective",3rd edition, Elsevier, 2010.
3. Mayer & Martin, “Optical Switching Networks”, Cambridge University Press, 2008.
4. Uyless Black, “Optical Networks – Third generation transport systems”,1st edition, Pearson, 2002.
5. John M. Senior, “Optical Fiber Communications - Principles and Practice”, Pearson Education, 2009.

14EC3012 MODERN DIGITAL COMMUNICATION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the design of optimum detectors.
- To understand the coherent and non-coherent receivers and its impact on different channel characteristics.
- To understand the equalization techniques and orthogonal frequency division multiplexing.

Course Outcomes:
After completion of the course, students will be able to

- Understand optimum detectors used to minimize the effects of inter symbol interference.
- Recognize various high level digital modulation schemes in the context of bandwidth and system performance.
- Design adaptive receiver equalizers and apply the advantages of multi carrier modulation

Course Description:
Review of Baseband modulation, Baseband detection - signals and noise - Detection of binary signals in Gaussian noise – ISI - Equalizers - Review of Band pass modulation - Detection of signals in Gaussian noise, coherent detection, non-coherent detection - error performance for binary systems - M-ary signaling and performance - Optimum detection and estimation - noise vector in signal space - Optimum M-ary receiver design - matched filter configuration - OFDM – generation and signal processing.

References:

1. Bernard Sklar, Pabithra Kumar Ray., “Digital Communications - fundamentals and applications”, AITBS India, 2nd Edition, 2009.
2. John G. Proakis., “Digital Communication”, McGraw Hill Publication, 4th Edition, 2009.
3. Stephen G. Wilson., “Digital Modulation and Coding”, Pearson Education, First Indian Reprint, 2003.

4. Simon Haykin, “Digital Communications”, John Wiley, 2006.
5. M.K.Simon, S.M.Hinedi and W.C. Lindsey, Digital Communication Techniques; Signalling and detection, Prentice Hall India, NewDelhi, 1999.
6. Richard Van Nee, Ramjee Prasad., “OFDM for Multimedia Communications”, Artech House Publication, 2001.
7. Theodore S. Rappaport, “Wireless Communications”, Pearson Education, 2nd edition, 2009.
8. Bikash kumar Dey,” Digital Communication”, NPTEL courseware, 2008.

14EC3013 WIRELESS COMMUNICATION NETWORKS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To introduce the concepts of wireless communication.
- To make the students to know the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in Wireless Communication.
- To enhance the understanding of Wireless Networks.

Course Outcomes:
After completion of the course, students will be able to
- Understand the concepts of wireless communication.
- Apply knowledge of propagation methods and channel models to improve the system performance.
- Acquire the knowledge on Wireless Networks

Course Description:
Wireless channel propagation and model - Propagation of EM signals in wireless channel – reflection, diffraction and scattering - small scale fading - channel classification - channel models – distributions - link power budget analysis - diversity schemes - MIMO Communications -Narrowband MIMO model - parallel decomposition of the MIMO channel - MIMO channel capacity - MIMO diversity gain – beamforming – diversity - multiplexing trade-offs - space time modulation and coding spatial multiplexing and blast architectures - SDMA, hybrid techniques, random access: Scheduling, power control, uplink downlink channel capacity - wireless networks - 3G overview - migration path to UMTS, UMTS basics, air interface - 3GPP network architecture – 4G features and challenges - technology path - IMS architecture - Introduction to wireless LAN - IEEE 802.11 WLAN - physical layer - MAC sub-layer.

References:
1. W. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2007.
2. Harry R. Anderson, “Fixed Broadband Wireless System Design” John Wiley – India, 2003.
3. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.
4. Simon Haykin& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
5. Rappaport. T.S., “Wireless Communications”, Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, Tata McGraw Hill, 2nd Edition, 2007.
7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.

14EC3014 ADVANCED RADIATION SYSTEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To provide an in depth understanding of basic antenna parameters, modern antenna concepts and practical antenna design for various applications.
- To understand the theory of different types of antennas used in communication systems.
- An in-depth study on design and analysis of array antenna.

Course Outcomes:

After completion of the course, students will be able to

- Understand antenna concepts and antenna parameters.
- Interpret the specifications of antenna and design their parameters accordingly
- Choose appropriate antennas for specified applications

Course Description:

Review of antenna theory - dipoles, monopole and loop antennas - linear and planar arrays - array synthesis - phased arrays - helical antennas - radiation from apertures - aperture distribution - horn and parabolic dish antennas - Yagi - Uda and log-periodic antennas - microstrip antennas and arrays - Dielectric Antennas - Method of Moments.

References

1. J.D. Krauss, "Antennas", McGraw Hill, 2005.
2. Balanis, "Antenna Theory - Analysis and Design", John Wiley, 3rd Edition, 2005.
3. R.E. Collin, "Antennas and Radio Wave Propagation", McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, "Antenna Engineering Handbook", McGraw Hill, 1984.
5. Ramesh Garg, I. Bahl, ApisakIttipiboon and P. Bhartia, "Microstrip Antenna Design Handbook", Artech house, 2000.
6. Hubregt.J.Visser, "Antenna Theory and applications", John Wiley & Sons Ltd, Newyork, 2012.

14EC3015 SATELLITE COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the concepts of satellite systems.
- To know about satellite launching, related control and space subsystems.
- To understand the fundamentals of space link design, multiple access techniques and different applications.

Course Outcomes:

Upon completion of the course, the students will be able to

- Understand satellite station keeping techniques and orbital mechanics
- Calculate the link power budget, modulation and medium access schemes to establish satellite link.
- To understand the working of commercial satellite transmissions.

Course Description:

Orbital parameters – GEO, LEO, MEO, and HEO orbits and Launching methods, Satellite bus and payload - Space craft configuration – Subsystems - Satellite uplink - down link. Power Budget – Noise Propagation factors - Rain and ice effects - Polarization calculations. Modulation and Multiplexing - Spread spectrum - Earth station parameters – location - propagation effects of ground. INTELSAT Series – INSAT - VSAT-Application: GSM, GPS, DTH and Video conferencing.

References

1. Louis. J. Ippolito Jr." Satellite Communication Systems Engineering", John Wiley Publications, 2008.
2. Timothy Pratt, Charles W. Bostian, Jeremy E. Allnutt,Satellite Communications, John Wiley and Sons, 2nd Edition, 2006.
3. Dennis Rody," Satellite Communication", McGraw Hill, 4th Edition, 2006.
4. Bruce R. Elbert, "The Satellite Communication Applications Hand Book" Artech House Boston, 2nd Edition 2003.
5. Gerard Maral, Michel Bousquet, "Satellite Communications Systems: Systems, Techniques and Technology", John Wiley, 5th Edition, 2010.

14EC3016 ERROR CONTROL CODING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the vector algebra concepts for the error control coding
- To learn about various error control codes.
- To analyze the error control parameters in communication.

Course Outcomes:

After completion of the course, students will be able to

- Understand the vector algebra concepts used for error control coding
- Understand different types of error control codes
- Analyze the error control

Course Description:

Vector Algebra - Galois Filed Arithmetic - BCH Codes – Decoding - Implementation of error correction - Binary and Non binary BCH and Reed-Solomon Codes - Burst error correcting codes - Fire code inter-leaved codes - Phased burst error correcting codes - Interleaved codes - phased burst error correcting codes - Convolution codes - Decoding of convolution codes - Transfer function - Application of Viterbi decoding - Turbo codes.

References:

1. Shu Lin & D.J. Costello - "Error Control Coding", 2nd edition, Pearson Education, 2013.
2. Shu Lin "Application of Error Control", 1974.
3. Simon Haykin, "Digital Communication", John Wiley and Sons, 2000.
4. Bernard Sklar, Pabitra Kumar Ray, "Digital Communications, Fundamentals and Applications", 2nd edition, Pearson Education, 2013.
5. Peter Sweeney, "Error Control Coding: From theory to Practice", Wiley, 1st Edition, 2002.

14EC3017 COMMUNICATION LAB-I

Credits: 0:0:2 **(Version 1.1)**

Co-requisite: 14EC3011 Optical Networks and Photonic Switching
14EC3012 Modern Digital Communication Techniques

Course Objectives

- To study and experiment different coding techniques in communication system.
- To Understand Satellite- GSM mobile communication & Software defined radio concepts
- To demonstrate modern digital communication techniques.

Course Outcomes:
After completion of the course, students will be able to

- Understand and experiment different coding techniques in wireless communication.
- Understand and experiment different digital modulation schemes.
- Gain experience in latest communication systems.

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3018 COMMUNICATION LAB-II

Credits: 0:0:2 **(Version 1.1)**
Co-Requisite: 14EC3013 Wireless Communication Networks
14EC3014 Advanced Radiation Systems

Course Objectives:

- To design, simulate and understand different types of antenna using EM Solvers and MIC hardware.
- Involve students in studies of communication network and its performance through network simulation
- To study GPS.

Course Outcomes:
After completion of the course, students will be able to

- Design and simulate antenna of given specification.
- Construct and analyze communication networks through network simulation tools
- Know the concepts in GPS

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3019 DIGITAL SYSTEM AND ASIC DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To know about designing of combinational and sequential circuits.
- To know about different ASIC design techniques**.**
- To know about architecture of different FPGAs and PLDs.

Course Outcomes:
After completion of the course, students will be able to

- Able to design digital logic circuits.
- Familiar with different ASIC design techniques.
- Familiar with different FPGA Architectures

Course Description:
Design of combinational circuits- Design of static hazard free and dynamic hazard free logic circuits-Mealy machine, Moore machine-Design of synchronous and asynchronous sequential logic circuits. Introduction to PLD – Classification - Design of combinational and sequential circuits using PLDs - ASM Chart -Types of ASICs – Design flow – Programmable ASICs - Programmable ASIC Logic Cells – Programmable ASIC I/O blocks - Programmable ASIC Interconnect -Design systems – Logic synthesis – Half gate ASIC – Schematic entry – PLA tools – EDIF – CFI design representation. Complex PLD's

(CPLD) - Design of combinational and sequential circuits using CPLD's - Introduction to Field Programmable Gate Arrays - Introduction to Actel - ACT2 family-Xilinx FPGA.

References

1. Palmer, J.E., Perlman, D.E., "Introduction to Digital Systems", Tata McGraw Hill, New Delhi, Reprint 1996.
2. Morris Mano,"Digital Logic and Computer Design",3rd edition Prentice Hall of India, 2002.
3. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", Prentice Hall International, Inc., New Jersey, 1995.
4. Robert K Dueck, "Digital Design with CPLD applications and VHDL", Thomson Asia, 2002.
5. Charles H Roth,"Digital Systems Design using VHDL",Cengage Learning India Pvt. Ltd, 2008.
6. Michael John Sebastian Smith "Application specific integrated circuits." Addison, Wesly Longman Inc., 2006.

14EC3020 CMOS VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To know the basics involved in the design of VLSI circuits.
- To understand about stick diagrams and Layouts.
- To know about various CMOS Design Styles.

Course Outcomes:

After completion of the course, students will be able to

- Understand CMOS processing technology, basic CMOS circuits, characteristics and performance.
- Draw stick diagram and layout based on the design rules.
- Design combinational and sequential circuits in CMOS design styles.

Course Description:

MOS Transistor- MOS Transistor under static conditions-Threshold voltage- -Channel length modulation - Velocity saturation - Hot carrier effect-Drain current Vs voltage charts - Sub threshold conduction - MOS structure capacitance - Design logic gates using CMOS devices - Stick Diagram - Static CMOS inverter - Evaluating the Robustness of CMOS Inverter - Performance of CMOS inverter: Dynamic behavior - Computing the capacitance propagation delay sizing inverter for performance - complementary CMOS design- Ratioed logic-DCVSL - Pass transistor logic - Differential pass transistor logic -Sizing of level restorer - Sizing in pass transistor - Dynamic CMOS design - Basic principles - Domino logic optimization of Domino logic-NPCMOS - logic style selection - Designing logic for reduced supply voltages - CMOS sequential logic design - CMOS subsystem design.

References

1. Jan.M.Rabaey.,Ananda Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits", 2nd Edition, 2003.
2. Neil H.E Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Pearson Education, 2002.
3. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital IC- Analysis and Design", 3rd Edition, Tata McGraw Hill publication, 2003.
4. Kiran Kumar V. G, Nagesh H. R, "Fundamentals of CMOS VLSI Design", Pearson, 2011.
5. Neil H. E. Weste, David Harris, Ayan Banerjee, "CMOS VLSI Design, A circuit and systems Perspective", 3rd Edition, 2011.

14EC3021 ANALYSIS AND DESIGN OF ANALOG INTEGRATED CIRCUITS

Credits: 3:1:0 **(Version 1.1)**

Course Objectives:

- To study single stage amplifier with different loads.
- To study the frequency response and noise analysis of amplifiers
- To study op-amp stability and its frequency compensation

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge in designing single stage amplifiers and differential pair amplifiers.
- Gain knowledge in frequency response, noise and feedback of single stage amplifiers
- Apply the concepts of stability and frequency compensation in op-amps.

Course Description:

Single stage Amplifiers: common source stage- source follower-common gate stage- cascode stage-Differential amplifiers: Single ended and differential operation- Basic differential pair- Differential pair with MOS loads- Passive and active current mirrors-Frequency response of amplifiers and noise analysis-Feedback topologies: Effect of loading in feedback networks-Operational amplifiers-Stability and frequency Compensation- Band gap References.

References

1. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2003
2. Willey M.C. Sansen, "Analog Design Essentials", The Springer International Series in Engineering and Computer Science ,First Edition , 2006.
3. Grebene, "Bipolar and MOS Analog Integrated Circuit Design", John Wiley &sons,Inc., 2003.
4. Phillip E.Allen, DouglasR.Holberg, "CMOS Analog Circuit Design", Third edition, Oxford University Press, 2013
5. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Fourth Edition, Wiley Student Edition, 2009.

14EC3022 VLSI TECHNOLOGY

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn about the different techniques involved in the fabrication of VLSI chips
- To understand various IC technologies
- To be familiarized with the back end modelling of chip design

Course Outcomes:

After completion of the course, students will be able to

- Understand the different techniques involved in the chip design
- Familiarize with the different IC technologies
- Familiarize with the back end modeling

Course Description:

Crystal growth- Wafer preparation- Epitaxy and Oxidation-Lithography and relative Plasma etching-Deposition, Diffusion,-Ion implantation and Metallization- oxidation – Epitaxy – Lithography – Etching and Deposition- NMOS IC Technology – CMOS IC Technology – MOS Memory IC technology - Bipolar IC Technology – IC Fabrication-VLSI assembly technology – Package fabrication technology.

References:

1. S.M.Sze, “VLSI Technology”, McGraw Hill, 2nd Edition. 1998.
2. James D Plummer, Michael D. Deal, Peter B. Griffin, “Silicon VLSI Technology: Fundamentals, Practice and Modeling”, Prentice Hall India.2000.
3. Wai Kai Chen, “VLSI Technology” CRC Press, 2003.
4. Rajesh Agarwal and Dr.Laxman Sahoo, “VLSI Technology and Design”,Technical Publications, Pune, 2008.
5. YasuoTarui, “VLSI Technology: Fundamentals and Applications”, 2011

14EC3023 SOLID STATE DEVICE MODELING AND SIMULATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn about the fundamentals of MOSFETs.
- To understand device physics and to observe experimentally the device performance characteristics and derive predictable equations and expressions for device performance under various scenarios of excitation.
- To get a vivid idea about most widely used device models used by the industry including BSIM and EKV.

Course Outcomes:

After completion of the course, students will be able to

- Understand the procedures used to construct the complicated MOSFET models using VLSI CAD tools.
- Introduce changes in the device models as well as contribute to the development of appropriate device models.
- Design MOSFETs in the nano dimensions .

Course Description:

Fundamentals and characteristics of MOSFET devices - MOS Capacitor - Different MOSFET modeling and its high frequency behavior - Noise modeling and nonlinearities in CMOS devices-.Advanced MOSFET models for circuit simulators- Other MOS models for analog/RF applications.

References:

1. TrondYtterdal, Yuhua Cheng and Tor A. Fjeldly, Wayne Wolf, “Device Modeling for Analog and RF CMOS Circuit Design”, John Wiley & Sons Ltd, 2003.
2. B. G. Streetman and S. Banarjee, “Solid State Electronic Devices”, Prentice-Hall of India Pvt. Ltd, New Delhi, India, 2010.
3. B. Bhattacharyya, “Compact MOSFET Models for VLSI Design”, John Wiley & Sons Inc., 2009.
4. Narain Arora, “MOSFET Modeling for VLSI Simulation, Theory and practice”, 2007.
5. T. Grasser, “Advanced Device Modeling and Simulation”, World scientific publishing, 2003.
6. Carlos Galup-Montoro and M. C. Schneider, “MOSFET Modeling for Circuit Analysis and Design”, World Scientific Publishing Co. Pvt. Ltd., 2007.

14EC3024 LOW POWER VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the concepts on different levels of power estimation.
- To study the design of low power SRAM circuits and energy recovery circuits.
- To study the techniques to reduce power at different levels.

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge in low power estimation and optimization at different levels.
- Design low power SRAMs and energy recovery circuits.
- Apply low power techniques in various circuits.

Course Description:

Introduction- Gate Level Logic Simulation- Architectural Level Analysis- Probabilistic Power Analysis- Circuit and logic level power optimization techniques- Special Techniques-Architecture and system- Leakage Current in Deep Sub-Micrometer Transistors- Deep Sub- Micrometer Device Design Issues-Low Voltage Circuit Design Techniques- SRAM Architecture- Energy Recovery Circuit Design.

References:

1. Gary Yeap, "Practical Low Power Digital VLSI Design", Kluwer academic publishers, 2001.
2. Kaushik Roy, Sharatprasad, "Low Power CMOS VLSI Circuit Design", John Wiley & Sons Inc., 2000.
3. Anantha Chadrasekaran and Robert Broderson, "Low Power CMOS Design",Standard Publishers, 2000.
4. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, "CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson edition, Second Indian reprint, 2003.
5. Abdellatif Bellaouar and Mohamed Elmasry, "Low Power Digital VLSI Design: Circuits and Systems", 2012.

14EC3025 CAD FOR VLSI CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the Physical design cycle of VLSI.
- To realizing the importance of various VLSI algorithms in CAD based VLSI Design.
- The study of design problems associated with CAD VLSI development.

Course Outcomes:

After completion of the course, students will be able to

- Understand how VLSI CAD design tools are developed with constraints and limitations.
- Familiarize various types of Algorithms in VLSI for Optimized design.
- Develop Physical design of VLSI systems using CAD

Course Description:

Introduction to VLSI Methodologies - VLSI Physical Design Automation – Fabrication process and its impact on Physical Design - A quick tour of VLSI design automation tools – Data structures and basic Algorithms - Algorithmic graph theory and computational complexity – Tractable and Intractable problems-Simulation – Logic synthesis – Verification – High level synthesis – Compaction. ASIC Construction-Partitioning methods – Floor planning – Placement - Global routing - Detailed routing- circuit extraction - DRC - Physical Design Automation of FPGAs

References:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", John Wiley, 2003.
2. Sabih H. Gerez, "Algorithms for VLSI Design Automation", John Wiley, 2004.
3. Sadiq M Sait, "VLSI physical Design Automation: Theory and Practices", World Scientific, 1999.
4. Steven Rubin, "Computer aids for VLSI Design", 2nd edition,1994.
5. Prithviraj Banerjee, "Parallel Algorithms for VLSI Computer-Aided Design", Springer, 2004.
6. Sarafzadeh, C.K. Wong, "An Introduction to VLSI Physical Design", McGraw Hill International Edition 1996.

14EC3026 TESTING AND TESTABILITY

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the methods of testing the combinational and sequential circuits.
- To know about various fault simulation techniques.
- To understand the difference between DFT and BIST

Course Outcomes:

After completion of the course, students will be able to

- Gain knowledge to test any VLSI circuits
- Know different testing and fault simulation methods.
- Understand BIST architectures and compression techniques

Course Description:

Motivation for testing - Fault models - Test generation algorithms for combinational and sequential logic circuits - Functional testing –Fault model based testing- Time frame expansion – Fault simulation techniques - Key testability concepts – Ad Hoc design for Testability – Scan based design - Signature analysis - Compression techniques - Built-in self-test –Architectures.

References:

1. Vishwani D. Agarwal, "Essential of Electronic testing for digital, memory and mixed signal circuits", Springer, 2000
2. Abramovici .M, Breuer, "Digital Systems Testing and Testable Design", Jaico Publishing House, 2001.
3. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Cliffs, 1998.
4. Parag K.Lala, " Digital circuit Testing and Testability", Academic press, 1997.

14EC3027 VLSI DIGITAL SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study about various VLSI architectures at the implementation level,
- To understand various approaches to analysis, estimation, and reduction of power consumption.
- To know how to design high speed, low-area, and low-power VLSI systems for broad range of DSP applications.

Course Outcomes:
After completion of the course, students will be able to

- Understand several existing VLSI optimization techniques
- Incorporate pipeline based architectures in the design.
- Modify the existing or new DSP architectures suitable for high speed and low area applications

Course Description:
Representations of DSP Algorithms-Iteration bound and algorithms for computing iteration bound - Pipelining and parallel processing of FIR filters for high speed/ low power applications - Retiming& Unfolding: Algorithmic strength reduction in filters and transforms - Systolic Array: Design Methodology-FIR systolic Arrays -Fast Convolution Algorithms- Scaling and roundoff noise computation -Bit level arithmetic architectures-Canonic Signed Digit Arithmetic-Distributed Arithmetic-Redundant Arithmetic-Numerical Strength Reduction Techniques

References:

1. Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and implementation", Wiley, Interscience, 2007.
2. U. Meyer Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, 2nd Edition, 2004.
3. Shoab Ahmed Khan, "Digital Design of Signal Processing Systems: A Practical Approach" , Wiley-Blackwell, 2011.
4. Jose E. France, Yannis Tsividis, "Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
5. S.Y.Kuang, H.J. White house, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall,1995.

14EC3028 ASIC DESIGN LAB

Credits: 0:0:2 **(Version 1.1)**
Co-requisite: 14EC3004 Hardware Description Languages

Course Objectives:

- Design of Digital Circuits for synthesis and simulation using HDL and Schematic Entry.
- Design of various steps involved in Physical Design such as Placement, Routing, DRC, Parasitic Extraction and Layout.
- Design and analysis of Analog Circuits

Course Outcomes:
After completion of the course, students will be able to

- Exposed to various tools such as Mentor Graphics (Front-end and Back-end), Tanner EDA and Cadence EDA tools.
- Able to design any Analog or Digital Circuits using the above tools.
- Able to use the tools for their projects and research works.

Experiments:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3029 SPEECH AND AUDIO SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the basic concepts of speech and audio.
- To study the speech processing methods in time and frequency domain
- To study the analysis of various M-band filter banks & transform coders for audio coding

Course Outcomes:

After completion of the course, students will be able to

- Express the speech and audio signals in terms of its time and frequency domain features.
- Understand various transform theory and filter bank theory for speech and audio coding.
- Synthesize speech and audio application block diagram and they can develop algorithms that could be used to implement the application.

Course Description:

Mechanics of speech - Nature of speech signal - Discrete time modelling of speech production - Classification of speech sounds - Absolute threshold of hearing - Critical bands- Masking. Machanics of audio - Perceptual entropy - PAQM - Cognitive effects in judging audio quality - Time - frequency analysis of audio - filter banks and transforms - Time and frequency domain methods for speech processing - Homomorphic speech analysis - Linear predictive analysis of speech - Application of LPC parameters - Formant analysis.

References:

1. UdoZölzer, "Digital Audio Signal Processing", John Wiley & sons Ltd , 2nd Edition, 2008.
2. Mark Kahrs and Karlheinz Brandenburg, "Applications of Digital Signal Processing to Audio and Acoustics", Kluwer Academic Publishers New York,2002.
3. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech Signals", Pearson Education, 4th Impression,2009.
4. Andreas Spanias, Ted Painter and Venkatraman Atti, "Audio Signal Processing And Coding", John Wiley & Sons, 2007.
5. Ben Gold,Nelson Morgan and Dan Ellis, "Speech and Audio Signal Processing", Second Edition, John Wiley & Sons ,2011.
6. T. F. Quatieri, "Discrete Time Speech Processing: Principles and Practice", Prentice Hall Inc, 2002.
7. L.R.Rabiner,B-H Juang and B.Yegnanarayana, "Fundamentals of Speech Recognition", Pearson Education, 1st Impression,2009.

14EC3030 BIOLOGICAL SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To introduce the characteristics of different biosignals
- To discuss linear and non-linear filtering techniques to extract desired information
- To introduce techniques for automated classification and decision making to aid diagnosis

Course Outcomes:

After completion of the course, students will be able to

- Analyze signals in time series domain & estimate the spectrum
- Understand the significance of detection techniques applied in biosignal processing.
- Extract the features using multivariate analysis.

Course Description:
Signal, System and Spectrum - Characteristics of dynamic biomedical signals, cross-spectral density and coherence function, cepstrum and homomorphism filtering - Time Series analysis and Spectral Estimation – linear prediction models, Application in Heart rate variability, PCG signals - Biosignal Classification and Recognition - Time Frequency And Multivariate Analysis - Time frequency representation, spectrogram, wavelet analysis – Data reduction techniques - Multivariate component analysis - Back propagation neural network based classification.

References:

1. Arnon Cohen, "Bio-Medical Signal Processing",Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, "Biomedical Signal Analysis- A case study approach", Wiley-Interscience/IEEE Press, 2nd Edition, 2015.
3. Willis J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, "Digital Signal processing- A Practical Approach", Pearson Education Ltd., 2002.
5. Raghuveer M. Rao and Ajith S.Bopardikar, "Wavelets transform – Introduction to theory and its applications", Pearson Education, India 2000.

14EC3031 MEDICAL IMAGE PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the operation of various imaging modalities
- To analyze the outcome of various image processing techniques
- To understand the overview of various dimensional imaging methods

Course Outcomes:
After completion of the course, students will be able to
- Get broad exposure to various applications of medical imaging techniques
- Apply these techniques to real time problems
- Conduct independent study and analysis of medical imaging systems

Course Description:
Acquisition of Images - rectilinear scanner - Emission computed Tomography multiple crystal scintillation cameras - Image Reconstruction from Projections in Two dimensions - Radon Transform- Projection Theorem – Fluoroscopy – CT - Image quality Digital fluoroscopy – cinefluorography - Imaging Reconstruction algorithms - Magnetic Resonance Imaging and Spectroscopy - Fundamentals - tissue contrast in MRI – angiography – spectrography - Ultra sound - Neuro magnetic Imaging - Quality control - Origin of Doppler shift – Limitations of Doppler systems.

References:

1. William R. Hendee, E. Russell Ritenour, "Medical Imaging Physics", A John Wiley & sons, Inc., Publication, 4th Edition 2002.
2. Geoff Dougherty, "Medical Image Processing: Techniques and Applications", Springer, 2011.
3. Z.H. Cho., J-oie, P. Jones and Manbir Singh, "Foundations of Medical Imaging", John Wiley and sons,1993.
4. Avinash C. Kak, Malcolm Shaney, "Principles of Computerized Tomographic Imaging", IEEE Press, New York, 1998.

5. Isaac Bankman (Editor), "Handbook of Medical Imaging: Processing and Analysis Management", Academic Press, 2000.

14EC3033 ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study about the aspects of clinical engineering
- Understand the electric shock hazards and safety devices.
- Understand the applications of various sensors

Course Outcomes:

After completion of the course, students will be able to

- Exhibit knowledge about the recent medical applications of electronics.
- Specify the type of sensor for physiological measurement.
- Apply the knowledge to conduct test and measurements.

Course Description :

Medical standards and recalibration, Need for Standardization, Hospital design, Hospital safety Regulations, Management and Legal aspects. Network topologies, LAN components, network operating system, planning and installing LAN in hospital set up-Fibre Optic Sensors for Measuring Physiological Parameters – Application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities- principles of smart sensors. EMI and EMC Applied to Hospital Equipment's- Virtual Reality Application -Human Factors and Human Perception, Computer graphics principles used in VR, Existing tools Tracking- Applications of Virtual Reality in Medicine

References:

1. Syed Amin Tabish, "Hospital and Health services Administration Principles and Practices", Oxford Press, New Delhi, 2001.
2. Jacob Kline, "Handbook of Biomedical Engineering", Academic Press INC ,Sandiego 1981.
3. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech House, 3rd Edition, 1986.
4. Eric Udd, "Fibre Optic Sensors and Introduction for Engineers and Scientists", Wiley Interscience Publication, New Delhi, 1991.
5. SK Basandia, "Local Area Network", Golgotia Publishing Pvt. Ltd., New Delhi, 1995.
6. R.C.Goyal, "Hospital Administration and Human Resource Management", 4th Edition, Prentice Hall of India, New Delhi, 2006.

14EC3034 COMPUTER BASED MEDICAL INSTRUMENTATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- Understand the basics of computerized data acquisition and processing
- Obtain knowledge about the PC hardware
- Understand various design and interfacing logics

Course Outcomes:

After completion of the course, students will be able to

- know the functional units in a PC and their applications
- Independently analyze various data acquisition system.
- Solve instrumentation tasks using both PC and interfacing methods.

Course Description:
Overview of Mother Boards – Processors – Memory - Adapter cards – Ports - Power supply (BIOS, DOS) interaction - Functional and Architecture Block diagram of a PC - Processors and Memory - 80X86 Processors - Architectures and Memory management - Peripheral Interfacing and Controllers – RAM, SDRAM and RDRAM, Cache memory, ROM and its types, Flash memory - I/O slots - Serial and Parallel ports – USB - FireWire port - Computerised Data Acquisition and Programming - in C - DSP in Medical applications - CAD In Medical Instrumentation - FPGA Design Logics - Instrumentation in LABview - Multisim Simulation with bio amplifiers - Mixed signal SoC applications in biomedical applications

References:

1. Ramachandra Lele, "Computers in Medicine Progress in Medical Informatics", Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, "PC Based Instrumentation: Concepts and Practice", Prentice Hall of India, New Delhi, 2007.
3. B.Govindarajalu, "IBM PC and Clones: Hardware, Troubleshooting and Maintenance", Tata McGraw Hill Publishing Company, New Delhi, 2005.
4. Herbert Schildt, "The Complete Reference – JAVA", Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, "Biometrics – The Ultimate Reference", Dream tech Publishers, New Delhi, 2003
6. Ranjan Parekh, "Principles of Multimedia", Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, "Trouble shooting, Maintaining and Repairing of PCs", Tata McGraw Hill Publishing Company, New Delhi, 2005

14EC3035 DIGITAL COMMUNICATION RECEIVERS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the basic concepts of digital receivers.
- To understand the principles involved in digital communication receivers under different channel conditions.
- To get exposed to equalization techniques employed in digital receivers.

Course Outcomes:
After completion of the course, students will be able to
- Understand different modulation techniques used in digital communication
- Apply mathematical formulations to find optimum detection of wireless signals
- To understand different equalization techniques for reception of signals in wireless environment.

Course Description:
Review of Digital Communication Techniques - Optimum Multiuser Detection, Correlating and Decorrelating Detection, Narrowband Interference Suppression, Synchronization techniques - Signal Processing for Wireless Reception - Adaptive Equalization - Echo cancellation.

References

1. X.Wang&H.V.Poor, "Wireless Communication Systems", Pearson, 2004.
2. R.Janaswamy, "Radio Wave Propagation and Smart Antennas for Wireless Communication", Kluwer, 2002
3. Iti Saha Misra, "Wireless Communications and Networks", Tata McGraw Hill, 2009.

4. Mohamed Ibnkahla, “Adaptive Signal processing in Wireless Communications”, CRC Press, 2008.
5. A.V.H. Sheikh, “Wireless Communications Theory & Techniques”, Kluwer Academic Publications, 2004.
6. John.G.Proakis, M. Salehi, “Fundamentals of Digital Communication Systems”, 5^{th} Pearson Education, 2005.
7. John R. Barry, E.A.Lee and D.G.Messerschmitt, “Digital Communication”, 3^{rd} Edition, Allied Publishers, 2004.

14EC3036 DETECTION AND ESTIMATION THEORY

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- Understand basics of detection and estimation theory.
- Design and analyse optimum detection schemes.
- Study different estimation schemes such as ML and MMSE estimators.

Course Outcomes:

After completion of the course, students will be able to

- Understand different estimation schemes.
- Understand the extraction of useful information from random observations in communication through probabilistic framework.
- Design an optimal estimator for signals with different noise parameters.

Course Description:

Binary Hypothesis Testing: Bayes, Minimax and Neyman-Pearson tests. Composite hypothesis testing - Signal Detection in Discrete Time - Models and detector structures. Coherent detection in independent noise - Detection in Gaussian noise - Detection of signals with random parameters - Detection of stochastic signals - Bayesian Parameter Estimation: Kalman - Bucy filter - Linear estimation.Orthogonality principle - Wiener- Kolmogorov filtering – causal and non-causal filters - Signal Detection in continuos time.

References:

1. Harry .L. Van Trees, Kristine L Bell, ZhiTian, Detection, Estimation and Modulation theory, Part I, 2^{nd} Edition, Wiley Publications 2013.
2. H.V. Poor, “An Introduction to Signal Detection and Estimation”, 2^{nd} Edition, Springer, 1994.
3. Mourad Bakat, “Signal Detection and Estimation”, 2^{nd} Edition, Artech House, 2005.
4. Athanasios Papoulis, S Unnikrishna Pillai, “Probabilty, Random Variabes and Stochastic Processes”, 4^{th} Edition, Mc Graw Hill, 2002.
5. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
6. Mandyam D. Srinath, P.K. Rajasekaran and R. Viswanathan, “Introduction to Statistical Signal Processing with Applications”, Prentice Hall, 1^{st} Edition, 1995.

14EC3037 DSP ARCHITECTURE AND PROGRAMMING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the fundamentals of DSP processors and develop the programming skills.
- To learn the third generation DSP architecture.
- To expose the advanced DSP architectures and their applications.

Course Outcomes:

After completion of the course, students will be able to

- Identify the basic architectural elements of DSP hardware.
- Gain knowledge in the trade-offs necessary in algorithm design for real-time DSP implementation;
- Understand the importance of real-time DSP for a broad class of engineering applications.

Course Description:

Fundamentals of programmable DSPs - Multiplier and Multiplier accumulator - Modified bus structures and Memory access in PDSPs - Multiple access memory - Multi-port memory -VLIW architecture - Pipelining - Special addressing modes in PDSPs - On chip peripherals. Texas and Analog Devices processors: Architecture of TMS320C5X processor and TMS320C6X processor - Architecture of ADSP-21XX processor and ADSP-210XX processor. Addressing modes and assembly language instructions - Application programs- Filter design and FFT calculation. Advanced processors architecture of TMS320C54X: Pipe line operation, Code Composer Studio. Architecture of TMS320C6X- Architecture of Motorola DSP563XX-Comparison of the features of DSP family processors.

References:

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications" Tata McGraw Hill Publishing Company Limited. New Delhi, 2nd Edition 2010.
2. Avtar Singh and S. Srinivasan, "Digital Signal Processing – Implementations using DSP Microprocessors with examples from TMS320C54XX", Thomson, 2004.
3. RulphChassaing and Donald Reay, "Digital Signal Processing and applications with the C6713 and C6416 DSK", John Wiley & Sons, 2nd Edition,2011.
4. RulphChassaing, "DSP applications using C and the TMS320C6X DSK", John Wiley & Sons, 2003.
5. Sen M.Kuo and Woon-Seng S.Gen, "Digital Signal Processors: Architectures, Implementations, And Applications", Pearson Education India, 2nd Impression,2009.
6. Sen M.Kuo, Bob H.Lee and Wenshun Tian, "Real-Time Digital Signal Processing: Fundamentals, Implementations and Applications", John Wiley & Sons, 2013.
7. User guides Texas Instrumentation, Analog Devices, Motorola, 2010

14EC3038 GLOBAL POSITIONING SYSTEM

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To introduce Global Positioning Systems
- To understand types of signals used in the GPS and accuracy limits
- Latest versions of GPS and its application

Course Outcomes:

After completion of the course, students will be able to

- Develop a strong foundation in the field of Global Positioning Systems.
- Acquire in-depth knowledge about working of Global positioning receivers.
- Understand various errors occurring in GPS and latest variant DGPS receivers and GPS applications

Course Description:

Introduction: GPS and GLONASS Overview - Satellite Navigation -Time and GPS – User position and velocity calculations Signal Characteristics: GPS signal components - purpose, properties. GPS Receivers

& Data Errors: SA errors - propagation errors Differential GPS: LADGPS – WADGPS GPS Applications: GPS in surveying, Mapping and Navigation.

References:

1. MohinderS.Grewal , Lawrence R.Weill, Angus P.Andrews, "Global Positioning Systems - Inertial Navigation and Integration", John Wiley& sons , 2002
2. E.D.Kaplan, "Global Positioning Systems – Inertial Navigation and Integration", John wiley & sons , 2001.
3. G S RAO, "Global Navigation Satellite Systems", McGraw-Hill publications, New Delhi, 2010
4. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, "GPS – Theory and Practice", Springer – Wien, New York ,2001.
5. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley & Sons, 2001.

14EC3039 OPTICAL SIGNAL PROCESSING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the basic optical signal properties
- To understand the working principle of spatial filtering system
- To study the working and applications of optical devices

Course Outcomes:

After completion of the course, students will be able to

- Learn the properties of optical signal
- Acquire knowledge on spatial filtering system
- Learn the working and application of optical devices

Course Description:

Fundamentals of geometrical and physical optics - Sample function - Geometrical optics - Basic laws - Refraction by prisms - Lens formula - Imaging condition - Optical invariants - Physical optics - Transforms: Fresnel- Fourier - Inverse Fourier and Extended Fourier - Spatial light modulation - Spatial light modulators - Detection process - System performance process - dynamic range - Raster format - Spectral analysis - Types of spatial filters - Optical signal processing and filter generation - Read out module - Orientation and sequential search - Applications of optical spatial filter – Acousto-optic cells - Spatial light modulators - Basic spectrum analyzer - aperture weighting - dynamic range and SNR- photo detector - Geometric considerations – radiometer - Overlapping of waves - optimum photo detector size for 1D and 2D structure - Optical radio - spatial and temporal frequencies - Distributed and local oscillator - Dynamic range comparison of heterodyne and power spectrum analyzers.

References:

1. Vanderlugt, "Optical Signal Processing", John Wiley & Sons, New York, 2005.
2. Mahlke Gunther, Goessing Peter, "Fiber optic cables: Fundamentals, Cable Engineering, System planning", John Wiley, 3rd Edition, 2001.
3. Hiroshi Murata, "Handbook of Optical Fibers and Cables" Marcel Dekker Inc., New York, 1998.
4. P.K. Das, "Optical Signal Processing Fundamentals", Narosa Publishing New Delhi, 1991.
5. Bradley G. Boone, "Signal Processing Wing Optics", Oxford University Press, 1998.

14EC3040 MICROWAVE INTEGRATED CIRCUITS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study different technologies of microwave integrated circuits and to study various encapsulation and mounting/bonding techniques of hybrid and monolithic MICs.
- To study planar transmission lines such as microstrip and coupled microstrip lines.
- To design and fabricate lumped passive elements working at microwave frequencies, design and analyze various planar microwave circuits.

Course Outcomes:

After completion of the course, students will be able to

- Understand the structural and constructional features of ICs at microwave range of communication.
- Design amplifier, oscillator, filter, attenuator circuits suitable for microwave transmission.
- Design application circuits to employ in radar, satellite, and mobile communication systems.

Course Description:

Fabrication process behind Hybrid(thick and thin film) MICs and Monolithic MICs - Methods of encapsulation and bonding of chips - Testing of fabricated chips - Numerical method, hybrid mode, and coupled mode analysis of microstrip lines - Even and odd mode analysis of slot lines, coplanar wave guides, and directional couplers such as branch line couplers - Design and fabrication of microstrip based lumped elements such as resistors, inductors, and capacitors along with certain non-reciprocal devices such as circulators, isolators, and phase shifters - Microwave amplifier and oscillator circuit designs and gain/stability analysis - Analysis of infinite terminated periodic structures such as nth order filters.

References

1. D. M. Pozar, Microwave Engineering, 3rd Edition, John Wiley & Sons, 2005.
2. Robert E.Collin, Foundations for Microwave Engg., 2nd ed., McGraw Hill, 2001.
3. Gupta,K.C, and Amarjitsingh , "Microwave Integrated Circuits", John Wiley and sons, Wiley Eastern Reprint, 2004.
4. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Prentice Hall, 1996.
5. Hoffmann, R.K , "Handbook of Microwave Integrated Circuits", Artec House, 1987.
6. Kneppo I, Fabian J, Pavel M ,"Microwave Integrated Circuits", Kluwer academic publishers, 2000.

14EC3041 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To explore the EMI/EMC concepts and principles.
- To understand the EMI shielding principles and Electromagnetic compatible PCB design.
- To learn EMI measurements and standards.

Course Outcomes:

After completion of the course, students will be able to

- Design and test radiation hazard free electronic products not susceptible to EMI
- Understand the concepts of EMI Coupling and decide shielding in cables and PCB
- Understand commercial and military testing standards

Course Description:
EMI/EMC Concepts - EMI Coupling Principles - EMI Control Techniques - EMC Design of PCBs - EMI Measurements and Standards; Standard for EMI/EMC - MILSTD461/462, IEEE/ANSI, CISPR/IEC, FCC regulations, British and Japan standard, VDE standard, EURO norms and comparison of Standard

References :

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, second Edition, 2001.
2. C R Paul, " Introduction to Electromagnetic Compatibility", John Wiley and Sons, 1992.
3. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech House, Norwood, 1987
4. Henry W.Ott. "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, Second Edition, 1988.
5. Donald R. J. White, William G. Duff, "A Handbook Series on Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications", Don White Consultants, 1971.

14EC3042 RF SYSTEM DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the fundamentals of RF system design
- To gain knowledge on the behavior and issues of passive and active components in RF applications
- To evaluate the performance of RF system applications using basic analysis techniques

Course Outcomes:
After completion of the course, students will be able to
- Understand RF system design fundamentals.
- Realize the issues arises in using passive and active components for RF system design.
- Analyze and evaluate the performance of the RF system.

Course Description:
Importance of RF design – behavior of passive components – chip components and circuit board considerations - issues and application. Analysis of Simple circuit in phasor domain - Impedance Transformation - RF filter design – Configuration – realization and implementation. Active RF components and applications RF amplifier designs, characteristics and applications Oscillators and Mixers – applications

References:

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design –Theory and Applications", Pearson Education Asia, 2nd Edition, 2000.
2. Reinhold Ludwig and Gene Bogdanov , "RF Circuit Design –Theory and Applications", Pearson Education Asia, 2nd Edition, 2009
4. Joseph. J. Carr," Secrets of RF Circuit Design", Mc Graw Hill Publishers, 3rd Edition 2001.
5. Matthew M. Radmanesh," Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002.
6. Chris Bowmick, John Blyer, Cheril Ajluni, RF Circuit Design, Newnes Elsevier Publications, 2nd Edition, 2011.

14EC3043 RF MEMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the mechanisms of MEMS relays and switches
- To learn the various micro machined passive elements, RF filters and MEMS phase shifters
- To understand the parameters of microstrip antennas

Course Outcomes:

After completion of the course, students will be able to

- Design MEMS relays and switches.
- Acquire knowledge in designing passive elements, RF filter, MEMs phase shifter.
- Design microstrip antennas

Course Description:

Importance of RF design – RF MEMs relays and switches, MEMs inductors and Capacitors, Micro-Machined RF filter design – capabilities, limitations and applications, MEMs phase shifter types – design, fabrications and applications, Microstrip antennas – design parameters – Reliability and thermal issues

References :

1. V.K. Varadan, K.J. Vinoy and K.A. Jose, "RF MEMS and their Applications", John Wiley & Sons Inc, 2002.
2. G.M. Rebeiz, "RF MEMS: Theory, Design and Technology", John Wiley & Sons Inc., 2003.
3. Hector J. De Santos, "RF MEMS Circuit Design for Wireless Communications" Artech House, 2002.
4. V. Kaajakari, "Practical MEMS," Small Gear Publishing, 2009.

14EC3044 NEURAL NETWORK FOR RF AND MICROWAVE DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the fundamentals of microstrip transmission line model
- To solve RF and Microwave design modeling problems using neural networks & CAD modeling tools
- To understand the optimization techniques for microwave device modeling.

Course Outcomes:

After completion of the course, students will be able to

- Acquire knowledge on Neural Networks & CAD tools for solving RF and microwave problems.
- Create models with neural networks for RF and Microwave Design.
- Choose relevant optimization techniques for microwave devices modeling

Course Description:

Neural network modeling approach-Multilayer perception - Back propagation - Radial Basis function - Initialization of neural model weight parameters – Data Generation, Splitting & scaling – Gradient based methods-GA for NN: The schema theorem – effect of crossover, Mutation-chromosomal representation - fitness function – setting the GA parameters and operators. Models for microstrip transmission lines– microstrip via -to strip line interconnect –models for CPW transmission line – CPW continuities – CPW opens and short -Optimization of Component structure – circuit optimization – CPW folded double stub filter – power divider –Multilayer - circuit design and optimization - CPW patch antenna design – yield optimization

References:

1. Q.J Zhang, K.C. Gupta, “Neural Networks for RF and Microwave Design” Artech house 2000.
2. A.J.F. Van Rooji, L.C Jain, R.P. Johnson, “Neural Network Training Using Genetic Algorithms” World Scientific Pub, 1997.
3. Qi-Jun Zhang, Kuldip C. Gupta, Vijay K. Devabhaktuni, “Artificial Neural Networks for RF and Microwave Design—From Theory to Practice”, IEEE Transactions On Microwave Theory And Techniques, Vol. 51, No. 4, April 2003.
4. Mike Golio, Janet Golio, RF and Microwave Circuits, Measurements, and Modeling, CRC Press, 2nd Edition, 2008.
5. N.C. Chauhan, M.V. Kartikeyan, A. Mittal, “Soft Computing Methods for Microwave and Millimeter – wave Design Problems”, Springer, 2014.

14EC3045 SMART ANTENNAS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To impart the fundamentals of smart antenna technologies for wireless communication
- To gain an understanding of the operation and application of spatial filtering accomplished by adaptive array antenna systems.
- To evaluate a system requirement for implementation of an appropriate smart antenna implementation

Course Outcomes:

After completion of the course, students will be able to

- Understand the mathematical modeling of smart antenna systems.
- Acquire knowledge in narrowband and broadband processing techniques.
- Design and integrate smart antenna system for Wireless applications.

Course Description:

Introduction: Antenna gain - Phased array antenna - power pattern - beam steering - degree of freedom - optimal antenna - adaptive antennas - smart antenna - key benefits of smart antenna technology - wide band smart antennas - Digital radio receiver techniques and software radio for smart antennas. Narrow and Broad Band Processing - Adaptive Processing: Direction of Arrival Estimation Methods - Diversity Combining

References:

1. Lal Chand Godara, "Smart Antennas" CRC press, 2004.
2. Joseph C Liberti, Theodore S Rappaport, "Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA Applications", Prentice Hall, 1999.
3. Constantine A Balanis, Panayiotis Ioannidis, “Introduction to smart antennas”, Morgan & Claypool Publishers, 2007.
4. T. K. Sarkar, Michael C. Wicks, M. Salazar-Palma, Robert J. Bonneau, “Smart Antennas”, John Wiley & Sons, 2003.
5. Ahmed El Zooghby, “Smart Antenna Engineering”, Artech House, 2005.
6. Chen Sun, Jun Cheng, Takashi Ohira, “Handbook on Advancements in Smart Antenna technologies for Wireless Networks”, Information Science Reference, 2009.
7. Frank Gross, “Smart Antenna for wireless communications with MATLAB”, Mc Graw Hill, 2005.

8. Zhizhang Chen, Gopal K. Gokeda, Yiqiang, "Introduction to Direction-of-Arrival Estimation", 1st Edition, Artech House, 2010.
9. Jeffrey Foutz, Andreas Spanias, "Narrowband Direction of Arrival Estimation for Antenna Arrays", Synthesis Lectures on Antennas, Morgan & Clay Pool Publishers, 2008.

14EC3046 COMMUNICATION NETWORK SECURITY

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the concepts of communication network security and different types of attacks associated with it.
- To know the different approaches and algorithms to handle security and to maintain data integrity and authenticity.
- To know the practical aspects of security features design and their implementation in wireless networking.

Course Outcomes:

After completion of the course, students will be able to

- Design a security system to detect security violations involved in information transmission.
- Acquire knowledge on different approaches to handle security problems in communication network security,
- Understand the security implementation in wireless networking

Course Description:

Conventional encryption model – Stegnography - Symmetric block ciphers - Stream Cipher - Key distribution - Public Key Cryptography - Message authentication and Hash functions - Digital signatures - IP Security - Authentication Header and Encapsulating Security Payload -Key Management - Web security - Secure Sockets Layer and Transport Layer Security - Secure Electronic Transaction - Malicious Programs, Firewall design, Antivirus Techniques.

References

1. Stallings,W, "Cryptography and Network security", Principles and Practice, 5th Edition, Prentice Hall, 2011.
2. Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, Second Edition, Prentice Hall, 2002.
3. Behrouz A. Forouzan, "Cryptography and Network security", Tata Mcgraw Hill, Special Indian Edition 2007.
4. William Stallings,"Network Security Essentials",Second Edition, Prentice Hall, 2004.
5. Charlie Kaufman,"Network Security-Private Communication in public world",Second Edition, Prentice Hall, 2004.

14EC3047 COMMUNICATION NETWORK ROUTING ALGORITHMS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To review the general routing concepts in circuit switching, packet switching networks and high speed networks
- To expose the students to the layered architecture of communication networks and the specific functionality of the network layer

- To enable the student to understand the basic principles of routing algorithms in conventional networks and evolving routing algorithms

Course Outcomes:

After completion of the course, students will be able to

- Understand general routing concepts in circuit switching, packet switching networks and high speed networks
- Understand the layered architecture of communication networks and the specific functionality of the network layer
- Know the basic principles of routing algorithms in conventional networks and evolving routing algorithms

Course Description:

Routing in circuit switching networks - routing in packet switching networks - routing strategies - routing in ATM networks - Distance Vector Routing - routing information protocol - Link State Routing - least resistance routing - open shortest path first protocol - EGP - BGP - IDRP - IDPR - IGRP - routing in cellular networks - routing in small and large sized packet radio networks - table driven and on-demand routing protocols in adhoc networks

References :

1. M.C.E. Perkins, "Ad Hoc Networking", Addison - Wesley Publication, Singapore, 2008.
2. S. Keshav, "An Engineering Approach to Computer Networking", Addison Wesley, 1st Edition, New Delhi, 2002.
3. C.K.Toh," Ad Hoc Mobile Wireless Networks", Pearson Education, New Delhi, 2007.
4. A.S. Tanenbaum, "Computer Networks", fifth edition, PHI, New Delhi, 2010.
5. William Stallings, "Data and Computer Communications", 8th Edition, Pearson Education, 2007.
6. Jochen Schiller, "Mobile Communications", Pearson Education, 8th Edition, New Delhi, 2008.

14EC3049 MOBILE COMMUNICATION NETWORKS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the operation model of mobile communication networks
- To understand the mobile network architecture and acquire background knowledge of wireless communication.
- To acquire knowledge on security issues in wireless networks

Course Outcomes:

After completion of the course, students will be able to

- Understand cellular mobile communication technologies and propagation models.
- Review about security issues and mobility management for cellular networks.
- Understand the protocols in different generations.

Course Description:

Introduction to wireless communication systems - Multiple access techniques - Network Planning - Network Dimensioning – Mobility Management Procedures, radio resources and power management - Mobile Radio Propagation and Air Protocols-AMPS, IS-95, IS-136, GSM, WCDMA, cdma2000 Mobile Data Networks : CDPD, GPRS, Wireless LAN – IEEE 802.11 standard - architecture-access schemes - Security Issues in Wireless Networks - wireless security protocols

References :

1. W. Stallings, "Wireless Communications and Networks", Prentice Hall, 2nd Edition, 2005.
2. T.S. Rappaport, "Wireless Communications: Principles & Practice", 2nd Edition, Prentice Hall, 2002.
3. J. Schiller,"Mobile Communications", Addison Wesley, 2nd Edition , 2004.
4. Kaveh Pahlavan,Prashant Krishnamurthy," Principles of Wireless Networks," PHI, 2011.
5. Man Young Rhee, "Mobile Communication Systems and Security", Wiley IEEE press, 2009.

14EC3050 SYSTEM ON CHIP DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To know about SoC Design and Fundamentals.
- To provide Knowledge about IP cores and application specific design.
- To learn about NoC and its validation

Course Outcomes:

After completion of the course, students will be able to

- Learn System-on-chip fundamentals
- Have knowledge about the applications and on-chip networking.
- Design SoC and NoC

Course Description:

SOC fundamentals-Essential issues of SoC design – A SoC for Digital still camera – Multimedia IP development : Image and video codecs-SOC software and energy management-SoC embedded software – Energy management techniques for SoC design-Design methodology for NOC based systems – Mapping Concurrent application onto architectural platforms. Packet switched network for on-chip communication – Energy reliability tradeoff for NoC's – Clocking strategies – Parallel computer as a NoC's region- MP-SoC from software to hardware – NoC APIs – multilevel software validation for NoC – Software for network on chip.

References:

1. Axel Jantsch, HannuTenhunen, "Network on chips", Kluwer Academic Publishers, 2003.
2. Youn-Long, Steve Lin, "Essential Issues of SoC Design: Designing Complex Systems-On-Chip", Springer, 2006.
3. A. Jerraya and W. Wolf, "Multiprocessor Systems-on-Chips", Morgan Kaufmann, 2004.
4. Umit Y.Ogras,Radu Marcules, "Modeling Analysis and Optimization of Network on Chip Communication Architectures", Springer.2006
5. Michael J. Flynn, Wayne Luk, "Computer System Design: System on Chip", John Wiley and Sons Inc. 2011.

14EC3051 RECONFIGURABLE COMPUTING

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand concepts of Reconfigurability
- To learn about FPGA based system design
- To provide the knowledge of CORDIC architectures

Course Outcomes:

After completion of the course, students will be able to

- Design reconfigurable architectures

- Gain knowledge on FPGA design.
- Implement different applications using FPGA

Course Description:

General Purpose FPGA Architecture - Reconfigurable Computing Devices- Reconfigurable Computing Systems- Reconfiguration Management- Hardware Description Languages (VHDL)- Compilation for Reconfigurable Computing Machines - Streaming Models- FPGA applications using block diagrams in simulink- Implementing Applications with FPGAs-Implementing arithmetic in FPGAs- CORDIC Architectures for FPGA computing- CORDIC algorithm- Architecture design-FPGA implementation of CORDIC Processors -Technology Mapping & FPGA Placement- SPIHT Image Compression- Run-time reconfiguration: Automatic Target Recognition- Implications of Floating Point for FPGAs.

References:

1. Scott Hauck, Andre Dehon, "Reconfigurable Computing", Elsevier publications, 2011.
2. Marco Lanzagorta, stphenbique, Robert Rosenberg, "Introduction to Reconfigurable
3. Supercomputing", Morgan &c laypool publisher series, 2010.
4. Pao-Ann Hsiung, Marco D, "Reconfigurable system Design & verification", CRC press, 2009.
5. Wayne Wolf , "FPGA-Based System Design", Pearson India, 2004.
6. Christophe Bobda, "Introduction to Reconfigurable Computing: Architectures, Algorithms, and Applications", Springer,2007.
7. Yoonjin Kim, Rabi N. Mahapatra , "Design of Low-Power Coarse-Grained Reconfigurable Architectures", CRC Press, 2010.

14EC3052 IP BASED VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn about IC manufacturing
- To know about IP components at various design levels
- To learn different floor planning techniques and IP design security

Course Outcomes:

After completion of the course, students will be able to

- Students will be aware of IP based components.
- Design and analyze the IP component of various combinational and sequential circuits.
- Understand various floor planning methods and IP based protection techniques

Course Description:

IC manufacturing- IC design techniques- IP based design- reliability- Layout Design and tools- Logic Gates: Combinational Logic Functions, Switch Logic- Low power gates-Delay- Yield-Gates as IP-Combinational Logic Networks-Standard Cell based Layout- Combinational network delay- Logic and Interconnect design- Power optimization-Switch logic network, logic testing-Sequential Machine-System design and Clocking-Performance analysis- Power optimization, Design validation and testing; Image Sensors, Subsystems as IP-Floor planning methods-Global Interconnect- Floor plan design- Off-chip Connections- Architecture Design- GALS systems, Architecture Testing- IP Components- Design Methodologies- IP in reuse based design-Constrained based IP protection-Protection of data and Privacy-constrained based watermarking for VLSI IP based protection.

References

1. Wayne wolf, "Modern VLSI Design: IP-based Design", Pearson Education, 2009.

2. Qu gang, Miodragpotkonjak, “Intellectual Property Protection in VLSI Designs: Theory and Practice”, Kluwer Academic Publishers,2007.
3. Hwaiyu Geng, “Semiconductor Manufacturing Handbook”, Mcgraw-Hill Companies, 2005.
4. Sarrafzadh,M wong, C K , “Introduction to VLSI Physical design” McGraw –Hill, 1999.
5. Frank vahid, Tony Givargis "Embedded System Design", John wiley & sons,2009.

14EC3053 DESIGN OF SEMICONDUCTOR MEMORIES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the importance of design and testing of memories.
- To know the functionality of different types of memories and the methods of testing it.
- To know the emerging techniques in design of memories.

Course Outcomes:
After completion of the course, students will be able to
- Gain the knowledge about recent developments in memories
- Design and test semiconductor memories.
- Gain knowledge to optimize the parameters in memory design.

Course Description:
Random Access Memory Technologies – SRAM , DRAM – Non Volatile Memories – MRAM, PROM, EPROM, EEPROM, Flash memories - RAM Fault Modeling – RAM Electrical Testing - IDDQ Fault modeling and testing – Application Specific Memory Testing – Volatile and Non Volatile memory Reliability issues – Radiation effects – Radiation Hardening Techniques – Advanced memory technologies – FRAM-GaAs–FRAM- MRAM-Analog memories – Experimental Memory Devices.

References:
1. Ashok K.Sharma, " Semiconductor Memories Technology, Testing and Reliability ", Wiley-IEEE Press, August 2002.
2. TegzeP.Haraszti, “CMOS Memory Circuits”, Kluwer Academic publishers, 2001.
3. Betty Prince, “Emerging Memories: Technologies and rends”, Kluwer Academic publishers, 2002.

14EC3054 HARDWARE DESIGN VERIFICATION TECHNIQUES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand the difference between verification and testing.
- To know about verification tools and plan.
- To learn about architecting test benches.

Course Outcomes:
After completion of the course, students will be able to
- Know the difference between verification and testing
- Write test benches to verify circuits.
- Perform self checking of circuits.

Course Description:
Functional Verification Approaches-Testing Versus Verification- Verification and Design Reuse - Linting Tools-Simulators-Third Party Models-Waveform Viewers-Code Coverage-Issue- Tracking Metrics - Verification plan-Levels of Verification-Verification Strategies –Specification Features – Test cases -Test

Benches - Simple Stimulus- Output Verification –Self Checking Test Benches -Reusable Verification Components – VHDL and Verilog Implementation

References:

1. Janick Bergeron, "Writing Test Benches Functional Verification of HDL Models",Springer 2nd Edition,2003.
2. Andreas Meyer, "Principles of Functional Verification" Elsevier Inc.,2004 .
3. Amir Palnitkar, "Design Verification with e" Prentice Hall, 1st Edition, 2003.

14EC3055 HIGH SPEED VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To learn in detail about non clocked and clocked logic styles, Latching Strategies and Asynchronous clocking techniques
- Will get knowledge about clock jitter skew
- Will know about clock generation and clock distribution

Course Outcomes:
After completion of the course, students will be able to
- Design any high speed VLSI Circuit.
- Understand different logic styles used in VLSI Design.
- Design different circuits by considering clock jitter and clock skew.

Course Description:
Clocked Logic Styles-Rail Domino Logic Styles, Dual-Rail Domino Structures, Latched Domino Structures, and Clocked pass Gate Logic,Non-Clocked logic styles-Circuit Design Margin-Design Variability-Application Induced Variations, Noise,Latching Strategies-Basic Latch Design, Latching Differential Logic, Race Free Latches for Pre-charged Logic, Asynchronous Latch Techniques-Interface Techniques-Signaling Standards, Chip-to-Chip Communication Networks, ESD Protection, Skew Tolerant Design, Clock Jitter and Skew–Clock Generation–Clock Distribution-Asynchronous clocking Techniques.

References:

1. Kerry Bernstein & et.al, "High Speed CMOS Design Styles", Kluwer Academic Publishers, 2001.
2. Evan Sutherland, Bob Stroll, David Harris, "Logical Efforts, Designing Fast CMOS Circuits", Kluwer Academic Publishers, 1999.
3. Howard Johnson and Martin Graham, "High Speed Digital Design: A Handbook of Black Magic" ,3rd Edition, Prentice Hall Modern Semiconductor Design Series, 2006
4. Masakazu Shoji, "High Speed Digital Circuits", Addison Wesley Publishing Company, 1996.
5. Ashok K. Goel, "High-Speed VLSI Interconnections", 2nd Edition, Wiley-IEEE Press,2007.

14EC3056 ANALOG VLSI DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To learn about device modeling.
- To analyze and learn the characteristics and architectures of ADCs and DACs.
- To learn about CMOS amplifiers and Comparators.

Course Outcomes:
After completion of the course, students will be able to

- Gain knowledge in device modeling.
- Understand the concepts of ADCs and DACs .
- Design various analog systems including DAC, ADC, CMOS amplifiers and Comparators**.**

Course Description:
Device Modeling: MOS Models-Bipolar Models- Analog Signal Processing-Digital-to-Analog Converters: Current Scaling- Voltage Scaling and Charge Scaling- Analog-To Digital Converters: Serial A/D Converters- Successive Approximation A/D –Parallel High Performance A/D Converters–Switched Capacitor Filters-CMOS Amplifiers: Differential Amplifiers- Cascode Amplifiers-Current Amplifiers-Output Amplifiers-High-Gain Amplifier Architectures-Comparators.

References:
1. Phillip E.Allen, DouglasR.Holberg, "CMOS Analog Circuit Design", 3rd Edition, Oxford University Press, 2013
2. Randall L.Geiger, Philip E.Allen, Noel K.Strader, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill International Co, 1990.
3. YannisTsividis, "Mixed Analog – Digital VLSI Device and Technology" World scientific publishing Co. Pvt. Ltd., 2002
4. P. V. Ananda Mohan, "VLSI Analog Filters: Active RC, OTA-C and SC", Birkhauser 2013.

14EC3057 CMOS MIXED SIGNAL CIRCUIT DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To design PLL and Analog Multiplier.
- To learn modeling and characteristics of Data Converters.
- To learn the steps to implement both analog and digital circuits in a single silicon wafer.

Course Outcomes:
After completion of the course, students will be able to

- Gain knowledge in designing PLL and Analog Multiplier.
- Design Data Converters and analyze its characteristics.
- Design & simulate analog and digital circuits.

Course Description:
Analog Multiplier Design- PLL-Simple PLL-Charge-pump PLL-Applications of PLL-Data Converter Modeling-Sampling and Aliasing : A Modeling Approach- Data Converter SNR: Effective Number of Bits-Clock Jitter-Improving SNR using Averaging-Decimating Filters for ADCs-Interpolating Filters for DACs-Using Feedback to improve SNR-Submicron CMOS Circuit Design-Submicron CMOS Overview and Models-Digital Circuit Design-Analog Circuit Design-Op-amp design-Circuit Noise-Implementing Data Converters:R-2R Topologies for DACs-Topologies without an op-amp-Op-amps in Data Converters.

References :
1. Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001.
2. Razavi, "Principles of Data Conversion System Design", S.Chand and company ltd, 2000.
3. Jacob Baker, "CMOS Mixed-Signal Circuit Design", Wiley India Private Limited, 2008.

4. Roubik Gregorian, Gabor C. Temes, "Analog MOS Integrated Circuits for Signal Processing", John Wiley & Sons,1986.
5. Baker, Li, Boyce, "CMOS : Circuit Design, Layout and Simulation", PHI, 2003.

14EC3058 VLSI CIRCUITS FOR BIO-MEDICAL APPLICATIONS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To give the essential knowledge and techniques for designing VLSI circuits for biomedical applications.
- Students learn about CMOS circuits for wireless medical applications.
- Students learn about the Integrated Circuits for Neural Interfacing.

Course Outcomes:

After completion of the course, students will be able to

- Understand the CMOS circuits for wireless medical applications.
- Design low power compact VLSI circuits for biomedical applications.
- Design Neuro Mimetic Integrated Circuits.

Course Description:

Neuro chemical sensing- Neuro potential sensing-Telemetry system- -Multimodal electrical and chemical sensing-Prothesis exterior body Unit and wireless link- Body Implantable Unit- CMOS circuits for implantable devices- CMOS circuits for wireless medical applications- Integrated Circuits for Neural Interfacing- Neuro Mimetic Integrated Circuits.

References :

1. Krzyszt of Iniewslei, "VLSI Circuits for Bio Medical Applications", Artech House Publishers, 2008.
2. RahulSarpeshkar, "Ultra Low Power Bioelectronics: Fundamentals, Biomedical Applications, and Bio-inspired Systems", Cambridge University Press, 2010.
3. E. Sanchez-Sinencio and A. G. Andreau, "Low-voltage/Low-power Integrated Circuits and Systems", Wiley,1998

14EC3059 VLSI FOR WIRELESS COMMUNICATION

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To study the design concepts of low noise amplifiers.
- To study the various types of mixers designed for wireless communication.
- To understand the concepts of CDMA in wireless communication

Course Outcomes:

After completion of the course, students will be able to

- Design any VLSI circuits for wireless applications.
- Design LNA and mixers.
- Design CDMA in wireless communication.

Course Description:

Integrated inductors- resistors- MOSFET and BJT amplifier design- Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers

– Power Amplifiers-Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer- Switching Mixer - Distortion in Unbalanced Switching Mixer - Conversion Gain in Unbalanced Switching Mixer- Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example- Data converters in communications, Adaptive Filters-Equalizers and transceivers- Implementations of CDMA System **.**

References :

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,2011
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press ,2003.
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI Wireless Design Circuits and Systems",Kluwer Academic Publishers, 2000.
5. BehzadRazavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 2000.
6. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997.

14EC3060 DATA CONVERTERS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the various techniques & architectures of D/A Converters.
- To learn the various techniques& architectures of A/D Converters.
- To study about the S/H circuit and testing of A/D and D/A Converters.

Course Outcomes:

After completion of the course, students will be able to

- Develop low power and high speed A/D Converters.
- Develop low power and high speed D/A Converters.
- Test low power and High speed A/D and D/A Converters.

Course Description:

Data Converter Fundamentals & Specifications of Converters- High Speed A/D Converters & D/A Converters: Design problems-Full-flash converters-Two step flash converters--Pipeline converter architecture-High speed D/A converter architecture: Voltage weighting based architecture-High Resolution A/D Converters- High Resolution D/A converters: Pulse width modulation D/A converters- Integrating D/A converters- Current weighting using ladder networks- Sample and hold amplifiers: Basic Sample –and – Hold Configuration-Integrating S/H Circuit-Switched Capacitor S/H circuit- -Sigma-delta A/D conversion:General Filter Architectures-Discussion of Basic Converter Architectures-Multi Stage Sigma-Delta Converter (MASH)-DC Testing of D/A Converters-Dynamic Testing of A/D Converters.

References:

1. Rudy van de Plassche, "CMOS Integrated Analog to Digital and Digital to Analog Converters", Springer International Edition, 2nd Edition, 2007.
2. Jacob Baker. R, Harry W. Li, David E. Boyce, "CMOS Circuit Design, Layout and Simulation", IEEE Press, 3rd Edition, 2010.
3. Randall L.Geiger, Philip E.Allen, Noel K.Strader, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill International Co, 1990.

14EC3061 SIGNAL INTEGRITY FOR HIGH SPEED DEVICES

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To learn the fundamentals and importance of signal integrity.
- To study about the different types of Di-Electric materials.
- To learn about differential cross talk and CMOS based transmission line model

Course Outcomes:

After completion of the course, students will be able to

- Implement signal integrity principles in the design of high speed circuits.
- Analyze about the different types of Di-Electric materials.
- Implement ESD protection techniques.

Course Description:

The importance of signal integrity-New realm of bus design-Electromagnetic fundamentals for signal integrity Maxwell equations-common vector operators-Wave propagations-Electrostatics-Magneto statics-Power flow and the pointing vector-Reflections of electromagnetic waves- Introduction -Mutual inductance and capacitance, Coupled wave equation-coupled line analysis-Modal analysis-Cross talk minimization signal propagation in unbounded conductive media-Classic conductor model for transmission model-Di-electric materials-Removal of common mode noise-Differential Cross talk-Virtual reference plane-Propagation of model voltages common terminology-Drawbacks of Differential signaling- Introduction-non ideal return paths-Via-IO design consideration-Push-pull transmitter-CMOS receivers-ESD protection circuits-On chip Termination.

References:

1. StephenHall, HowardL.Heck, “Advanced Signal Integrity for High-Speed Digital Designs”,Wiley Publishers, 2009.
2. James Edgar Buchanan, “Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS”, McGraw-Hill, 1996
3. Fabien Ndagijimana,”Signal Integrity: From High Speed to Radiofrequency Applications”, Wiley, 2014.
4. Francescaromana Maradei , Spartaco Caniggia, “Signal Integrity and Radiated Emission of High-Speed Digital Systems”, 2008.

14EC3062 NANO SCALE FET

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the necessary of scaling of MOS transistor and to introduce the concepts of nanoscale MOS transistor concepts.
- To study various device performance and its characteristics.
- To study the various types of nano scaled MOS transistors.

Course Outcomes:

After completion of the course, students will be able to

- Get an in-depth knowledge about different MOSFETs, its characteristics and the scaling methods.
- design the Nanoscale devices for low power VLSI applications and Microwave applications.
- Develop circuit level designs using different FETs in analog and digital applications.

Course Description:

Introduction to novel MOSFETs and different scaling methods-Physics of Multigate MOS system, MOSFET IV characteristics, and other effects of FETs-Nanowire FETs and transistors at the molecular Scale- Radiation effects in SOI MOSFETs along with scaling effects-Circuit design using Multigate devices- Analog and digital Circuits and its performances-Tri Gate Devices – Junctionless Transistors.

References:

1. J P Colinge, "FINFETs and other multi-gate transistors", Springer – Series on Integrated Circuits and Systems, 2008
2. Mark Lundstrom Jing Guo, "Nanoscale Transistors: Device Physics, Modeling and Simulation", Springer, 2006.
3. David Esseni, Palestri, Selmi "Nanoscale MOS Transistors: Semi-Classical Transport and Applications", Cambridge University Press, 2011.
4. Gary Wiederrecht, "Handbook of Nanoscale Optics and Electronics"
5. M S Lundstorm, "Fundamentals of Carrier Transport", 2nd Edition, Cambridge University Press, 2000.
6. Saraju P. Mohanty, NagarajanRanganathan, Elias Kougianos, PriyardarsanPatra, "Low-Power High-Level Synthesis for Nanoscale CMOS Circuits", Springer, 2008.
7. Amit Chaudhry, "Fundamentals of Nanoscaled Field Effect Transistors", Springer, 2013.

14EC3063 NANOSCALE DEVICES AND CIRCUIT DESIGN

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:

- To understand the device technologies for sub 100nm CMOS and device scaling of single and Multigate MOSFETs.
- To familiarize the characteristics of various Nano scale devices.
- Design of Nanoscale circuits using non-classical devices.

Course Outcomes:

After completion of the course, students will be able to

- Understand the current trend in the Nanotechnology based on Electronics.
- Design new emerging devices in Nanoscale.
- Gain knowledge to develop the applications of various NANO-scale devices and circuits.

Course Description:

CMOS scaling challenges in Nano Scale regimes and emerging CMOS technologies. Device scaling , ballistic MOSFET and different scattering mechanisms. Emerging Nanoscale devices such as heterostructure nano wire MOS- CNT MOSFET – SET – RTD. Nanoscale CMOS design and performance optimization for data paths-Nanoscale circuits- Statistical circuit design and CMOS Circuit design using non classical devices.

References:

1. Lundstrom, M., "Nanoscale Transport: Device Physics, Modeling, and Simulation", Springer. 2000
2. Maiti, C.K., Chattopadhyay, S. and Bera, L.K., "Strained-Si and Hetrostructure Field Effect Devices", Taylor and Francis, 2007
3. Hanson, G.W., "Fundamentals of Nanoelectronics", Pearson India, 2008.
4. Wong, B.P., Mittal, A., Cao Y. and Starr, G., "Nano-CMOS Circuit and Physical Design", Wiley, 2004

5. Lavagno, L., Scheffer, L. and Martin, G., "EDA for IC Implementation Circuit Design and Process Technology", Taylor and Francis, 2005.
6. SandipKundu, AswinSreedhar, "Nanoscale CMOS VLSI Circuits: Design for Manufacturability", McGraw Hill Professional, 2010.
7. Niraj K. Jha, Deming Chen Springer, "Nanoelectronic Circuit Design" 2010.
8. J.-P. Colinge "FinFETs and Other Multi-Gate Transistors", Springer, 2008.

14EC3064 PHOTONICS

Credits: 3:0:0 **(Version 1.1)**

Course Objectives:
- To understand deeply about photonics along with Plasmonics.
- To understand about Nanophotonics, Biophotonics and photonic crystals.
- To understand the importance of applications using Photonics.

Course Outcomes:
After completion of the course, students will be able to
- Gain deep knowledge on photonics along with Plasmonics.
- Gain knowledge on Nanophotonics, Biophotonics and Photonic crystals.
- Develop new applications using Photonics.

Course Description:
Quantum confined materials - Plasmonics based on surface plasmonics resonance - new approaches in Nanophotonics- Near-field scanning optical microscopy - Biophotonics - DNA protein interactions and Photonic crystals - Photonic Crystal Laser - PC based LEDs- Photonic crystal fibers (PCFs).

References:
1. H.Masuhara, S.Kawata and F.Tokunaga, " NanoBiophotonics", Elsevier Science, 1st Edition 2007.
2. V.M. Shalaev and S.Kawata, "Nanophotonics with Surface Plasmons (Advances in Nano-Optics and Nano-Photonics)", Elsevier Science & Technology,2007.
3. B.E.A. Saleh and A.C.Teich, "Fundamentals of Photonics", John-Wiley& Sons, New York, 2nd Edition, 2007.
4. M.Ohtsu, K.Kobayashi, T.Kawazoe, and T.Yatsui, "Principles of Nanophotonics (Optics and Optoelectronics)", CRC Press, 2008.
5. P.N. Prasad "Introduction to Biophotonics", John Wiley & Sons, 2003.
6. J.D.Joannopoulos, Steven G.Johnson, R.D.Meade and J.N.Winn, " Photonic Crystals", Princeton University Press, 2nd Edition, 2008.

14EC3067 EMBEDDED SYSTEM LAB

Credits: 0:0:1 **(Version 1.1)**
Co-Requisite: 14EC3002 Advanced Embedded Systems

Course Objectives:
- To perform various mathematical and logical operations
- To learn interfacing of external circuits with ARM processor
- Expertise in Keil software.

Course Outcomes:
After completion of the course, students will be able to
- Understand the basic functionality of embedded system

- Design and implement real time embedded systems using ARM processor
- Using Keil software for the project work.

Experiments:
The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester

LIST OF SUBJECTS

Sub.Code	Subject	Credits
13EC301	Hardware Design Verification Techniques	4:0:0
13EC302	Signal Detection and Estimation Theory	4:0:0
14EC1001	Basic Electronics Engineering	3:0:0
14EC2001	Digital Electronics	3:1:0
14EC2002	Electron Devices	3:0:0
14EC2003	Signals and Systems	3:1:0
14EC2004	Digital Electronics Lab	0:0:2
14EC2005	Electron Devices and Circuits lab	0:0:2
14EC2006	Electronic Circuits	3:0:0
14EC2007	Transmission Lines and Wave guides	3:1:0
14EC2008	Linear Integrated Circuits	3:0:0
14EC2009	Microprocessor and Interfacing techniques	3:0:0
14EC2010	Linear Integrated Circuits Lab	0:0:2
14EC2011	Microprocessor lab	0:0:1
14EC2012	Pulse and Wave Shaping Circuits	3:0:0
14EC2013	Communication Theory and Systems	3:0:0
14EC2014	Digital Signal Processing	3:1:0
14EC2015	Microcontroller and its Applications	3:0:0
14EC2017	Electronics and Communication Lab	0:0:2
14EC2018	Digital Signal Processing Lab	0:0:2
14EC2019	Microcontroller lab	0:0:1
14EC2020	Antenna Theory and Wave propagation	3:1:0
14EC2021	Digital Communication	3:1:0
14EC2022	Microwave and Optical Communication	3:0:0
14EC2023	Advanced Communication Lab	0:0:2
14EC2024	Microwave and Optical Communication Lab	0:0:2
14EC2025	Computer Communication	3:0:0
14EC2026	Advanced Microprocessor Architecture	3:0:0
14EC2027	Advanced Microcontroller	3:0:0
14EC2028	Advanced Microcontroller lab	0:0:2
14EC2029	Embedded System Design	3:0:0
14EC2030	ARM Processors	3:0:0
14EC2031	ARM Lab	0:0:2
14EC2032	Testing for Embedded System	3:0:0
14EC2033	Embedded lab	0:0:2
14EC2034	Fault Tolerant Techniques	3:0:0
14EC2035	PCB Design Lab	0:0:2
14EC2037	Telecommunication Switching Methods	3:0:0
14EC2038	Cellular Mobile Communication	3:0:0
14EC2039	Mobile Computing	3:0:0
14EC2041	High Speed Networks	3:0:0
14EC2042	Routing Algorithms for Wireless Mobile networks	3:0:0

14EC2043	Advanced Digital Communication Systems	3:0:0
14EC2044	Fundamentals of Wireless Communication	3:0:0
14EC2045	Spread Spectrum Systems	3:0:0
14EC2046	Optoelectronics	3:0:0
14EC2047	Solid State Microwave Devices	3:0:0
14EC2048	Fiber Optic Communication	3:0:0
14EC2049	Radar Communication	3:0:0
14EC2050	Basics of Satellite Communication	3:0:0
14EC2051	RF Circuit Design	3:0:0
14EC2052	Antenna Design Lab	0:0:2
14EC2053	Advanced Wireless lab	0:0:2
14EC2054	Bio-Medical Signal Processing	3:0:0
14EC2055	Adaptive Signal Processing	3:0:0
14EC2056	Wavelet Techniques	3:0:0
14EC2058	Neural Networks and Fuzzy Systems	3:0:0
14EC2059	Optimization Techniques	3:0:0
14EC2060	Multimedia Compression Techniques	3:0:0
14EC2061	Soft Computing	3:0:0
14EC2062	Machine Learning Algorithms for Image Processing	3:0:0
14EC2063	Signal Processing Lab	0:0:2
14EC2064	Advanced Signal Processing Lab	0:0:2
14EC2065	Information Theory and Coding	3:0:0
14EC2066	Digital System Design	3:0:0
14EC2067	Verilog HDL	3:0:0
14EC2068	VHDL	3:0:0
14EC2069	VLSI Design	3:0:0
14EC2070	ASIC Design	3:0:0
14EC2071	VLSI Subsystem Design	3:0:0
14EC2072	Analysis and Design of Digital IC	3:0:0
14EC2073	Low power techniques in VLSI Design	3:0:0
14EC2074	VLSI Fabrication Techniques	3:0:0
14EC2075	Nano electronics	3:0:0
14EC2076	VHDL Lab	0:0:2
14EC2077	Verilog Lab	0:0:2
14EC2078	IC Design Lab	0:0:2
14EC2079	Microprocessors and Microcontrollers	3:1:0
14EC2080	Communication Engineering	3:0:0
14EC2081	Monolithic Microwave Integrated Circuits	3:0:0
14EC2082	Semi Conductor Device Modelling	3:0:0
14EC2083	Verification of VLSI Circuits	3:0:0
14EC2084	Design of Analog CMOS IC	3:0:0
14EC2085	CAD for VLSI Design	3:0:0
14EC2086	Testing of VLSI Circuits	3:0:0
14EC2087	Micro Electro Mechanical Systems	3:0:0

14EC2088	Microprocessor and Microcontroller Lab	0:0:2
14EC2090	Fundamentals of Electronics	3:0:0
14EC2091	Electron Devices and Instrumentation	3:0:0
14EC2092	Electron Devices and Instrumentation lab	0:0:2
14EC3001	Statistical Digital Signal Processing	3:0:0
14EC3002	Advanced Embedded Systems	3:0:0
14EC3003	Computational Intelligence and Optimization Techniques	3:0:0
14EC3004	Hardware Description Languages	3:0:0
14EC3005	Advanced Digital Image Processing	3:0:0
14EC3007	Wireless and Optical Networks	3:0:0
14EC3008	VLSI Design Techniques	3:0:0
14EC3009	HDL Lab	0:0:1
14EC3010	Data Compression Techniques	3:0:0
14EC3011	Optical Networks and Photonic Switching	3:0:0
14EC3012	Modern Digital Communication Techniques	3:0:0
14EC3013	Wireless Communication Networks	3:0:0
14EC3014	Advanced Radiation Systems	3:0:0
14EC3015	Satellite Communication	3:0:0
14EC3016	Error Control Coding	3:0:0
14EC3017	Communication Lab – I	0:0:2
14EC3018	Communication Lab – II	0:0:2
14EC3019	Digital System and ASIC Design	3:0:0
14EC3020	CMOS VLSI Design	3:0:0
14EC3021	Analysis and Design of Analog Integrated Circuits	3:0:0
14EC3022	VLSI Technology	3:0:0
14EC3023	Solid State Device Modeling and Simulation	3:0:0
14EC3024	Low Power VLSI Design	3:0:0
14EC3025	CAD for VLSI Circuits	3:0:0
14EC3026	Testing And Testability	3:0:0
14EC3027	VLSI Digital Signal Processing	3:0:0
14EC3028	ASIC Design Laboratory	0:0:2
14EC3029	Speech and Audio Processing	3:0:0
14EC3030	Bio signal Processing	3:0:0
14EC3031	Medical Image Processing	3:0:0
14EC3032	Advanced Digital Signal Processing for Control Engineers	3:0:0
14EC3033	Advances in Electronics Applied to Hospital Engineering	3:0:0
14EC3034	Computer based Medical Instrumentation	3:0:0
14EC3035	Digital Communication Receiver	3:0:0
14EC3036	Detection and Estimation Theory	3:0:0
14EC3037	DSP Architecture and Programming	3:0:0
14EC3038	Global Positioning System	3:0:0
14EC3039	Optical Signal Processing	3:0:0
14EC3040	Microwave Integrated Circuits	3:0:0
14EC3041	Electromagnetic Interference and Compatibility	3:0:0

14EC3042	RF System Design	3:0:0
14EC3043	RF MEMS	3:0:0
14EC3044	Neural Network for RF and Microwave Design	3:0:0
14EC3045	Smart Antennas	3:0:0
14EC3046	Communication Network Security	3:0:0
14EC3047	Communication Network Routing Algorithms	3:0:0
14EC3048	Embedded Sensor Networks	3:0:0
14EC3049	Mobile Communication Networks	3:0:0
14EC3050	System On –Chip Design	3:0:0
14EC3051	Reconfigurable Computing	3:0:0
14EC3052	IP Based VLSI Design	3:0:0
14EC3053	Design of Semiconductor Memories	3:0:0
14EC3054	Hardware Design Verification Techniques	3:0:0
14EC3055	High Speed VLSI Design	3:0:0
14EC3056	Analog VLSI Design	3:0:0
14EC3057	CMOS Mixed Signal Circuit Design	3:0:0
14EC3058	VLSI Circuits for Bio-Medical Applications	3:0:0
14EC3059	VLSI for Wireless Communication	3:0:0
14EC3060	Data Converters	3:0:0
14EC3061	Signal Integrity for High Speed Devices	3:0:0
14EC3062	Nanoscale FET	3:0:0
14EC3063	Nanoscale Devices and Circuit Design	3:0:0
14EC3064	Photonics	3:0:0
14EC3065	Communication and Switching Techniques	3:0:0
14EC3066	Advanced Communication Engineering	3:0:0
14EC3067	Embedded systems lab	0:0:1
14EC3068	Signal Processing lab	0:0:1
14EC3069	Advanced Digital Signal Processing lab	0:0:2
14EC3070	Nanoelectronics and VLSI Design	3:0:0
14EC3071	Digital Image Processing	3:0:0
14EC3072	Advanced Digital Signal Processing	3:0:0
14EC3073	FPGA Design for Industrial Applications	3:0:0
14EC3074	FPGA Control Design Laboratory	0:0:2
14EC3075	Medical Signal Processing	3:0:0
14EC3076	Embedded Systems for Biomedical Instrumentation	3:0:0
14EC3077	Embedded Networking	3:0:0
14EC3078	Real Time and Embedded Control Automation	3:0:0

13EC301 HARDWARE DESIGN VERIFICATION TECHNIQUES

Credits:4:0:0

Course Objective

1. To provide in-depth knowledge in the area of VLSI circuits verification and verification methodologies.
2. To understand the test plan and tools used.
3. To provide knowledge to carry out an effective functional verification of a design.

Course Outcome

- Ability to perform functional verification of hardware design.
- Knowledge about verification methodologies and verification tools used.
- Ability to architect test benches and test cases.

Unit I: INTRODUCTION

Reconvergence Model - Human Factor- Formal Verification – Equivalence checking - Functional Verification Approaches - Testing Versus Verification- Verification and Design Reuse- cost of verification.

Unit II: VERIFICATION TOOLS

Linting Tools- Limitations of Linting Tools – Linting verilog source code – Linting VHDL source code – Code reviews – Simulators – Stimulus and Response – Event driven simulation – Cycle based simulation – Co-simulators - Third Party Models – Hardware modelers - Waveform Viewers - Code Coverage – Issue - Tracking Metrics.

Unit III: VERIFICATION PLAN

Role of verification plan - Levels of Verification-Unit level Verification – Reusable component verification – ASIC and FPGA verification – System level verification – Board level verification - Verification Strategies – Verifying the response – Random verification – Specification to Features – Features to Test cases - Test Cases to Test Benches.

Unit IV: STIMULUS AND RESPONSE

Simple Stimulus- Generating a complex waveform – Generating synchronized waveform – Aligning waveforms in delta time – Generating Synchronous Data waveforms - Encapsulating waveform generation – Abstracting waveform generation – Verifying the Output – Self Checking Test Benches – Complex Stimulus – Complex Response – Prediction of Output

Unit V: ARCHITECTING TESTBENCHES

Reusable Verification Components – Procedural Interface – Development Process - Verilog Implementation – VHDL Implementation - Autonomous Generation and Monitoring – Input and Output Paths- Verifying Configurable Designs.

Text Book

1. Janick Bergeron, “Writing Test Benches Functional Verification of HDL Models” Springer 2nd Edition,2003

REFERENCES

1. Andreas Meyer, “Principles of Functional Verification” Newnes, 2003.
2. Samir Palnitkar, “Design Verification with e”, Prentice Hall, 2003.
3. Thomas Kropf “Introduction to Formal Hardware Verification”, Springer Verlag, 1999.
4. M Kerrel Iran and Robert P Kustbern, “Verification of Digital and Hybrid Systems”, springer-verlag, 2000

13EC302 SIGNAL DETECTION AND ESTIMATION THEORY

Credits: 4:0:0

Course Objective:

- Understand basics of detection and estimation theory.
- Design and analyze optimum detection schemes.
- Study different estimation schemes such as ML and MMSE estimators.

Course Outcome:

- Knowledge on signal detection in the presence of noise.
- Apply probability and signal processing techniques for detection of signals and parameters from available data in continuous and discrete form.
- Identify the optimal estimator/detector.

Unit I: BINARY HYPOTHESIS TESTING

Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.

Unit II: SIGNAL DETECTION IN DISCRETE TIME

Models and detector structures. Coherent detection in independent noise. Detection in Gaussian noise. Detection of signals with random parameters. Detection of stochastic signals. Performance evaluation of signal detection procedures.

Unit III: BAYESIAN PARAMETER ESTIMATION

MMSE, MMAE and MAP estimates. Nonrandom parameter estimation. Exponential families. Completeness theorem. Maximum Likelihood estimation. Information inequality. Asymptotic properties of MLEs.

Unit IV: DISCRETE TIME

Kalman- Bucy filter. Linear estimation. Orthogonality principle. Wiener- Kolmogorov filtering – causal and non-causal filters.

Unit V: SIGNAL DETECTION IN CONTINUOUS TIME

The Detection of Deterministic and Partly Determined Signals in Gaussian Noise-Coherent Detection-Detection of Signals with unknown parameters-Detection of Random Signals on Gaussian Noise-Detection of Gaussian Signals in White Noise; Estimator-Correlator representation of Likelihood for Stochastic Signals.

Text Books:

1. Harry .L. Van Trees, Kristine L Bell, Zhi Tian, Detection, Estimation and Modulation theory, Part I, Second Edition, Wiley Publications 2013.
2. H.V. Poor, An Introduction to Signal Detection and Estimation, Second Edition, Springer, 1994.

Reference Books:

1. Mourad Bakat, Signal Detection and Estimation, Second Edition, Artech House, 2005.
2. Athanasios Papoulis, S Unnikrishna Pillai, Probabilty, Random Variabes and Stochastic Processes, ISBN 0073660116, Fourth Edition, Mc Graw Hill, 2002
3. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
4. Mandyam D. Srinath, P.K. Rajasekaran and R. Viswanathan, Introduction to Statistical Signal Processing with Applications, Prentice Hall, 1996.
5. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993
6. J.C.Hancock & P.A. Wintz, Signal Detection Theory, Mc-Graw Hill, 1966.

14EC1001 BASIC ELECTRONICS ENGINEERING

Credits: 3:0:0

Objective:

- To impart the basic knowledge about the passive components.
- To know about the fundamentals of electronics and some electronic devices.
- To get the knowledge about the various analog communication techniques.

Outcome:

- Student get an overview about the basics of electronics.
- Able to get an idea about communication and some applications in communication.

Course Contents:

Introduction to passive components and semiconductor- Types of Resistors – Types of capacitors – Types of inductors – N type & P type semiconductor – PN junction diode –Half wave rectifier, Zener diode -Bipolar Junction Transistor - Field Effect Transistors (JFET, MOSFET) - UJT. Number system – Boolean algebra – logic gates – karnaugh map (4 variables), combinational circuit -Basic block of communication system – need for modulation – types of analog modulation - AM and FM signal-Block diagram of AM and FM transmitter - Superhetrodyne receiver-Principle of Television - Satellite communication – Radar System - Fiber optic communication- ISDN

Reference Books.

1. Robert Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Pearson Education Edition, 2009.
2. Muthusubramanian ,R, Salivahanan S, Muraleedharan K.A, "Basic Electrical Electronics & Computer Engineering "Tata Mc.Graw Hill, 2009
3. Anokh Singh, "Principles of Communication Engineering" S.Chand Co., 2001
4. V.K.Metha."Principles of Electronics",Chand Publications,2008.

14EC2001 DIGITAL ELECTRONICS

Credits 3:1:0

Course objective:

- To learn about number systems, binary codes and the basic postulates of Boolean algebra.
- To study formal procedures for the analysis and design of combinational and sequential circuits
- To learn the implementation of digital circuits in programmable logic devices and about different logic families.

Course outcome

- The student understands number systems, binary codes and the basic postulates of Boolean algebra.
- The students acquire knowledge to design various combinational and sequential circuits.
- The student gains better understanding in the implementation of digital circuits in programmable logic devices and about different logic families.

Course Contents

Number Systems- Postulates & Theorems of Boolean Algebra – Canonical Forms – Simplification of Logic Functions using Karnaugh map - QuineMcclusky method-Combinational Logic Circuits- Implementation of Logical Functions using Multiplexers-Flipflops-Design of Synchronous sequential circuits-Synchronous and Asynchronous Counters-Design of Synchronous Counters-Shift Registers-Basic Structure of PLDs-Logic Families(CMOS-TTL-ECL).

Reference Books

1. MorrisMano,"Digital logic and computer Design", 3rd edition Prentice Hall of India,2002.
2. A. Anand Kumar, "Fundamental of Digital Circuits", PHI, 2nd Edition 2009.

3. Jain R.P, “Modern Digital Electronics”, Third edition, Tata Mcgraw Hill,2003
4. Floyd T.L., “Digital Fundamentals ", Prentice Hall, 9th edition, 2006.
5. V.K. Puri, “Digital Electronics: Circuits and Systems”, Tata McGraw Hill, First Edition, 2006.

14EC2002 ELECTRON DEVICES

Credits 3:0:0

Course objective:
- To understand the mechanisms of current flow in semi-conductors.
- To familiarize on the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- To design practical circuits and to analyze various components.

Course outcome
- The students understand the mechanisms of current flow in semiconductors.
- The students are familiarized with the principle of operation, capabilities and limitation of various advanced semiconductor devices and its practical application.
- The students design practical circuits and do the necessary analysis.

Course Contents
Semiconductor in Equilibrium: Charge carriers in semiconductors, Extrinsic semiconductors-Charge neutrality, position of Fermi energy level-carrier transport phenomena-Carrier generation and recombination-Continuity equation –Quasi Fermi energy levels-PN junctions : basic structure, applied bias- PN junction diode : PN junction current, small signal model of the PN junction-BJT:Bipolar transistor action, Ebers moll model- static characteristics of transistors – JFET : JFET concepts, JFET characteristics – MOSFET : structure and Characteristics – UJT –SCR - DIAC – TRIAC-Zener diode – Tunnel diodes– LED.

Reference Books
1. Donald A. Neamen, “ Semiconductor physics and Devices “,Tata McGraw Hill, 3rd Edition, 2007
2. Millman&Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2007.
3. Malvino A P, “Electronic Principles”, , McGraw Hill International, 7th Edition 2006.
4. David.A.Bell, "Electronic Devices & Circuits ", Oxford University Press, 5th Edition 2008.
5. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Pearson Education Edition, 2009.

14EC2003 Signals and systems

Corequisite: 14MA2004 Laplace Transforms, Fourier Series and Transforms /
14MA2003 Mathematical Transforms

Credits3:1:0

Course objective:
- To impart the basic knowledge about discrete and continuous time signals and systems.
- To know about the frequency of continuous time signals and systems using CTFT and Laplace transform.
- To understand the sampling process and frequency analysis of discrete time signals and systems using DTFT and Z transform.

Course outcome
- Students gain knowledge about discrete and continuous time signals and systems.
- Students acquire knowledge about the frequency of continuous time signals and systems using CTFT and Laplace transforms.

- Students are familiarized on the sampling process and frequency analysis of discrete time signals and systems using DTFT and Z transform.

Course Contents
Classification of Continuous-time signals & Discrete-time signals. Properties of Continuous-time systems and Discrete time systems. Continuous linear time-invariant systems &Discrete linear shift-invariant systems, impulse response: differential equations and difference equations, convolution integral and sum. System analysis and frequency response using CT Fourier transform & Laplace transform. Sampling, System analysis and frequency response using DT Fourier transform and Z transform.

Reference Books

1. Alan V Oppenheim, Alan S Wilsky and Hamid Nawab S, "Signals & Systems", 2^{nd} Edition, PHI, New Delhi, Reprint 2009.
2. Simon Haykin and Barry Van Veen, "Signals & Systems", 2nd Edition, John Wiley and Sons Inc., 2005
3. Samir S Solimon and Srinath M.D., "Continuous and Discrete Signals and Systems", 2nd Edition, PHI, 2003.
4. Rodger E Zaimer and William H Tranter, "Signals & Systems – Continuous and Discrete", McMillan Publishing Company, 4th Edition, III Reprint, 2002.
5. B.P. Lathi, Signal Processing and Linear Systems,Oxford University Press, Incorporated, 2009.
6. Steven T. Karris , "Signals and Systems with MATLAB Computing and Simulink Modeling ", Orchard Publications, 4th Edition 2008

14EC2004 DIGITAL ELECTRONICS LAB

Credits 0:0:2

Co-Requisite: 14EC2001 Digital Electronics.

Course Objective
- To learn the basic characteristics of all logic gates.
- To design combinational circuits.
- To design sequential circuits.

Course Outcome
- The student understands the basic characteristics of all logic gates.
- The student is able to design combinational circuits.
- The student is able to design sequential circuits.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2005 ELECTRON DEVICES AND CIRCUITS LAB

Credits 0:0:2

Co-Requisite: 14EC2002 Electron Devices
14EE2001 Electric Circuits & Networks.

Objective:
- To understand the characteristics of diodes, FET and UJT.
- To design rectifiers, amplifiers, oscillators and regulators.
- To understand the basic Network theorems.

Outcome:
- The students understand the characteristics of diodes, FET and UJT.

- The students are able to design rectifiers, amplifiers, oscillators and regulators.
- The students understand the basic Network theorems.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2006 ELECTRONIC CIRCUITS

Credits3:0:0

Pre requisites: 14EC2002 Electron Devices

Course objective:
- To know about the analysis and design of power supplies and Amplifier circuits.
- To understand about the analysis and design of feedback amplifiers
- To know about the analysis and design oscillators and tuned amplifiers

Course outcome
- Students understand to design simple power supplies and Amplifier circuits.
- Students are familiarized with the analysis and design of feedback amplifiers.
- Students gain better idea about oscillators and tuned amplifiers

Course Contents
Rectifier – rectifier parameters - Capacitor and inductor filters –series and shunt regulator- Short circuit and over load protection. - Transistor Biasing circuits –small scale modelling of FET– FET biasing circuits- Single stage Amplifier - RC coupled and Transformer coupled amplifiers- Power amplifiers: Class A, AB, B and D – Feedback circuits – Differential amplifier - Barkhausen criterion – RC and LC – Crystal oscillators– Tuned amplifiers-problems-Multivibrators.

Reference Books

1. Millman .J. &Halkias.C , "Electronic Devices And Circuits", Tata McGraw Hill, 2007.
2. Mathur S.P, Kulshrestha D.C., Chanda P.R., “Electronic Devices Applications and Integrated Circuits, Umesh Publications, 2004.
3. Malvino A.P., “Electronic Principles”, McGraw Hill International, 2005.
4. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits Theory”, PHI, 8th Edition, 2003.
5. Allen Moltershed,”Electronic Devices & Circuits”,PHI,1998.

14EC2007 TRANSMISSION LINES AND WAVEGUIDES

Credits3:1:0

Pre requisites: 14EE2004 Electromagnetic Fields

Course objective:
- To understand the fundamental concepts of transmission lines and waveguides.
- To understand the essentials of impedance matching and calculates the impedance and admittance using the Smith chart.
- To apply basic electromagnetic concepts with Microwave resonators.

Course outcome
- Students understand the characteristics of transmission lines.
- Students acquire knowledge on impedance matching and also to calculate the impedance and admittance using the Smith chart.

- Students understand the basic electromagnetic concepts with Microwave resonators.

Course Contents
Transmission Line: Fundamentals- General Solution of the transmission line – the Line at Radio Frequencies: One eighth wave line – the Quarter wave line -the Half wave line -Circle diagram - The Smith Chart – Single stub matching and double stub matching. Waves between parallel planes of perfect conductors – Rectangular Waveguides –Circular Wave Guides and Resonators-Microstripline, Stripline, Slot lines, Coplanar Waveguide and Fin line.

Reference Books
1. J.D. Ryder, "Networks, Lines and Fields", PHI, New Delhi, 2003
2. R.E. Collin, Foundations for Microwave Engineering (2/e), McGraw-Hill, 2002.
3. David M. Pozar "Microwave Engineering", 2nd Edition, John Wiley 2004.
4. E.C. Jordan and K.G.Balmain "Electro Magnetic Waves and Radiating System, PHI Learning, New Delhi, 2003.
5. David K.Cheng, "Field and Waves in Electromagnetism", Pearson Education, 1989.

14EC2008 LINEAR INTEGRATED CIRCUITS

Credits3:0:0

Pre requisite:14EC2006 Electronic Circuits

Course objective:
- To learn about IC 741 and its applications.
- To learn about IC 555 and its applications.
- To get knowledge about IC fabrication.

Course outcome
- The students acquire knowledge on IC 741 and its applications.
- The students acquire knowledge on IC 555 and its applications.
- The students acquire knowledge on IC fabrication.

Course Contents
Characteristics of Op-amp-Applications-Comparators-Multivibrators-Oscillators-Voltage Regulators using IC723-Active Filters-555 Timers (Astable and Monostable operation)-Applications of 555 Timers-PLL-ADC-DAC-IC Fabrication (Diode,BJT,FET)

Reference Books
1. Roy Choudhury.D., Shail Jain, "Linear Integrated Circuits", New Age International Publications, 3rd Edition,2007.
2. Gayakwad.A.R., "Op-Amps & Linear IC's", PHI, 4th Edition,2004
3. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers & LinearIntegrated Circuits", PHI 6th Edition, 2001.
4. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits",TMH, 3rd Edition, 2002.
5. Millman & Halkias," Integrated Electronics", Mac Graw Hill, 1991.

14EC2009 MICROPROCESSOR AND INTERFACING TECHNIQUES

Credits 3:0:0

Course objective:
- To impart basic concepts of microprocessor 8 bit (8085).
- To impart basic concepts of microprocessor 16 bit (8086).

- To introduce interfacing devices, programmable peripheral devices and applications.

Course outcome
- The student acquires programming skills in 8085.
- The student acquires programming skills in 8086.
- The student understands the interfacing devices, programmable peripheral devices and applications.

Course Contents
Study of 8085 processor- 8088/86 Architecture- Memory and I/O interfacing- Introduction to Pentium Processor- Case studies – Microprocessor based System design.

Reference Books

1. Ramesh.S.Gaonkar "Microprocessor Architecture, Programming & Applications With 8085/8080a", Penram International, 2006.
2. Rafiquzzaman.M. "Microprocessor Theory and Applications-Intel and Motorola",PHI, 2007.
3. D.V. Hall "Microprocessor and Interfacing Programming and Hardware", McGraw Hill Publishing Company, 2nd Edition, 1990.
4. Liu, Gibson, "Microcomputer System: 8086/8088 family architecture, programming and design", Prentice Hall PTR, 2nd Edition 1986.
5. Ajit Pal,"Microprocessor Principles & Application",TataMcGraw Hill Publishing Company,1st Reprint 2003.
6. Walter A. Triebel, Avatar Singh, The 8088 & 8086 Microprocessor, program, Interfacing, Software, Hardware and Applications, Prentice Hall of India, Fourth Edition, 2007. ISBN 81-297-0298-3
7. Krishna Kant, Microprocessors and Microcontrollers: Architecture, Programming and System Design, 2007, PHI Learning Private Limited. ISBN 978-81-203-3191-4
8. Barry B. Brey, The Intel Microprocessors Architecture, Programming and Interfacing, Eighth Edition, 2009, Pearson Education, ISBN 978-81-317-2622-8

14EC2010 LINEAR INTEGRATED CIRCUITS LAB

Credits 0:0:2

Co-Requisite: 14EC2008 Linear Integrated Circuits.

Objective:
- To design basic circuits using IC741.
- To design different multi vibrators and oscillators using IC741 and IC555.

Outcome:
- The students design basic circuits using IC741.
- The students design different multi vibrators and oscillators using IC741 and IC555.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2011 MICROPROCESSOR LAB

Credits 0:0:1

Co-Requisite: 14EC2009 Microprocessor and Interfacing circuits.

Objective:
- To develop assembly level programming skills.

- To design interfacing circuits for various applications.

Outcome:

- The students develop assembly level programming skills.
- The students are able to design interfacing circuits for various applications.

Experiments

The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2012 PULSE AND WAVE SHAPING CIRCUITS

Credits 3:0:0

Pre requisites: 14EC2006 Electronic Circuits

Course objective:

- To design various linear and non-linear wave shaping circuits.
- To design various multi vibrators, blocking oscillators and time based generators
- To impart knowledge about the different analog circuits in practical applications.

Course outcome

- Students understand to design various linear and non-linear wave shaping circuits.
- Students understand to design various multi vibrators, blocking oscillators and time based generators
- Students gain knowledge about the different analog circuits in practical applications.

Course Contents

High pass and low pass RC circuits – attenuators- clippers – clamper - Bi stable Multi vibrator - Triggering methods – Design - Schmitt Trigger –Applications – Mono stable Multi vibrator- Astable Multi vibrator - General feature of a time base signal- exponential circuit - Miller and Bootstrap time base generators- Blocking Oscillators – Sampling gates.

Reference Books

1. Millman&Taub “Pulse Digital and Switching Waveforms”, McGraw Hill, 2nd Edition 2007.
2. Suryaprakash Rao Mothiki, “Pulse and Digital Circuits”, McGraw Hill, 2nd Reprint 2009.
3. Ronald Tocci, “Fundamentals of Pulse and Digital Circuits”, Merrill Publishing Company, 3rd Edition, 1997.
4. David A Bell, “Solid State Pulse Circuits”, PHI, Fourth Edition, 2005.
5. Millman.J & Halkias.C, “ Electronic Devices & Circuits”,Tata McGraw Hill, 2007.

14EC2013 COMMUNICATION THEORY AND SYSTEMS

Credits3:0:0

Pre requisite:14EC2003 Signals & Systems and 14EC2007 Transmission Lines & Wave Guides

Course objective:

- To impart the basic concepts of communication systems, transmitter and receiver.
- To understand analog modulation and demodulation techniques.
- To analyze the adverse effect of noise on signals.

Course outcome

- The students understand basic concepts of communication systems, transmitter and receiver.
- The students understand analog modulation and demodulation techniques.
- The student acquires knowledge to analyze the adverse effect of noise on signals.

Course Contents

Communication system block diagram, Need for modulation, Need for wireless communication, Types of modulation, Amplitude modulation, Double sideband suppressed carrier system, Single sideband suppressed carrier system, AM power calculation, AM with a complex wave, Low level and High level modulation, AM generation and detection, Double sideband suppressed carrier generation and detection, Vestigial side band, Frequency modulation, FM generation and Detection, Phase modulation, AM Transmitter, AM Receiver, SSB Transmitter, ISB Transmitter, FM Transmitter, FM Receiver, Noise and Interference analysis, Signal to Noise Ratio calculation of DSB-SC and SSB-SC, Signal to Noise Ratio calculation of FM Receiver.

Reference Books

1. Anokh Singh, A.K.Chhabra,"Principles of Communication Engineering", S.Chand Co.,7th Edition, 2013.
2. Dennis Roddy & John Coolen, "Electronic Communication", Pearson Education Limited, 4th Edition, 2012.
3. G.Kennedy, "Electronic Communication Systems", McGraw Hill, 5th Edition, 2012.
4. Taub and Schilling , "Principles of Communication Systems", McGraw Hill, 2ndEdition, 2003.
5. Simon Haykins, "Communication Systems" John Wiley, 4th Edition, 2004.

14EC2014 DIGITAL SIGNAL PROCESSING

Credits3:1:0

Pre requisites: 14EC2003 Signals and Systems

Course objective:

- To impart basic knowledge about digital signal processing
- To understand Digital (IIR and FIR) filter design procedures.
- To know about the finite word length effects and PDSPs.

Course outcome

- The students gain basic knowledge about digital signal processing.
- The students understand Digital (IIR and FIR) filter design procedures.
- The students acquire knowledge on finite word length effects and PDSPs.

Course Contents

Circular Convolution and sectioned convolution, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations-Impulse Invariant and Bilinear Transformation. Design of FIR Digital filters: Window method, frequency sampling Method. Effect of finite register length in DSP. Adaptive Filter: Basics of Wiener and LMS – PDSPs.

Reference Books

1. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2007.
2. Emmanuel C. Ifeacher and Barrie W. Jervis, "Digital Signal Processing – A Practical Approach", Wesley Longman Ltd., 2nd Edition, 2004
3. SanjitK.Mitra, "Digital Signal Processing - A Computer Based Approach", Tata McGraw-Hill, New Delhi, 2nd Edition, 2001Johny R. Johnson, " Introduction to Digital Signal Processing", PHI, 2006
4. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", McGraw Hill International, 2007
5. Venkatramani B, M. Bhaskar, 'Digital Signal Processors Architecture, Programming and Applications', Tata McGraw– Hill Publishing Company Limited, New Delhi, 2002.

14EC2015 MICROCONTROLLER AND ITS APPLICATIONS

Credits 3:0:0

Course objective:

- To understand the basic concepts of 8-bit microcontroller (8031&8051) and 8-bit PIC microcontroller.
- To interface the peripheral devices to the microcontrollers.
- To write assembly language programs in 8031 and PIC.

Course outcome

- The students understand the basic concepts of 8-bit microcontroller (8031&8051) and 8-bit PIC microcontroller.
- The students gain knowledge to interface the peripheral devices to the microcontrollers.
- The students acquire programming skills in 8031 and PIC.

Course Contents

Organization of 8031 and 8051 microcontrollers, I/O ports, External memory, Interrupts, Assembly language programming, Counter and Timers – Serial data input and output, PIC- Program memory ,CPU Registers, Register file structure, Block diagram of PIC16C74 ,I/O Ports, Timers 0,1 and 2 features, Interrupt Logic ,Serial Peripheral Interface ,I^2C Bus. ADC, UART, PIC family parts - Simple applications - Keyboard interfacing, ADC, Sensor interfacing and Signal conditioning

Reference Books

1. Kenneth J.Ayala "The 8051 Microcontroller Architecture, Programming & Applications" –Penram International Publishing –2008.
2. Muhammad Ali Mazidi, J.G.Mazidi, R.D.Mckinlay, "The 8051 Microcontroller and Embedded Systems" Second Edition Prentice Hall-2007.
3. John B Peatman, "Design with PIC Micro Controllers", Pearson Education IndiaSeries, New Delhi, 2005.
4. Rafiquzzaman.M. "Microprocessor Theory and Applications-Intel and Motorola",PHI, 2007.Intel Handbook

14EC2016 CAD FOR ELECTRONICS ENGINEERS

Credits 3:0:0

Pre requisite: 14EC2003 Signals and Systems and 14EC2006 Electronic Circuits.

Course Objective:

- To provide an introduction to the fundamentals of Computer-Aided Design tools for the modelling, design, analysis, test, and verification of digital systems, Labview, Matlab and PCB design.
- To design, code, and test small MATLAB programs that meet requirements expressed by engineers. This includes a basic understanding of top-down design.
- To illustrate the role of computer programming in solving engineering problems.

Course outcome

- Have a working familiarity with graphics tools in MATLAB.
- Able to write solution programs that can solve the engineering problems.
- Have a working familiarity with XILINX

Course Contents

Introduction- Programming basics- Control statements-loop statements-decision statements- User-defined functions-plot- Logic-level synthesis and optimization of combinational and sequential circuits-XILINX - Physical design automation (placement, floor-planning, routing), Lab-View, Introduction to MATLAB, SIMULINK- DTFT-Sampling- Analog modulation-Pass band Digital transmission-PCB Design-Characters and strings- Cell arrays- Cell arrays, working with numeric/text data (file I/O)- Structures and structure arrays- Objects and Classes- Array of objects, constructor that handles variable number of args- Inheritance, Recursion- Sorting and Searching- Divide and Conquer

Reference Books

1. C. F. Van Loan and K.-Y. D. Fan. , Insight Through Computing: A Matlab Introduction to Computational Science and Engineering , SIAM Publication, 2009,
2. Brian R. Hunt,Ronald L. Lipsman,Jonathan M. Rosenberg, A Guide to MATLAB, for Beginners and Experienced Users
3. G.DeMicheli,” Synthesis and Optimization of Digital Circuits”, McGraw-Hill, 1994.
4. Won.Y.Yang,Yong.S.Cho,Won.G.Jeon.,Jeong.W.Lee,Jong.H.Paik,Jaekwon Kim, Mi-Hyun Lee, Kyu. I.Lee, Kyung.W.Park, Kyung.S.Woo,” MATLAB/Simulink for Digital Communication,Hongrung Publishing, 2012.

14EC2017 ELECTRONICS AND COMMUNICATION LAB

Credits0:0:2

Co-Requisite: 14EC2013 Communication theory and Systems.
14EC2012 Pulse and Wave Shaping Circuits.

Objective:

- To design wave shaping circuits.
- To design multi vibrator circuits.
- To analyze the different types of modulation and demodulation techniques.

Outcome:

- The students design wave shaping circuits.
- The students design multi vibrator circuits.
- The students analyze the different types of modulation and demodulation techniques.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2018 DIGITAL SIGNAL PROCESSING LAB

Co-Requisite: 14EC2014 Digital Signal Processing

Credits: 0:0:2

Objective:

- To apply the knowledge in real time DSP applications like FIR,IIR filters and FFT
- To gain knowledge on ADSP BS533 & Texas instrument TMS320C6416/6713 DSK.

Outcome:

- The students apply the knowledge in real time DSP applications like FIR,IIR filters and FFT
- The students gain knowledge on ADSP BS533 & Texas instrument TMS320C6416/6713 DSK.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2019 MICROCONTROLLER LAB

Co-Requisite: 14EC2015 Microcontroller and its Applications

Credits 0:0:1

Objective:

- To impart knowledge about programming using micro controllers and it's applications
- To improve the programming skills
- To encourage the students to have innovative ideas of their own

Outcome:

- The student will be able to perform assembly level programming.
- Improved programming skills
- Confidence to work in core companies

Experiments

The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2020 ANTENNA THEORY AND WAVE PROPAGATION

Pre requisites:14EC2013 Communication Theory & Systems

Credits3:1:0

Course objective:

- To understand basic terminology in an antenna.
- To understand the field distribution due to antenna elements.
- To familiarise on various antenna types and wave propagation.

Course outcome

- The students acquire knowledge on the basic terminology in an antenna.
- The students understand the field distribution due to antenna elements.
- The students acquire knowledge on various antenna types and wave propagation.

Course Contents

Review of antenna theory- dipoles, monopole and loop antennas- linear and planar arrays- array synthesis- phased arrays- helical antennas- radiation from apertures- aperture distribution- horn and parabolic dish antennas- Yagi - Uda and log-periodic antennas-microstrip antennas and arrays- Dielectric Antennas-Ground Wave-Propagation, Free-space Propagation, Ground Reflection, Surface waves, Diffraction-Wave propagation in complex environments, Tropospheric Propagation, Tropospheric scatter. Ionospheric propagation: Structure of ionosphere, Sky waves, skip distance, Virtual height, Critical frequency, MUF, Electrical properties of ionosphere, Effects of earth's magnetic fields, Faraday rotation, Whistlers.

Reference Books

1. J.D. Karus, Antennas, McGraw Hill, 2007.
2. E.C.Jordan and Balmain, "Electromagnetic waves and Radiating Systems", Pearson Education / PHI, 2006
3. A.R.Harish, M.Sachidanada, "Antennas and Wave propagation", Oxford University Press, 2007.
4. Balanis, Antenna Theory - Analysis and design, John wiley, 2007.
5. R.E. Collin, Antennas and radiowave propagation, McGraw Hill, 1985.
6. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw Hill, 1984.
7. I.J. Bahl and P. Bhartia, Microstrip antennas, Artech house,1980.

14EC2021 DIGITAL COMMUNICATION

Prerequisite: 14MA2015 Probability, Random Process and Numerical Methods

Credits3:1:0

Course objective:
- To study the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To learn baseband pulse transmission and pass band pulse transmission.
- To learn error control coding and spread spectrum modulation schemes.

Course outcome
- The students understand sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- The students gain knowledge on baseband pulse transmission and pass band pulse transmission.
- The students acquire knowledge on error control coding and spread spectrum communication

Course Contents
Basic building blocks of Digital communication System, Analog versus Digital communication, Advantages and disadvantages of digital communications. Sampling and Quantization process, PCM- types Delta Modulation and types, baseband pulse transmission, ISI and Nyquist criterion, Generation, Detection, Signal space diagram, bit error probability and Power spectra of M-ary Signaling Schemes MSK- Digital modulation tradeoffs, Optimum receiver for both baseband and passband.-Source Coding- Shannon's Theorem- linear ,cyclic and convolutional codes generation, spread spectrum techniques.

Reference Books
1. Simon Haykins, "Communication Systems" John Wiley, 4th Edition, 2004
2. John G.Proakis, "Digital Communication" McGraw Hill 3rd Edition, 2008
3. Sam K.Shanmugam "Analog & Digital Communication" John Wiley.2006
4. Taub& Schilling, "Principles of Digital Communication " Tata McGraw-Hill" 28^{th} Reprint, 2003.
5. Bernard Sklar, "Digital Communication, Fundamental and Application" Pearson Education Asia, 2nd Edition, 2001.

14EC2022 MICROWAVE AND OPTICAL COMMUNICATION

Pre requisites: 14EC2020 Antenna and Wave Propagation.

Credits3:0:0

Course Objective:
- To understand the basic building blocks of Microwave Communication system.
- To understand the basic building blocks of Optical Communication system
- To get familiarised with the various generators and receivers in Microwave and Optical links.

Course outcome
- The students understand the basic building blocks of Microwave Communication system.
- The students understand the basic building blocks of Optical Communication system
- The students are familiarised with the various generators and receivers in Microwave and Optical links.

Course Contents
Review of Electromagnetics- All types of microwave passive devices with Scattering matrix. Mechanism of operation and its applications of Microwave vacuum tube devices and Microwave solid state devices. Optical

communication- Types of fibres and its effects. Types of optical transmitters and receivers with mode of operation and applications.

Reference Books

1. Samuel.Y.Liao, "Microwave Devices and Circuits", Prentice Hall of India Pvt Ltd., 3rd Edition, 5th Reprinting, 2000
2. Keiser.G. "Optical Fibre Communications", McGraw Hill, 3rd edition, 2000
3. Collin. R.E, "Foundation of Microwave Engineering", McGraw-Hill, II Edition, 1992.
4. Annapurna Das, Sisir K. Das, "Microwave Engineering", Tata McGraw-Hill Co.,Ltd., 1st Edition, 1999. Reprint 2001.
5. Gower.J "Optical Communication Systems", Prentice Hall, 2nd edition, 5th Reprint, 2001. John Senior "optical communications" Prentice Hall India.

14EC2023 ADVANCED COMMUNICATION LAB

Co-Requisite: 14EC2021 Digital communication.
14EC2020 Antenna theory and wave propagation.

Credits 0:0:2

Objective:

- To determine the radiation pattern of different antennae.
- To analyze the characteristics of different transmission lines.
- To analyze the performance of different digital modulation techniques.

Outcome:

- The students determine the radiation pattern of different antennae.
- The students analyze the characteristics of different transmission lines.
- The students analyze the performance of different digital modulation techniques.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2024 MICROWAVE AND OPTICAL COMMUNICATION LAB

Credits 0:0:2

Co-Requisite: 14EC2022 Microwave and Optical Communication

Objective

- To analyze the characteristics of different microwave and optical devices.
- To analyze the performance of various microwave and optical links.

Outcome

- The students analyze the characteristics of different microwave and optical devices.
- The students analyze the performance of various microwave and optical links.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2025 COMPUTER COMMUNICATION

Credits3:0:0

Pre-requisites: 14EC2021 Digital Communication /14EC2013 Communication theory and Systems

Course objective:

- To understand protocol architecture for wired and wireless network.
- To familiarise with different local area networks.
- To understand routing, transport and application layer protocols.

Course outcome

- The students understand protocol architecture for wired and wireless network.
- The students are familiarised to different local area networks.
- The students understand routing, transport and application layer protocols.

Course Contents

Protocols-OSI model – TCP / IP protocol suite –Transmission media-Switching- Modem-Data link control-Wired LANS -Wireless LANS – ATM-Logical addressing-Internet Protocols-IPv4-IP addressing-Subnetting-IPv6-Routing protocols- UDP – TCP –SCTP- Congestion Control – Quality of services- Domain Name System (DNS) – E-mail – SMTP-FTP – WWW – HTTP.

Reference Books

1. 1.Behrouz A. Foruzan, "Data Communication and Networking", Tata McGraw-Hill, Fourth Edition:
2. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fourth Edition, 2003:
3. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education.
4. William Stallings, "Data and Computer Communication", Eighth Edition, Pearson Education.
5. Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002;

14EC2026 ADVANCED MICROPROCESSOR ARCHITECTURE

Credits3:0:0

Course objective:

- To impart knowledge in advanced microprocessor
- To train the students towards various architectures of advanced microprocessors
- To expose the students towards the recent trends in the microprocessor field

Course outcome:

- The student can employ their knowledge in Embedded field
- Gained confidence to incorporate microprocessors in real time applications
- Utilize the knowledge gained in microprocessors to design projects

Course Contents

Fundamentals Of Computer Design-Instruction- Pipelining-Difficulties In Implementing Pipelines, Extending The Pipeline To Handle Multicycle Operations, Instruction Set Design And Pipelining-Parallel Computer Models And Instruction Level Parallelism-Issues in The Memory Hierarchy Design- Multiprocessors-Advanced Processors-CISC Scalar Processors, RISC Scalar Processors,Superscalar Processors, VLIW Architectures, Vector And Symbolic Processors

Reference Books

1. Kai Hwang, "Advanced computer architecture", TMH,1993
2. D. A. Patterson and J. L. Hennessey, "Computer organization and design," Morgan Kaufmann, 2nd Ed,2007

3. J.P.Hayes, “Computer Architecture and organization”, MGH,1998.
4. Harvey G.Cragon,”Memory System and Pipelined processors”; Narosa Publication,1998
5. Mano, M M., "Computer system Architecture", Prentice Hall of India, 3rd Edition, 1993

14EC2027 ADVANCED MICROCONTROLLER

Credits3:0:0

Course objective:

- To impart knowledge regarding the architecture and applications of advanced microcontrollers
- To give exposure to microcontrollers which are used in industries.
- To equip them with adequate programming skills

Course outcome

- The students gain knowledge about the various higher end microcontrollers
- Gained confidence to incorporate microcontrollers in real time applications
- Utilize the knowledge gained in microcontrollers to design projects

Course Contents

MCS51 FAMILY FEATURES: 8051 Interrupt Structure – Timer modules – Serial Features – Port Structure – Power Saving Modes -Comparison of 8031, 8051 and 8751. **MOTOROLA 68HC11:** 68HC11 features – Different modes of operation and memory map– Functions of I/O ports in single chip and expanded multiplexed mode – Timer system of 68HC11 – Input capture, output compare and pulsed accumulator features of 68HC11.**PIC MICROCONTROLLER:** CPU architecture – Timer – Interrupts – I/O port expansion– I2C bus – A/D converter – Instruction set. Typical applications: Stepper motor control –DC motor control – AC power control using any microcontroller mentioned above.

Reference Books

1. Muhammad Ali Mazidi, Janice GillispieMazidi, “8051 Microcontroller and Embedded Systems” Prentice Hall, 1999.
2. Kenneth J. Ayala, “The 8051 Microcontroller Architecture Programming and Applications”, Penram International, 2nd Edition, 2004
3. John B Peatman “Design with PIC Microcontrollers”, Pearson Education Asia, Singapore, 8th Edition, 2004
4. “8-bit Embedded controllers”, Intel corporation,1990.
5. Mano, M M., "Computer system Architecture", Prentice Hall of India, 3rd Edition, 1993

14EC2028 ADVANCED MICROCONTROLLER LAB

Credits 0:0:2

Co-Requisite: 14EC2027 Advanced Microcontroller

Objective:

- To impart knowledge about programming using micro controllers and it’s applications
- To improve the programming skills
- To encourage the students to have innovative ideas of their own

Outcome:

- The student will be able to perform assembly level programming.
- Improved programming skills
- Confidence to work in core companies

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2029 EMBEDDED SYSTEM DESIGN

Credits:3:0:0

Course Objective:

- To understand the basic concepts of Embedded System
- To acquire Knowledge in Real time Embedded system, programming languages and tools.
- To explore the potential areas utilizing embedded processors in real time systems

Course Outcome:

The students

- Acquire designing skills in Hardware
- Good Programming skills using Software Tools of Embedded System
- Acquired knowledge to do embedded projects

Course Contents

Introduction to Embedded Systems, Embedded Design Life cycle, Hardware Interfacing Techniques- Serial Communication ,RTC and EEPROM interface, Relay, Stepper and DC motor; Software Development tools and Programming Techniques-IDE-Timer Programming, Serial port programming, Getting Embedded Software into Target System Debug Kernels; Real Time Operating Systems.

Reference Books:

1. Arnold Berger, ―Embedded System Design: An Introduction to Processes, Tools, and Techniques CMP Books,2001.
2. Muhammad Ali Mazidi, ―The 8051 Microcontroller and Embedded Systems , Second Edition, Prentice - Hall, Inc.2006
3. David E Simon, ―An Embedded Software Primer Pearson Education Asia, 2006.
4. Rajkamal, Embedded Systems: Architecture, Programming and Design, Tata McGraw -Hill,2003.
5. Wayne Wolf, ―Computers as Components Morgan Kaufmann Publishers, 2005.
6. Douglas V. Hall, ―Microprocessors and Interfacing: Programming and Hardware, Second Edition, Tata McGraw-HillEdition, 2001.

14EC2030 ARM PROCESSORS

Credits3:0:0

Course objective:

- To impart basic knowledge about architecture of ARM processor
- To get familiarized with the instruction sets in ARM Processors
- To explore the necessity of ARM processors in DSP

Course outcome:

- Design systems using ARM processors
- Good understanding about the different registers in ARM
- Use ARM processors for a variety of real time applications

Course Contents:

CISC AND RISC Architecture– Block diagram-Introduction to ARM7/ARM9 and ARM extensions – Pipelines – Memory - Architecture – Memory interfacing – Bus architecture Programming in assembly language (ALP) – The **ARM** instruction set – Introduction to ARM thumb – Thumb Programmes model – **ARM**/Thumb inter working-Data Types- Abstraction in software Design–Expressions – Loops – Functions and Procedures – Conditional

Statements –Use of Memory.Memory Size and Speed – On Chip Memory – Caches – Cache Design–Protection Unit Registers – ARM Protection Unit – CP15 MMU Registers –ARM MMU Architecture Synchronization–Context Switching Input and Output. DSP and Embedded Applications.

Reference Books

1. SteveFurber, ―ARM System on Chip Architecture Addison- Wesley Professional Second Edition, Aug 2000.
2. Andrew NSloss, Dominic Symes, Chris Wright,ARM System Developer‘s Guide , Designing and Optimizing System Software, Morgan Kaufmann Publishers, Elsevier, 2004.
3. Ricardo Reis, Design of System on a Chip: Devices and Components Springer FirstEdition, July 2004.
4. Jason Andrews, Co-Verification of Hardware and Software for ARM System on Chip Design (EmbeddedTechnology) Newnes, BK and CD-ROM (Aug 2004).
5. Rashinkar P, Paterson and Singh L, System on a Chip Verification –Methodologies and Techniques, Kluwer Academic Publishers, 2001

14EC2031 ARM LAB

Credits 0:0:2

Co-Requisite: 14EC2030 ARM Processors

Objective:

- To explore the necessity of ARM Processor in DSP
- To improve the programming skills
- To encourage the students to have innovative ideas of their own

Outcome:

- The student are able to use ARM processor for real time applications.
- Improved programming skills
- Confidence to work in core companies

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2032 TESTING FOR EMBEDDED SYSTEM

Credits 3:0:0

Course Objective

- To expose students to various techniques of testing for embedded system
- To impart knowledge about testing in embedded systems
- To explore the potential areas in Embedded systems

Course outcome

- The students obtain in depth knowledge in various testing techniques of embedded system
- Apply testing schemes for embedded projects
- Debug the embedded projects

Course Contents

Physical faults and their modeling. Fault equivalence and dominance; fault collapsing. Fault simulation: parallel, deductive and concurrent techniques; critical path tracing. Test generation for combinational circuits: Boolean difference, D-algorithm, Podem, etc. Exhaustive, random and weighted test pattern generation; aliasing and its effect on fault coverage. PLA testing: cross-point fault model, test generation, easily testable designs. Memory testing: permanent, intermittent and pattern-sensitive faults; test generation. Delay faults and hazards; test generation techniques. Test pattern generation for sequential circuits: time-frame expansion method, ad-hoc and structures techniques, scan path and LSSD, boundary scan. Built-in self-test techniques. Testing issues in embedded core based systems.

Reference Books

1. N. K. Jha and S. Gupta, Testing of Digital Systems, Cambridge University Press,2003
2. M. L. Bushnell and V. D. Agrawal, Essentials of Electronic Testing, Kluwer Academic Publishers,2000
3. M. Abramovici, M. A. Breuer and A. D. Friedman, Digital Systems Testing and Testable Design, Wiley-IEEE Press,1994
4. P. H. Bardell, W. H. McAnney and J. Savir, Built-in Test for VLSI: Pseudorandom Techniques, Wiley Interscience,1987.
5. P. K. Lala, Fault Tolerant and Fault Testable Hardware Design, Prentice-Hall,1985.
6. A. Krstic and K-T Cheng, Delay Fault Testing for VLSI Circuits, Kluwer Academic Publishers,1998.

14EC2033 EMBEDDED LAB

Credits 0:0:2

Co-Requisite : 14EC2029 Embedded system design

Objective:

- To gain knowledge about RTOS using Embedded C
- To improve the programming skills
- To encourage the students to have innovative ideas of their own

Outcome:

- The student will be able to write programs for RTOS using Embedded C language.
- Improved programming skills
- Confidence to work in core companies

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2034 FAULT TOLERANT TECHNIQUES

Credits3:0:0

Course objective:

- To teach the basic principles, concepts of fault tolerant strategies
- To impart knowledge about fault tolerance in distributive system
- To provide understanding about different fault tolerant scheduling algorithms

Course outcome

- Good understanding about fault tolerant strategies
- Knowledge about the different evaluation techniques and about fault tolerance in real time systems
- Ability to use different tools like HIMAP for analysing evaluation techniques

Course Contents

Dependability concepts-dependability measures-classification of faults and failures;

Fault tolerant strategies- Fault detection and recovery;Fault tolerant design techniques-Hardware, software redundancy and information redundancy Fault tolerance in distributed systems- check pointing and recovery, stable storage and RAID architectures, and data replication and resiliency. Dependability evaluation techniques and tools-Fault trees, Markov chains; HIMAP tool. Analysis of fault tolerant hardware and software architectures.Fault tolerance in real-time systems-Time-space tradeoff, fault tolerant scheduling algorithms

Reference Books

1. Palmer,J.E., Perlman, D.E., “Introduction to Digital Systems”, McGraw Hill Book Company, International Student Edition, 1993.
2. Nelson, V.P., Nagale H.T., Carroll, B.D., and Irwin J.D., “Digital Logic Circuit Analysis and Design”, Prentice Hall International, Inc., New Jersey, 1995.
3. John V. Oldfield and Richard C.Dorf, “Field Programmable Gate Arrays: Reconfigurable Logic for Rapid Prototyping and Implementation of Digital Systems”, John Wiley, 1995.
4. D.K.Pradhan, "Fault - Tolerant computing - theory and Techniques" vol.I & II, Prentice hall 1986
5. "Programmable logic devices databook and design guide" National semiconductors, 1989
6. Navabi, Z., “VHDL : Analysis and Modelling of Digital Systems”, Prentice Hall Inc., 1989.
7. David Pellerin, Douglas Taylor"VHDL Made Easy" Prentice Hall Inc., 1997.

14EC2035 PCB DESIGN LAB

Credits 0:0:2

Co-Requisite: 14EC2001 Digital Electronics

Objective:

- To familiarize the design of simple circuits using PCB
- To improve the knowledge on circuits design
- To encourage the students to have innovative ideas of their own

Outcome:

- The student will be able to emulate PCBs for simple electronic circuits.
- Improved knowledge on circuits
- Confidence to work in core companies

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HoD/Director and notify it at the beginning of each semester.

14EC2037 TELECOMMUNICATION SWITCHING NETWORKS

Credits: 3:0:0

Pre requisite: 14EC2025 Computer Communication.

Course objective :

- To understand the fundamentals of a telecom switching office, such as digital multiplexing, digital switching and digital subscriber access.
- To gain knowledge on the mathematical model for the analysis of telecommunication traffic.
- To learn ISDN, DSL / ADSL, and fibre optic systems in subscriber loop.

Course outcome:

- The students understand the fundamentals of a telecom switching office, such as digital multiplexing, digital switching and digital subscriber access.
- The students acquire knowledge on the mathematical model for the analysis of telecommunication traffic.
- The students learn ISDN, DSL / ADSL, and fibre optic systems in subscriber loop.

Course Contents

Multiplexing - FDM – TDM - Digital Transmission and Multiplexing- SONET/SDH: SONET Multiplexing overview, SONET optical standards, SONET networks – SONET rings. Digital Switching - Space Division

Switching, Time Division Switching - STS Switching, TST Switching ,Digital Cross-Connect Systems. Network Synchronization Control And Management - Timing Recovery - Timing Inaccuracies - Network Synchronization, Network Control, Network Management. Digital Subscriber Access - ISDN U Interface, ISDN D Channel Protocol - High-Data-Rate Digital Subscriber Loops- Digital Loop Carrier Systems - Voice band Modems. Traffic Analysis - Traffic Characterization- Network Blocking Probabilities- Delay Systems.

References

1. J. Bellamy, "Digital Telephony", John Wiley, 2003, 3rd Edition.
2. R.A.Thomson, "Telephone switching Systems", Artech House Publishers, 2000.
3. W. Stalling, " Data and Computer Communications" Prentice Hall, 1993.
4. T.N.Saadawi, M.H.Ammar, A.E.Hakeem, "Fundamentals of Telecommunication Networks", Wiley Interscience, 1994.
5. W.D. Reeve, "Subscriber Loop Signaling and Transmission Hand book", IEEE Press(Telecomm Handbook Series), 1995.
6. Viswanathan. T., "Telecommunication Switching System and Networks", Prentice Hall of India Ltd., 1994.

14EC2038 CELLULAR MOBILE COMMUNICATION

Credits: 3:0:0

Course Objective:

- To understand the state of art techniques in wireless communication
- To learn the fundamental and emerging trends in Mobile Communication, wireless network/protocol architecture and broadcast systems.
- To analyze the various wireless protocol architectures.

Course Outcome:

- The students understand the state of art techniques in wireless communication
- The students learn the fundamental and emerging trends in Mobile Communication, wireless network/protocol architecture and broadcast systems
- The students analyze the various wireless protocol architectures.

Course Contents:

Wireless Transmission-Signal Propagation-Multiplexing and Modulation-Cellular Systems-Multiple Access Techniques. Evolution of mobile communication and radio systems – cellular concept – frequency reuse – channel assignment – co-channel interference – hand off –interference & system capacity. Telecommunication and basics of Satellite Systems. Broadcast Systems and Radio transmission concepts. Wireless ATM services and functions – Routing Protocols

Reference Books:

1. William Y.Lee "Cellular Mobile Communication, Analog And Digital" Tata McGrawHill, 1998.
2. Rappaport T.S "Wireless Communication" Pearson Education, 2003.
3. Jochen Schiller, "Mobile Communications", Addison Wesley Publishers, 2000.
4. Yi-Bing Lin and ImrichChlamtac, "Wireless and Mobile Network Architecture",John Wiley and Sons, New Delhi, 2nd Edition, 2001.
5. Feher K., "Wireless Digital Communications", Prentice Hall of India, New Delhi,1995.

14EC2039 MOBILE COMPUTING

Credits: 3:0:0

Prerequisite: 14EC2038 Cellular Mobile Communication

Course objective:

- To familiarise with various mobile standards and generation.

- To understand the basics concepts of 4G Networks
- To understand the basic concepts of 4G mobile application development.

Course outcome:

- The students are familiar with various mobile standards and generation.
- The students acquire knowledge on basics concepts of 4G Networks
- The students understand the basic concepts of 4G mobile application development.

Course Contents

Standards for Voice oriented Data Communication - Standards for Data and Voice Communication- Mobile Computing Architecture- Data dissimination- Mobility management-Walsh Codes-IS-95 CDMA One System-WCDMA 3G standards- CDMA2000 3G standards-OFDM-packet delivery and handover management-location management-registration-tunnelling and encapsulation-route optimization-Super 3G and Pre-4G-3GPP LTE and WiMax 802.16e standard-Features of 4G-LTE Advanced and Advanced WiMax 802.16m-Mobile Computing-Novel Applications-Limitations- Mobile application languages-XML and JAVA, mobile application development platforms.

References

1. Raj Kamal"Mobile Computing"Oxford University Press, Second edition,2012.
2. KumkumGarg" Mobile Computing- Theory and Practice", Pearson,2010.
3. William Y.Lee "Cellular Mobile Communication, Analog And Digital" Tata McGrawHill, 1998.
4. Rappaport T.S "Wireless Communication" Pearson Education, 2003.
5. Yi-Bing Lin and ImrichChlamtac, "Wireless and Mobile Network Architecture", John Wiley and Sons, New Delhi, 2nd Edition, 2001.

14EC2041 HIGH SPEED NETWORKS

Credits: 3:0:0

Course Objective:

- To gain knowledge on ATM and Frame relay.
- To acquire knowledge on the survey of developments in High Speed Networks.
- To understand the techniques involved to support real-time traffic and congestion control.

Course Outcome:

- The students gain knowledge on ATM and Frame relay.
- The students acquire knowledge on the survey of developments in High Speed Networks.
- The students understand the techniques involved to support real-time traffic and congestion control.

Course Contents:

Frame Relay Networks – Asynchronous transfer mode –Architecture, logical Connection, cell, service categories – High Speed LANs:Fast Ethernet, Gigabit Ethernet, Fibre Channel – Wireless LANs: applications, Architecture of 802.11- Queuing Analysis- Queuing Models – Single Server Queues –Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control- TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm –Performance of TCP over ATM– ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations - RSVP – goals, characteristics, data Flow, operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture.

References:

1. William Stallings, "High Speed Networks And Internet", Pearson Education, Second Edition, 2002.
2. Warland, PravinVaraiya, "High performance communication networks", Second Edition , Jean Harcourt Asia Pvt. Ltd., , 2001.
3. IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.

4. Abhijit S. Pandya, Ercan Sea, “ATM Technology for Broad Band TelecommunicationNetworks”, CRC Press, New York, 2004.
5. William Stallings, “ISDN and Broadband ISDN with Frame Relay and ATM”, Pearson Education, Fourth Edition, 1999.

14EC2042 ROUTING ALGORITHMS FOR WIRELESS MOBILE NETWORKS

Credits:3:0:0

Course objective:

- To understand the importance of routing algorithms.
- To analyze the various topology based routing algorithms.
- To design an efficient routing algorithm for a highly dynamic mobile environment.

Course outcome:

- The students understand the importance of routing algorithms.
- The students analyze the various topology based routing algorithms.
- The students design an efficient routing algorithm for a highly dynamic mobile environment.

Course Contents:

Introduction to routing in mobile networks- Routing strategies- Choices- types- Power aware routing metrices-Dominating set based routing- Geometric routing- Delaunay triangulation-Self organized routing-Tree based multicast routing protocol-Mesh based multicast routing protocol- Energy efficient multicasting-Routing in Hybrid Wireless Networks-Preferred ring based routing schemes for load balancing-Clustering-Performance metrics and analysis- Graphs-Subgraphs-topology- Planar graph- Directed graph- Critical transmission range- transmission range based topology-RNG-LMST- DLEDSR

References:

1. Ivan Stojmenovic”Hand book of Wireless Networks and Mobile Computing”, John Wiley & Sons,Inc.ISBN0-471-41902(Paper);0-471-22456-1(Electronic), 2002
2. Siva Ram Murthy. C and Manoj. B.S, “AdHoc Wireless Networks: Architectures and protocols”, Prentice Hall PTR, 2004
3. Miguel Labrador, Pedro Wightman“Topology Control in Wireless Sensor Networks-with a companion tool for teaching and research” Springer Science,ISBN:978-1-4020-9584-9.
4. SudipMisra, Issac Woungang, Subhas Chandra Misra”Guide to Wireless AdHoc Networks”,Springer Verlag London ltd,2009.
5. Iti Saha Misra, “Wireless Communications and Networks – 3G and Beyond”, Tata McGraw Hill, 2012.

14EC2043 ADVANCED DIGITAL COMMUNICATION SYSTEMS

Credits:3:0:0

Pre requisite: 14EC2021 Digital Communication

Course Objective:

- To understand the optimal synchronous receiver for different types of signals with error probability.
- To acquire knowledge on the various types of channels.
- To analyze the performance of various equalizers.

Course Outcomes

- The students understand the optimal synchronous receiver for different types of signals with error probability.
- The students acquire knowledge on the various types of channels.
- The students analyze the performance of various equalizers.

Course Contents:

Digital Baseband transmission- Optimal Synchronous receiver for binary and multilevel signals with error probability- Baseband transmission in basic access ISDN Systems-Optimal Asynchronous receiver-Communication Channel properties- baseband equivalent channel- Subscriber loop channel- line of sight radio channel- mobile radio channel- WLAN channel-HF Channel- Optical fibre Channel- Channel with ISI as a finite state machine- Linear equalizers- ZF equalizers- MSE equalizers- LS equalizers- Decision Feedback equalizer- Equalizers using MAP symbol by symbol detection – Maximum Likelihood equalizers- Turbo equalization- Blind Adaptive equalization- Equalizers for MIMO systems-PLL for continuous signals- PLL for sampled signals -Maximum likelihood carrier phase estimation- Timing synchronization.

Reference Books:

1. Krzysztof Wesolowski , "Introduction to Digital Communication Systems", John Wiley & Sons, Ltd, 2009(Reprint 2012).
2. Taub& Schilling, "Principles of Digital Communication", Tata McGraw-Hill" 28thReprint, 2003.
3. Bernard Sklar, "Digital Communication, Fundamental and Application" Pearson Education Asia, 2nd Edition,2001
4. Upmanynu Madhow," Fundamentals of Digital Communication", Cambridge University Press, 2009.
5. John.B.Anderson, "Digital Transmission Engineering", Wiley India Pvt. Ltd, 2012.

14EC2044 FUNDAMENTALS OF WIRELESS COMMUNICATION

Credits: 3:0:0

Course objective

- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods and Channel models.
- To enhance the understanding of various transceivers and its multiple access schemes.

Course outcome

- The students learn the concepts of wireless communication.
- The students acquire knowledge about the various propagation methods and Channel models.
- The students have an enhanced understanding of various transceivers and its multiple access schemes.

Course Contents

Review Of Wireless Systems: History Of Wireless Communications, Wireless Vision, Technical Issues, Current Wireless Systems, The Wireless Spectrum, Methods For Spectrum Allocation, Spectrum Allocations For Existing Systems, The Cellular Design Fundamentals. Path Loss, Shadowing And Capacity Of Wireless Channels: Free-Space Path Loss, Two-Ray Model, Simplified Path Loss, Shadow Fading, Path Loss And Shadowing, Outage Probability. Statistical Multipath Channel Models: Time-Varying Channel Impulse, Narrowband Fading Models,Level Crossing Rate And Average Fade Duration, Wideband Fading Models, Power Delay Profile, Coherence Bandwidth, Doppler Power Spectrum And Channel Coherence, Capacity Of Wireless Channels-Selective Fading Channels.

Reference Books

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2007.
2. William C Y Lee, "Mobile Communications Engineering, Theory and Applications", Second Edition, McGraw Hill International editions, 1998.
3. Theodore S Rappaport, "Wireless Communications", Pearson Education, Asia , New Delhi, Second Edition, 2002
4. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Prentice Hall, 2003.
5. Vijay.K.Garg," Wireless Communications and Networking", Elsevier-Morgan Kaufmann Publishers, Reprint 2013.

14EC2045 SPREAD SPECTRUM SYSTEMS

Credits 3:0:0

Course objectives

- To learn the various spread spectrum generation techniques and its synchronization.
- To generate various spreading sequences.
- To learn various spread spectrum systems.

Course outcome

- The students learn the various spread spectrum generation techniques and its synchronization.
- The students gain knowledge on the generation of various spreading sequence.
- The students learn various spread spectrum systems.

Course Contents

Equalization of digital data transmission system - Realization imperfections – Degradation- presence of pulse noise jamming - Low probability detection scheme - Direct Sequence Spread Spectrum (DSSS) - Frequency Hop Spread Spectrum Systems - examples -DSSS methods employing BPSK, QPSK and MSK - FHSS methods - Coherent SFHSS- Non coherent SFHSS and FFHSS techniques - Hybrid DS/FH spread spectrum - Complex envelope representation- PN sequence- Maximal length sequences - Gold codes - Rapid Acquisition systems - Non-linear code- Optimal tracking of wideband signals - Early-late tracking loops - Code tracking loops for FHSS - Optimum synchronization techniques - Multiple dwell and sequential detectors - Synchronization using a matched filter - Synchronization by estimating the received spreading code.

Reference books

1. Ziemer R E and Peterson R L, "Digital Communication and Spread Spectrum Systems", Macmillan Publishing Co., 1985.
2. Dixon R C, "Spread Spectrum Systems", Wiley Interscience, 1976.
3. Holms J K, "Coherent Spread Spectrum Systems", Wiley Interscience, 1982.
4. Upmanynu Madhow," Fundamentals of Digital Communication", Cambridge University Press, 2009.
5. John.B.Anderson, "Digital Transmission Engineering", Wiley India Pvt. Ltd, 2012.

14EC2046 OPTOELECTRONICS

Credits 3:0:0

Pre requisite: Engineering Physics

Course objectives

- To gain knowledge on the basics of solid state physics and understand the nature and characteristics.
- To gain knowledge on principle of optical detection mechanism, modulation techniques.
- To understand the optical switching and optoelectronic integrated circuits in transmitters and receivers.

Course outcome

- The students gain knowledge on the basics of solid state physics and understand the nature and characteristics.
- The students gain knowledge on principle of optical detection mechanism, modulation techniques.
- The students understand the optical switching and optoelectronic integrated circuits in transmitters and receivers.

Course Contents

Elements of Light and Solid State Physics-Display Devices and Lasers-terminologies and technical concepts-Optical Detection Devices- Photo Conductors – Performance-Optoelectronic Modulators-Optical Switching and Logic Devices-Optoelectronic Integrated Circuits- transmitters-Receivers and Guided wave devices.

Reference books

1. J. Wilson and J.Haukes, “Opto Electronics – An Introduction”, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Bhattacharya “Semiconductor Opto Electronic Devices”, Prentice Hall of India Pvt., Ltd., New Delhi, 1995.
3. Jasprit Singh, “Opto Electronics – As Introduction to materials and devices”, McGraw Hill International Edition, 1998.
4. John Gowar, “Optical Communication System”, PHI, 2002.
5. John. M.Senior,” Optical Fibre Communication”, Pearson Education Ltd, 2012.

14EC2047 SOLID-STATE MICROWAVE DEVICES

Credits:3:0:0

Course objectives

- To gain knowledge to apply EM wave equations to microwave systems and components.
- To design waveguide and micro strip transmission lines with given characteristics.
- To understand the operation principles of basic passive and active microwave devices.

Course outcome

- The students gained knowledge to apply EM wave equations to microwave systems and components.
- The students design waveguide and micro strip transmission lines with given characteristics.
- The students understand the operation principles of basic passive and active microwave devices.

Course Contents

Amplifiers - Microwave semiconductor devices and models; Power gain equations, stability, impedance matching, constant gain and noise figure circles; Small signal, low noise, high-power and broadband amplifier designs; Oscillators - One port, two port, YIG dielectric and Gunn-diode oscillators; Two terminal microwave devices and circuits;PIN diodes and uses as switches, phase shifters and limiters; Varactor diodes, IMPATT and TRAPATT devices, transferred electron devices; Microwave BJTs. GaAs FETs, low noise and power GaAs FETs and their applications. Microwave Mixers.

Reference books

1. S.Y. Liao, “Microwave Circuit Analysis and Amplifier Design”, Prentice Hall, 1987
2. G.D. Vendelin, A.M. Pavio, U.L. Rohde, “Microwave Circuit Design, Using Linear and Nonlinear Techniques Techniques”, John Wiley, 1990.
3. Y. Konishi, “Microwave Integrated Circuits”, Marcel Dekker, 1991.
4. Samuel.Y.Liao, “Microwave Devices and Circuits”, Prentice Hall of India Pvt Ltd., 3rd Edition, 5th Reprinting, 2000.
5. Collin. R.E, “Foundation of Microwave Engineering”, McGraw-Hill, II Edition, 1992.
6. Annapurna Das, Sisir K. Das, “Microwave Engineering”, Tata McGraw-Hill Co.,Ltd., 1st Edition, 1999. Reprint 2001.

14EC2048 FIBRE OPTIC COMMUNICATION

Credits: 3:0:0

Course objectives

- To learn optical laws, definitions, optical fibre structures and fabrication.
- To gain knowledge on signal degradation, power launching and coupling in optical fibres.
- To analyze on the various optical transmitters, receivers and optical links.

Course outcome

- The students acquire knowledge optical laws, definitions, optical fibre structures and fabrication.

- The students gain knowledge on signal degradation, power launching and coupling in optical fibres.
- The students analyze on the various optical transmitters, receivers and optical links.

Course Contents

Introduction to vector nature of light, propagation of light through cylindrical dielectric rod, Ray model, wave model-types of optical fibres-Modal analysis-Signal degradation - dispersion and attenuation. Fabrication - measurement techniques-OTDR.Sources - LEDs and Lasers-Detectors - pindetectors, detector responsivity, noise, optical receivers.;Optical link design - BER calculation, quantum limit, power panelities.;Optical switches - coupled mode analysis of directional couplers, electro-optic switches.;Nonlinear effects in fibre optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication. Optical amplifiers - EDFA, Raman amplifier, and WDM systems.

Reference Books

1. J.Keiser, Fibre Optic Communication McGraw-Hill, 2nd Ed. 1992.
2. J.E. Midwinter, Optical fibres for transmission, John Wiley, 1979.
3. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G.Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fibre optic Communication Systems, John Wiley and sons, 1992.

14EC2049 RADAR COMMUNICATION

Credits 3:0:0

Course objectives

- To understand the principles and techniques in Radar.
- To understand about the propagation of radio waves
- To understand the importance of radar communication in navigation.

Course outcome

- Students will understand the principles and techniques in Radar.
- Students will understand about the propagation of radio waves
- Students will understand the importance of radar communication in navigation.

Course Contents:

Basic Radar –Applications- Radar equation- Detection of Signals in Noise- Receiver Noise-Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations- MTI from a Moving Platform (AMIT) – Pulse Doppler Radar –Tracking –Types-Detection of Signals in Noise –Propagation -Refraction -Propagation -Nonstandard Propagation - The Radar Antennas –Types-Radar Transmitters –types-Radar Receivers - types-Navigation methods -Radio Direction Finding – types –Radio Ranges-Hyperbolic Systems of Navigation (Loran and Decca)

Reference books

1. Prof. A.K.Sen and Dr. A.B. Bhattacharya, “Radar Systems and Radio Aids To Navigation”, Khanna Publishers, 1992
2. J.C. Toomay, “ Principles Of Radar”, Prentice Hall Of India-2004.
3. Merrill I. Skolnik ," Introduction to Radar Systems", Tata McGraw-Hill (3rd Edition)2003.
4. N.S.Nagaraja, Elements of Electronic Navigation Systems, 2nd Edition, TMH, 2000.
5. Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004

14EC2050 BASICS OF SATELLITE COMMUNICATION

Credits 3:0:0

Course objectives

- To understand the function of spacecraft subsystems and its performance.
- To apply orbital mechanics formula and tools to spacecraft mission design.
- To understand launch systems and analyze their effect on satellite and payload design.

Course outcome

- The students understand the function of spacecraft subsystems and its performance.
- The students acquire knowledge to apply orbital mechanics formula and tools to spacecraft mission design.
- The students understand launch systems and analyze their effect on satellite and payload design.

Course Contents

Elements of orbital mechanics-Equations of motion- Tracking and orbit determination- Orbital correction/control-Satellite launch systems- Multistage rocket launchers and their performance- Elements of communication satellite design- Spacecraft subsystems-Reliability considerations-Spacecraft integration Multiple access techniques-FDMA,TDMA,CDMA- Random access techniques- Satellite on-board processing- Satellite link design: Performance requirements and standards- Design of satellite links – DOMSAT, INSAT, INTELSAT and INMARSAT. Satellite - based personal communication- Earth station design- Configuration- Antenna and tracking systems- Satellite broadcasting.

Reference books

1. D.Roddy, "Satellite Communication ",(4/e), McGraw- Hill, 2009.
2. T.Pratt&C.W.Bostain, "Satellite Communication", Wiley 2000.
3. Proakis, John, and MasoudSalehi, " Communication Systems Engineering",PHI, 2001..
4. Haykin, Simon. Communication Systems. 5th ed. New York, NY: Wiley, 2009.
5. B.N.Agrawal, "Design of Geosynchrons Spacecraft", Prentice- Hall,1986.

14EC2051 RF CIRCUIT DESIGN

Credits 3:0:0

Course objectives

- To design RF filters and amplifiers.
- To understand the configuration of high frequency oscillator.
- To analyze high frequency mixers and PLL.

Course outcome

- The students gain knowledge to design RF filters and amplifiers.
- The students understand the configuration of high frequency oscillator.
- The students understand and analyze high frequency mixers and PLL.

Course Contents

High frequency Resistors, Capacitor and Inductors – Transmission Line Analysis: Line equation, Micro strip line-Matching by Discrete Components - Design of two-component matching network, Design of T and π matching network- Matching by micro strip line - Design of matching network - Design of stub matching-**:** Components: RF Diode, RF Bipolar junction Transistor, RF field effect transistor - Modelling: Diode model, Transistor model, and FET model - Measurement of AC parameters of BJT and FET - Classes of operation and efficiency of Amplifiers - BJT biasing network - FET biasing networks.- Basic oscillator model - Design of fixed frequency oscillator - Dielectric resonator oscillator - voltage controlled oscillator - Gun element oscillator - Basic concepts - Design of single ended mixer- Double ended mixer.

Reference books

1. Reinhold Ludwig Pavel Bretchko, “RF Circuit Design” Pearson Education Asia Publication, New Delhi, 2001.
2. Matthew M. Radmanesh “Radio Frequency and Microwave Electronics illustrated”, Pearson Education Asia Publication, New Delhi, 2001.
3. Peter. P Kenington “High linearity RF Amplifier Design”, Artech House, Mumbai, 2002.
4. Joseph . J. Carr, “Secrets of RF Circuit Design”, McGraw Hill Publishers, Third Edition, 2000.
5. Ulrich L. Rohde and David P. NewKirk, “RF / Microwave Circuit Design”, John Wiley & Sons USA 2000.
6. Roland E. Best, “Phase - Locked Loops: Design, simulation and applications”, McGraw Hill Publishers 5th edition 2003.

14EC2052 ANTENNA DESIGN LAB

Credits:0:0:2

Co-Requisite: 14EC2081 Monolithic Microwave Integrated Circuits.

Objective:

- To design and analyze the characteristics of different antennae.
- To design and analyze micro strip lines.
- To understand and analyze the different types of MMICs.

Outcome:

- The students design and analyze the characteristics of different antennae.
- The students design and analyze micro strip lines.
- The students understand and analyze the different types of MMICs.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2053 ADVANCED WIRELESS LAB

Credits:0:0:2

Co-Requisite: 14EC2038 Cellular Mobile Communication.

Objective:

- To design various filters used in wireless communication
- To simulate various wireless environments and analyze its characteristics.

Outcome:

- The students understand and design filters used in wireless communication
- The students simulate various wireless environments and analyze its characteristics.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2054 BIO MEDICAL SIGNAL PROCESSING

Credits 3:0:0

Pre requisite: 14EC2014 Digital Signal processing

Course objectives

- To know the theoretical and practical aspects of Bio-medical signal processing
- To have a better idea about biomedical devices

- To get familiarized with the concept of wavelets and time frequency models

Course outcome

- Able to learn concepts like prediction techniques and filtering
- Able to understand adaptive signal processing and wavelets
- Apply their knowledge for ECG, EEG and EMG signal processing applications

Course Contents

Sources of bioelectric potential, resting & action potential, propagation of action potentials in nerves; ECG: Pre-processing, wave form recognition, automated diagnosis based on decision theory, EEG: Evoked responses, averaging techniques, pattern recognition in EEG waves, EMG: Wave pattern studies, biofeedback. application of signal processing techniques such as linear prediction, lattice - filtering & adaptive signal processing; introduction to wavelets & time frequency models and their applications to heart sounds, faetal ECG & vesicular sound signals; signal processing techniques for detection of pathologies in speech production system

Reference books

1. E.N. Bruce, Biomedical Signal Processing and Signal Modelling, John Wiley and Sons, 2001.
2. W. J. Tompkins, Biomedical Signal Processing; Prentice Hall, 1995.
3. M. Akay,Wavelets and Time frequency methods for Biomedical signal Processing; IEEE Press, 1995.
4. L. Rabinar, Digital Processing of speech signals; Prentice Hall, 1978.
5. A. C. Guyton,Human Physiology; Prism International, 1991.

14EC2055 ADAPTIVE SIGNAL PROCESSING

Credits:3:0:0

Course Objective:

- To know the theoretical and practical aspects of adaptive signal processing and learning algorithms
- To get the knowledge about the estimation theory, optimum filtering.
- To impart knowledge on linear adaptive signal processing, nonlinear adaptive signal processing, and Blind adaptive techniques.

Course Outcome:

- Able to get an idea about the Adaptive signal processing
- Apply their knowledge in radar, sonar, geophysics and communication (spread spectrum techniques) applications.
- Apply their knowledge in real time applications.

Course Contents

Linear and non-linear estimation theory. Signal modelling. Optimal filtering, Adaptive filtering as an extension of the optimal least mean square error case. Adaptive algorithms: Orthogonalized adaptive filters, Least squares adaptive filters, Blind adaptive filtering, adaptive equalization and echo cancellation, adaptive lattice filters.

Reference Books

1. S. Haykin, Adaptive filter theory, Prentice Hall, 2005.
2. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
3. Ali H. Sayed, Fundamentals of Adaptive Filtering, John Wiley, 2003.
4. D. Manolakis, V. Ingle, S. Kogan, Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing,McGraw Hill, 1999.
5. J. Triechler, C. Johnson, M. Larimore, Theory and Design of Adaptive Filters, Prentice-Hall, 1995.
6. P. Diniz, Kluwer, Adaptive Filtering: Algorithms and Practical Implementation, 1997.

14EC2056 WAVELET TECHNIQUES

Credits 3:0:0

Course objectives

- This course provide student a practical understanding of wavelet transforms
- The properties of wavelet transforms are well dealt with.
- Knowledge on the concept of multi resolution transforms are imparted

Course outcome

- Students can understand where Fourier transform fails and where Wavelet transform is preferable .
- Students can identify which wavelet transform is a suitable for a particular application.
- Students understand wavelet based analysis of multi scale phenomenon.

Course Contents

Continuous wavelets and short time Fourier Transform- Designing orthogonal wavelet systems- Discrete wavelets and relation to filter banks- Computing and plotting scaling and wavelet functions- Biorthogonal wavelets- Designing of wavelets using frequency domain approach- Wavelet packet analysis- M Band wavelets- Multi resolution transforms.

Reference books

1. K.P.Soman, K.I. Ramachandran and N.G. Resmi , "Insight Into Wavelets From Theory to Practice", PHI Learning Private Limited, 2011
2. Rao R.M and Bopardikar A.S., "Wavelet transforms : Introduction to theory and Applications", Pearson Education Asia, Pvt Ltd. 2000
3. Strang G. and Nguyen T., "Wavelet Filter Banks", WellesleyCamebridge Press, 1996
4. Mallet S., "Wavelet Signal Processing", Academic Press, 1999.
5. D. Manolakis, V. Ingle, S. Kogan, "Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing",McGraw Hill, 1999.

14EC2058 NEURAL NETWORKS AND FUZZY SYSTEMS

Credits: 3:0:0

Course objectives

- To impart knowledge on the fundamentals of Neural network
- To gain understanding about Fuzzy logic
- To get familiarized with the different architectures involved in neural networks

Course outcome

- Apply the concepts of neural network and fuzzy logic in practical applications
- Confidence to use the concept of neural networks in medical field.
- Ability to work in imaging based companies

Course Contents

Artificial neural network – Applications, architectures, Training, McCulloch-Pitt Neuron,Backpropogation neural network. Hebb Net, Perceptron, Adaline, Associative neural network. Maxnet, Mexican hat, Hamming net, KohonenSelf_Organizing Maps, Linear Vector Quantization, Counter propagation, Adaptive Resonance Theory. Fuzzy logic basics, Defuzzification methods, Rule based systems, Applications of Fuzzy logic

Reference books

1. Laurence Fausett, "Fundamentals of Neural Networks, Architecture, Algorithm and Applications", Prentice-Hall, Inc, 2004.
2. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", Mc.Graw Hill International Editions, 1997.
3. Phillip D. Wasserman, "Neural Computing theory and practice, Van Nostrand Reinhold", New York, 1989.

4. Jacek M. Zurada, “Introduction to Artificial Neural Networks”, Jaico Publishing House, 1997.
5. George J. Klir and Bo Yuan, ‘Fuzzy Sets and Fuzzy Logic – Theory and Applications’, Printice Hall of India, 2002.
6. Limin Fu, ‘Neural Networks in Computer Intelligence’, McGraw Hill, 1994.

14EC2059 OPTIMIZATION TECHNIQUES

Credits:3:0:0

Course Objective:

- To learn the fundamental Optimization techniques
- To get the knowledge about the convex optimization, Linear programming, unconstrained optimization and constrained optimization.
- To know about convergence, Line search

Course Outcome:

- Able to apply these techniques to solve optimization problems in real-time applications.
- Able to form novel Optimization algorithm.
- Able to analyse the pros and cons of existing algorithms.

Course Contents

Motivation. mathematical review , matrix factorizations, sets and sequences, convex sets and functions, linear programming and simplex method, Weierstrass' theorem, Karush Kuhn Tucker optimality conditions, algorithms, convergence, unconstrained optimization, Line search methods, method of multidimensional search, steepest descent methods, Newton's method, modifications to Newton's method , trust region methods, conjugate gradient methods, quasi-Newton's methods. constrained optimization, penalty and barrier function methods, augmented Lagrangian methods, polynomial time algorithm for linear programming, successive linear programming, successive quadratic programming- Ant colony & PSO techniques- Contourlet transforms

Reference Books:

1. R. Fletcher Practical Optimization (2nd Edition) John Wiley & Sons, New York, 1987.
2. M.S.Bazaraa ,H.D.Sherali and C.Shetty , Nonlinear Programming, Theory and Algorithms, John Wiley and Sons, New York, 1993.
3. S.S Rao.. Optimization: Theory and Practices, New Age Int. (P) Ltd. Publishers, New Delhi.
4. Chong, E.K.P.and Zak, S. H.. An Introduction to Optimization, John Wiley & Sons, N.Y.
5. Peressimi A.L., Sullivan F.E., Vhl, “J.J.Mathematics of Non-linear Programming”, Springer Verlag

14EC2060 MULTIMEDIA COMPRESSION TECHNIQUES

Credits:3:0:0

Prerequisite: 14EC2014 Digital Signal Processing & 14EC2021 Digital Communication

Course Objective:

- To understand the characterization of speech and image waveforms.
- To learn about the various compression techniques for text data, audio, image and video signals.
- To know about the speech and video coding standards.

Course Outcome:

- Understand the compression techniques
- Motivated to develop efficient algorithms for compression
- Able to use the knowledge gained in real time applications in the media industry

Course Contents:
Speech and Image waveform characterization - Source model; Quantization - optimal and adaptive quantization, vector quantization and structures for VQ; Predictive Coding - DPCM, Linear Prediction, prediction gain; Transform Coding - orthogonal transforms, Subband coding, bit allocation; Entropy Coding - Huffman, Run-length, Arithmetic and Lempel-Ziv coding; Speech and Video coding standards.

Reference Books:

1. Khalid Sayood, “Introduction to Data Compression”, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Solomon, “Data Compression, The complete reference”, Springer Verlag New York INC, 2nd edition 2001.
3. Peter Symes, “Digital Video Compression”, McGraw Hill Pub., 2004.
4. Mark Nelson, “Data compression”, BPB Publishers, New Delhi,1998.
5. Mark S.Drew, Ze-Nian Li, “Fundamentals of Multimedia” PHI, 1st Edition, 2003
6. Yun A Shi, Huifang Sun, “Image & Video compression for Multimedia Engineering, Fundamentals, Algorithms & Standards”, CRC Press, 2003

14EC2061 SOFT COMPUTING

Credits:3:0:0

Course Objective:
- To learn about Artificial neural networks and Fuzzy sytems.
- To impart knowledge on Neuro Fuzzy modeling
- Gaining understanding about Genetic Algorithm

Course Outcome:
- Knowledge on concepts of soft computational techniques.
- Able to apply soft computational techniques to solve various problems.
- Motivated to solve research oriented problems.

Course Contents:
Artificial Neural Networks-Basic concepts- Supervised neural networks – Unsupervised neural networks – Applications - Fuzzy Systems - Fuzzy sets-Fuzzy functions – Fuzzy rules - Fuzzy classification-Fuzzy control methods - Neuro-Fuzzy Modeling - Adaptive Neuro Fuzzy based inference systems – CART algorithm – Data clustering algorithms - Genetic Algorithm –Fundamentals – crossover operators - reproduction operators - simulated annealing- Random search- Downhill simplex search- Applications.

Reference Books:

1. Laurene Fausett,”Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Pearson Education India, 2006.
2. Timothy J Ross, “Fuzzy logic with Engineering Applications”, John Wiley and Sons, 2009.
3. S.Rajasekaran and G A VijayalakshmiPai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications”, Prentice Hall India, 2003.
4. Jang J.S.R., Sun C.T and Mizutani E, “Neuro Fuzzy and Soft Computing: A Computational Approach to Learning Machine Intelligence”, Prentice Hall, 1997.
5. Jacek M. Zurada, “Introduction to Artificial Neural Networks”, Jaico Publishing House, 1997.
6. George J. Klir and Bo Yuan, ‘Fuzzy Sets and Fuzzy Logic – Theory and Applications’, Printice Hall of India, 2002.

14EC2062 MACHINE LEARNING ALGORITHMS FOR IMAGE PROCESSING

Credits:3:0:0

Prerequisite: 14EC2014 Digital Signal processing

Course Objective:

- To learn the fundamental pattern recognition techniques for signal & image processing applications
- To gain understanding on different estimation techniques
- To get familiarized with the use of neural networks in pattern recognition.

Course outcome

Students are

- able to apply these techniques to solve recognition problems in real-time applications
- able to form novel pattern recognition algorithm.
- able to analyse the pros and cons of existing algorithms.

Course Contents

Overview of Pattern Recognition- Introduction to Statistical Pattern Recognition- Parametric &Non Parametric Approaches for Pattern Recognition- Maximum Likelihood Estimation- Bayesian Parameter Estimation- Nonparametric Estimation – Direct Estimation of Probabilities – Direct Classification using the Training Set– Nearest Neighbour Rule – NNR Approach- Linear Discriminant Functions – Fisher's Linear Discriminant- Linear Separability – Design of Linear Classifiers-Introduction to Support Vector Machines- Neural Network Structures for Pattern Recognition Applications – Neural Network Based Pattern Associator – Unsupervised Learning in Neural Pattern Recognition

Reference Books

1. Robert Schalkoff, "Pattern Recognition-Statistical, Structural and Neural Approaches", John Wiley & sons, Inc, New York, 2005.
2. Earl Gose, R.Johnsonbaugh and Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Limited, 1999.
3. Rojer Jang, T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice Hall of India Private Limited, 2003.
4. Duda, R. O., Hart, P. E., and Stork, D. G,"Pattern Classification", 2nd edition, John Wiley & Sons, NewYork,2001.
5. Tou and Gonzales,"Pattern Recognition Principles", Wesley Publication Company,London,1974.

14EC2063 SIGNAL PROCESSING LAB

Credits:0:0:2

Objective:

- To impart knowledge on the different algorithms used for the compression of images.
- To learn about the techniques used to enhance the quality of images
- To improve MATLAB programming skills

Outcome:

- Ability to analyze various compression and image processing techniques.
- Confidence to work in multi media companies
- Expected to use the knowledge gained in real time applications.

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2064 ADVANCED SIGNAL PROCESSING LAB

Credits:0:0:2

Objective:

- To learn about the various kinds of optimization techniques.
- To improve the knowledge on necessity of equalization and different techniques involved.
- Programming for digital systems

Outcome:

- The students will analyze various optimization techniques and equalization techniques.
- Better programming skills
- Motivated to work in core companies

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2065 INFORMATION THEORY AND CODING

Credits 3:0:0

Pre requisite: 14EC2021 Digital Communication

Course objectives

- To learn the basics of information theory
- To calculate channel capacity and other measures
- To apply the control specific coding methods to calculate the rate and error probabilities.

Course outcome

- The students understand the basics of information theory
- The student gain knowledge to calculate channel capacity and other measures
- The students analyze and apply specific coding methods calculate the rate and error probabilities.

Course Contents

Information-Entropy-Mutual information, entropy for discrete ensembles, Shannon's noiseless coding theorem, Encoding of discrete sources-.Markov sources; Shannon's noisy coding theorem and converse for discrete channels, Channel capacity and bounds for discrete channels- Algebraic Coding Theory-Fundamentals- Introduction to finite fields- construction of finite fields and its properties-Convolutional code generator functions-Distance properties and error bounds-soft input output decoding- Convolutional coding in Mobile applications-Turbo codes-LDPC codes-Product Codes-Concatenated Convolutional Codes- Space Time Codes-Spatial Channels-Orthogonal Space Time Block Codes-Spatial Multiplexing

Reference books

1. Andre Neubauer, Jurgen Freudenberger, Volker Kuhn, “Coding theory: Algorithms, Architectures and Applications” John Wiley & Sons Ltd, Reprint 2012.
2. Robert. H. Morelos- Zaragoza, “The Art of Error Correcting Coding”, Second Edition, John Wiley & Sons Ltd, Reprint 2013.
3. Tom Richardson, Rudiger Urbanke, “Modern Coding Theory” Cambridge University Press, 2009.
4. W. Cary Huffman and Vera Pless, “Fundamentals of Error Correcting Codes”, Cambridge University Press, Reprint 2007
5. Simon Haykins, “Digital Communications”, John Wiley, 1st edition, Reprinted, 2004.
6. N. Abramson, Information and Coding, McGraw Hill, 1963.

14EC2066 DIGITAL SYSTEM DESIGN

Credits3:0:0

Pre requisites: 14EC2001Digital Electronics

Course objective:

- Advanced digital system concepts are introduced.
- Various PLD's are discussed
- To learn about the different design methodologies involved in PLDs

Course outcome

- Good knowledge to design digital circuit.
- Architectures of various families of PLD's are learned
- Knowledge about different design tools involved in PLDs

Course Contents

Review of Combinational Logic Circuits: Shannon's expansion theorem- Sequential Logic Circuits: Mealy machine - Moore machine - State diagrams - State table minimization –State assignments - Design of synchronous and asynchronous sequential logic circuits working in the fundamental mode and pulse mode- Programmable Logic Devices-Programmable Logic Element (PLE),Programmable Logic Array (PLA), Programmable Array Logic (PAL), Design of state machine using Algorithmic State Machines (ASM) chart as a design tool- CPLDS - Structure of Complex PLD's (CPLD)-Design of combinational and sequential circuits using CPLD's.

Reference Books

1. Charles H.Roth, " Digital system Design with VHDL", Thomson, 1998
2. James E. Palmer, David E. Perlman, "Introduction to Digital Systems ", Tata McGraw Hill, 1996.
3. Robert Dueck ," Digital design with CPLD applications and VHDL ", Thomson ,2004
4. Bob Zeidman , "Designing with CPLDs and FPGAs ", CMP ,2002
5. Neil H. E. Weste,DavidHarrisayan Banerjee "Principles of CMOS VLSI Design : A Systems Perspective", Pearson Education India,2nd Edition ,2002.

14EC2067 VERILOG HDL

Credits3:0:0

Course objective:

- To learn various Verilog Programming Techniques.
- To understand different steps involved in Verilog Programming
- Knowledge about different types of modelling

Course outcome:

- Students will be able to write program using Verilog HDL
- Programming for combinational and sequential circuits
- Able to write program for real time applications

Course Contents

Design Methodology – Module – Ports – Basic concepts – Operators – Number specification –
Data types – Arrays – Parameters – Gate delays – Operator types – Conditional statements – Multi way branches - Loops - Switch – Modeling elements – Implementation of Basic circuit using
Dataflow & Behavioral Modeling- Component Assignments – Switch level modeling – Applications of all dataflow, behavioral and Structural modeling in FPGA – FSM Implementation – Test Benches

Reference Books

1. Samir Palnitkar, "Verilog HDL", Pearson Publication", II Edition. 2003.
2. M.D. Ciletti, "Advanced Digital Design with the VERILOG HDL" PHI.2008

3. I.Bhaskar, "A VHDL Synthesis Primer", BS Publications,III edition,2004.
4. Essentials of VLSI Circuits and Systems, K. Eshraghian Kamran PHI of India Ltd.,2008
5. Principles of CMOS VLSI Design : A Systems Perspective, Neil H. E. Weste,DavidHarrisayan Banerjee ,Pearson Education India,2nd Edition ,2002.
6. SadiqM.Sait, Habib Youssef, "VLSI Physical Design Automation", World Scientific Publishing,1998

14EC2068 VHDL

Credits3:0:0

Course objective:

- To learn various VHDL modeling
- To familiarize with operator overloading
- To have an understanding about generics and modelling delays

Course outcome:

- Students will be able to write program using VHDL
- Programming for combinational and sequential circuits
- Able to write program for real time applications

Course Contents

Design flow process –Software tools – Data objects - Data types – Data operators – Entities and Architectures Concurrent signal assignment – conditional signal assignment - selected signal assignment - concurrent and sequential statements – Data flow, Behavioral Modeling. Structural Modeling Component declaration and instantiation.– Test bench – Examples – CPU- Traffic light controller Functions – Procedures – Packages – Libraries – Attributes – Operator Overloading – Generics – Modeling Delays

Reference Books

1. J. Bhaskar, "A VHDL Synthesis Primer", BS Publications, III Edition, 2008.
2. Douglas Perry, "VHDL", 3rd Edition, McGraw Hill 2001.
3. K. Eshraghian Kamran ,Essentials of VLSI Circuits and Systems, PHI of India Ltd.,2008
4. Neil H. E. Weste,DavidHarrisayan Banerjee ,Principles of CMOS VLSI Design :A Systems Perspective, ,Pearson Education India,2nd Edition ,2002.
5. SadiqM.Sait, Habib Youssef, "VLSI Physical Design Automation", World Scientific Publishing,1998

14EC2069 VLSI DESIGN

Credits 3:0:0

Course objective:

- The purpose of this course is to give an exposure to VLSI Design Process.
- To get familiarized with Layout Design and stick diagrams.
- To understand the CMOS logic Design styles

Course outcome

- Understand the MOS Transistor under static condition.
- Design various CMOS logic Styles**.**
- Use the knowledge gained in designing for practical applications

Course Contents

VLSI Design Process- Layout Styles – Full Custom Design-Semi Custom
Approaches: Gate array design style-Standard cell design style-Overview of wafer fabrication (NMOS,CMOS)-MOS Transistor Structure-MOS Transistor under static condition and Second order Effects-Small signal AC Characteristics-Stick Diagrams - Design Rules & layout (NMOS ,CMOS) – CMOS logic styles.

Reference Books

1. K. Eshraghian Kamran “Essentials of VLSI Circuits and Systems”, PHI of India Ltd.,2008
2. Neil H. E. Weste,DavidHarrisayan Banerjee “Principles of CMOS VLSI Design : A Systems Perspective”, Pearson Education India,2nd Edition ,2002.
3. SadiqM.Sait, Habib Youssef, “VLSI Physical Design Automation”, World Scientific Publishing,1998
4. N.A. Sherwari, “Algorithms for VLSI Physical Design Automation”, John Wiley, 2003.
5. Jan.M.Rabaey, AnanthaChandraKasan and BorivojeNikolic, **“**Digital Integrated Circuits –A Design Perspective”, Pearson Education, 2nd Edition 2003.

14EC2070 ASIC DESIGN

Credits3:0:0

Course objective:

- To study different types of programmable ASICs
- To know about ASIC interconnects
- To gain understanding on then Physical design of ASICs.

Course outcome

- Knowledge in the complete design flow of ASICs
- Ability to appreciate the necessity of ASICs
- Confidence in using ASICs for real time applications

Course Contents

Types of ASICS-Design Flow - Logical Effort-Programmable ASIC: Antifuse-Static RAM-EPROM and EEPROM-Programmable ASIC Logic Cells: Actel 123-Xilinx XC 4000 –Altera MAX 5000/7000- Xilinx I/O Block-Programmable ASIC Interconnect: Actel ACT – Xilinx LCA – Xilinx EPLD –Altera FLEX-EDIF – Logic synthesis – Half gate ASIC – Schematic entry.

Reference Books

1. M.J.S.Smith, “Application Specific Integrated Circuits”, Addison, Wesly Longman Inc., 2006.
2. S.D. Brown R.J. Francis, J.Rox, Z.G. Urumesic, “Field Programmable Gate Arrays”,Kluwer Academic Publishers, 2007
3. Principles of CMOS VLSI Design : A Systems Perspective, Neil H. E. Weste,David Harrisayan Banerjee, Pearson Education India,2nd Edition ,2002.
4. SadiqM.Sait, Habib Youssef, “VLSI Physical Design Automation”, World Scientific Publishing,1998
5. G.D.Micheli, “Synthesis and optimization of Digital circuits”, Tata McGraw Hill, 2004.

14EC2071 VLSI SUBSYSTEM DESIGN

Credits3:0:0

Course objective:

- To know the design challenges and guidelines for digital circuit design
- To understand the design of complex digital circuits.
- To understand control logic implementation of PLA and ROM

Course outcome

- Have the knowledge of Circuit and System view together
- Design complex and high performance, low power digital circuits.
- Familiar with structured and clocking strategies

Course Contents

Design Strategies- Structured Strategies- Design Methods- Basic of Digital Circuits- Data path Operations- Binary Adders and Subtractors- Carry Look Ahead - Various Multipliers: Array, Wallace Tree, Serial multipliers - Parity Generators- Comparators – Clocking Strategies- Two Phase and Four Phase Clocking- Binary Synchronous and Asynchronous Counters - Shifters- Memory Elements: Memory Core- Memory Peripheral Circuit- RAM-ROM-CAM-Serial Access Memory- Control: FSM Design Procedure- Control Logic Implementation- PLA,ROM Control Implementation

Reference Books

1. Wayne Wolf,"Modern VLSI Design System On Chip" Pearson Education,2002.
2. Jan.M.Rabaey, AnanthaChandraKasan and BorivojeNikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education, 2007.
3. Neil H.E. Weste, KamranEshraghian , "Principles of VLSI Design -A Ciruits and Systems Perspective", Pearson Education India, 2nd Edition, 2002.
4. Kamran Eshraghian, Douglas A.Pucknell, SholehEshraghian, "Essentials of VLSI Circuits and Systems", Eastern Economy Prentice Hall of India, New Delhi, 2005.
5. John.P.Uyemura,"Introduction to VLSI Circuit Systems",John Wiley & Sons Inc.2002.

14EC2072 ANALYSIS AND DESIGN OF DIGITAL IC

Credits3:0:0

Course objective:

- To study the basic concepts of MOS transistor
- To study about the different delay models
- To know various circuit design processes and design any Combinational Logic Circuits or Sequential Logic Circuits.

Course outcome

- To design circuits using different CMOS styles
- To do analysis on CMOS structures.
- Understand the characteristics of CMOS devices

Course Contents

Physical Structure of MOS Transistors-MOS Transistor Switches- Resistance Estimation- CMOS Inverter-DC Characteristics- Switching Characteristics: Analytic Delay Models-Empirical Delay Models-Gate Delays-CMOS Gate Transistor sizing-Static CMOS Design: Complementary CMOS-Ratioed Logic-Pass-Transistor Logic-Dynamic CMOS Design: Dynamic Logic-Domino Logic-np-CMOS- Designing Sequential Logic Design :Static Latches and Registers –Dynamic Latches and Registers

Reference Books

1. Kang ,Leblebigi "CMOS Digital IC Circuit Analysis & Design", McGraw Hill, 2003.
2. Jan.M.Rabaey, AnanthaChandrakasan, BorivojeNikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education, 2nd Edition 2003.
3. Neil H E West and Kamran Eshranghian, "Principles of CMOS VLSI Design : A System Perspective", Addison Wesley, 2nd edition, 2002
4. AnanthaChadrasekaran and Robert Broderson, "Low Power CMOS Design", Standard Publishers, 2000.
5. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, "CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson edition, Second Indian reprint, 2003

14EC2073 LOW POWER TECHNIQUES IN VLSI DESIGN

Credits3:0:0

Course objective:

- To study the concepts on different levels of power estimation
- To learn the fundamentals of optimization techniques
- To have an idea about Low Voltage Circuit Design Techniques

Course outcome

- Knowledge in low power techniques
- To design chips with less power consumption and high performance circuits.
- To understand the problems associated with micrometer device design

Course Contents

Introduction- Gate Level Logic Simulation- Architectural Level Analysis- Circuit and logic level power optimization techniques- Special Techniques-Architecture and system- Leakage Current in Deep Sub-Micrometer Transistors- Deep Sub- Micrometer Device Design Issues-Low Voltage Circuit Design Techniques-- SRAM Architecture- Energy Recovery Circuit Design.

Reference Books

1. Gary yeap, "Practical Low Power Digital VLSI Design", Kluwer academic publishers, 2001.
2. Kaushik Roy, Sharatprasad, "Low Power CMOS VLSI Circuit Design", John Wiley & Sons Inc., 2000.
3. AnanthaChadrasekaran and Robert Broderson, "Low Power CMOS Design", Standard Publishers, 2000.
4. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, "CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson edition, Second Indian reprint, 2003
5. Kang ,Leblebigi "CMOS Digital IC Circuit Analysis & Design", McGraw Hill, 2003.
6. Jan.M.Rabaey, AnanthaChandrakasan, BorivojeNikolic, "Digital Integrated Circuits – A Design Perspective", Pearson Education, 2nd Edition 2003.

14EC2074 VLSI FABRICATION TECHNIQUES

Credits3:0:0

Course objective:

- Knowledge about device fabrication process of BJT and MOSFET along with their different device technologies.
- Knowledge about ECL and I2L circuits
- Familiar with BiCMOS technology

Course outcome

- Students are expected to design VLSI circuits following technological constraints
- Expected to solve problems associated with etching and diffusion
- Gain confidence to work with cutting edge technologies like that of MESFET

Course Contents

Introduction :Introduction to VLSI fabrication-BJT and CMOS Fabrication Process a Brief Overview -Clean Room and Safety Requirements- Silicon CrystalGrowth, Epitaxy – VPE and MBE.Oxidation and Diffusion:Oxidation:Silicon Dioxide Growth for Thick and Thin Films: Solid State Diffusion Modelling and Technology - Diffusion Systems - Ion Implantation Modeling and Technology – Damage Annealing – Masking during Implantation.Lithography and Etching: Basic Process Explaining Lithography – Positive and Negative Resist and their Comparison –Light Sources. Optical Lithography- X-ray Lithography – E-beam Lithography. Wet Chemical Etching- Dry Etching, Plasma Etching System. Deposition Techniques: Physical Vapor Deposition – Thermal Evaporation and Sputtering – Metallization, Chemical Vapor Deposition Techniques: CVD Techniques for Deposition of Polysilicon, Silicon Dioxide, Silicon Nitride.Integrated Device Fabrication: BJT fabrication – Isolation techniques; Junction Isolation, LOCOS, Trench Isolation – Realization of ECL and I2L Circuits. MOSFET fabrication – CMOS Fabrication – Latch-up in CMOS – Bi-CMOS Technology – MESFET Technology, VLSI Assembly And Packaging.

Reference Books

1. S. A. Campbell, “The Science and Engineering of Microelectronic Fabrication” 2nd Edition, Oxford University Press, 2001.
2. G. S. May and S. M. Sze, “ Fundamentals of Semiconductor Fabrication”, John Wiley Inc., 2004.
3. C.Y. Chang and S.M.Sze (Ed), “ULSI Technology”, McGraw Hill Companies Inc, 1996.
4. S.M. Sze (Ed), “VLSI Technology”, 2nd Edition, McGraw Hill, 1988.
5. S.K. Ghandhi, “VLSI Fabrication Principles”, 2nd Edition, John Wiley Inc., Newyork reprint 2004.

14EC2075 NANO ELECTRONICS

Credits 3:0:0

Course objective

- To impart knowledge about the basic concepts of Nano electronic devices
- To recognize the necessity of Carbon Nanotubes in electronics

Course outcome

- The students will understand the concepts of nano regime such as coloumb blockade , electron tunnelling and the necessity of Nanodevices
- They will know the domains in which nanodevices play a major role and are inevitable
- They would be able to widen their knowledge about spintronic devices

Course Contents

Introduction, CMOS Scaling, limits to scaling, system integration limits (interconnect issues etc.), The nanoscale MOSFET, Vertical MOSFETs, Resonant Tunneling Transistors, Single electron transistors, Optoelectronic, and Spintronic devices, Molecular electronics involving single molecules as electronic devices, transport in molecular structures, molecular systems as alternatives to conventional electronics, molecular interconnects, Carbon nanotube electronics, bandstructure& transport, devices, applications.

Reference Books

1. Karl Goser, Peter Glosekotter, Jan Dienstuhl., “Nanoelectronics and Nanosystems” , Springer, 2004
2. C.P. Poole Jr., F.J. Owens ,”Introduction to Nanotechnology,” ,Wiley (2003).
3. Waser Ranier,”Nanoelectronics and Information Technology (Advanced Electronic Materials and Novel Devices), WaserRanier,Wiley-VCH (2003).
4. K.E. Drexler ,Nanosystems, , Wiley (1992)
5. John H. Davies,The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

14EC2076 VHDL LAB

Credits 0:0:2

Co-Requisite: 14EC2068 VHDL

Objective:

- To learn various VHDL modeling
- To familiarize with operator overloading
- To have an understanding about generics and modelling delays

Outcome:

- Able to write VHDL Program for combinational and sequential circuits.
- Ability to write VHDL programs for real time applications
- Confidence to design real time projects

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2077 VERILOG LAB

Credits 0:0:2

Co-Requisite: 14EC2067 Verilog HDL

Objective:
- To learn various Verilog Programming Techniques.
- To understand different steps involved in Verilog Programming
- Knowledge about different types of modelling

Outcome:
- The student will be able to write Verilog Program for combinational and sequential circuits.
- Ability to write Verilog programs for real time applications
- Confidence to work in core companies

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2078 IC DESIGN LAB

Credits 0:0:2

Co-Requisite: 14EC2070 ASIC Design

Objective:
- To study different types of programmable ASICs
- To know about ASIC interconnects
- To gain understanding on the Physical design of ASICs.

Outcome:
- The student will be able to design a system using CAD tools for ASIC.
- Knowledge in the complete design flow of ASICs
- Confidence in using ASICs for real time applications

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2079 MICROPROCESSORS AND MICROCONTROLLERS

Credits 3:1:0

Course Objective:
- To learn the basic 8085 Microprocessor architecture, working and programming.
- To understand the operation of 8051 Microcontroller.
- To accumulate the knowledge about PIC Microcontroller.

Course Outcome
- Knowledge about the processing of microcontroller and microprocessor.
- Able to use it for real time applications.

- Clear idea about PIC Microcontroller.

Course Contents

Functional Block of 8085 Microprocessor – Timing and control signals- Instruction set –Assembly language programs –Timing Diagram – Architecture of 8051 Microcontroller – Instruction cycle- Instruction fetching and execution. Instruction set and programming. I/O, Timer, Interrupt and serial programming– Interrupt priority in 8051 - 8051 interfacing to external memory – 8051 interfacing with different external devices and Motors.

Reference Books

1. Krishna Kant,” Microprocessors and Microcontrollers: Architecture, Programming and System Design 8085, 8086, 8051, 8096”, PHI Learning Pvt Ltd, New Delhi, 1st Edition, 2010.
2. Myke Predko,” Programming customizing the 8051 Microcontroller”, Tata McGraw Hill Publications, New Delhi, 1st Edition 2007.
3. Crisp, “Introduction to Microprocessors and Microcontrollers”, Elsevier/ Reed Elsevier India Pvt. Ltd, New Delhi, 2nd Edition, 2009.
4. Kenneth J. Ayala, “8051 Microcontroller”, Cengage Learning, New Delhi, 3rd Edition, 2004.
5. Mazidi and D.MacKinlay, “8051 Microcontroller and Embedded Systems using Assembly and C”, Pearson Education Low Price Edition, New Delhi, 2006.

14EC2080 COMMUNICATION ENGINEERING

Credits 3:0:0

Course Objective

- Learn the basic principles, concepts and types of communication systems.
- Understand the various design issues in a communication system.
- Gain knowledge about communication medium and television.

Course Outcome

- Analyze and design basic communication systems, particularly with application to noise free analog and digital communications.
- Apply concepts and techniques from circuit analysis to communication systems.
- Develop the ability to compare and contrast the strengths and weaknesses of various communication methods.

Course Contents

Analog Modulation - Principle of Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM), AM and FM transmitters and receivers, AM and FM modulators and demodulators , Effects of noise in AM and FM systems.Digital Communication Systems - PAM, PPM, PDM, PCM, Delta modulation, Digital modulation and demodulation systems, Modem functions. Data Transmission - Twisted pair and coaxial cables, Fiber optics, Sources and detectors, Error detection and correction, Multiplexing, TDM and FDM, Applications of communication systems . Scanning process – Television Transmitter & Receiver – Camera – Introduction to LCD and LED televisions.

Reference books

1. Anokh Singh, “Principles of Communication Engineering”, S. Chand & Company, New Delhi, 5th Edition, 2010.
2. Wayne Tomasi, “Electronic Communication Systems: Fundamentals Through Advanced”, Pearson Education, Arizona, 5th Edition 2012.
3. William Schweber, “Electronic Communication Systems - A Complete Course”, Prentice Hall International, New Jersey, 4th Edition, 2002.
4. Kennedy G, “Electronic Communication Systems”, Tata McGraw-Hill Education India Private Limited, New Delhi, 4th Edition, 2011.
5. Simon Haykins, “Communication Systems”, John Wiley & Sons, New Jersey, 5th Edition, 2009.
6. Bruce Carlson. A, “Communication Systems”, Tata McGraw- Hill Education India Private Limited, New Delhi, 5th Edition, 2009.

14EC2081 MONOLITHIC MICROWAVE INTEGRATED CIRCUITS

Credits 3:0:0

Prerequisite: 14EC2022 Microwave and Optical Communication.

Course objectives

- To study the different technologies of microwave integrated circuits.
- To analyze the micro strip line.
- To design and fabricate different lumped elements and non-reciprocal components.

Course outcome

- To study the different technologies of microwave integrated circuits.
- To analyze the micro strip line.
- To design and fabricate different lumped elements and nonreciprocal components.

Course Contents

Introduction to microwave integrated circuits: Active and passive components. Analysis of microstrip lines: variational method, conformal transformation, numerical analysis; losses in microstrip lines; Slot line and Coupled lines; Design of power dividers and combiners, directional couplers, hybrid couplers, filters.;Microstrip lines on ferrite and garnet substrates; Isolators and circulators; Lumped elements in MICs.;Technology of MICs: Monolithic and hybrid substrates; thin and thick film technologies, computer aided design.

Reference books

1. Leo Young and H. Sobol, Ed. Advances in Microwaves, Vol.2, Academic Press Inc., 1974.
2. B.Bhatand ,"Stripline-like transmission lines for MICs", John Wiley, 1989.
3. T.K. Ishii, "Handbook of Microwave Technology", vol. I, Academic Press, 1995.
4. Annapurna Das, Sisir K. Das-"Microwave Engineering"– Tata McGraw-Hill,2000.
5. Gupta,K.C, and Amarjit singh – "Microwave Integrated Circuits" – John Wileyand sons – Wiley Eastern Reprint, 1978.
6. I. Hoffmann, R.K – "Handbook of Microwave Integrated Circuits" – Artec House, 1987.

14EC2082 SEMICONDUCTOR DEVICE MODELLING

Credits3:0:0

Course objective:

- To learn the physics behind the semiconductor devices and study the various models.
- To understand the BJT, MOSFET and other semiconductor devices from the device perspective.
- To be familiarized with MOSFET analysis models

Course outcome:

- Clear understanding of semiconductor devices helps the students in learning the advanced semiconductor devices
- The students are able to analyse various device designs
- Able to understand the blockheads while modelling nano scale devices

Course Contents

Semiconductor Physics Semiconductor Materials and Structures- Band Structures – Electron-Hole Statistics – Carrier Mobility and Conductivity– Carrier Diffusion– Avalanche Multiplication - P-N Junction Theory – Built-In Potential – P-N Electrostatics –Current-Voltage Relation In P-N Junction – Diffusion Capacitance – Diode Equivalent Circuit – Breakdown Voltage – Junction Curvature Effect – Transient Behavior **BJT Device Analysis -** BJT Current- Voltage Relation – Current Gain – Band Gap Narrowing – Auger Recombination – Early Effect – Punch-Through In BJT – Breakdown Voltage In BJT – Small Signal Equivalent Circuit – Cut-Off Frequency – Switching Behavior. **MOSFET analysis models –** large and small signal characteristics - MOSFET SPICE model level 1,2,3 and 4.

Reference Books
1. S. M. Sze, “Semiconductor Devices: Pioneering Papers”, World Scientific PublishingCompany, 2004.
2. D. P. Foty, “MOSFET Modeling with SPICE, Principles and Practices”, Prentice HallPTR, 1997.
3. H. C. deGraff and F. M. Klaassen, “Compact Transistor Modelling for Circuit Design”,Springer-VerlogWein, New York, 1990.
4. E. Getreu, “Modeling the Bipolar Transistor”, Elsevier Scientific Publishing Company,1978.
5. P.E. Gray et al., “Physical Electronics and Circuit Models for Transistors”, John Wiley &Sons, 1964.

14EC2083 VERIFICATION OF VLSI CIRCUITS

Credits3:0:0

Course objective:
- To understand the difference between verification and testing.
- To know about verification tools and plan.
- To learn about architecting test benches.

Course outcome
- Students are able to know the difference between verification and testing
- Students are capable of writing test benches to verify circuits**.**
- The students have an idea about self checking test benches and reusable verification components

Course Contents

Functional Verification Approaches-Testing Versus Verification- Verification and Design Reuse - Linting Tools- Simulators-Third Party Models-Waveform Viewers-Code Coverage-Issue- Tracking Metrics - Verification plan- Levels of Verification-Verification Strategies –Specification Features – Test cases -Test Benches - Simple Stimulus-Output Verification –Self Checking Test Benches Reusable Verification Components – VHDL and Verilog Implementation

Reference Books
1. Janick Bergeron, “Writing Test Benches Functional Verification of HDL Models” Springer 2nd Edition Feb 2003.
2. Andreas Meyer, “Principles of Functional Verification” Newnes , Oct 2003.
3. Amir Palnitkar, “Design Verification with e” Prentice Hall 1st Edition ,2003.
4. D. P. Foty, “MOSFET Modeling with SPICE, Principles and Practices”, Prentice HallPTR, 1997
5. N.A. Sherwari, “Algorithms for VLSI Physical Design Automation”, John Wiley, 2003.

14EC2084 DESIGN OF ANALOG CMOS IC

Credits 3:0:0

Course objective:
- To learn about various types of analog systems-
- To understand the concepts of CMOS amplifiers and Filters
- To be familiar with Digital to Analog Converters and Analog to Digital Converters.

Course outcome
- Students will be able to understand the concepts of analog design.
- Able to design various analog systems
- Understand the drawbacks of analog systems

Course Contents

Switches- active resistors- current source and sink - Amplifiers: Differential Amplifiers- Cascode Amplifiers- Current Amplifiers-Output Amplifiers- Low pass filters - High pass filters – Band Pass filters – Analog Systems: Digital-to- Analog Converters- Analog-To Digital Converters.

Reference Books

1. Philip E. Allen, Douglas R. Halberg, “CMOS Analog Circuit Design”, OxfordUniversity Press, 2nd Edition, 2003.
2. RandallL.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques forAnalog and Digital Circuits”, McGraw Hill International Co, 1990.
3. YannisTsividis, “Mixed Analog – Digital VLSI Device and Technology” Worldscientific publishing Co. Pvt. Ltd., 2002
4. Neil H. E. Weste,DavidHarrisayan Banerjee ,”Principles of CMOS VLSI Design : A Systems Perspective”, ,Pearson Education India,2nd Edition ,2002.
5. SadiqM.Sait, Habib Youssef, “VLSI Physical Design Automation”, World Scientific Publishing,1998

14EC2085 CAD FOR VLSI DESIGN

Credits3:0:0

Course objective:

- To provide knowledge about CAD Algorithm, placement and routing.
- Understanding of simulation based algorithms
- To gain knowledge on synthesis and MCMs.

Course outcome:

- Acquire knowledge of CAD Algorithm, placement, routing ,simulation ,synthesis and MCMs is expected.
- Design VLSI devices using CAD.
- Understand the simulation based algorithms

Course Contents

Role of CAD tools in the VLSI Design process - Data Structures-Complexity Issues- Graph algorithms, Genetic algorithm- Simulated Annealing - Event driven, Switch level and Circuit simulation - CAD algorithms - logic synthesis - Technology independent and dependent logic optimization - Partitioning -KL, FM algorithms- Placement – Simulation based algorithms-Partitioning based algorithms - Floor planning - Global routing – Grid routing - detailed routing –over the cell routing.

Reference Books

1. N.A. Sherwari, “Algorithms for VLSI Physical Design Automation”, John Wiley, 2003.
2. S.MSait,H.Youssef, “VLSI Physical Design Automation”,World scientific, 1999.
3. Sabih. H. Gerez “Algorithms for VLSI Design Automation” John Wiley & Sons, 2004.
4. G.D.Micheli, “Synthesis and optimization of Digital circuits”, Tata McGraw Hill, 2004.
5. D. P. Foty, “MOSFET Modeling with SPICE, Principles and Practices”, Prentice HallPTR, 1997

14EC2086 TESTING OF VLSI CIRCUITS

Credits3:0:0

Course objective:

- To understand the methods of testing combinational and sequential circuits.
- To know about various fault simulation techniques.
- To understand the difference between DFT and BIST

Course outcome

- Students have the knowledge to test any VLSI circuits
- Students are able to decide which testing method to be applied for a given circuit to be tested.
- They gain confidence to work in the testing sector of core companies

Course Contents
Motivation for testing - Fault models - Test generation algorithms for combinational logic circuits - Functional testing –Fault model based testing- Time frame expansion – Fault simulation techniques - Key testability concepts – Ad Hoc design for Testability – scan based design - Signature analysis - Compression techniques-Built-in self-test – Architectures.

Reference Books

1. Vishwani D. Agarwal "Essential of Electronic testing for digital, memory and mixed signal circuits", Springer, 2000
2. Abramovici .M, Breuer .M.A. and Friedman .A.D, "Digital Systems Testing and Testable Design", Wiley, 1994.
3. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Englewood Cliffs, 1998.
4. ParagK.Lala, "Digital circuit testing and testability", Academic press, 1997.
5. S.M. Sze (Ed), "VLSI Technology", 2nd Edition, McGraw Hill, 1988

14EC2087 MICRO ELECTRO MECHANICAL SYSTEMS

Credits3:0:0

Course objective
- To create awareness about the concepts of MEMS and Microsystems .
- To highlight the necessity of Micro fabrication and Micro machining.
- To provide an insight into the operation of cutting edge MEMS devices.

Course outcome
- The students will understand the necessity of MEMS in thrust areas like sensors&actuators
- They will know the Materials used in Microsystems and the devices in nano electronics.

Course Contents
Historical Background –Engineering Science for Microsystems -Design and Fabrications-Materials for MEMS: Silicon& its compounds, Quartz, -Microfabrication and Micromachining: Bulk Micromachining Surface - Micromachining Microsensors: inertial, thermal, optical, chemical and biological Microactuators:Electrostatic, thermal - 3-D electromagnetic actuators and sensors, RF/ Electronics devices, Optical/ Photonic devices, Medical devices

Reference Books

1. Tai-Ran Hsu, "MEMS & Microsystems Design & Manufacture", Tata McGraw Hill,2002
2. Stephen D. Senturia, "Microsystem Design" by, Kluwer Academic Publishers, 2001.
3. Marc Madou,Fundamentals of Microfabrication by, CRC Press, 1997.Gregory Kovacs, Micromachined Transducers Sourcebook WCB McGraw-Hill, Boston, 1998.
4. M.-H. Bao, Micromechanical Transducers: Pressure sensors, accelrometers, and gyroscopes by Elsevier, New York, 2000
5. John H. Davies, "The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998

14EC2088 MICROPROCESSOR AND MICROCONTROLLER LAB

Credits: 0:0:2

Corequisite: 14EC2079 Microprocessors and Microcontrollers

Course Objective
- Will enable the students to understand the programming techniques of Microprocessor and Microcontrollers.
- Able to design suitable control application using microcontrollers.

Description
This laboratory demonstrates the operation of microprocessor and microcontrollers. The software development using microprocessor and microcontroller will be done.

Course Outcome
- Student will be able to design hardware and software requirements for an application using Microprocessor/Microcontroller.

Experiments
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC2090 FUNDAMENTALS OF ELECTRONICS

Credits: 3:0:0

Objective:
- To impart the basic knowledge about the passive components.
- To know about the fundamentals of electronics and some electronic devices.
- To get the knowledge about the various analog communication techniques.

Outcome:
- Students get an overview about the basics of electronics,
- Student get an overview about the semiconductor, integrated circuits
- Able to get an idea about the communication and some applications in communication

Course Description:
Introduction to Semiconductor - semiconductor devices: diode, transistor, FET, MOSFET, UJT- basic op-amp applications- Integrated circuits - transistor as an amplifier and a switch – oscillator principles - Digital System – Semiconductor memory – Microprocessor - transducers – signal conditioning unit – telemetry circuits – virtual instrumentation– Measuring instruments – communication system - Introduction to Noise – modulation & demodulation techniques – antenna principle – radio receiver & transmitter Satellite communication – Fibre optics – Micro and Nano electronics.

Reference Books:

1. Robert Boylestad, "Electronic Devices & Circuit Theory", Sixth Edition, PHI, 1998
2. Albert Paul Malvino, Donald P Leach, "Digital Principles and Applications", Tata McGraw Hill, IV Edition, 1991.
3. Roody & Coolen, "Electronic Communication", PHI, 1995
4. W.D. Cooper, A.D. Helfrick, "Electronic Instrumentation and Measurement Techniques", 3rd Edition.
5. V.K.Metha."Principles of Electronics",Chand Publications,2008.
6. Anokh Singh, "Principles of Communication Engineering" S.Chand Co., 2001
7. Muthusubramanian R, Salivahanan S, Muraleedharan Ka , "Basic Electrical Electronics & Computer Engineering "Tata Mc.Graw Hill, 2005.
8. Nanoelectronics and Nanosystems: From transistors to Molecular and Quantum Devices by K. Goser (Edition, 2004), Springer. London.

14EC2091 ELECTRON DEVICES AND INSTRUMENTATION

Credits: 3:0:0

Objective:
- To understand the mechanisms of current flow in semi-conductors.
- To understand the diode operation and switching characteristics
- To know about the measuring and analysis techniques.

Outcome:

- Student will be familiarized with the principle of operation, capabilities and limitation of various electronic devices.
- Students can able to design practical circuits and to analyze various components with the instruments.
- Gives better idea to design own electronics projects for general applications

Course Description:

Intrinsic And Extrinsic Semiconductors - Theory of PN Diodes - Open circuit junction – Forward And Reverse Characteristics - Diode Equation- Applications: Half wave rectifier, full wave rectifier, Bridge rectifier - Hall Effect - Theory of FET, UJT and Thyristor - Special Semiconductor Devices – LED – LCD – optocouplers – Gunn diodes - Varactor diode – Transducers - Digital Instruments - Digital Voltmeters and Multimeters, - Data Display and Recording System - Computer Controlled Test System - Microprocessor based measurements.

Reference Books:

1. Millman & Halkias, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2007.
2. Malvino A P, "Electronic Principles", , McGraw Hill International, 7th Edition 2006
3. Rangan C.S., "Instrumentation Devices and Systems", Tata McGraw Hill, Second Edition, 1998.
4. W.D. Cooper, A.D. Helfrick, "Electronic Instrumentation and Measurement Techniques", 3rd Edition.
5. Robert Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 9th Pearson Education Edition, 2009
6. Muthusubramanian R, Salivahanan S, Muraleedharan Ka , "Basic Electrical Electronics & Computer Engineering "Tata Mc.Graw Hill, 2005

14EC2092 ELECTRON DEVICES AND INSTRUMENTATION LAB

Credits: 0:0:2

Objective:

- To learn practically about different Electron Devices and its operation.
- To learn about the Instrument handling and its analysis
- To learn the simulation of various electronics circuits

Outcome:

- Students will be able to understand the device characteristics and help them to develop experimental skills.
- Students will be able to do various analyses with electronic instrumentations.
- They can able to simulate and analysis the various circuit by using PSPICE

Experiments

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3001 STATISTICAL DIGITAL SIGNAL PROCESSING

Credits 3:0:0

Course Objective:

- To learn the concepts of signal processing and analyze the statistical properties of signals.
- To estimate the spectrum using Parametric and Non Parametric methods.
- To design filter / Linear Predictor for Communication Systems.

Course outcome

Upon completion of the course, student will be able to

- Generate the various special types of random processes in communication receivers.
- Estimate / Evaluate the Power Spectrum.

- Design a Filter / Predictor in signal processing.

Course Contents

Discrete Random Processes- Energy- Power Spectral Density - Parseval's Theorem –Wiener Khintchine Relation-– Periodogram-Sum Decomposition Theorem-Discrete Random Signal Processing using linear system-Parametric and Non-Parametric Spectrum Estimation Methods -Wiener, Kalman Filtering, Levinson-Durban Algorithms Least Square Method, Adaptive Filtering, Non-stationary Signal Analysis, Wigner-Ville Distribution, Multirate Signal Processing- Single and multistage realization - Poly phase realization-Wavelet Analysis

References

1. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Reprint, 2008.
2. John G.Proakis, DimitrisG.Manolakis, "Digital Signal Processing", Prentice Hall of India, 4th Edition, 2007.
3. P.P Vaithyanathan, "Multirate systems and filter Banks", Prentice Hall of India, 1993.
4. Emmanuel C. Ifeacher and Barrie W. Jervis, "Digital Signal Processing – A Practical Approach", Wesley Longman Ltd., 2nd Edition, 2004
5. PetreStoica and Randolph Moses, ``Spectral Analysis of Signals``, Prentice Hall, 2005.
6. S. Haykin, Adaptive filter theory, Prentice Hall, 2005
7. B. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

14EC3002 ADVANCED EMBEDDED SYSTEMS

Credits 3:0:0

Course Objective:

- To study the overview of Embedded System Architecture
- To focus on distributed Embedded Architecture and its accessing protocols
- To understand about the design methodologies in hardware and software design.

Course Outcome:

Upon completion of the course, student will be able to

- Construct embedded system hardware
- Develop software programs to control embedded system
- Outline validation and testing methodologies for embedded system

Course Contents:

Embedded systems overview- processor technology -automation-synthesis-verification. Processing elements - single and general purpose processor design, Programme's view and development environment – ASIPs -- Memory – types, hierarchy, caches, advanced RAM. Interfacing - I/O addressing, interrupts, DMA-Arbitration- multilevel bus architectures- protocols- Standard single purpose processor's peripherals. Design and development of latest Embedded systems using Embedded C.

References:

1. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/Software Introduction, Third edition, John Wiley & sons, 2010
2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2008.
3. Jonathan.W.Valvano, Embedded Microcomputer systems: Real Time Interfacing, Third edition, cengage learning, 2012
4. Santanuchattopadhyay, Embedded system Design, PHI Learning Pvt. Ltd., 2010
5. Steave Heath, Embedded system Design, Second edition, 2003
6. Daniel D. Gajski, Samar. Abdi, Andreas. Gerstlauer Embedded system design: Modeling, synthesis and verification", Springer, 2009

14EC3003 COMPUTATIONAL INTELLIGENCE AND OPTIMIZATION TECHNIQUES

Credits 3:0:0

Course Objective:

- To learn the key aspects of Neural networks
- To know the components of Fuzzy logic and Genetic algorithm
- To gain insight on Neuro Fuzzy modeling and support vector machines

Course Outcome:

Students will be able to:

- Implement machine learning through Neural networks and support vector machines
- Develop a Fuzzy expert system.
- Use Genetic Algorithm to solve the optimization problem

Course contents:

Evolution of Computing - Genetic algorithm – basics, optimization problems, Applications.Supervised Learning Neural Networks –Unsupervised Learning Neural Networks – Adaptive Resonance Architectures – Advances in NeuralNetworks.Fuzzy logic basics - Fuzzy Inference Systems –Fuzzy Decision Making. Neuro-fuzzy modeling-Adaptive Neuro-Fuzzy Inference Systems –Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification –Case Studies

References:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
2. George J. Klir and Bo Yuan, “fuzzy sets and fuzzy logic-theory and applications”, prentice hall,1995.
3. James A. Freeman and David M. Skapura, “Neural networks algorithms, applications, andprogramming techniques”, Pearson Edn., 2003.
4. David E.goldberg, “Genetic algorithms in search, optimization and machine learning”, Addison Wesley, 2007.
5. Mitchell Melanie, “An introduction to genetic algorithm”, Prentice Hall, 1998.
6. S.N.Sivanandam, S.N.Deepa, “Introduction To Genetic Algorithms”, Springer, 2007.
7. E. Sanchez, T. Shibata, and l. A. Zadeh, Eds., "Genetic Algorithms and Fuzzy logic systems: Softcomputing perspectives, advances in fuzzy systems - applications and theory", vol. 7, River edge,World scientific, 1997.

14EC3004 HARDWARE DESCRIPTION LANGUAGES

Credits 3:0:0

Course Objective

- HDL programming is fundamental for VLSI design and hence this course is given.
- To know about the various modeling techniques in VHDL and Verilog.
- To learn the advanced programming techniques and transistor level modeling in VHDL and Verilog HDL
- To get familiar with various synthesis Techniques.

Course Outcome

The student will be able to

- Write programs in VHDL and Verilog HDL for modeling digital electronic circuits.
- Will be able to verify the circuit using Test bench .
- Will be able to synthesis the circuit after programming for implementation .
- Knowledge in synthesizing circuits using HDL

Course Contents :
Basic Concepts-VHDL-Operators- Data types- Number specification- System tasks and compiler directives- Modules and ports- Gate-level Modeling, Dataflow Modeling- Behavioral Modeling-example for each modeling – test bench-.Tasks and Functions-example-useful modeling techniques-Timing and delays-Switch level modeling- user defined primitives- -Basic Concepts: Verilog-Data Objects- Data Types, Operators- Concurrent and Sequential Assignment Statements- Different Styles of Modeling- Simple Examples-test bench- -Procedure and functions – examples - packages - Generic constants and statements - examples. Component and configuration-Introduction to synthesis - Verilog synthesis-modeling tips for Verilog logic synthesis-combinational and Sequential logic synthesis using VHDL- VHDL modeling restrictions..

References

1. Samir Palnitkar,"Verilog HDL", Pearson education, 2004.
2. Peter J.Ashenden, "The designer guide to VHDL", Morgan Kaufmann Publishers In; 3rd Revised edition edition , 2006
3. Douglas L. Perry, "VHDL Programming by Example", TATA McGRAW-HILL Edition, 2002.
4. Joseph Cavanagh, "Verilog HDL, Digital Design and Modeling", 2007.
5. Thomas &Moorby's, "The Verilog Hardware Description Language, Fifth Edition", 2008.
6. Bhasker, "A Verilog HDL primer", Star Galaxy Publishing, 2005.

14EC3005 ADVANCED DIGITAL IMAGE PROCESSING

Credits 3:0:0

Objectives:

- To understand the image fundamentals and mathematical transforms necessary for image processing
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion**.**

Outcomes:

Upon completion of the course, student will be able

- To apply image processing techniques in both the spatial and frequency (Fourier) domains.
- To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
- To conduct independent study and analysis of feature extraction techniques.

Course Content:

Fundamentals, 2D image transforms, Image enhancement in spatial and frequency domain, Morphological image processing. Edge, Active contour, Texture, Model, Atlas and Wavelet based Segmentation. Localized feature extraction, shape, boundary, Moments and Texture descriptors. Registration – basics, Transformation functions-resampling. Image fusion – pixel, Multiresolution and region based fusion.3D image visualization - 3D Data sets, Volumetric display, Stereo Viewing, Ray tracing, Image processing in 3D, Measurements on 3D images.

References:

1. John C.Russ, "The Image Processing Handbook", CRC Press,2007.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 2008.
3. ArdeshirGoshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications",John Wiley and Sons,2005.
4. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, Inc., Second Edition, 2004.
5. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education,Inc., 2002.
6. Rick S.Blum, Zheng Liu,"Multisensor image fusion and its Applications",Taylor& Francis,2006.

14EC3007 WIRELESS AND OPTICAL NETWORKS

Credits 3:0:0

Course Objectives:

- To understand the fundamentals of wireless networks.
- To learn the concepts of optical networks.
- To give adequate exposure to the emerging technologies and their potential impact.

Course Outcomes:

Upon completion of the course, student will be able to

- Design the 4G and LTE networks.
- Design broadband fiber optic networks.
- Design Hybrid wireless – optical networks

Course Contents:

Access Technologies : Hybrid fiber coax, Cable Modem, WLAN, IEEE 802.11, WiMAX / 802.16, Optical Access Networks,Overview of 3G, 3GPP Network, 4G technologies, Software defined radio, Cognitive radio, IMS architecture, ABWAS, MVNO, LTE, Internetworking. Session Mobility, Internetworking architecture for WLAN and GPRS, LMDS, MMDS. PON Architectures- Protocols and Scheduling Algorithms, Hybrid Optical–Wireless Access Network Architecture, Radio Over fiber architectures.

References:

1. KavehPahlavan and Prashant Krishnamurthy, "Principle of Wireless network- A Unified Approach", Prentice Hall, 2006.
2. Clint Smith and Daniel Collins, "3G Wireless Networks", Tata Mcgraw Hill, 2nd Edition, 2007.
3. Vijay K. Garg, "Wireless Communication and Networking", Elsevier, 2007.
4. Moray Rumney, "LTE and the Evolution to 4G Wireless Design and Measurement Challenges", Agilent Technologies, 2009.
5. Leonid G. Kazovsky, Ning Cheng, Wei-Tao Shaw, David Gutierrez, Shing-Wa Wong, "Broadband Optical Access Networks", John Wiley and Sons, New Jersey, 2011.
6. Uyless D. Black," Optical Networks: Third Generation Transport Systems", Prentice Hall PTR, 2007.

14EC3008 VLSI DESIGN TECHNIQUES

Credits 3:0:0

Objectives:

- To understand the concepts of MOS transistors operations and their AC, DC characteristics.
- To know the fabrication process of CMOS technology and its layout design rules
- To know the concepts of power estimation and delay calculations in CMOS circuits.

Outcomes:

- To design CMOS based circuits
- To design layout for CMOS fabrication
- To design and simulate a VLSI system

Course Contents:

MOS transistor theory, MOS models and small signal AC characteristics. CMOS technologie and Layout design rules, Latch up in CMOS circuits, CMOS process enhancements, CAD issues, Fabrication and packaging. NMOS and CMOS Inverters, Transmission gates, Static CMOS design, dynamic CMOS design. Circuit characterization and performance estimation. VLSI system components - circuits and system level physical design, Basics of CMOS testing

References:

1. Neil H.E. Weste and Kamran Eshraghian, Principles of CMOS VLSI Design,Pearson Education ASIA, 2nd edition, 2000.
2. John P.Uyemura "Introduction to VLSI Circuits and Systems", John Wiley & Sons, Inc.,2002.
3. Eugene D.Fabricius, "Introduction to VLSI Design" McGraw Hill International Edition,1991
4. W.Wolf,Modern VLSI Design- System on chip design,3rd edition,Pearson publication,2004

14EC3009 HDL LAB

Co-Requisite: 14EC3004 Hardware Description Languages

Credits 0:0:1

Course Objective

- To design and analyze the performance of Digital systems
- To be able to design any digital circuit using Verilog and VHDL
- To know about the Xilinx software tools.

Course Outcome

Upon completion of the course, student will able to

- To design and analyze the performance of Digital systems
- To design any digital circuit using Verilog and VHDL
- Have expertise in the Xilinx software tools.

Experiments

The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3010 DATACOMPRESSION TECHNIQUES

Credits 3:0:0

Objectives:

- To explore the special features and representations of different data types.
- To analyze different compression techniques for text data and audio signals
- To analyze various compression techniques for image and video signals

Outcomes:

- Identify the various compression techniques in text and audio.
- The ability to apply various compression techniques in image and video compression.
- The ability to apply above knowledge and skills to compression techniques.

Course Content :

Introduction Special features of Multimedia, Storage requirements for multimedia applications, Lossy& Lossless compression techniques, vector quantization, LBZ algorithm, Text Compression Compression techniques, Arithmetic coding, Shannon- Fanon coding - LZW family algorithms, Audio Compression Audio compression techniques, Wavelet based compression, Video Compression Video compression techniques and standards, Motion estimation and compensation techniques.

References

1. Khalid Sayood, Introduction to Data Compression, Morgan Kauffman Harcourt India, 2005.
2. David Salomon, Data Compression – The Complete Reference, Springer Verlang, 2006.
3. Yun Q.Shi and Huifang Sun, Image and Video Compression for Multimedia Engineering –Fundamentals, Algorithms & Standards, CRC press, 2003.

4. Peter Symes, Digital Video Compression, McGraw Hill Publication, 2004.
5. Mark Nelson, Data Compression, BPB Publishers, 2000.
6. Mark S.Drew and Ze-Nian Li, Fundamentals of Multimedia, PHI, 2009

14EC3011 OPTICAL NETWORKS AND PHOTONIC SWITCHING

Credits 3:0:0

Course Objective

- To learn various components of optical networks.
- To understand various generation and broadcast optical networks.
- To study the importance of Photonic Packet Switching

Course outcome

Upon completion of the course, student will able to

- Understand the components of optical networks
- Know various generation of broadcast optical Networks.
- Acquire knowledge on Photonic Packet Swiching

Course Contents

Network evolution and optical system components Optical network architecture – SONET/SDH, MAN layered, Broadcast and select network – MAC protocol – test beds. Wavelength routing network – test beds Photonic packet switching and access network Network design, control and management.

References

1. Rajiv Ramaswamy& Kumar N.Sivarajan, "Optical Networks: A practical perspective", Harcourt Asia Private Limited, Singapore, 2nd edition 2004.
2. D.W.Smith, Ed., “Optical Network Technology”, Chapman and Hall, London, 1995.
3. Biswanath Mukherjee, "Optical Communication Networks", McGraw-Hill, 1997.
4. P.E.Green Jr, “Fiber optic network”, Prentice Hall, NJ 1993.

14EC3012 MODERN DIGITAL COMMUNICATION TECHNIQUES

Credits 3:0:0

Course Objective

- To understand the basics of signal-space analysis.
- To understand the coherent and non-coherent receivers and its impact on different channel characteristics.
- To understand the equalization techniques and orthogonal frequency division multiplexing.

Course outcome

After completion of the course, the students are able to

- Understand the concepts of signal space analysis.
- Understand coherent and non-coherent receivers
- Appreciate different equalization techniques and comprehend the generation of OFDM signals and processing the signals

Course Contents

Review of Baseband modulation, Baseband detection – signals and noise, Detection of binary signals in Gaussian noise, ISI, Equalization, Review of Bandpass modulation, Detection of signals in Gaussian noise, coherent detection, non-coherent detection, error performance for binary systems, M-arysignaling and performance, Optimum detection and estimation, noise vector in signal space, optimum M-ary receiver design, matched filter configuration, OFDM – generation and signal processing.

References

1. Bernard Sklar., “Digital Communications”, Pearson Education, second edition, 2001.
2. John G. Proakis., “Digital Communication”, McGraw Hill Publication, 4th edition, 2001
3. Stephen G. Wilson., “Digital Modulation and Coding”, Pearson Education, First Indian Reprint, 2003.
4. Simon Haykin, “ Digital Communications”, John Wiley, 2006.
5. M.K.Simon, S.M.Hinedi and W.C. Lindsey, Digital Communication Techniques; Signalling and detection, Prentice Hall India, NewDelhi, 1999.
6. Richard Van Nee &Ramjee Prasad., “OFDM for multimedia communications”, Artech House Publication, 2001.
7. Theodore S. Rappaport, “Wireless Communications”, Pearson Education, 2nd edition, 2002.

14EC3013 WIRELESS COMMUNICATION NETWORKS

Credits 3:0:0

Course Objective

- To introduce the concepts of wireless communication.
- To make the students to know the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in Wireless Communciation.
- To enhance the understanding of Wireless Networks.

Course outcome

Upon Completion of the course, student will able to

- Understand the concepts of wireless communication.
- Apply knowledge of propagation methods and channel models to improve the system performance.
- Acquire the knowledge on Wireless Networks

Course Contents

Wireless channel propagation and model , Propagation of EM signals in wireless channel – reflection, diffraction and scattering-small scale fading- channel classification- channel models –distributions, link power budget analysis, diversity schemes, MIMO Communications-Narrowband MIMO model, parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO diversity gain:beamforming, diversity-multiplexing trade-offs, space time modulation and coding spatial multiplexing and blast architectures. SDMA, hybrid techniques, random access: Scheduling, power control, uplink downlink channel capacity, wireless networks 3G overview, migration path to UMTS, UMTS basics, air interface, 3GPP network architecture,4g features and challenges, technology path, IMSarchitecture - introduction to wireless LAN - IEEE 802.11 WLAN - physical layer- MAC sublayer.

References

1. W. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. Harry R. Anderson, “Fixed Broadband Wireless System Design” John Wiley – India, 2003.
3. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.
4. Simon Haykin& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
5. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill,2007.
7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007

14EC3014 ADVANCED RADIATION SYSTEMS

Credits 3:0:0

Course Objective

- To learn the fundamental parameters of antenna radiation and its significance in antenna design for specific applications
- To study different types of antenna and its design methodology.
- To understand various Numerical methods in antenna simulation.

Course outcome

Upon completion of the course, student will able to

- Apply various numerical techniques for analysis of different antennas.
- Evaluate the desired parameters for application specific antenna design.
- Design and simulate any type of antenna using simulation software tools. Ex. FEKO.

Course Contents

Review of antenna theory, dipoles, monopole and loop antennas, linear and planar arrays, array synthesis, phased arrays, helical antennas, radiation from apertures, aperture distribution, horn and parabolic dish antennas, Yagi - Uda and log-periodic antennas, microstrip antennas and arrays, Dielectric Antennas-Method of Moments.

References

1. J.D. Krauss, “Antennas”, McGraw Hill, 2005.
2. Balanis, “Antenna Theory - Analysis and Design”, John Wiley, 1982.
3. R.E. Collin, “Antennas and Radio Wave Propagation”, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, “Antenna Engineering Handbook”, McGraw Hill, 1984.
5. Ramesh Garg, I. Bahl, Apisak Ittipiboon and P. Bhartia, “Microstrip Antenna Design Handbook”, Artech house,2001
6. Hubregt.J.Visser, “Antenna Theory and applications”, John Wiley & Sons Ltd, Newyork, 2012.

14EC3015 SATELLITE COMMUNICATION

Credits 3:0:0

Course Objective

- To learn about the science and parameters behind the orbiting satellites.
- To study various multiplexing schemes and earth station parameters used for satellite communication.
- To understand the orbital concepts in navigational systems.

Course outcome

Upon completion of the course, the students are able to

- Analyse different navigational services
- Apply various remote sensing concepts for Safety of Life Services
- Evaluate the performance of any satellite networks.

Course Contents

Orbital parameters-GEO, LEO & MEO orbits. Frequency selection-Attitude and orientation control- Spin stabilisation techniques-Space craft configuration-Subsystems-Satellite uplink -down link. Power Budget- - Noise-Propagation factors- Rain and ice effects- Polarization calculations. Modulation and Multiplexing-Spread spectrum-Earth station parameters-location- propagation effects of ground. INTELSAT Series-INSAT- VSAT-Application: GSM, GPS, DTH and Video conferencing.

References

1. Dennis Rody," Satellite Communication", McGraw Hill, 2006.
2. Bruce R. Elbert, "The Satellite Communication Applications Hand Book” Artech House Boston,1997
3. Louis. J. Ippolito Jr." Satellite Communication Systems Engineering", John Wiley Publications, 2008.
4. Tri T.Ha,"Digital Satellite Communication",2nd Edition, McGraw Hill,New york.1990.
5. K.Feher,”Digital Communication Satellite / Earth Station Engineering”, Prentice Hall Inc, New Jersey,1983

14EC3016 ERROR CONTROL CODING

Credits 3:0:0

Course Objective

- To know the mathematics behind the coding algorithms.
- To learn about various error control codes.
- To study the error control parameters in communication.

Course outcome

Upon completion of the course, the students are able to

- Understand the vector mathematics behind the error control coding techniques.
- Understand different types of error control code like life cyclic redundancy codes and convolution codes.
- Analyze the error control parameters and evolve new methods for specific application to improve performance.

Course Contents

Vector Algebra - Galois Filed Arithmetic- BCH Codes- Decoding- implementation of error correction-Binary and Non binary BCH and Reed-Solomon Codes- Burst error correcting codes- Fire code interleaved codes- phased burst error correcting codes interleaved codes- phased burst error correcting codes- Convolutional codes-Decoding of convolutional- Application of Viterbi decoding-Turbo codes.

References

1. Shu Lin & D.J. Costello - "Error Control Coding", 2nd edition ,PHI, 2004.
2. Shu Lin "Application of error control", 1974
3. Simon Haykin, "Digital Communication", John Wiley and Sons, 1988
4. Bernard Sklar, Digital Communications, fundamentals and Applications, Pearson Education, 2001

14EC3017 COMMUNICATION LAB-I

Co-Requisite : 14EC3011 Optical Networks and Photonic Switching
14EC3012 Modern Digital Communication Techniques

Credits 0:0:2

Course Objective

- To study and experiment different signaling techniques in communication system using OTDR and various mobile communication standards.
- To demonstrate modern digital communication techniques.

Course outcome

Upon Completion of the course, student will able to

- Understand the different signaling techniques in communication concepts and use it appropriately.
- Analyze and apply a systematic design approach to communication projects and also have good research inspiration.

Experiments:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3018 COMMUNICATION LAB-II

Co-Requisite : 14EC3013 Wireless Communication Networks
14EC3014 Advanced Radiation Systems

Credits 0:0:2

Course Objective

- To design, simulate and understand different types of antenna using EM Solvers.
- Involve students in studies of communication network and its performance through network simulation

Course outcome

Upon Completion of the course, student will able to

- Design and simulate antenna of given specification.
- Construct and analyze communication networks through network simulation tools

Experiments:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3019 DIGITAL SYSTEM AND ASIC DESIGN

Credits 3:0:0

Course Objective

- To know about designing of combinational and sequential circuits.
- To Know about architecture of different FPGAs and PLDs.
- To know about different ASIC design techniques **.**

Course outcome

- Students will be able to design digital circuits.
- Will get familiarized with different ASIC design Techniques.
- Will get knowledge of different FPGA Architectures

Course Contents

Design of combinational circuits, Design of static hazard free and dynamic hazard free logic circuits, Mealy machine, Moore machine, Design of synchronous and asynchronous sequential logic circuits. Basic concepts, Programming technologies, Design of combinational and sequential circuits using PLDs, ASM Chart.Types of ASICs – Design flow – Programmable ASICs - Programmable ASIC Logic Cells –Programmable ASIC I/O blocks - Programmble ASIC Interconnect -Design systems – Logic synthesis – Half gate ASIC – Schematic entry – PLA tools – EDIF – CFI design representation. Structure Complex PLD's (CPLD). Design of combinational and sequential circuits using CPLD's, , Introduction to Field Programmable Gate Arrays - Introduction to Actel ACT2 family, Xilinx SPARTAN, VIRTEX FPGA.

References

1. Palmer, J.E., Perlman, D.E., "Introduction to Digital Systems",Tata McGraw Hill, New Delhi, Reprint 1996.
2. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "Digital Logic Circuit Analysis and Design", PrenticeHall International, Inc., New Jersey, 1995.
3. Robert K Dueck, “Digital Design with CPLD applications and VHDL”, Thomson Asia, 2002.
4. Michael John Sebastian Smith "Application specific integrated circuits." Addison, Wesly Longman Inc., 2006.

14EC3020 CMOS VLSI DESIGN

Credits 3:0:0

Course Objective

- To study the basics involved in the design of VLSI circuits.
- To learn about stick diagrams and Layouts.
- To learn the concepts in CMOS Design Styles.

Course outcome

- Students will be able to understand CMOS processing technology, basic CMOS circuits, characteristics and performance.
- Students will be able to draw stick diagram and layout based on the design rules.
- Designing of combinational and sequential circuits in CMOS.

Course Contents

MOS Transistor- MOS Transistor under static conditions-Threshold voltage- Resistive operation-saturation region -Channel length modulation-velocity saturation-Hot carrier effect-drain current Vs voltage charts - sub threshold conduction - equivalent resistance-MOS structure capacitance-Design logic gates using CMOS devices-Stick Diagram. Static CMOS inverter-Evaluating the Robustness of CMOS Inverter. Performance of CMOS inverter: Dynamic behavior-Computing the capacitance propagation delay sizing inverter for performance- Static CMOS design-Complementary CMOS - static properties- complementary CMOS design- Ratioed logic-DC VSL - Pass transistor logic - Differential pass transistor logic -Sizing of level restorer-Sizing in pass transistor-Dynamic CMOS design-Basic principles - Domino logic optimization of Domino logic-NPCMOS-logic style selection -Designing logic for reduced supply voltages-CMOS sequential logic design- CMOS subsystem design.

References

1. Jan.M.Rabaey.,AnithaChandrakasan, Borivoje Nikolic, "Digital Integrated Circuits", Second Edition, 2003.
2. Neil H.E Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Addition Wesley, 1998.
3. Sung-Mo Kang, Yusuf Leblebici, “CMOS Digital IC- Analysis and Design”, 3rd Edition, Tata McGraw Hill publication, 2003.
4. Kiran Kumar V. G, Nagesh H. R, “Fundamentals of CMOS VLSI Design”, Pearson, 2011.
5. Neil H. E. Weste, David Harris, Ayan Banerjee, “CMOS VLSI Design, A circuit and systems Perspective”, 3rd Edition, 2011.

14EC3021 ANALYSIS AND DESIGN OF ANALOG INTEGRATED CIRCUITS

Prerequisite: 14EC3020 CMOS VLSI Design

Credits 3:0:0

Course Objective:

- To study single stage amplifier with different loads.
- To study the frequency response and noise analysis
- To study OP-amn, stability and its frequency compensation

Course outcome :

- Students will gain knowledge in designing of single stage amplifiers and differential pair amplifiers.
- Students will apply the concepts of stability and frequency compensation in op-amps.
- Students will be able to design various analog circuits.

Course Contents :
Single stage amplifiers- Common source stage- Source follower-Common gate stage-Cascode stage, Single ended and differential operation, Basic differential pair- Differential pair with MOS loads- Passive and active current mirrors-Frequency response and noise analysis- Feedback topologies- Effect of loading in feedback networks-Operational amplifiers-Stability and frequency Compensation- Bandgap references.

References

1. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2001
2. Willey M.C. Sansen, "Analog design essentials", Springer, 2006.
3. Grebene, "Bipolar and MOS Analog Integrated circuit design", John Wiley &sons,Inc., 2003.
4. Phillip E.Allen, DouglasR.Holberg, "CMOS Analog Circuit Design", Second edition, Oxford University Press, 2002
5. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Fourth Edition, Wiley Student Edition, 2009.

14EC3022 VLSI TECHNOLOGY

Credits 3:0:0

Course Objective
- To study the manufacturing concepts of VLSI devices.
- To build a chip with the design rules or layout rules.
- Fabrication process that allows this technology evolution is the minimum feature size that can be printed on the chip

Course outcome
- The students will know about various technologies used for fabricating VLSI devices and design rules.
- To learn about the technology customization for the chip design economically
- A popular nanotechnology application MEMS structures will be learnt.

Course Contents
Crystal growth- Wafer preparation- Epitaxy and Oxidation-Lithography and relative Plasma etching- Deposition, Diffusion,-Ion implantation and Metallization- oxidation – Epitaxy – Lithography – Etching and Deposition- NMOS IC Technology – CMOS IC Technology – MOS Memory IC technology - Bipolar IC Technology – IC Fabrication-VLSI assembly technology – Package fabrication technology.

References

1. S.M.Sze, "VLSI Technology", McGraw Hill Second Edition. 1998.
2. James D Plummer, Michael D. Deal, Peter B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Prentice Hall India.2000.
3. Wai Kai Chen, "VLSI Technology" CRC Press, 2003.
4. Rajesh Agarwal and Dr.LaxmanSahoo, "VLSI Technology and Design",Technical Publications Pune, 2008.
5. YasuoTarui, "VLSI Technology: Fundamentals and Applications", 2011

14EC3023 SOLID STATE DEVICE MODELING AND SIMULATION

Credits 3:0:0

Course Objective
- This course introduces the principles of device modelling.
- To understand device physics and to observe experimentally the device performance characteristics combined so as to lead to predictable equations and expressions for device performance under various scenarios of excitation.
- The most widely used device models used by the industry including BSIM and EKV models discussed.

Course outcome

- The student who completes this course will be in a position to understand the procedures used to construct the complicated device models that are widely used in VLSI CAD tools.
- The students will be in the position to understand the changes introduced in the device models as well as contribute to the development of appropriate device models.

Course Contents

Fundamental and characteristics of MOSFET devices such as surface and electrostatic potential, Accumulation, Depletion and Inversion etc.Different MOSFET modeling and its high frequency behavior - Noise modeling and nonlinearities in CMOS devices- Different BSIM4 MOSFET modeling with characteristics- Other MOS models for analog/RF applications.

References

1. TrondYtterdal, Yuhua Cheng and Tor A. Fjeldly, Wayne Wolf, "Device Modeling for Analog and RF CMOS Circuit Design", John Wiley & Sons Ltd, 2003.
2. B. G. Streetman and S. Banarjee, "Solid State Electronic Devices", Prentice-Hall of India Pvt. Ltd, New Delhi, India, 2010.
3. B. Bhattacharyya, "Compact MOSFET Models for VLSI Design", John Wiley & Sons Inc., 2009.
4. Narain Arora, "MOSFET Modeling for VLSI Simulation, Theory and practice", 2007.
5. T. Grasser, "Advanced Device Modeling and Simulation", World scientific publishing, 2003.
6. P. Godse and U. A. Bakshi, "Solid state Devices and circuits", First Edition, 2009

14EC3024 LOW POWER VLSI DESIGN

Credits 3:0:0

Prerequisite: 14EC3020 CMOS VLSI Design

Course Objective

- To study the concepts on different levels of power estimation.
- To study the techniques to reduce power at different levels.
- To study the design of energy recovery circuits.

Course outcome

- Students will get knowledge in low power techniques.
- To design low power SRAMs.
- To design chips with low power consumption and high performance circuits**.**

Course Contents

Introduction- Gate Level Logic Simulation- Architectural Level Analysis- Probabilistic Power Analysis-Circuit and logic level power optimization techniques- Special Techniques-Architecture and system- Leakage Current in Deep Sub-Micrometer Transistors- Deep Sub- Micrometer Device Design Issues-Low Voltage Circuit Design Techniques- SRAM Architecture- Energy Recovery Circuit Design.

References

1. Gary yeap, "Practical Low Power Digital VLSI Design", Kluwer academic publishers, 2001.
2. Kaushik Roy, Sharatprasad, "Low Power CMOS VLSI Circuit Design", John Wiley & Sons Inc., 2000.
3. AnanthaChadrasekaran and Robert Broderson, "Low Power CMOS Design",Standard Publishers, 2000.
4. Kiat,Seng Yeo, Samir S.Rofail, Wang,Ling Goh, "CMOS/BiCMOS ULSI Low Voltage, Low Power", Pearson edition, Second Indian reprint, 2003.
5. Abdellatif Bellaouar and Mohamed Elmasry, "Low Power Digital VLSI Design: Circuits and Systems", 2012.

14EC3025 CAD FOR VLSI CIRCUITS

Prerequisite: 14MA3010 Graph Theory and Algorithms

Credits 3:0:0

Course Objective

- To study the Physical design cycle of VLSI
- Due to continuous scaling of semiconductor technology, most of the VLSI designs employ millions of transistors and circuits of this size can only be carried out with the aid of CAD VLSI design tools.
- The design flow organization for VLSI, the standard cell based synthesis methodologies for digital VLSI, floor planning and placement principles and related topics will all be covered.

Course outcome

- To understand how VLSI tools are developed and the constraints and limitation under which they can be operated successfully.
- In the VLSI industry, the both user and the developer of the VLSI tools must have a firm understanding of how these tools are developed and the constraints and limitation under which they can be operated successfully.
- Students are expected to have completed one of the important prerequisites for professionals in the area of VLSI design. .

Course Contents

Introduction to VLSI Methodologies –VLSI Physical Design Automation – Fabrication process and its impact on Physical Design-A quick tour of VLSI design automation tools – Data structures and basic Algorithms - Algorithmic graph theory and computational complexity – Tractable and Intractable problems-Simulation – Logic synthesis – Verification – High level synthesis – Compaction. ASIC Construction-Partitioning methods – Floor planning – Placement – Global routing –Detailed routing- circuit extraction –DRC - Physical Design Automation of FPGAs

References

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", John Wiley, 2003.
2. Sabih H. Gerez," Algorithms for VLSI design automation", John Wiley, 2004.
3. M.J.S.Smith, "Application – Specific Integrated Circuits", Addison, Wesly Longman Inc.,1997.
4. StevenRubin,"Computer aids for VLSI Design", 2nd edition,1994.
5. Prithviraj Banerjee, "Parallel Algorithms for VLSI Computer-Aided Design", Springer, 2004.

14EC3026 TESTING AND TESTABILITY

Credits 3:0:0

Course Objective

- To understand the methods of testing combinational and sequential circuits.
- To know about various fault simulation techniques.
- To understand the difference between DFT and BIST

Course outcome

- Students will have the knowledge to test any VLSI circuits
- Students will be able to decide which testing method to be applied for a given circuit to be tested.

Course Contents

Motivation for testing - Fault models - Test generation algorithms for combinational logic circuits - Functional testing –Fault model based testing- Time frame expansion – Fault simulation techniques - Key testability concepts – Ad Hoc design for Testability – scan based design - Signature analysis - Compression techniques-Built-in self-test – Architectures.

References

1. Vishwani D. Agarwal,"Essential of Electronic testing for digital, memory and mixed signal circuits", Springer, 2000
2. Abramovici .M, Breuer , "Digital Systems Testing and Testable Design", Jaico Publishing House, 2000
3. Robert J. Feugate, Jr. Steven M., "Introduction to VLSI testing", Prentice Hall, Cliffs, 1998.
4. ParagK.Lala, " Digital circuit Testing and Testability", Academic press, 1997
5. Abramovici .M, Breuer .M.A. and Friedman .A.D, "Digital Systems Testing and Testable Design", Wiley, 1994.

14EC3027 VLSI DIGITAL SIGNAL PROCESSING

Credits 3:0:0

Course Objective

- This paper integrates VLSI architecture theory and algorithms.
- It addresses various architectures at the implementation level, and presents several approaches to analysis, estimation, and reduction of power consumption.
- Explains how to design high-speed, low-area, and low-power VLSI systems for broad range of DSP applications.

Course outcome

- The students will be able to apply several optimization techniques to improve implementations of DSP algorithms.
- To be able to optimize design in terms of area, speed and power and also to be able to incorporate pipeline based architectures in the design.
- Students will have the ability to modify the existing or new DSP architectures suitable for VLSI for high speed and low area applications

Course Contents

Iteration Bound & Pipelining / Parallel Processing: Representations of DSP Algorithms- Iteration bound and algorithms for computing iteration bound - Pipelining and parallel processing of FIR filters for high speed low power applications.Retiming& Unfolding: Solving system inequalities for retiming techniques- Algorithm and properties of unfolding-Applications-Algorithmic strength reduction in filters and transforms Systolic Array: Design Methodology- FIR systolic Arrays-Selection of Scheduling Vector- Fast Convolution Algorithms Scaling and Round Off Noise: Scaling and roundoff noise computation- Bit level arithmetic architectures- Canonic Signed Digit Arithmetic- Distributed Arithmetic- Redundant Arithmetic-Numerical Strength Reducing Techniques: Subexpression Elimination- Multiple Constant Multiplication- Subexpression Sharing in Digital Filters Additive and Multiplicative Number Splitting.

References

1. Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and implementation", Wiley, Interscience, 2007.
2. U. Meyer Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2004.
3. Mohammed Isamail and Terri Fiez, "Analog VLSI Signal and Information Processing", McGraw Hill, 1994
4. Jose E. France, YannisTsividis,"Design of Analog-Digital VLSI Circuits for Telecommunication and Signal Processing", Prentice Hall, 1994.
5. S.Y.Kuang, H.J. White house, T. Kailath, "VLSI and Modern Signal Processing", Prentice Hall,1995.

14EC3028 ASIC DESIGN LAB

Credits 0:0:2

Co-Requisite: 14EC3004 Hardware Description Language

Course Objective

- Design of Digital Circuits for Synthesis and Simulation using HDL and Schematic Entry.
- Design of various steps involved in Physical Design such as Placement, Routing, DRC, Parasitic Extraction and Layout.
- Design and analysis of Analog Circuits

Course outcome

- Students are exposed to various tools such as Mentor Graphics (Front-end and Back-end) and Tanner EDA tools and Cadence EDA tools.
- Students can design any analog or digital circuits using the above tools.
- Students can use the tools for their Projects and Research works.

Experiments:
The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3029 SPEECH AND AUDIO SIGNAL PROCESSING

Credits 3:0:0

Course objectives:

- To study the analysis of various M-band filter banks for audio coding
- To learn various transform coders for audio coding.
- To study the speech processing methods in time and frequency domain

Course outcomes :

- To design CMOS based circuits
- To design layout for CMOS fabrication
- To design and simulate a VLSI system

Coursecontents:
Mechanics of speech and audio - Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Absolute Threshold of Hearing - Critical Bands- Masking, Perceptual Entropy - PAQM - Cognitive effects in judging audio quality. Time-frequency analysis - filter banks and transforms.Audio coding and transform coders.Time and frequency domain methods for speech processing, Homomorphic speech analysis.Linear predictive analysis of speech, Application of LPC parameters. Formant analysis

References:

1. Digital Audio Signal Processing, Second Edition, UdoZölzer, A John Wiley& sons Ltd Publications,2008
2. Applications of Digital Signal Processing to Audio and Acoustics, Mark Kahrs, Karlheinz Brandenburg, Kluwer Academic Publishers New York, Boston, Dordrecht, London , Moscow,2002
3. Digital Processing of Speech signals – L.R.Rabiner and R.W.Schaffer - Prentice Hall –1978

14EC3030 BIOLOGICAL SIGNAL PROCESSING

Credits 3:0:0

Courseobjectives:

- To introduce the characteristics of different biosignals
- To discuss linear and non-linear filtering techniques to extract desired information
- To introduce techniques for automated classification and decision making to aid diagnosis

Courseoutcomes:

- To analyze signals in time series domain & estimate the spectrum
- To understand the significance of wavelet detection applied in Biosignal processing.
- To extract the features using multivariate component analysis.

Coursecontents:

Signal, System and Spectrum Characteristics of dynamic biomedical signals, cross-spectral density and coherence function, cepstrum and homomorphism filtering. Time Series Analysis and Spectral Estimation – linear prediction models, Application in Heart rate variability, PCG signals, Biosignal Classification and Recognition, Time Frequency And Multivariate Analysis Time frequency representation, spectrogram, wavelet analysis – Data reduction techniques, Multivariate component analysis, Back propagation neural network based classification.

References:

1. Arnon Cohen, Bio-Medical Signal Processing Vol I and Vol II, CRC Press Inc., Boca Rato, Florida 1999.
2. Rangaraj M. Rangayyan, ‘Biomedical Signal Analysis-A case study approach’, Wiley-Interscience/IEEE Press, 2002
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India, New Delhi, 2003.
4. Emmanuel C. Ifeachor, Barrie W.Jervis, ‘Digital Signal processing- A Practical Approach’ Pearson education Ltd., 2002
5. Raghuveer M. Rao and AjithS.Bopardikar, Wavelets transform – Introduction to theory and its applications, Pearson Education, India 2000

14EC3031 MEDICAL IMAGE PROCESSING

Credits 3:0:0

Courseobjectives:

- To understand 2D and 3D image reconstruction techniques.
- To gain sound knowledge about CT, MRI, nuclear and ultrasound imaging.
- To realize the factors those affect the quality of medical images**.**

CourseOutcomes:

The students will be able to

- analyze the physiological events associated with the human system.
- describe the influences of artifacts in image quality
- identification of new developments in health care system

Course contents:

Acquisition of Images, rectilinear scanner, Emission computed Tomography multiple crystal scintillation cameras, Image Reconstruction from Projections in Two dimensions, Radon Transform, Projection Theorem, Fluoroscopy, CT, Image quality Digital fluoroscopy, cinefluorography. Imaging Reconstruction algorithms, Magnetic Resonance Imaging and Spectroscopy- Fundamentals - tissue contrast in MRI – angiography, spectrography. Ultra sound, Neuro magnetic Imaging, Quality control, Origin of Doppler shift – Limitations of Doppler systems

References:

1. William R. Hendee, E. Russell Ritenour, “Medical Imaging Physics”:A John Wiley & sons, Inc., Publication, Fourth Edition 2002.

2. Geoff Dougherty, “Medical Image Processing: Techniques and Applications”, Springer,2011.
3. Z.H. Cho., J-oie, P. Jones and Manbir Singh, “Foundations of Medical Imaging”, John Wiley and sons,1993.
4. Avinash C. Kak, Malcolm Shaney, Principles of Computerized Tomographic Imaging,IEEE Press, Newyork-1998.

14EC3032 ADVANCED PROCESSORS FOR CONTROL AND AUTOMATION

Credit: 3:0:0

Course Objective:

- To learn recent trends in advanced microcontroller applications.
- To learn microcontroller implementation for control applications
- To understand programming with 8 and 32 bit microcontrollers.

Course Outcome:

The students will be able to

- program microcontrollers for embedded applications.
- illustrate architecture differences and to show common characteristics.
- design the microcontroller for real time projects.

8 bit processor**:** 8051 architecture, Programming examples with stepper motor, dc motor, interfacing timer with control applications, CPU Architecture of PIC microcontroller –temperature, flow process interfacing , A/D converter, UART , 16 bit processor/32 bit processor: Introduction to 16/32 bit processor, ARM architecture, The ARM instruction set, The thumb instruction set , programming examples with control applications

References

1. Raj Kamal – “Microcontrollers – Architecture, Programming, Interfacing and System Design”, Pearson Education, USA, 2005.
2. SteaveFurber,” ARM system–on–chip architecture” Addison Wesley, New Delhi, 2000.
3. John.B.Peatman, “Design with PIC Micro Controller”, Pearson Education, USA, 2003.
4. Mohammad Ali Mazide, Janice GillispicMazidi, RolinD.Mckinlay, “ The 8051 micro controller and embedded systems using assembly and C”, prentice Hall of India, Hyderabad, 2006.
5. Kenneth Ayala ,”The 8051 Microcontroller”, Thomson Delmar Learning , New Jersey, 2004.

14EC3033 ADVANCES IN ELECTRONICS APPLIED TO HOSPITAL ENGINEERING

Credits 3:0:0

Courseobjectives:

- To study about the aspects of clinical engineering
- To study about the various aspects of electronics used in hospitals
- Know the importance of calibration of medical devices

Course outcomes:

The students will be have the

- ability to specify the type of networking facility to be provided in the hospital
- capability to identify the electromagnetic effects on medical devices and to make the devices electromagnetically compatible
- ability to specify the type of optic sensor for physiological measurement

Coursecontents:

Medical standards and recalibration,Need for Standardization, Hospital design, Hospital safetyRegulations, Management and Legal aspects. Network topologies, LAN components,network operating system,planning and installing LAN in hospital set up-Fibre Optic Sensors for Measuring Physiological Parameters – Application of the sensors in measuring pressure, temperature, flow, rotation and chemical activities- principles of smart sensors.EMIand EMC Applied to Hospital Equipment's- Virtual Reality Application -Human Factorsand Human Perception, Computer graphics principles used in VR,Existing tools Tracking- Applications of Virtual Reality in Medicine

References:

1. Syed Amin Tabish "Hospital and Health services Administration Principles and Practices Oxford Press New Delhi 2001
2. Jacob Kline, "Handbook of Biomedical Engineering", Academe press INC ,Sandiego 1981.
3. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech House 3rd Edition, 1986.
4. Eric Udd, "Fibre Optic Sensors and Introduction for engineers and scientists",WileyInterscience Publication, New Delhi, 1991.
5. SK Basandia, Local Area Network,Golgotia Publishing Pvt. Ltd., New Delhi, 1995
6. R.C.Goyal,'Hospital administration and human resource management', 4th edition, Prentice Hall of India, New Delhi, 2006.

14EC3034COMPUTER BASED MEDICAL INSTRUMENTATION

Credits 3:0:0

Courseobjectives:

- To teach PC hardware and its related interfacing
- To understand the basics of computerized data acquisition and programming.
- To provide knowledge about biometrics and network security

Courseoutcomes:

The students will have knowledge on

- Hardware behind data acquisition
- Scope of virtual reality in health care
- Develop an insight knowledge about the biometrics and network security

Course contents:

Overview of Mother Boards - Processors, Memory, Adapter cards, Ports, Power supply (BIOS, DOS) interaction,Functional and Architecture Block diagram of a PC, Processors and Memory - 80X86 Processors, Architectures and Memory management,Peripheral Interfacing and Controllers – RAM ,SDRAM and RDRAM, Cache memory,ROM and its types, Flash memory, I/O slots,Serial andParallel ports,USB, FireWire port.Computerised Data Acquisition and Programming - in C - DSP in Medical applications. CAD In Medical Instrumentation - FPGA Design Logics, Instrumentation in LAB view,Multisim Simulation with bio amplifiers,Mixed signal SoC applications in biomedical applications

References:

1. RamachandraLele, Computers in Medicine Progress in Medical Informatics, Tata McGraw Hill Publishing Company, New Delhi, 2005
2. N.Mathivanan, PC Based Instrumentation: Concepts and Practice, Prentice Hall of India, New Delhi 2007.
3. B.Govindarajalu, IBM PC and Clones: Hardware, Trouble shooting and Maintenance, Tata McGraw Hill Publishing Company, New Delhi, 2005 19
4. Herbert Schildt, The Complete Reference – JAVA, Tata McGraw Hill Publishing Company, New Delhi, 2005
5. John P Woodward, Biometrics – The Ultimate Reference, Dreamtech Publishers, New Delhi, 2003
6. Ranjan Parekh, Principles of Multimedia, Tata McGraw Hill Publishing Company, New Delhi, 2006
7. Stephen J Bigelow, Trouble shooting, Maintaining and Repairing of PCs, Tata McGraw Hill Publishing Company, New Delhi, 2005

14EC3035 DIGITAL COMMUNICATION RECEIVERS

Prerequisite: 14EC3012 Modern Digital Communication Techniques

Credits 3:0:0

Course Objective

- To learn wireless channel conditions
- To apply signal processing algorithms to design an optimum wireless reception.
- To design an Optimum multiuser detection for wireless environment

Course outcome

Students are able to

- evaluate the performance of wireless signaling environment
- apply mathematical formulation to find Optimum detection of wireless signal
- develop signal processing algorithms for wireless signal reception.

Course Contents

Review of Digital Communication Techniques-Optimum Multiuser Detection,Correlating and Decorrelating Detection, Narrowband Interference Suppression, Synchronization techniques-Signal Processing For Wireless Reception-Adaptive Equalization-Echo cancellation.

References

1. X.Wang&H.V.Poor, Wireless Communication Systems, Pearson, 2004.
2. R.Janaswamy, Radio Wave Propagation and Smart Antennas for WirelessCommunication, Kluwer, 2002
3. ItiSahaMisra,"Wireless Communications and Networks,"Tata McGraw Hill,2009.
4. Mohamed Ibnkahla, Adaptive Signal processing in Wireless Communications, CRC Press, 2008.
5. A.V.H. Sheikh, Wireless Communications Theory & Techniques, Kluwer Academic Publications, 2004
6. A.Paulrajetal, Introduction to Space-time Wireless Communications, Cambridge University Press, 2003

14EC3036 DETECTION AND ESTIMATION THEORY

Prerequisite: 14EC3012 Modern Digital Communication Techniques
14EC3001 Statistical Digital Signal Processing

Credits 3:0:0

Course Objective

- Understand basics of detection and estimation theory.
- Design and analyze optimum detection schemes.
- Study different estimation schemes such as ML and MMSE estimators.

Course outcome

Students are able to

- effectively use the probability and signal processing techniques to estimate signals and parameters and detect events from data in discrete time and continuous time signal.
- understand different estimation schemes.
- design an optimal estimator/detector for specific application.

Course Contents

Binary Hypothesis Testing: Bayes, Minimax and Neyman-Pearson tests. Composite hypothesis testing. Signal Detection In Discrete Time: Models and detector structures. Coherent detection in independent noise.Detection in Gaussian noise.Detection of signals with random parameters.Detection of stochastic signals-Bayesian Parameter Estimation: Kalman- Bucy filter. Linear estimation.Orthogonality principle. Wiener- Kolmogorov filtering – causal and non-causal filters. Signal Detection in Continuos Time.

References
1. Harry .L. Van Trees, Kristine L Bell, ZhiTian, Detection, Estimation and Modulation theory, Part I, Second Edition, Wiley Publications 2013.
2. H.V. Poor, “An Introduction to Signal Detection and Estimation”, Second Edition, Springer, 1994.
3. MouradBakat, “Signal Detection and Estimation”, Second Edition, Artech House, 2005.
4. Athanasios Papoulis, S Unnikrishna Pillai, “Probabilty, Random Variabes and Stochastic Processes”, ISBN 0073660116, Fourth Edition, Mc Graw Hill, 2002
5. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
6. Mandyam D. Srinath, P.K. Rajasekaran and R. Viswanathan, “Introduction to Statistical Signal Processing with Applications”, Prentice Hall, 1996.

14EC3037 DSP ARCHITECTURE AND PROGRAMMING

Credits 3:0:0

Course Objective
- Fundamentals of DSP Processors and Programming Skills
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

Course outcome

Students are able to
- identify the basic architectural elements of DSP hardware;
- gain an appreciation for the trade-offs necessary in algorithm design for real-time DSP implementation;
- acquire an appreciation of the importance of real-time DSP for a broad class of engineering applications.

Course Contents

Fundamentals Of Programmable DSP -Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs –Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals. TMS320C5X PROCESSOR -TMS320C6X PROCESSOR -ADSP PROCESSORS -Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs – Filter design, FFT calculation - ADVANCED PROCESSORS Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

References
1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications” – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, “Digital Signal Processing – Implementations using DSP Microprocessors with examples from TMS320C54XX”, cengage Learning India Private Limited, Delhi 2012
3. User guides Texas Instrumentation, Analog Devices, motorola.
4. RulphChassaing, “Digital Signal Processing and applications with the C6713 and C6416 DSK”, a John Wiley& sons, inc., publication, 2005

14EC3038 GLOBAL POSITIONING SYSTEM

Prerequisite: 14EC3015 Satellite Communication

Credits 3:0:0

Course Objective
- To introduce Global Positioning Systems

- To understand types of signals used in the GPS systems and accuracy limits
- Latest versions of GPS and its application

Course outcome

Student will able to

- develop a strong foundation in the field of Global Positioning Systems.
- acquire in-depth knowledge about working of Global positioning receivers.
- understand various errors occurring in GPS and latest variant DGPS receivers and GPS applications

Course Contents

Introduction:GPS and GLONASS Overview - Satellite Navigation -Time and GPS – User position and velocity calculations Signal Characteristics: GPS signal components - purpose, properties. GPS Receivers & Data Errors: SA errors - propagation errors Differential GPS: LADGPS – WADGPS GPS Applications: GPS in surveying, Mapping and Navigation.

References

1. MohinderS.Grewal , Lawrence R.Weill, Angus P.Andrews, "Global positioning systems - Inertial Navigation and Integration", John wiley& sons , 2002
2. E.D.Kaplan, "Global positioning systems – Inertial Navigation and Integration", John wiley&sons , 2001.
3. G S RAO, Global Navigation Satellite Systems, McGraw-Hill publications, New Delhi, 2010
4. B. Hoffman – Wellenhof, H. Liehtenegger and J. Collins, 'GPS – Theory and Practice', Springer – Wien, New York ,2001.
5. James Ba – Yen Tsui, 'Fundamentals of GPS receivers – A software approach', John Wiley & Sons,2001.

14EC3039 OPTICAL SIGNAL PROCESSING

Prerequisite: 14EC3011 Optical Networks and Photonic Switching

Credits 3:0:0

Course Objective

- To study the basic optical signal properties.
- To understand the working principle of spatial filtering system.
- To study the working and applications of acousto-optic devices..

Course outcome

Students are able to

- handle acoustic-Optic Devices
- apply signal processing algorithm to improve quality of optical signal.
- acquire knowledge in the operation of homodyne and heterodyne spectrum analyzers

Course Contents

Fundamentals of geometrical and physical optics - Sample function - geometrical optics - basic laws - Refraction by prisms- lens formula- imaging condition- optical invariants- physical optics-Transforms: Fresnel- Fourier- Inverse Fourier and Extended Fourier- Spatial light modulation- spatial light modulators- detection process- system performance process- dynamic range- raster format- spectral analysis- Types of spatial filters- optical signal processing and filter generation- read out module- orientation and sequential search- applications of optical spatial filter- Acousto-optic cells- spatial light modulators-basic spectrum analyzer - aperture weighting- dynamic range and SNR- photo detector- geometric considerations – radiometer- Overlapping of waves- optimum photo detector size for 1D and 2D structure- Optical radio- spatial and temporal frequencies- Distributed and local oscillator - Dynamic range comparison of heterodyne and power spectrum analyzers.

References

1. Vanderlught, "Optical Signal Processing", John Wiley & Sons, New York, 2005

2. Mahlke Gunther, Goessing Peter, “Fiber optic cables: Fundamentals, Cable Engineering, System planning”, John Wiley, 3rd Edition, 2001
3. Hiroshi Murata, “Handbook of Optical Fibers and Cables” Marcel Dekker Inc., New York, 1998.
4. P.K. Das, “Optical Signal Processing Fundamentals”, Narosa Publishing New Delhi, 1991.
5. Bradley G. Boone, “Signal Processing using Optics”, Oxford University Press, 1998.

14EC3040 MICROWAVE INTEGRATED CIRCUITS

Credits 3:0:0

Course Objective

- To study different technologies of microwave integrated circuits and to study various encapsulation and mounting/bonding techniques of hybrid and monolithic MICs.
- To study planar transmission lines such as microstrip and coupled microstrip lines.
- To design and fabricate lumped passive elements working at microwave frequencies, design and analyze various planar microwave circuits.

Course outcome

Students are able to

- understand the structural and constructional features of ICs at microwave range of communication
- design amplifier, oscillator, filter, attenuator circuits which suits at microwave transmission
- develop application circuits to employ in radar, satellite, and mobile communication systems

Course Contents

Fabrication process behind Hybrid (thick and thin film) MICs and Monolithic MICs.Methods of encapsulation and bonding of chips. Testing of fabricated chips. Numerical method, hybrid mode, and coupled mode analysis of microstrip lines. Even and odd mode analysis of slot lines, coplanar wave guides, and directional couplers such as branch line couplers. Design and fabrication of microstrip based lumped elements such as resistors, inductors, and capacitors along with certain non-reciprocal devices such as circulators, isolators, and phase shifters.Microwave amplifier and oscillator circuit designs and gain/stability analysis. Analysis of infinite terminated periodic structures such as nth order filters.

References

1. D. M. Pozar, “Microwave Engineering”, 3rd Edition, John Wiley & Sons, 2005.
2. Robert E.Collin, “Foundations for Microwave Engg”., 2nd ed., McGraw Hill, 2001
3. Gupta,K.C, and Amarjitsingh , “Microwave Integrated Circuits”, John Wiley and sons, Wiley Eastern Reprint, 1978.
4. Samuel Y. Liao, “Microwave Devices and Circuits”, 3rd Edition, Prentice Hall, 1996.
5. Hoffmann, R.K , “Handbook of Microwave Integrated Circuits”, Artec House, 1987.
6. Kneppo I, Fabian J, Pavel M ,”Microwave Integrated Cicuits”, Kluwer academic publishers 2000.

14EC3041 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Credits 3:0:0

Course Objective

- To formulate the new adaptable procedures for EMI and EMC principles.
- To design the Electromagnetic compatible PCB.
- To understand shielding in cables

Course outcome

Students are able to

- design and test electronic products with radiation hazard free and susceptible to EMI
- apply the concepts of EMI Coupling and shielding in cables and other equipments
- analyze the testing requirements of electronics products.

Course Contents

EMI/EMC Concepts-EMI Coupling Principles-EMI Control Techniques-EMC Design of PCBs-EMI Measurements And Standards-Standard for EMI/EMC-MILSTD461/462, IEEE/ANSI, CISPR/IEC, FCC regulations, British and Japan standard, VDE standard, EURO norms and comparison of Standard

References

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York second Edition 2001.
2. C R Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons 1992.
3. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artechhourse, Norwood, 1987
4. Henry W.Ott. "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, Second Edition, 1988.
5. Donald R. J. White, William G. Duff, "A Handbook Series on Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications", Don White Consultants, 1971.

14EC3042 RF SYSTEM DESIGN

Credits 3:0:0

Course Objective

- To study the importance of RF design, behavior and issues.
- To learn the design of RF filters, configuration, realizations and implementation.
- To study the design of active RF components and applications.
- To discuss about the various RF amplifier designs, oscillators and applications.

Course outcome

Students are able to have

- knowledge in RF filter design and RF amplifier design.
- knowledge in high frequency oscillator configuration, mixers and phase locked loops.

Course Contents

Importance of RF design – behavior – considerations – issues and application. RF filter design – configuration – realization and implementation. Active RF components and applications RF amplifier designs, characteristics and applications Oscillators and Mixers - applications

References

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design – Theory and Applications", Pearson Education Asia, Mc Graw Hill Publishers 5th edition, 2003.
2. Joseph. J. Carr," Secrets of RF Circuit Design", Mc Graw Hill Publishers, Third Edition 2000.
3. Matthew M. Radmanesh," Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002.

14EC3043 RF MEMS

Credits 3:0:0

Course Objective

- To study the importance of RF design, behavior and issues.
- To know about various electronic components of which moving sub-millimeter-sized parts provide RF functionality
- Understand parameters of Microstrip antennas – reliability and thermal issues

Course outcome

Students are able to

- identify the main characteristics of each MEMs

- understand knowledge in RF filter design and RF amplifier design.
- acquire Knowledge in MEMs phase shifter - design, fabrication and evaluation.
- design parameters of Microstrip antennas – reliability and thermal issues

Course Contents

Importance of RF design – RF MEMs relays and switches, MEMs inductors and Capacitors, Micro-Machined RF filter design – capabilities, limitations and applications, MEMs phase shifter types – design, fabrications and applications, Microstrip antennas – design parameters – Reliability and thermal issues

References

1. V.K. Varadan, K.J. Vinoy and K.A. Jose, "RF MEMS and their Applications", John Wiley & Sons Inc, 2002.
2. G.M. Rebeiz, "RF MEMS: Theory, Design and Technology", John Wiley & Sons Inc., 2003.
3. Hector J. De Santos, "RF MEMS Circuit Design for Wireless Communications" Artech House, 2002.

14EC3044 NEURAL NETWORK FOR RF AND MICROWAVE DESIGN

Prerequisite: 14EC3003 Computational Intelligence and Optimization Techniques

Credits 3:0:0

Course Objective

- To focus new, unconventional alternatives for conquering RF and microwave design and modelling problems using neural networks.
- To understand optimization using Neural Networks techniques.
- To understand Microstrip transmission line model.

Course outcome

Students are able to

- create models with neural networks for RF and Microwave Design.
- understand Neural Network model evaluation for RF and Microwave Design
- acquire knowledge on Neural Networks for conquering the toughest RF and microwave CAD problems.

Course Contents

Neural network modelling approach-Multilayer perception-Back propagation-Radial Basis function-Initialization of neural model weight parameters – Data Generation, Splitting & scaling –Gradient based methods-GA for NN: The schema theorem –effect of crossover, Mutation-chromosomal representation-fitness function –setting the GA parameters and operators. Models for microstrip transmission lines–microstrip via- to stripline interconnect –models for CPW transmission line –CPW continuities –CPW opens and short-Optimization of Component structure –circuit optimization –CPW folded double stub filter –power divider –Multilayer-circuit design and optimization -CPW patch antenna design –yield optimization.

References

1. Q.J Zhang, K.C. Gupta, "Neural Networks for RF and Microwave Design" Artech house 2000.
2. A.J.F. Van Rooji, L.C Jain, R.P. Johnson, "Neural Network Training Using Genetic Algorithms" World Scientific Pub, 1997.

14EC3045 SMART ANTENNAS

Prerequisite: 14EC3001 Statistical DigitalSignal Processing

Credits 3:0:0

Course Objective

- To introduce the Smart antenna concepts for wireless communications.

- To discuss various array signal processing techniques and methodologies.
- To understand narrowband and broadband processing techniques.

Course outcome

Students are able to

- understand the mathematical modeling of smart antenna systems.
- acquire knowledge in narrowband and broadband processing techniques.
- design and integrate smart antenna system for Wireless applications.

Course Contents

Introduction: Antenna gain- Phased array antenna- power pattern- beam steering- degree of freedom- optimal antenna- adaptive antennas- smart antenna -key benefits of smart antenna technology- wide band smart antennas- Digital radio receiver techniques and software radio for smart antennas. Narrow and Broad Band Processing: Adaptive Processing: Direction of Arrival Estimation Methods: Diversity Combining.

References

1. Lal Chand Godara, "Smart Antennas" CRC press, 2004
2. Balanis, "Antenna Theory: Analysis and Design", John Wiley and Sons, 2005.
3. Joseph C Liberti, Theodore S Rappaport, "Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA Applications", Prentice Hall 1999

14EC3046 COMMUNICATION NETWORK SECURITY

Credits 3:0:0

Course Objective

- To make the student understand the importance and goals of communication network and information security and introduce him to the different types of attacks.
- To expose the student to the different approaches to handling security and the algorithms in use for maintaining data integrity and authenticity.
- To enable the student to appreciate the practical aspects of security features design and their implementation in wired and wireless internetworking domain

Course outcome

Students are able to

- design a better internet security system to detect and correct security violations that involve in the transmission of information.
- acquire knowledge on different approaches to handle security problems in communication network security,
- design a better internet security system to detect and correct security violations that involve in the transmission of information.

Course Contents

Conventional encryption model, Stegnography, Symmetric block ciphers, Stream Cipher, Key distribution. Public Key Cryptography, Message authentication and Hash functions, Digital signatures. IP Security - Authentication Header and Encapsulating Security Payload, Key Management. Web security - secure sockets layer and transport layer security, secure electronic Transaction. Malicious Programs, firewall design, antivirus techniques.

References

1. Stallings,W, "Cryptography and Network security", Principles and Practice, 3rdEdition, Prentice Hall, 2002.
2. Baldwin.R and Rivest.R."TheRC5,RC5-CBC,TC5-CBC-PAD and RC5-CT5 Algorithms, RFC2040", October 1996.
3. Charlie Kaufman, Radia Perlman, Mike Speciner, “Network Security”, Second Edition, Prentice Hall, 2002.

4. Behrouz A. Forouzan, “Cryptography and Network security”, Tata Mcgraw Hill, Special Indian Edition 2007.

14EC3047 COMMUNICATION NETWORK ROUTING ALGORITHMS

Credits 3:0:0

Course Objective

- To review the routing concept in circuit switching & packet switching networks in general and high speed networks in particular.
- To expose the students to the layered architecture for communication networks and the specific functionality of the network layer.
- To enable the student to understand the basic principles of routing and the manner this is implemented in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.

Course outcome

Student will able to

- understand the layered architecture for communication networks and the specific functionality of the network layer.
- understand the different routing algorithms existing and their performance characteristic
- explore the functionalities of routing algorithms of Wired and Wireless Networks.

Course Contents

Routing in circuit switching networks, Routing in packet switching networks, Routing strategies, Routing in ATM networks. Distance Vector Routing, Routing Information Protocol, Link State Routing, Open Shortest Path First Protocol, EGP, BGP and IDRP Protocols. Routing in cellular networks, Routing in small and large sized packet radio networks, Table driven and On-demand routing protocols in Adhoc Network.

References

1. M C.E. Perkins, "AdHoc Networking", Addison - Wesley Publication, Singapore, 2001.
2. S. Keshav, "An Engineering Approach to Computer Networking", Addison - Wesley, New Delhi, 2001.
3. Steen Strub, "Routing in Communication Networks", Prentice Hall International, New York, 1995.
4. A.S. Tanenbaum, " Computer Networks", PHI, New Delhi, 2003.
5. William Stallings, "Data and Computer Communications", 6th Edition, Pearson Education, 2002.

14EC3048 EMBEDDED SENSOR NETWORKS

Credits 3:0:0

Course Objective

- To introduce the basic concepts of Sensor Networks
- To introduce the overview of communication Protocols of wireless sensor networks
- To introduce the tracking techniques, sensor database and energy management

Course outcome

Students are able to

- understand the concepts of sensor networks, different types of protocols and techniques used in WSN
- acquire knowledge in IEEE 802.15.4 standards for Wireless Sensor Networks.
- understand different tracking techniques, sensor database and energy management in WSN.

Course Contents

Introduction, difference with traditional networks, architecture, components, Time synchronization protocols, Transport Layer protocol, Network layer protocol, Data link protocol, S-MAC protocol, IEEE 802.15.4 and Zigbee. Tracking scenario, ToA, TDoA, and AoA, Positioning by signal strength-tracking algorithms-Trilateration-Multilateration-Pattern matching-Nearest neighbor algorithms, network based tracking. Sensor Network Data Bases, Data aggregation, power management, IEEE 802.11 and Blue tooth, their implications in WSN

References

1. Mohammad Ilyas and ImadMahgoub, “Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems” CRC Press, 2009.
2. Feng Zhao, Leonidas J. Guibas, “Wireless Sensor Networks: An Information Processing Approach” Morgan Kaufmann Publishers, 2004.
3. Michel Banatre, Pedro Jose Marron, AnibalOllero and Adam Wolisz, “Cooperating Embedded Systems and Wireless Sensor Networks”, ISTE Ltd,2008.

14EC3049 MOBILE COMMUNICATION NETWORKS

Credits 3:0:0

Course Objective

- To understand the operation model of MobileCommunciation Networks
- To understand the mobile network architecture and also acquire background knowledge of Wireless Communication.
- To acquire knowledge on security issues in Wireless networks.

Course outcome

Students are able to

- understand about cellular mobile communication technologies and propagation models.
- review about packet networks and mobility management for wireless communication networks.
- apply knowledge for solving Wireless channel issues and impairments like interference, channel capacity and QoSetc

Course Contents

Operation of Mobile Communication Networks-Channel Division techniques-Network Planning and Resource allocation-Network Dimensioning –Mobility Management Procedures, Radio Propagation Models and Air Protocols-AMPS, IS-95, IS-136, GSM, GPRS, EDGE, WCDMA, cdma2000, Mobile Network Architecture, Wireless LAN –IEEE 802.11 standard-Basic DCF access scheme- DCF Access Scheme with Handshaking, PCF Access Scheme, Security Issues in Wireless Networks-Secure Routing-security in Group Communciation –Denial of Service attacks

References

1. W. Stallings, "Wireless Communications and Networks", Prentice Hall,Second Edition, 2005.
2. T.S. Rappaport, "Wireless Communications: Principles & Practice", Second Edition, Prentice Hall, 2002.
3. J. Schiller,”Mobile Communications", Addison Wesley, 2nd Edition ,2004.

14EC3050 SYSTEM ON CHIP DESIGN

Prerequisite: 14EC3004 Hardware Description Languages

Credits 3:0:0

Course Objective

- To know about SoC Design and Fundamentals.
- To know about IP cores and application specific design.
- To know about NoC and its validation

Course outcome

- Students will learn System-on-chip fundamentals
- Students will have knowledge about the applications and On-chip networking.
- Students will gain confidence to design SoC and NoC .

Course Contents

SOC fundamentals-Essential issues of SoC design – A SoC for Digital still camera – Multimedia IP development : Image and video codecs-SOC software and energy management-SoC embedded software – Energy management techniques for SoC design-Design methodology for NOC based systems – Mapping Concurrent application onto architectural platforms. Packet switched network for on-chip communication – Energy reliability tradeoff for NoC's – Clocking strategies – Parallel computer as a NoC's region- MP-SoC from software to hardware – NoC APIs – multilevel software validation for NoC – Software for network on chip.

References

1. Axel Jantsch, HannuTenhunen, "Network on chips", Kluwer Academic Publishers, 2003.
2. Youn-Long, Steve Lin, "Essential Issues of SoC Design: Designing Complex Systems-On-Chip", Springer, 2006.
3. A. Jerraya and W. Wolf, eds., Multiprocessor Systems-on-Chips, Morgan Kaufmann, 2004.

14EC3051 RECONFIGURABLE COMPUTING

Prerequisite: 14EC3004 Hardware Description Languages

Credits 3:0:0

Course Objective

- To understand what is reconfigurability
- To learn about reconfigurable computing.
- To know about systems with technology mapping and placement

Course outcome

- Students will get knowledge of reconfigurable computing
- Students will be able to do any FPGA based system design.
- Students will be capable of designing reconfigurable architectures

Course Contents

GeneralPurpose FPGA Architecture - Reconfigurable Computing Devices- Reconfigurable Computing Systems- Reconfiguration Management- Hardware Description Languages (VHDL)- Compilation for Reconfigurable Computing Machines -Streaming Models- FPGA applications using block diagrams in simulink- Implementing Applications with FPGAs-Implementing arithmetic in FPGAs- CORDIC Architectures for FPGA computing-CORDIC algorithm- Architecture design-FPGA implementation of CORDIC Processors -Technology Mapping & FPGA Placement- SPIHT Image Compression- Run-time reconfiguration: Automatic Target Recognition-Implications of Floating Point for FPGAs.

References

1. Scott Hauck, Andre Dehon, "Reconfigurable Computing", Elsevier publications, 2011.
2. Marco Lanzagorta, stphenbique, Robert Rosenberg, "Introduction to Reconfigurable supercomputing", Morgan &claypool publisher series, 2010.
3. Pao-Ann Hsiung, Marco D, "Reconfigurable system Design & verification", CRC press, 2009.

14EC3052 IP BASED VLSI DESIGN

Prerequisite : 14EC3025 CAD for VLSI Circuits
14EC3024 Low power VLSI Design
14EC3026 Testing and Testability

Credits 3:0:0

Course Objective

- To learn about IC manufacturing
- To analyse the combinational, sequential and subsystem design and to study about different floor planning techniques and architecture design
- To know about IP components at various design levels
- To have an introduction to IP design security

Course outcome

- Students will be aware of IP based components.
- Students will be able to design and analyse various combinational and sequential circuits and each IP component attach with it
- They will know about IP based protection technique**s**

Course Contents

IC manufacturing- IC design techniques- IP based design- reliability- Layout Design and tools- Logic Gates: Combinational Logic Functions, Switch Logic- Low power gates-Delay- Yield-Gates as IP-Combinational Logic Networks-Standard Cell based Layout- Combinational network delay- Logic and Interconnect design- Power optimization-Switch logic network, logic testing-Sequential Machine-System design and Clocking-Performance analysis- Power optimization, Design validation and testing; Image Sensors, Subsystems as IP-Floor planning methods-Global Interconnect- Floor plan design- Off-chip Connections- Architecture Design- GALS systems, Architecture Testing- IP Components- Design Methodologies- IP in reuse based design-Constrained based IP protection-Protection of data and Privacy-constrained based watermarking for VLSI IP based protection.

References

1. Wayne wolf, “Modern VLSI Design: IP-based Design”, Pearson Education, 2009.
2. Qu gang, Miodragpotkonjak, “Intellectual Property Protection in VLSI Designs: Theory and Practice”, Kluwer Academic Publishers, 2003.
3. W. Wolf, "Modern VLSI Design: IP-Based Design," Prentice Hall, 4th Ed., 2008.

14EC3053 DESIGN OF SEMICONDUCTOR MEMORIES

Prerequisite: 14EC3020 CMOS VLSI Design

Credits 3:0:0

Course Objective

- To understand the importance of design and testing of memories.
- To know about the functionality of different types of memories and the methods of testing it.
- To know about the emerging techniques in design of memories.

Course outcome

- Students will have the knowledge about recent developments in memories
- Students will be capable of designing and testing semiconductor memories.
- Students will have the knowledge to optimize the parameters in memory design.

Course Contents

Random Access Memory Technologies – SRAM , DRAM – Non Volatile Memories – MRAM, PROM, EPROM, EEPROM, Flash memories - RAM Fault Modeling – RAM Electrical Testing - IDDQ Fault modeling and testing – Application Specific Memory Testing – Volatile and Non Volatile memory Reliability issues – Radiation effects – Radiation Hardening Techniques – Advanced memory technologies – FRAM-GaAs–FRAM- MRAM-Analog memories – Experimental Memory Devices.

References

1. Ashok K.Sharma, " Semiconductor Memories Technology, Testing and Reliability ", Wiley-IEEE Press, August 2002.
2. TegzeP.Haraszti, "CMOS Memory Circuits", Kluwer Academic publishers, 2001.
3. Betty Prince, " Emerging Memories: Technologies and rends", Kluwer Academic publishers, 2002.

14EC3054 HARDWARE DESIGN VERIFICATION TECHNIQUES

Prerequisite: 14EC3004 Hardware Description Languages

Credits 3:0:0

Course Objective

- To understand the difference between verification and testing.
- To know about verification tools and plan.
- To learn about architecting test benches.

Course outcome

- Students will know the difference between verification and testing
- Students will be capable of writing test benches to verify circuits.
- Students will be capable of doing self checking of circuits.

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Course Contents

Functional Verification Approaches-Testing Versus Verification- Verification and Design Reuse - Linting Tools-Simulators-Third Party Models-Waveform Viewers-Code Coverage-Issue- Tracking Metrics - Verification plan-Levels of Verification-Verification Strategies –Specification Features – Test cases -Test Benches - Simple Stimulus-Output Verification –Self Checking Test Benches -Reusable Verification Components – VHDL and Verilog Implementation

References

1. Janick Bergeron, "Writing Test Benches Functional Verification of HDL Models" Springer 2nd Edition Feb 2003.
2. Andreas Meyer, "Principles of Functional Verification" Elsevier Inc.,2004 .
3. Amir Palnitkar, "Design Verification with e" Prentice Hall 1st Edition ,2003.

14EC3055 HIGH SPEED VLSI DESIGN

Prerequisite : 14EC3020 CMOS VLSI Design

Credits 3:0:0

Course Objective

- To learn in detail about non clocked and clocked logic styles, Latching Strategies and Asynchronous Clocking Techniques
- Will get knowledge about clock jitter skew
- Will know about clock generation and clock distribution

.

Course outcome

- Students can design any high speed VLSI Circuit.
- Will be having knowledge of different logic styles.
- Can design different circuits by considering clock jitter and clock skew**.**

Course Contents

Non-Clocked logic styles- Clocked Logic Styles - Circuit Design Margin-Design Variability- Latching Strategies-Asynchronous Latch Techniques-Interface Techniques- Clock Jitter and Skew – Clock Generation – Clock Distribution – Single Phase Clocking – Multi-Phase Clocking- Asynchronous Techniques.

References

1. Kerry Bernstein & et.al, “High Speed CMOS Design Styles”, Kluwer Academic Publishers, 2001.
2. Evan Sutherland, Bob Stroll, David Harris, “Logical Efforts, Designing Fast CMOS Circuits”, Kluwer Academic Publishers, 1999.
3. Howard Johnson and Martin Graham, "High Speed Digital Design: A Handbook of Black Magic”,3rd Edition, Prentice Hall Modern Semiconductor Design Series, 2006
4. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996

14EC3056 ANALOG VLSI DESIGN

Prerequisite: 14EC3021 Analysis and Design of Analog Integrated Circuits

Credits 3:0:0

Course Objective

- To learn about device modeling.
- To analyze and learn about various types of analog systems including ADC and DAC.
- To learn about CMOS amplifiers and Comparators..

Course outcome

- Students will gain knowledge in device modeling.
- Students will be able to understand the concepts of analog design.
- They will be able to design various analog systems including DAC,ADC and Comparators**.**

Course Contents

Device Modeling: MOS Models-Bipolar Models- Analog Signal Processing-Digital-to-Analog Converters: Current Scaling- Voltage Scaling and Charge Scaling- Analog to Digital Converters: Serial A/D Converters- Successive Approximation A/D –Parallel High Performance A/D Converters –Continuous Time Filters: Low Pass Filters- High Pass Filters- Band Pass Filters.-Switched Capacitor Filters-CMOS Amplifiers: Differential Amplifiers- Cascode Amplifiers-Current Amplifiers-Output Amplifiers-High-Gain Amplifier Architectures-Comparators.

References

1. Philip E. Allen, Douglas R. Halberg, “CMOS Analog Circuit Design”, Oxford University Press, 2nd Edition, 2003.
2. Randall L.Geiger, Philip E.Allen, Noel K.Strader, “VLSI Design Techniques for Analog and Digital Circuits”, McGraw Hill International Co, 1990.
3. YannisTsividis, “Mixed Analog – Digital VLSI Device and Technology” World scientific publishing Co. Pvt. Ltd., 2002
4. P. V. Ananda Mohan, “VLSI Analog Filters: Active RC, OTA-C and SC”, Birkhauser 2012.

14EC3057 CMOS MIXED SIGNAL CIRCUIT DESIGN

Prerequisite: 14EC3020 CMOS VLSI Design
14EC3021 Analysis and Design of Analog Integrated Circuits

Credits 3:0:0

Course Objective

- This course aims to introduce the problems in implementing both analog and digital circuits in a single silicon wafer.
- Students will learn about PLL and analog multiplier.
- Students will learn about the modeling approach of ADC and DAC.

Course outcome

- Students will gain knowledge in PLL and analog multiplier.
- Students will be able to design Data Converters.
- Students will be designing Op-amps used in Data Converters.

Course Contents

Analog Multiplier Design- PLL-Simple PLL-Charge-pump PLL-Applications of PLL-Data Converter Modeling-Sampling and Aliasing : A Modeling Approach- Data Converter SNR: Effective Number of Bits-Clock Jitter-Improving SNR using Averaging-Decimating Filters for ADCs-Interpolating Filters for DACs-Using Feedback to improve SNR-Submicron CMOS Circuit Design-Submicron CMOS Overview and Models-Digital Circuit Design-Analog Circuit Design-Op-amp design-Circuit Noise-Implementing Data Converters:R-2R Topologies for DACs-Topologies without an op-amp-Op-amps in Data Converters.

References

1. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, 2001.
2. Razavi, “Principles of data conversion system design”, S.Chand and company ltd, 2000.
3. Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2002.
4. Gregorian, Temes, “Analog MOS Integrated Circuits for signal processing”, John Wiley & Sons,1986.
5. Baker, Li, Boyce, “CMOS : Circuit Design, layout and Simulation”, PHI, 2000.

14EC3058 VLSI CIRCUITS FOR BIO-MEDICAL APPLICATIONS

Prerequisite: 14EC3020 CMOS VLSI Design

Credits 3:0:0

Course Objective

- To give the essential knowledge and techniques for designing VLSI circuits for biomedical applications.
- Students learn about CMOS circuits for wireless medical applications.
- Students learn about the Integrated Circuits for Neural Interfacing**.**

Course outcome

- Students will be able to understand the CMOS circuits for wireless medical applications.
- Students will be able to design low power compact VLSI circuits for biomedical applications.
- Students will be able to design Neuro Mimetic Integrated Circuits.

Course Contents

Neuro chemical sensing- Neuro potential sensing-Telemetry system- -Multimodal electrical and chemical sensing-Prothesis exterior body Unit and wireless link- Body implantable unit- CMOS circuits for implantable devices-CMOS circuits for wireless medical applications- Integrated circuits for Neural Interfacing- Neuro Mimetic Integrated Circuits.

References
1. Krzyszt of Iniewslei, “VLSI Circuits for Bio Medical Applications”, Artech House Publishers, 2008.
2. Rahul Sarpeshkar, "Ultra Low Power Bioelectronics: Fundamentals, Biomedical Applications, and Bio-inspired Systems", Cambridge University Press, 2010.
3. E. Sanchez-Sinencio and A. G. Andreau “Low-voltage/Low-power Integrated Circuits and Systems “, Wiley,1998

14EC3059 VLSI FOR WIRELESS COMMUNICATION

Prerequisite: 14EC3021 Analysis and Design of Analog Integrated Circuits
14EC3056 Analog VLSI Design

Credits 3:0:0

Course Objective
- To study the design concepts of low noise amplifiers.
- To study the various types of mixers designed for wireless communication.
- To understand the concepts of CDMA in wireless communication

Course outcome
- Students will be able to design any VLSI circuits for wireless applications.
- Students will be able to design LNA and mixers.
- Students will be able to design CDMA in wireless communication.

Course Contents
Integrated inductors- resistors- MOSFET and BJT amplifier design- Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers-Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer- Switching Mixer - Distortion in Unbalanced Switching Mixer - Conversion Gain in Unbalanced Switching Mixer- Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example- Data converters in communications, Adaptive Filters-Equalizers and transceivers-Implementations of CDMA System **.**

References
1. B.Razavi ,”RF Microelectronics” , Prentice-Hall ,1998.
2. Bosco H Leung “VLSI for Wireless Communication”, Pearson Education, 2002.
3. Thomas H.Lee, “The Design of CMOS Radio –Frequency Integrated Circuits’, Cambridge University Press ,2003.
4. Emad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design Circuits and Systems”,Kluwer Academic Publishers, 2000.
5. BehzadRazavi, “Design of Analog CMOS Integrated Circuits” McGraw-Hill, 1999.
6. J. Crols and M. Steyaert, “CMOS Wireless Transceiver Design,” Boston,Kluwer Academic Pub., 1997.

14EC3060 DATA CONVERTERS

Prerequisite : 14EC3021 Analysis and Design of Analog Integrated Circuits
14EC3056 Analog VLSI Design

Credits 3:0:0

Course Objective
- To learn the various techniques& architectures of D/A Converters.
- To learn the various techniques& architectures of A/D Converters.
- To study about the S/H circuit and testing of A/D and D/A Converters.

Course outcome

- Will be able to develop low power and High speed A/D Converters.
- Will be able to develop low power and High speed D/A Converters.
- Will be able to test low power and High speed A/D and D/A Converters.

Course Contents

Data Converter - Fundamentals & Specifications of Converters- High Speed A/D Converters & D/A Converters: Design problems-Full-flash converters-Twostep flash converters--Pipeline converter architecture-High speed D/A converter architecture- Voltage weighting based architecture-High Resolution A/D Converters- High Resolution D/A converters: Pulse width modulation D/A converters- Integrating D/A converters- Current weighting using ladder networks- Sample and hold amplifiers: Basic Sample –and –Hold Configuration-Integrating S/H Circuit-Switched Capacitor S/H circuit- Sigma-delta A/D conversion - General Filter Architectures-Discussion of Basic Converter Architectures-Multi Stage Sigma-Delta Converter (MASH)-DC Testing of D/A Converters-Dynamic Testing of A/D Converters.

References

1. Rudy van de Plassche, "CMOS Integrated Analog to Digital and Digital to Analog Converters", Springer International Edition, Second Edition, 2007.
2. Jacob Baker. R, Harry W. Li, David E. Boyce, "CMOS Circuit Design, Layout and Simulation", IEEE Press, Fifth Edition, 2003.
3. Randall L.Geiger, Philip E.Allen, Noel K.Strader, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill International Co, 1990.

14EC3061 SIGNAL INTEGRITY FOR HIGH SPEED DEVICES

Credits 3:0:0

Course Objective

- To learn the fundamental and importance of signal integrity.
- To analyze and minimize cross talk in unbounded conductive media.
- To study about the different types of Di-Electric materials.
- To learn about differential cross talk and CMOS based transmission line model

Course outcome

- Students will be able to implement signal integrity principles in the design of high speed circuits.
- To analyze about the different types of Di-Electric materials.
- To implement ESSD protection Circuits.

Course Contents

The importance of signal integrity-New realm of bus design-Electromagnetic fundamentals for signal integrity-Maxwell equations - common vector operators-Wave propagations-Electrostatics-Magneto statics-Power flow and the poynting vector-Reflections of electromagnetic waves- Introduction -Mutual inductance and capacitance-Coupled wave equation-coupled line analysis-Modal analysis-Cross talk minimization signal propagation in unbounded conductive media-Classic conductor model for transmission model- Di-electric materials- Removal of common mode noise-Differential Cross talk-Virtual reference plane-Propagation of model voltages common terminology-Drawbacks of Differential signaling- Introduction- non ideal return paths-Vias-IO design consideration-Push-pull transmitter-CMOS receivers-ESSD protection circuits-On chip Termination.

References

1. StephenHall,HowardL.Heck,"Advanced Signal Integrity for High-Speed Digital Designs" ,Wiley Publishers,2009.
2. JamesEdgar Buchanan, " Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS",McGraw-Hill,1996

14EC3062 NANO SCALE FET

Prerequisite: 14EC3023 Solid State Device Modelling and Simulation

Credits 3:0:0

Course Objective

- To understand the necessary of scaling of MOS transistor and to introduce the concepts of nanoscale MOS transistor concepts.
- To study their performance characteristics.
- To study the various nano scaled MOS transistors.

Course outcome

- Students will get an in-depth knowledge about different MOSFETs, its characteristics and the scaling methods.
- Students can design the new Nanoscale devices for high frequency and low power VLSI circuits and Microwave applications .
- They will get good base on circuit level performance of different FETs in analog and digital applications

Course Contents

Introduction to novel MOSFETs and different scaling methods-Physics of Multigate MOS system, MOSFET IV characteristics, and other effects of FETs-Nanowire FETs and transistors at the molecular Scale- Radiation effects in SOI MOSFETs along with scaling effects-Circuit design using Multigate devices- Analog and digital Circuits and its performances.

References

1. J P Colinge, FINFETs and other multi-gate transistors, Springer – Series on integrated circuits and systems, 2008
2. Mark Lundstrom Jing Guo, Nanoscale Transistors: Device Physics, Modeling and Simulation, Springer, 2006.
3. David Esseni, Palestri, Selmi "Nanoscale MOS Transistors: Semi-Classical Transport and Applications", Cambridge University Press 2011.
4. Gary Wiederrecht, "Handbook of Nanoscale Optics and Electronics"
5. M S Lundstorm, Fundamentals of Carrier Transport, 2nd Ed., Cambridge University Press, Cambridge UK, 2000.
6. "Low-Power High-Level Synthesis for Nanoscale CMOS Circuits", Saraju P. Mohanty, NagarajanRanganathan, Elias Kougianos, PriyardarsanPatra, Springer, 2008.
7. J.P. Colinge "FinFETs and Other Multi-Gate Transistors", Springer, 2007

14EC3063 NANOSCALE DEVICES AND CIRCUIT DESIGN

Prerequisite: 14EC3023 Solid State Device Modelling and simulation
14EC3062 Nanoscale FET/14NT3009 Nanoscale Transistors

Credits 3:0:0

Course Objective

- To learn about leakage current and its control and reduction techniques in CMOS devices.
- To understand the device technologies for sub 100nm CMOS and device scaling of single and Multigate MOSFETs.
- To familiarize the low power design and voltage scaling issues in Nano scale devices.
- Study about various NANO-scale devices and design CMOS circuit using non-classical devices.

Course outcome

- Students can understand the current trend in the Nanotechnology in the Electronics.

- Students can understand the applications of various NANO-scale devices.
- They can design new emerging devices.

Course Contents

CMOS scaling challenges in Nano Scale regimes and emerging CMOS technologies. Device scaling and ballistic MOSFET and different scattering mechanisms. Emerging Nanoscale devices such as silicon and heterostructurenano wire MOS, CNT MOSFET, SET, RTD etc. Nanoscale CMOS design and performance optimization for data paths-Nanoscale circuits- Statistical circuit design and CMOS Circuit design using non classical devices.

References

1. Lundstrom, M., “Nanoscale Transport: Device Physics, Modeling, and Simulation”, Springer. 2000
2. Maiti, C.K., Chattopadhyay, S. and Bera, L.K., “Strained-Si and Hetrostructure Field Effect Devices”, Taylor and Francis, 2007
3. Hanson, G.W., “Fundamentals of Nanoelectronics”, Pearson, India., 2008.
4. Wong, B.P., Mittal, A., Cao Y. and Starr, G., “Nano-CMOS Circuit and Physical Design”, Wiley, 2004
5. Lavagno, L., Scheffer, L. and Martin, G., “EDA for IC Implementation Circuit Design and Process Technology”, Taylor and Francis, 2005.
6. SandipKundu, AswinSreedhar, McGraw Hill Professional, “Nanoscale CMOS VLSI Circuits: Design for Manufacturability”, 2010.
7. Niraj K. Jha, Deming Chen Springer, “Nanoelectronic Circuit Design” 2010.

14EC3064 PHOTONICS

Credits 3:0:0

Course Objective

- To understand deeply about photonics along with Plasmonics.
- To understand about Nanophotonics, Biophotonics and photonic crystals.

Course outcome

- The students will deeply get knowledge on photonics along with Plasmonics.
- They will get knowledge on Nanophotonics, Piophotonics and Photonic crystals.

Course Contents

Quantum confined materials-Plasmonics based on surface plasmon resonance new approaches in Nanophotonics-Near-field scanning optical microscopy-Biophotonic- DNA protein interactions and Photonic crystals- Photonic Crystal Laser- PC based LEDs- Photonic crystal fibers (PCFs).

References

1. H.Masuhara, S.Kawata and F.Tokunaga, “ NanoBiophotonics”, Elsevier Science, 2007.
2. V.M. Shalaev and S.Kawata, “Nanophotonics with Surface Plasmons (Advances in Nano-Optics and Nano-Photonics)”, 2007.
3. B.E.A. Saleh and A.C.Teich, “Fundamentals of Photonics”, John-Weiley& Sons, New York, 2nd edition,2007.
4. M.Ohtsu, K.Kobayashi, T.Kawazoe, and T.Yatsui, “ Principles of Nanophotonics(Optics and Optoelectronics)”, University of Tokyo, Japan, 2003.
5. P.N. Prasad, “ Introduction to Biophotonics”, John Wiley & Sons, 2003.
6. J.D.Joannopoulos,Steven G.Johnson, R.D.Meade and J.N.Winn, “ Photonic Crystals”, Princeton University Press, 2nd edition,2008.

14EC3065 COMMUNICATION AND SWITCHING TECHNIQUES

Credits: 3:0:0

Objective:

- To learn switching, signalling and traffic in the context of telecommunication network.
- To explore the evolution of switching systems from manual and electromechanical systems to stored-program-controlled digital systems.

Outcome:

The student will be able to

- learn about the various switching techniques in the telecommunication network.
- understand the concepts of telecommunication traffic.

Course Contents

Introduction: The development and basic of telecommunications-multiplexing schemes - evolution of switching systems and telecommunications traffic: switching techniques- switching system evolution-traffic - mathematical model-lost call systems-queuing systems-simulation-switching networks: link systems-grades of service- graph theory systems- switching networks-control of switching systems: call processing functions-stored program control -signaling-packet switching: statistical multiplexing- networks-routing-network management.

References:

1. V.S.Bagad, Telecommunications Switching Systems and Networks, Technical publication pune, 2009, First edition .
2. ThiagarajanViswanathan, Telecommunication Switching Systems and Networks, Prentice Hall of India, Twenty sixth printing, 2006.
3. Robert G.Winch, Telecommunication Transmission System, Second Edition, Tata Mcgraw-hill Education Private Ltd, 2004.
4. Wayne Tomasi, Advanced Electronics Communication System, Sixth edition, Prentice Hall of India, 2003.
5. J.E.Flood, Telecommunications Switching, Traffic and Networks, Pearson Education, 1999, Second Impression 2007.

14EC3066 ADVANCED COMMUNICATION ENGINEERING

Credits: 3:0:0

Course Objectives:

- To impart depth knowledge on the basic concepts of modern data communications systems and networks
- To provide better understanding of optical fibre transmission, satellite and microwave radio communication

Course Outcome:

- The student will be able to
- get in-depth knowledge about digital modulation techniques and systems
- get knowledge about components, architecture, protocols and topology of data communications
- understand the working principles of optic fiber and satellite communication

Course Contents

Information capacity-Digital modulation techniques- Trellis Code Modulation-Pulse Modulation- PCM, DPCM, DM - Vocoders-Pulse Transmission - Data Communications – Network Architecture- Open System Interconnection - Serial and Parallel Data Transmission-Codes- Character Synchronization-Data communication hardware – Modems - Protocol Functions - Data link protocols-PSDN-CCITT X.25 User to Network Interface Protocol-ISDN-ATM-LAN-Ethernet - TDM–Statistical TDM – FDM–WDM - EM spectrum - Optical fiber communications system –Fiber types- Configurations -Classifications-Losses - Sources and Detectors-Lasers – Microwave radio communications – Satellite communication – Spacing and Frequency Allocation–Radiation Patterns – Link Models.

References:

1. Wayne Tomasi, Advanced Electronic Communication Systems, Sixth Edition, Prentice Hall of India, 2005.
2. Simon Haykins, Communication Systems, Fifth Edition, Wiley Publications, 2009.
3. George Kennady, Bernard Davis, Electronic communication systems, Fourth Edition, Tata McGraw Hill. Reprint 2008.
4. Hebert Taub, Donald L Schilling, Principles of Communication Systems, Third Edition, Tata McGraw Hill, 2008.
5. Timothy Pratt, Satellite Communications, Second Edition, John Wiley & Sons, Reprint 2008.
6. Ray Horak, Communication Systems and Networks, Third Edition, Wiley Publications,2002.

14EC3067 EMBEDDED SYSTEM LAB

Co-Requisite: 14EC3002 Advanced Embedded Systems

Credits 0:0:1

Course Objectives

- To perform various mathematical and logical operations
- To learn interfacing of external circuits with ARM processor
- Expertise in Keil software.

Course outcome

Upon completion of the course, student will able to

- Understand the basic functionality of embedded system
- Design and implement real time embedded systems using ARM processor
- Using Keil software for the project work.

Experiments:

The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3068 SIGNAL PROCESSING LAB

Co-Requisite: 14EC3005 Advanced Digital Image Processing

Credits 0:0:1

Course Objectives

- Better understanding on image processing fundamentals
- To implement various image processing algorithms
- To learn basics of MATLAB/ Image processing tool box

Course outcome

Student will able to

- design and test image processing algorithms
- take up real time projects in image processing area
- expertise in MATLAB/Image processing tool box.

Experiments:

The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3069 ADVANCED DIGITAL SIGNAL PROCESSING LAB

Co-Requisite: 14EC3001 Statistical Digital Signal Processing
14EC3010 Data Compression Techniques

Credits 0:0:2

Course Objective

- To find the power spectrum by using Periodogram, Modified Periodogram, Barlett& Welch method.
- To design linear predictive system, Whitening filter, Inverse filter &Kalman filter and compression algorithms.

Course outcome

- Find power spectrum and analyze the performance.
- Design various digital filters and analyze their performance.

Experiments : The faculty conducting the laboratory will prepare a list of 6 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3070 NANOELECTRONICS AND VLSI DESIGN

Credits: 3:0:0

Course Objective:

- To learn about the various aspects of nanoelectronics.
- The objective of this course is to make the students familiar with the properties behaviour and applications and implementation microelectronic technology into integrated circuits.
- To understand the integrated electronics with its advanced technologies methods.

Course Outcome:

- Student will be familiarized with the principle of operation, capabilities and applications and implementation of electronic technology into integrated circuits.
- Students will understand the concepts behind ICs with advanced techniques
- Students will have indepth knowledge on MOS technology

Course Contents:

Semiconductor Physics - digital electronics - capabilities of nanoelectronics, Quantum electron devices - short channel MOS transistor – split gate transistor - Principles of Single Electron Transistor (SET) – SET circuit design – Replacement Technologies – Physical limits - electronic noses - semiconductor sensor array - Logic Devices, Electron Devices for Logic Applications - Introduction to MOS Technology - electrical properties of MOS circuits – CMOS Inverter - Layout Design - Tools for VLSI Design - CMOS Design Projects & Fast VLSI Circuits – Lithography process - Final objectives of integrated chip and systems.

Reference Books:

1. K. Goser ,Nanoelectronics and Nanosystems: From transistors to Molecular and Quantum Devices by (Edition, 2004), Springer. London.
2. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse ,Nanotechnology: basic science and emerging technologies –, Overseas Press (2005)
3. Rainer Waser (ed) ., Nanoelectronics and information technology : Advanced electronic materials and novel devices (2nd edition) Wiley VCH Verlag Weiheim (2005)
4. Ramon Pallas-Areny, John G. Webster John, Sensors and signal conditioning, 2nd edition, Wiley & Sons ,2001.
5. Geiger R.L., Allen P.H., & Starder N.R., “VLSI Design Techniques For Analog & Digital Circuits”, McGraw Hill International Edition, 1990.
6. Douglas A. Pucknell and Kamran Eshraghian, Basic VLSI Design Systems and Circuits, Prentice Hall of India Pvt. Ltd., 2003

14EC3071 DIGITAL IMAGE PROCESSING

Credits 3:0:0

Course objective

- To introduce the fundamentals of digital image processing
- To study the techniques for improving the quality of spoilt images and segmenting image components
- To deal with the compression of images to save storage space

Course outcome

- Confidence to perform an image processing task for a specific application
- Ability to utilize the knowledge gained in the field of Bio medical imaging
- Ability to use the knowledge gained for improving the resolution of images

Course Contents

Review of image processing, 2D transforms - DFT, DCT, KLT-Basic gray level transformation, Histogram processing, Enhancement using arithmetic/logic operations, Smoothing and Sharpening - spatial and frequency domain filters, Homomorphic filtering, Color transformations-Image Degradation/Restoration model, Noise probability density functions, Mean and order statistics filters, Linear, position-invariant degradations, Estimating the degradation function, Inverse, Wiener and Constrained Least Squares filtering, Geometric transformations.-Morphological operators, Morphological algorithms, Edge detection, Edge linking and boundary detection, Thresholding–global and adaptive, Region based segmentation, Watershed segmentation, Use of motion in segmentation

References

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education Inc., Second Edition, 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education Inc., 2002.
3. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing using MATLAB, 2 Edition", Tata McGraw Hill, 2010.
5. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", Tata McGraw Hill, 2009.
6. S.Sridhar, "Digital Image processing" Oxford University Press, 2011

14EC3072 ADVANCED DIGITAL SIGNAL PROCESSING

Credits: 3:0:0

Course Objective:

- To introduce the fundamental concepts of signals, systems and signal processing.
- To impart knowledge on the concepts of Fourier Transforms
- To cover the types of digital filters that is fundamental to a wide variety of application areas.

Course Outcome:

- Perform operations on signals and determine the characteristics of a system.
- Obtain the spectrum of a signal using Fourier Transforms
- Design digital filters for practical applications

Course Contents:

Signals and systems classifications- system concepts- Types- system model representation-convolution-controllability - Discrete Time Signals in Transform Domain - Discrete Fourier Transform, Fast Fourier Transform, Z Transform-Digital Filters: Design and Realization of Infinite Impulse Response (IIR) and Finite Impulse Response (FIR) digital filters.-Multirate Signal Processing - Interpolation and Decimation, Polyphase filter structures, Application

References

1. John .G.Proakis, “Digital Signal Processing Principles, Algorithms and Applications”, Addision Wesley, USA, 2006.
2. Sanjit .K. Mitra “Digital Signal Processing A Computer based approach”, Tata McGraw, New Delhi, 2007
3. Emmanuel C.Ifeachor “Digital Signal Processing A Practical Approach”, Addison – Wesley, California, 2002.

14EC3073 FPGA DESIGN FOR INDUSTRIAL APPLICATIONS

Credits: 3:0:0

Course Objective:

- To introduce the Hardware Description Languages.
- To learn the Programmable Logic Devices.
- To deal with design of combinational & sequential logic circuits in FPGA.

Course Outcome:

- Design the different programmable logic devices.
- Write the program in VHDL.
- Implement digital systems in FPGA

Course Contents:

Programmable logic devices - Types of ASICs, Type of FPGA, Introduction to VHDL, Basic concepts, Identifiers, Data operators, Data types, data objects, Behavioral modeling, Data flow modeling, Structural modeling, VHDL code for controlling level, temperature, and flow process.

References

1. Stephen Brown and Zvonk Vranesic “Fundamentals of Digital Logic with VHDL Deisgn” Tata McGraw Hill, New Delhi 2007.
2. Charles H. Roth Jr. “Fundamentals of Logic design” Jaico Publishing House Mumbai, 2004.
3. Parag K Lala, “Digital System design using PLD” BS Publications, Hyderabad,2003
4. J. Bhaskar, “A VHDL Synthesis Primer”, BS Publications, Hyderabad, 2004.
5. M.J.S .Smith, "Application Specific Integrated Circuits”, Addison Wesley LongmanInc., New Delhi, 2006.

14EC3074 FPGA CONTROL DESIGN LABORATORY

Co-requisite: FPGA Design for Industrial Applications

Credit: 0:0:2

Course Objective:

- To illustrate theoretical concepts and to give the students the opportunity to build and test the digital systems.
- To learn the use of the Xilinx 9.2 ISE tool for designing and implementing digital systems on FGPA.
- To allow one to capture designs, simulate, implement and test circuits for control applications.

Course Outcome:

- Apply theoretical concepts to build digital systems.
- Design combinational and sequential digital systems.
- Analyze the various control process and implement the same in FPGA

Experiments:

The faculty conducting the laboratory will prepare a list of 12 experiments and get the approval of HOD/Director and notify it at the beginning of each semester.

14EC3075 MEDICAL SIGNAL PROCESSING

Credits: 3:0:0

Course Objective:

- To understand physiological parameters
- To discuss data reduction and techniques
- To introduce matlab programming

Course Outcome:

- Identify the method to interface biosignals in medical applications
- Interface image processing signals with embedded systems
- Analyze bio signals

Course Contents:

Introduction to Bio-Medical Signals **-** The nature of Bio-Medical Signals, objectives of Bio-Medical signal analysis, Cardiological Signal Processing**:** ECG signal and its characteristics - Review of Wiener filtering problem, principle of adaptive filter, adaptive noise canceller, cancellation of 60Hz interference in ECG, cancellation of ECG signal from the EMG of chest muscle, cancellation of maternal ECG in fetal ECG, cancellation of high frequency noise in electro surgery, Data Reduction Techniques, special effects and applications in Bio-Medical signal processing, filter design and applications in Bio-Medical signal processing.

References:

1. Biomedical Signal Processing: Principles and Techniques, D.C.Reddy, Tata McGraw-Hill Education, 2005

14EC3076 EMBEDDED SYSTEMS FOR BIOMEDICAL INSTRUMENTATION

Credits: 3:0:0

Course Objective:

- To introduce the basic concepts of embedded systems and applications to biomedical instrument design
- To study various software tools for embedded Systems with real time examples.
- To learn the concepts of interfacing issues with real time signals.

Course Outcome:

- Design and Analyze the systems for disease diagnosis and treatment methods
- Apply real time models and languages in medical image processing applications
- Analyze interface issues related to embedded systems.

Course Contents:

Definitions - Software tools for designing an embedded systems, Design process in embedded system, Interface issues related to embedded systems, Embedded software development process and tools, Host and target machine, Simulation and Emulation of embedded systems, Java based embedded system design, embedded implementation of patient motoring system, body sensor networks, wireless technology for biomedical applications Case studies in medical signal and image processing, embedded system development for classifying and diagnosis of diseases.

References

1. RajKamal, "Embedded Systems Architecture, Programming and Design", Tata McGrawHill, Second Edition, 2008.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2005.
3. Frank Vahid, Tony Givargis, "Embedded Systems Design", Wiley India, 2006
4. Tim Wilhurst, "An Introduction to the Design of Small Scale Embedded Systems, Palgrave, 2004.
5. Webster J.G, "Medical Instrumentation application and design", John Wiley and sons, New York 3rd edition, 1999.
6. Kavyan Najarian and Robert Splerstor, "Biomedical signals and Image processing", CRC press, Taylor and Francis, New York, 2006.

14EC3077 EMBEDDED NETWORKING

Credits: 3:0:0

Course Objective:
- To impart knowledge on Serial and parallel communication protocols
- To understand the USB and CAN bus for PIC microcontrollers
- To understand the Embedded Ethernet for Rabbit processors.

Course outcome:
- Build application projects using USB and CAN bus
- Develop applications using Embedded Ethernet for Rabbit processors.
- Apply the networking concepts to real time projects.

Course Contents:
Embedded Networking- Introduction, Serial communication, Synchronous Serial Protocols, Inter Integrated Circuits, USB AND CAN BUS, Data flow types, Enumeration, Descriptors, PIC 18 Microcontroller, Types of errors, Nominal Bit Timing, Building a Network: Hardware options, Cables, Connections and network speed, Ethernet Controllers, Exchanging messages using UDP and TCP .

References

1. Frank Vahid, Givargis ‘Embedded Systems Design: A Unified Hardware/Software Introduction’, Wiley Publications
2. Jan Axelson, ‘Parallel Port Complete’ , Penram publications, 2010
3. Dogan Ibrahim, ‘Advanced PIC microcontroller projects in C’, Elsevier 2008
4. Jan Axelson ‘Embedded Ethernet and Internet Complete’, Penram publications, 2007
5. Bhaskar Krishnamachari, ‘Networking Wireless Sensors’, Cambridge press 2005

14EC3078 REAL TIME AND EMBEDDED CONTROL AUTOMATION

Credits: 3:0:0

Course Objective:
- To introduce the basic concepts of Embedded Systems and interface issues.
- To understand the various techniques used for Embedded Systems with real time examples .
- To learn the real time models, languages and operating systems.

Course Outcome:
- Classify the different techniques in embedded systems.
- Analyze real time examples.
- Design embedded systems for real world applications

Course Contents:
System Design- Definitions, Overview of microprocessors, Controllers and DSPs, Architecture and typical applications, Interface issues related to embedded systems- relays, dc motor, stepper motor- techniques for embedded systems: state machine and state tables in embedded design, event based, process based and graph based models, high level language descriptions of software for embedded system, java based embedded system design, real time models, language and operating systems: real time languages, real time kernel, os tasks, task states, task scheduling, interrupt processing, clocking communication and synchronization, control blocks, memory requirements and control, kernel services, micro c/os – II Real Time Operating System: study of micro c/os. II RTOS, RTOS system level functions, task service functions, time delay functions, memory allocation related functions, semaphore related functions, mailbox related functions, queue related functions

References

1. RajKamal, “Embedded Systems Architecture, Programming and Design”, Tata McGrawHill , Second Edition, 2008.

2. Tim Wilhurst, “An Introduction to the Design of Small Scale Embedded Systems, Palgrave, 2004.
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2005.
4. Frank Vahid, Tony Givargis, “Embedded Systems Design”, Wiley India, 2006.