11th BOS 13 Jan 2015

SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY

COURSE STURCTURE

M. TECH. ICT

SPECIALIZATION:

Embedded Systems

GAUTAM BUDDHA UNIVERSITY
GAUTAM BUDH NAGAR, GREATER NOIDA
2014-2015

SEMESTER- I

Sr.No	Course Code	Courses	L-T-P	Credits
		THEORY		
1	EC537	Embedded Systems Concepts and Design	3-1-0	4
2	CS523	Advanced Computer Architecture	3-1-0	4
3	EC539	Advanced Digital Signal Processing	3-1-0	4
4	CS527	Research Techniques in ICT	3-0-0	3
5	SS101	Human Values & Buddhist Ethics	2-0-0	2
		PRACTICALS		
6	EC589	Advanced Digital Signal Processing Lab	0-0-3	2
7	EC587	Embedded System Lab	0-0-3	2
8	GP531	General Proficiency	---	1
		Total	14-3-6	22
		Total Contact Hours	23	

SEMESTER- II

Sr. No.	Course Code	Courses	L-T-P	Credits
		THEORY		
1	MA402	Modeling and Simulation	3-1-0	4
2	EC560	VLSI Architecture	3-0-0	3
3	EC564	Software for Embedded Systems	3-0-0	3
4	EC566	Real Time Systems	3-0-0	3
5		Elective-1	3-0-0	3
		PRACTICALS		
6	EC586	VLSI Architecture Lab	0-0-3	2
7	EC592	Project	0-0-10	5
8	GP532	General Proficiency	---	1
		Total	**15-1-13**	**24**
		Total Contact Hours	29	

Electives (1)

Sr.No	Course Code	Courses
1	EC538	Analog IC design
2	EC552	CMOS Digital IC Design
3	EC554	Embedded Systems for Wireless and Mobile Communication
4	EC556	VLSI Technology
5	EC558	Embedded C
6	EC570	System Specifications and Modeling
7.	EC572	Elements of System Reliability
8.	CS 598	Embedded Linux
9.	EC548	System on Chip

SEMESTER – III

Sr. No.	Course Code	Courses	L-T-P	Credits
		THEORY		
1	EC661	FPGA Architecture and Applications	3-0-0	3
2	EC663	Hardware Software Co design	3-0-0	3
3		Elective-2	3-0-0	3
4		Elective-3	3-0-0	3
		PRACTICALS		
5	EC683	Hardware Software Co Design Lab	0-0-3	2
7	EC691	Dissertation Part-I	0-0-14	7
8	GP631	General Proficiency	---	1
		Total	**12-0-17**	**22**
		Total Contact Hours	29	

Electives (2 & 3)

Sr.No	Course Code	Courses
1	EC653	Network for Embedded Systems
2	EC669	Algorithm for VLSI design Automation
3	EC657	Microelectronics
5	CS699	Robotics
6	CS661	Expert Systems Design
7	CS679	Fuzzy Set Theory
8	CS647	Software Maintenance
9	EC659	Microcontrollers for Embedded System Design
10	EC671	Microcontroller Based System Design
11	EC655	Sensor and Actuator

SEMESTER-IV

Sr. No	Course Code	Courses	L-T-P	Credits
1	EC690	Dissertation Part-II	---	21
2	GP632	General Proficiency	---	1
		Total	---	**22**

Grand Total Credits = 90

EMBEDDED SYSTEM CONCEPTS AND DESIGN			
Course Code:	**EC537**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

Unit I:

Overview of Embedded Systems: Characteristics of Embedded Systems. Comparison of Embedded Systems with general purpose processors. General architecture and functioning of micro controllers. 8051 micro controllers architecture,Programming of 8051 microcontroller.

PIC Microcontrollers: Architecture, Registers, memory interfacing, interrupts, instructions, programming and peripherals.

Unit II:

ARM Processors: Comparison of ARM architecture with PIC micro controller, ARM 7 Data Path, Registers, Memory Organization, Instruction set, Programming, Exception programming, Interrupt Handling, Thumb mode Architecture.

Unit III:

Bus structure: Time multiplexing, serial, parallel communication bus structure. Bus arbitration, DMA, PCI, AMBA, I2C, and SPI Buses.

Unit IV:

Embedded Software: Conceptual software for Real Time Systems, Software Quality Measurement, Compilers for embedded system.

Unit V:

RTOS: Embedded Operating Systems, Multi Tasking, Multi Threading, Real-time Operating Systems, RT-Linux introduction, RTOS kernel, Real-Time Scheduling.

Text Books:

1. Design with PIC Microcontrollers, John B. Peatman, Pearson Education Asia, 2002.
2. ARM System Developer's Guide: Designing and Optimizing System Software, Andrew N. Sloss, Dominic Symes, Chris Wright, Morgan Kaufman Publication, 2004.
3. Computers as components: Principles of Embedded Computing System Design, Wayne Wolf, Morgan Kaufman Publication, 2000.

References:

1. The Design of Small-Scale embedded systems, Tim Wilmshurst, Palgrave2003.
2. Embedded System Design , Marwedel ,Peter , Kluwer Publishers , 2004.

ADVANCED COMPUTER ARCHITECTURE			
Course Code:	**CS523**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

UNIT I

Introduction to parallel processing: parallelism in uniprocessor system, basic uniprocessor architecture, parallel processing mechanism, balancing of sub system bandwidth, multiprogramming and time sharing, parallel computer structures, pipeline computers, array computers, multiprocessor systems, dataflow computer concept, architectural classification scheme: multiplicity of instruction-data streams, serial versus parallel processing, parallelism versus pipelining, parallel processing applications, productive modeling simulation, engineering design and automation.

UNIT II

Principles of pipelining and vector processing: pipelining- an overlapped parallelism, principles of linear pipelining, clock period, efficiency, throughput, classification of pipeline processors, general pipeline and reservation tables.

UNIT III

Principles of designing pipeline processors: effect of branching, data buffering and bussing structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, reservation and latency analysis, collision free scheduling, state diagram, greedy cycle, pipeline schedule optimization, pipeline throughput, pipeline efficiency.

UNIT IV

Structure and algorithm for array processors: SIMD array processor, SIMD computer organization, inter – PE communication, SIMD interconnection network, static versus dynamic networks, cube interconnection network, shuffle-exchange omega networks, parallel algorithms and SIMD matrix multiplication.

UNIT V

Multiprocessor architecture and scheduling: functional structure, loosely coupled and tightly coupled multiprocessor, deterministic scheduling strategy, deterministic scheduling model, control flow versus data flow computer, data flow graphs and languages.

References Books:

1. Kai Hwang, “Advanced Computer Architecture”, Tata McGrawHill Edition
2. Kai Hwang and Faye A. Briggs, “Computer Architecture and Parallel Processing”, McGraw-Hill International Edition
3. Richard Y. Kain, “Advanced Computer Architecture: a Systems Design”, Prentice Hall.
4. James M. Feldman, Charles T. Retter, “Computer architecture: a designer's Text Based on a generic RISC”, McGraw-Hill
5. Jurij Silc, Borut Robic, Theo Ungerer, “Processor Architecture: From Dataflow to Superscalar and Beyond”, Springer.
6. Hennessy and Patterson, “Computer Architecture: A Quantitative Approach”, Elsevier.
7. Dezso and Sima, “Advanced Computer Architecture”, Pearson.
8. Quinn, “Parallel Computing: Theory & Practice”, TMH.
9. Quinn, “Parallel Programming in C with MPI and Open MP”, TMH

ADVANCED DIGITAL SIGNAL PROCESSING			
Course Code:	**CS539**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: Design of Digital Filter

FIR filter- Magnitude response and phase response, Window techniques for design of linear phase FIR filter- Rectangular ,Hamming and Kaiser window.Frequency sampling method. IIR Filters- Magnitude response and phase response,group delay, Design of IIR Filter- Approximation of Derivatives, Bilinear Transformation method. Butterworth filter.

UNIT II: Linear Prediction And Optimum Linear Filter

Discrete Random Process: Stationary process, ensemble averages, auto correlation and auto covariance. Wiener filter- FIR Wiener filter and IIR Wiener filter. Innovation representation of stationary random process-low pass filtering of white noise. Relationships between the filter parameters and the autocorrelation sequence.

UNIT III : Estimation of Parametric and Non-parametric Spectra

The peridogram energy density spectrum of a discrete-time signals. Aperiodic signals- Estimation of autocorrelation function and power spectrum of random signal. Non-parametric method: Barlett method, Welch method and Blackman and Tukey method. Parametric method- AR, MA, ARMA model based power spectrum estimation, Yule- Walker method for the AR model using Durbin's algorithm.

UNIT IV : Designing of Adaptive Filter

Applications of adaptive filter: system modeling, channel equalization, echo cancellation, noise cancellation. FIR adaptive filter- LMS algorithm, properties of LMS algorithm. Adaptive direct form filter- RLS algorithms, properties of RLS algorithms. Adaptive lattice ladder filter- recursive least square lattice- ladder algorithms.

UNIT V: Multirate Digital Signal Processing

Mathematical description of change of sampling rate- Interpolation and decimation. Sampling rate conversion – structures for rational sampling rate conversion, poly phase filter, structures sampling rate conversion of bandpass signals. Application of multirate signal processing- subband coding of speech signals. Digital filter bank- polyphase filter structure, elimination of aliasing.

Text Books:

[1] John G.Proakis, Dimitris G. Manolakis, Digital Signal Processing, Pearson Education, 2002.
[2]Rafael C. Gonzalez,Richard E.Wood, Digital Signal Processing Pearson Education, Inc. 2nd Edition,2004.

References:

[1] John G.Proakis et.al., Algorithms for Statistical Signal Processing ,Pearson Education,2002.

RESEARCH TECHNIQUES IN ICT			
Course Code:	**CS527**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION TO RESEARCH TECHNIQUES

Meaning of research, objectives of research, motivation in research, types of research (Introduction to experimental test bed, algorithmic research, simulation research, mathematical modeling approach), characteristics and prerequisites of research, significance of research, research process, sources of research problem, criteria of identifying the problem, necessity of defining the problem, errors in selecting research problem, technique involved in defining the problem, report and paper writing.

UNIT II DATA ANALYSIS AND STATISTICAL TECHNIQUES

Data and their analyses, quantitative methods and techniques, Measure of central tendency, measures of variation, frequency distribution, analysis of variance, methods, Correlation analysis, regression analysis, time series and forecasting, introduction to discriminant analysis, factor analysis, cluster analysis, conjoint analysis, probability distribution, binomial distribution, poisson distribution, uniform distribution, exponential distribution, and normal distribution, sampling methods, test of hypothesis.

UNIT III MATHEMATICAM MODELING

Steps of modeling, operations research models like queuing theory, stochastic processes, application of models, conceptual framework development and validation techniques, optimization techniques.

UNIT IV ALGORITHMIC RESEARCH

Algorithmic research problems, types of algorithmic research, types of solution procedure, steps of development of algorithm, steps of algorithmic research, design of experiments,

UNIT V SIMULATION AND SOFT COMPUTING TECHNIQUES

Introduction to soft computing, artificial neural network, genetic algorithm, fuzzy logic and their applications, tools of soft computing, need for simulation, types of simulation, simulation language, fitting the problem to simulation study, simulation models, output analysis, data simulation packages like MATLAB, NS2, ANSYS, Cadence.

Reference Books:

1. Research Methodologies, R. Panneerselvam, Prentice Hall, 2007.
2. Research in Education, Best John V. and James V Kahn, Wiley eastern, 2005.
3. Elements of Educational Research, Sukhia, S.P., P.V. Mehrotra, and R.N. Mehrotra, PHI publication, 2003.
4. Methodology of Research Education, K. Setia, IEEE publication, 2004.
5. Research methodology, Methods and Techniques, Kothari, C.R., 2000.

Advanced Digital Signal Processing Lab			
Course Code:	**EC589**	**Credits:**	**2**
No. of Lab (Hrs/Week):	**3**	**End Sem Exam Hours:**	**2**
Total No. of Lab Sessions:	**10**		

Programs/Experiments List:

1. To develop a program for computing cross correlation and autocorrelation of two discrete time sequences.
2. To develop a program for partial fraction decomposition of a transfer function.
3. To design digital IIR filters (LPF, HPF, BPF, BSF) using MATLAB.
4. To develop a program for up sampling of sinusoidal signal by factor L and down sampling by factor M.
5. To develop a program for the design of FIR low pass, High pass, Band pass and Band stop filters using Kaiser Window with 'C'.
6. Introduction to Lab View.
7. To Study and Implement Circular Convolution using TMS320C6713 Digital Signal Processing Starter Kit (DSK).
8. To compute DFT using TMS320C6713 Digital Signal Processing Starter Kit (DSK)
9. To design FIR filter using TMS320C6713 Digital Signal Processing Starter Kit
10. To design IIR filter using TMS320C6713 Digital Signal Processing Starter Kit

EMBEDDED SYSTEM LAB			
Course Code:	**EC587**	**Credits:**	**2**
No. of Lab (Hrs/Week):	**3**	**End Sem Exam Hours:**	**2**
Total No. of Lab Sessions:	**10**		

Programs/Experiments List:

1. Study of ARM evaluation system.
2. Interfacing ADC and DAC.
3. Interfacing Keyboard and LCD
4. Interfacing EEPROM and Interrupt.
5. Interfacing Read toggle switch and Relay.
6. Interfacing LED and PWM.
7. Interfacing seven segments LED.
8. Interfacing Real time clock and Serial port.
9. Interfacing Stepper motor and Temperature sensor.
10. Flashing two LEDs.
11. Reading LM35 and plotting in LCD.
12. Design and implementation of Traffic light controller in FPGA.
13. Design and implementation of 4 bit Updown counter in FPGA.
14. Interrupt processing performance characteristics of ARM& FPGA.
15. Implementation of Zigbee protocol with ARM 7.

VLSI ARCHITECTURE			
Course Code:	**EC560**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: CMOS DESIGN

Overview of digital VLSI design Methodologies- Logic design with CMOS-transmission gate circuits-Clocked CMOS-dynamic CMOS circuits, Bi-CMOS circuits, Layout diagram, Stick diagram, IC fabrications – Trends in IC technology.

UNIT II: PROGRAMABLE LOGIC DEVICES

Programming Techniques-Anti fuse-SRAM-EPROM and EEPROM technology, Re-Programmable Devices Architecture- Function blocks, I/O blocks, Interconnects, Xilinx-XC9500,Cool Runner - XC-4000,XC5200, SPARTAN, Virtex - Altera MAX 7000-Flex 10KStratix.

UNIT III: BASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT AND ROUTING

System partition , FPGA partitioning, Partitioning methods- floor planning, placement, physical design flow, global routing, detailed routing, special routing, circuit extraction – DRC.

UNIT IV: ANALOG VLSI DESIGN

Introduction to analog VLSI Design of CMOS 2stage-3 stage Op-Amp -High Speed and High frequency op-amps-Super MOS-Analog primitive cells-realization of neural networks.

UNIT V: LOGIC SYNTHESIS AND SIMULATION

Overview of digital design with Verilog HDL, hierarchical modeling concepts, modules and port definitions, gate level modeling, data flow modeling, behavioral modeling, task & functions, Verilog and logic synthesis-simulation-Design examples, Ripple carry Adders, Carry Look ahead adders, Multiplier, ALU, Shift Registers, Multiplexer, Comparator, Test Bench.

Text Books:

1. M.J.S Smith, “Application Specific integrated circuits”,Addition Wesley Longman Inc.1997.
2.Kamran Eshraghian,Douglas A.pucknell and Sholeh Eshraghian,”Essentials of VLSI circuits and system”, Prentice Hall India,2005.
3. Wayne Wolf, “ Modern VLSI design “ Prentice Hall India,2006.
4. Mohamed Ismail ,Terri Fiez, “Analog VLSI Signal and information Processing”, McGraw Hill International Editions,1994.
5.Samir Palnitkar, “Verilog HDL, A Design guide to Digital and Synthesis” 2nd Ed,Pearson,2005.
6. John P. Uyemera “Chip design for submicron VLSI cmos layout and simulation “, Cengage Learning India Edition”, 2011.

SOFTWARE FOR EMBEDDED SYSTEMS			
Course Code:	**EC564**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I :INTRODUCTION

compilers, assemblers, debuggers, linkers, loaders, example codes of linker and loaders; interrupt writing; cross compilers; cross assemblers; emulators; in-circuit emulators; Remote debuggers; embedded tools - example of - keil; RTOS - examples of (QNX, vxWorks, OSE, Nucleus, iOS; Windows CE; Android) ; Programming - Java ME; Embedded C, Ada; UML and VisSim, writing device drivers; Networking protocol stacks; writing space critical programs; firmware; codecs; Disassemblers, Decompilers, Hex Editors & Hex Viewers

UNIT II :C PROGRAMMING TOOLCHAIN IN LINUX

C preprocessor - Stages of Compilation - Introduction to GCC - Debugging with GDB – The Make utility - GNU Configure and Build System - GNU Binary utilities - Profiling - using gprof -Memory Leak detection with valgrind - Introduction to GNU C Library

UNIT III :EMBEDDED C AND EMBEDDED OS

Adding Structure to 'C' Code: Object oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts. Creating embedded operating system: Basis of a simple embedded OS, Introduction to sEOS, Using Timer 0 and Timer 1, Portability issue, Alternative system architecture, Important design considerations when using sEOS

UNIT IV :TIME-DRIVEN MULTI-STATE ARCHITECTURE AND HARDWARE

Multi-State systems and function sequences: Implementing multi-state (Timed) system -Implementing a Multi-state (Input/Timed) system. Using the Serial Interface: RS232 - The Basic RS-232 Protocol - synchronous data transmission and baud rates - Flow control – Software architecture - Using on-chip UART for RS-232 communication - Memory requirements – The serial menu architecture - Examples. Case study: Intruder alarm system.

UNIT V: EMBEDDED JAVA

Introduction to Embedded Java and J2ME – Smart Card basics – Java card technology overview – Java card objects – Java card applets – working with APDUs – Web Technology for Embedded Systems.

REFERENCES:

1. Steve Oualline, 'Practical C Programming 3rd Edition', O'Reilly Media, Inc, 2006.
2. Stephen Kochan, "Programming in C", 3rd Edition, Sams Publishing, 2009.
3. Michael J Pont, "Embedded C", Pearson Education, 2007.
4. Zhiqun Chen, 'Java Card Technology for Smart Cards: Architecture and Programmer's Guide', Addison-Wesley Professional, 2000.

REAL TIME SYSTEMS			
Course Code:	**EC566**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION

Introduction – Issues in Real Time Computing, Structure of a Real Time System,Task, classes, Performance Measures for Real Time Systems, Estimating Program Run Times. Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms, Uniprocessor scheduling of IRIS tasks, Task assignment, Mode changes, and Fault Tolerant Scheduling.

UNIT II PROGRAMMING LANGUAGES AND TOOLS

Programming Languages and Tools – Desired language characteristics, Data typing, Control structures, Facilitating Hierarchical Decomposition, Packages, Run – time (Exception) Error handling, Overloading and Generics, Multitasking, Low level programming, Task Scheduling, Timing Specifications, Programming Environments, Run – time support.

UNIT III REAL TIME DATABASES

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time Systems.

UNIT IV COMMUNICATION

Real – Time Communication – Communications media, Network Topologies Protocols, Fault Tolerant Routing. Fault Tolerance Techniques – Fault Types, Fault Detection. Fault Error containment Redundancy, Data Diversity, Reversal Checks, Integrated Failure handling.

UNIT V EVALUATION TECHNIQUES

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models For Hardware Redundancy, Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm, Impact of faults, Fault Tolerant Synchronization in Hardware, Fault Tolerant Synchronization in software.

References Books:

1. C.M. Krishna, Kang G. Shin, "Real Time Systems", McGraw - Hill International Editions, 1997
2. By Albert M. K. Cheng , “Real-time systems: scheduling, analysis, and verification” wiley.

ELECTIVE –I

ANALOG IC DESIGN			
Course Code:	**EC538**	**Credits:**	**3**
No. of lectures:	**3**	**Mid sem Exam hours:**	**2**
Total no of lectures:	**45**	**End sem exam hours:**	**3**

UNIT 1: INTEGRATED CIRCUITS AND MODELING:

MOS transistors, CMOS Processing, Bipolar junction transistors, voltage sources and references, IC voltage regulator, characteristics and parameter of voltage, CMOS layout and design rules, Analog layout, SPICE modeling parameters, Diode model, MOS Threshold voltage and body effect.

UNIT 2: CURRENT MIRRORS AND AMPLIFIERS:

CMOS current mirror, CMOS biasing, small signal analysis, Common source amplifier, common gate amplifier, cascade gain stage, Fully differential circuitry, automatic tuning loops, MOS differential pair and gain stage, Bipolar current mirrors, frequency response.

UNIT 3: NOISE ANALYSIS AND MODELING:

cascode op amps, regulated cascade, settling, skewing, low noise design, offset, mismatch, low voltage design tradeoffs, Noise model for circuit elements, Noise passive component model, Time domain analysis, frequency domain analysis, Noise analysis.

UNIT 4: BASIC OPAMP DESIGN AND COMPENSATION:

Two stage CMOS OPAMP, Feedback and Opamp compensation, precision passive elements, gain bandwidth and power considerations, folded cascade opamp, current mirror opamp, current feedback opamp, and common mode feedback opamp.

UNIT 5: COMPARATORS AND CONVERTORS:

D/Aconvertor architecture, nyquist rate ADC, Oversampling ADC's, CMOS and BICMOS comparators, Charge injection errors, PLL with charge pump phase comparators.CMOS transconductors.

Text Books:

[1] Allen and Holberg, CMOS Analog Circuit Design, Oxford University Press
[2] Hurst and Meyer, Analysis and Design of Analog Integrated Circuits, Wiley
[3] Behzad Razavi, Design of Analog CMOS ICs, 2000. John Wiley
[4] Jaeger and Blalock, Microelectronics Circuit Design, McGraw Hill

References:

[1] Agarwal & Lang, Foundations of Analog and Digital Electronic Circuits, (The Morgan Kaufmann Series in Computer Architecture and Design)
[2] Behzad Razavi, Introduction to Microelectronics, 2006. John Wiley

CMOS Digital IC Design			
Course Code:	**EC552**	**Credits:**	**3**
No. Of lectures:	**3**	**Mid sem Exam hours:**	**2**
Total no of lectures:	**45**	**End sem exam hours:**	**3**

UNIT 1: CMOS TRANSISTOR THEORY:
MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, MOS Device Design Equations, The Complementary CMOS Inverter-DC Characteristics, The Differential Inverter, The Transmission Gate, The Tri State Inverter, Bipolar Devices, Resistance Estimation Capacitance Estimation, Switching Characteristics CMOS-Gate Transistor Sizing, Sizing Routing Conductors, Charge Sharing, Design Margining.

UNIT 2: CMOS CIRCUIT AND LOGIC DESIGN:
CMOS Logic Gate Design, Basic Physical Design of Simple Gate, CMOS Logic Structures, Clocking Strategies, I/O Structures, Low Power Design, CMOS transmission gates, pass transistors, NAND/NOR AOI and OAI designing and layouts.

UNIT 3: BASICS OF DIGITAL CMOS DESIGN:
Combinational MOS Logic circuits Introduction, CMOS logic circuits, complex logic circuits, Behavior of high stable elements, SR latch Circuit, clocked latch and Flip Flop Circuits, CMOS D latch and triggered Flip Flop. Voltage boot strapping synchronous dynamic circuit techniques, Dynamic CMOS circuit techniques.

UNIT 4: SYSTEM AND IC DESIGN:
Design Strategies CMOS Chip Design Options, Design Methods, Design Capture Tools, Design Verification Tools, Static and Dynamic CMOS design- Domino and NORA logic - combinational and sequential circuits -Method of Logical Effort for transistor sizing -power consumption in CMOS gates- Low power CMOS design.

UNIT 5: ADVANCE DIGITAL INTEGRATED CIRCUITS:
Review of Moore's law and CMOS Scaling, benefits of system-on-chip integration in terms of cost, power, and performance comparison on System-on-Board, System-on-Chip, and System-in-Package. Typical goals in SoC design – cost reduction, A canonical SoC Design, On chip buses and interfaces, MPSoCs. Techniques for designing MPSoCs, Performance and flexibility for MPSoCs design

Text Books:
[1] Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits - Analysis & Design,MGH, Second Ed., 1999.
[2] Jan M Rabaey, Digital Integrated Circuits - A Design Perspective, Prentice Hall, 1997
[3] Ken Martin, Digital Integrated Circuit Design, Oxford University Press, 2000
[4] Rao R. Tummala, Madhavan Swaminathan, "Introduction to system on package sop-Miniaturization of the Entire System", McGrawHill-2008.

References:
[1] Analysis and Design of Digital Integrated Circuits, Third Edition, David A. Hodges, Horace G. Jackson, and Resve A. Saleh, McGraw-Hill, 2004.
[2] R. J. Baker, H. W. Li, and D. E. Boyce, CMOS circuit design, layout, and simulation. New York: IEEE Press, 1998.

Embedded Systems for Wireless & Mobile Communication	
Course Code: EC554	**Credits: 3**
No. of Lectures (Hrs/Week): 3	**Mid Sem Exam Hours: 2**
Total No. of Lectures: 45	**End Sem Exam Hours: 3**

Unit-I

Introduction to wireless technologies: WAP services, Serial and Parallel Communication, Asynchronous and synchronous Communication, FDM,TDM, TFM, Spread spectrum technology Introduction to Bluetooth: Specification, Core protocols, Cable replacement protocol

Unit-II

Bluetooth Radio: Type of Antenna, Antenna Parameters, Frequency hoping. Bluetooth Networking: Wireless networking, wireless network types, devices roles and states, adhoc network, scatter net Connection establishment procedure, notable aspects of connection establishment, Mode of connection, Bluetooth security, Security architecture, Security level of services, Profile and usage model: Generic access profile (GAP), SDA, Serial port profile, Secondary bluetooth profile.

Unit-III

Hardware: Bluetooth Implementation, Baseband overview, packet format, Transmission buffers, Protocol Implementation: Link Manager Protocol, Logical Link Control Adaptation Protocol, Host control Interface, Protocol Interaction with layers.

Unit-IV

Programming with Java: Java Programming, J2ME architecture, Javax. bluetooth package Interface, classes, exceptions, Javax. obex Package: interfaces, classes.

Unit-V

Bluetooth services registration and search application, bluetooth client and server application. Overview of IrDA, HomeRF, Wireless LANs, JINI

Reference books:

1. Bluetooth Technology by C.S.R. Prabhu and A.P. Reddi; PHI
2. Wireless communication by Rappaport
3. Mobile communication by Schiller
4. Mobile communication by C.Y.Lee

VLSI TECHNOLOGY			
Course Code:	**EC556**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: CRYSTAL GROWTH, WAFER PREPARATION, EPITAXY AND OXIDATION

Electronic Grade Silicon, Czochralski crystal growing, Silicon Shaping, processing consideration, Vapor phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation, Growth Mechanism and kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxide properties, Redistribution of Dopants at interface, Oxidation of Poly Silicon, Oxidation induced Defects.

UNIT II: LITHOGRAPHY AND RELATIVE PLASMA ETCHING

Optical Lithography, Electron Lithography, X-Ray Lithography, Ion Lithography, Plasma properties, Feature Size control and Anisotropic Etch mechanism, relative Plasma Etching techniques and Equipments

UNIT III: DEPOSITION, DIFFUSION, ION IMPLANTATION AND METALLIZATION

Deposition process, Polysilicon, plasma assisted Deposition, Models of Diffusion in Solids, Flick‟s one dimensional Diffusion Equation – Atomic Diffusion Mechanism –Measurement techniques - Range theory- Implant equipment. Annealing Shallow junction – High energy implantation – Physical vapour deposition – Patterning.

UNIT IV: PROCESS SIMULATION AND VLSI PROCESS INTEGRATION

Ion implantation – Diffusion and oxidation – Epitaxy – Lithography – Etching and Deposition- NMOS IC Technology – CMOS IC Technology – MOS Memory IC technology - Bipolar IC Technology – IC Fabrication.

UNIT V: ASSEMBLY TECHNIQUES AND PACKAGING OF VLSI DEVICES

Analytical Beams – Beams Specimen interactions - Chemical methods – Package types – banking design consideration – VLSI assembly technology – Package fabrication technology.

Text Books:

[1] S.M.Sze: VLSI Technology, Mc.Graw Hill Second Edition. 2002.
[2] Richard Jaegar, Introduction to Microelectronics Fabrication, Addison-Wesley, 2006.
[2] Douglas A. Pucknell and Kamran Eshraghian: Basic VLSI Design, Prentice Hall India, 2003.

References:

[1] Amar Mukherjee: Introduction to NMOS and CMOS VLSI System design, Prentice Hall India, 2000.
[2] Wayne Wolf : Modern VLSI Design, Prentice Hall India,1998.
[3] Plummer, Deal and Graffin, Silicon VLSI Technology: Fundamentals, Practice and Modeling, Prentice Hall, 2000

EMBEDDED C			
Course Code:	**EC558**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT – I:

Programming Embedded Systems in C

Introduction ,What is an embedded system, Which processor should you use, Which programming language should you use, Which operating system should you use, How do you develop embedded software, Conclusions

Introducing the 8051 Microcontroller Family

Introduction, What's in a name, The external interface of the Standard 8051, Reset requirements ,Clock frequency and performance, Memory issues, I/O pins, Timers, Interrupts, Serial interface, Power consumption ,Conclusions

UNIT – II:

Reading Switches

Introduction, Basic techniques for reading from port pins, Example: Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions

UNIT – III:

Adding Structure to the Code

Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the 'Hello Embedded World' example, Example: Restructuring the goat-counting example, Further examples, Conclusions

UNIT – IV:

Meeting Real-Time Constraints

Introduction, Creating 'hardware delays' using Timer 0 and Timer 1, Example: Generating a precise 50 ms delay, Example: Creating a portable hardware delay, Why not use Timer 2?, The need for 'timeout' mechanisms, Creating loop timeouts, Example: Testing loop timeouts, Example: A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout, Conclusions

UNIT – V:

Case Study: Intruder Alarm System

Introduction, The software architecture, Key software components used in this example, running the program, the software, Conclusions

TEXT BOOKS:

1. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008

REFERENCE BOOKS:

1. PICmicro MCU C-An introduction to programming, The Microchip PIC in CCS C – Nigel Gardner

SYSTEM SPECIFICATIONS AND MODELING			
Course Code:	**EC570**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT –I:

Design representations: Behavioral, Structural, Physical; Levels of abstraction; Design methodologies, System specification, profiling, analysis and estimation, System-level design: partitioning, scheduling, communication synthesis; System-level modeling: processor and RTOS modeling, transaction-level modeling

Co- Design Issues:

Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

Co- Synthesis Algorithms:

Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

UNIT –II:

Prototyping and Emulation:

Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure

Target Architectures:

Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT –III:

Compilation Techniques and Tools for Embedded Processor Architectures:

Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

UNIT –IV:

Design Specification and Verification:

Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

UNIT –V:

Languages for System – Level Specification and Design-I:

System – level specification, design representation for system level synthesis, system level specification languages,

Languages for System – Level Specification and Design-II:

Heterogeneous specifications and multi language co-simulation, the cosyma system and lycos system.

TEXT BOOKS:

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf –2009, Springer.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers

REFERENCE BOOKS:

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont - 2010 – Springer

ELEMENTS OF SYSTM RELIABILITY			
Course Code:	**EC572**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Reliability Fundamentals

Causes of Failures, Useful Life of Components, Hazard Functions, Bathtub Curve Characteristic, Type of Failures: Early Failures, Constant Failure Rate, Wear-Out Failures, Failure Data Analysis, Mean Time to Failure (MTTF), Mean Residual Life (MRL), Mean Time Between Failure (MTBF), Mean Time To Recovery (MTTR), availability, maintainability.

Unit II: Reliability Mathematics

Classical Set Theory, Boolean algebra, Sample Space, Probability Theory, Bayes Theorem, Probability plots for various Distributions (Exponential, Weibull, Normal and Gamma), Cumulative Distributions, Variance, Moments, Estimation Theory, Laplace Transform, Markov Processes, Random Number Generation, Probability Plots.

Unit III: Reliability Modeling

Series, Parallel, Series-Parallel, Standby and k-out-of-m Modeling. Recent System Reliability Evaluation Techniques. Allocation Problem, Optimal Reliability Redundancy and Redundancy Allocation.

Unit IV: Electronics and Software System Reliability

Reliability of Electronic Components, Electronic System Reliability Prediction, Software Errors, Software structure and Modularity, Fault Tolerance, Software Reliability, Prediction and Measurement, hardware/software Interfaces. Musa's Operational Profiles, Reliability Stability and Reliability Growth Model, Hardware Reliability vs. Software Reliability, Software Reliability Metrics, Software Reliability Prediction.

Unit V: Reliability Testing and Analysis

Test Environments, Testing for Reliability and Durability, Failure Reporting, Pareto Analysis, Accelerated Test Data Analysis, CUSUM Charts, Exploratory Data Analysis and Proportional Hazards Modeling, Reliability Demonstration, Reliability Growth Monitoring.

Text Books:

[1] Elsayed A. Elsayed, Reliability Engineering, Wiley Publication, 2nd edition, 2012.
[2] Aggarwal K. K., Reliability Engineering, Kluwer Academic Publishers, Boston Publication.
[3] Software Reliability Engineering, John D. Musa, Tata McGRAW Hill, 2005.

Reference Books:

[1] Kapur K. C. and L. R. Lamberson, Reliability in Engineering Design, John Wiley & Sons,
[2] Ramakumar R., Reliability Engineering: Fundamentals and Applications, Prentice Hall.
[3] Misra K. B., Reliability Analysis and Prediction: A Methodology Oriented Treatment, Elsevier Publication.

EMBEDDED LINUX			
Course Code:	**CS 598**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit 1

Introduction: Embedded Linux, Real Time Linux,Types of Embedded Linux systems, Advantages of Linux OS, Using distributions, Examples of Embedded Linux systems- system architecture, Types of host/target architectures for the development of Embedded Linux Systems, Debug setups, Boot Configurations, Processor architectures supported by Linux

Unit 2

Cross platform Development toolchain: GNU tool chain basics, Kernel Headers Setup, Binutils setup, Bootstrap Compiler Setup, Library Setup, Full Compiler Setup, Using the tool chain, C library alternatives, JAVA, Perl, Python, Ada, IDEs , Terminal Emulators

Unit 3

Kernel and Root File System

Kernel Considerations- selection, configuration , Compiling and Installing the kernel Root File System Structure, Librariries, Kernel Modules, Kernel Images, Device Files, Main System Applications, Custom Applications, System Initialization

Unit 4

Storage Device Manipulation

MTD-Supported Devices,Disk Devices, Swapping

Root FilesystemSetup: Filesystem Types for Embedded Devices, Writing a Filesystem Image to Flash using an NFS-Mounted Root Filesystem, Placing a Disk Filesystem on a RAM Disk, Rootfs and Initramfs, Choosing a Filesystem's Type and Layout, Handling Software Upgrades

Setting Up the Bootloader Embedded Bootloaders, Server Setup for Network Boot, Using the U-Boot Bootloader

Unit 5

Device Drivers: Introduction, Building and running modules, Char Drivers,Allocating memory, USB Drivers, Device Model, Memory mapping and DMA, Block Drivers, TTY Drivers

Text Books:

1. Building Embedded Linux Systems **,** Karim Yaghmour, JonJasonBrittain and Ian F. Darwin Masters, Gilad Ben-Yossef, and Philippe Gerum**,** O'Reilly

2. Linux Device Drivers, Alessandro Rubini, Jonathan Corbet, O'Reilly

Reference:

1. Embedded Linux Primer A Practical Real – World Approach, Christopher Hallinan, PHI

2. Embedded Linux System Design and Development, P Raghavan, Amol Lad, SriramNeelakandan, Auerbach Publications

3. Essential Linux Device Drivers, Alan Cox, Sreekrishnan,Venkateswaran, Pretice Hall

4. Embedded Linux Hardware, Software and Interfacing Craig Hollabaugh, Pearson Education

SYSTEM ON CHIP			
Course Code:	**EC 548**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT –I:

Introduction to the System Approach:

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT –II:

Processors:

Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline. Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT –III:

Memory Design for SOC:

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache. Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

UNIT -IV:

Interconnect Customization and Configuration:

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design ontoReconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

UNIT –V:

Application Studies / Case Studies:

SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

TEXT BOOKS:

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.
2. ARM System on Chip Architecture – Steve Furber –2nd Ed., 2000, Addison Wesley Professional.

REFERENCE BOOKS:

1. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st Ed., 2004, Springer
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM.
3. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

FPGA ARCHITECTURE AND APPLICATIONS			
Course Code:	**EC661**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT – I:
Introduction to Programmable Logic Devices:
Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices – Architecture of Xilinx Cool Runner XCR3064XL CPLD Implementation of a Parallel Adder with Accumulation.

UNIT – II:
Field Programmable Gate Arrays:
Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated specialized Components of FPGAs, and Applications of FPGAs.

UNIT – III
SRAM Programmable FPGAs:
Introduction, Programming Technology, Device Architecture, The Xilinx XC2000, XC3000 And XC4000 Architectures.

UNIT – IV
Anti-Fuse Programmed FPGAs:
Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT – V
Design Applications:
General Design Issues, Counter Examples, A Fast Video Controller, A position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

TEXTBOOKS:
1. Field Programmable Gate Array Technology by Stephen M. Trimberger, Springer International Edition.
2. Digital Systems Design by Charles H. Roth Jr, Lizy Kurian John, Cengage Learning.

REFERENCE BOOKS:
1. Field Programmable Gate Arrays by John V. Oldfield, Richard C. Dorf, Wiley India.
2. Digital Design Using Field Programmable Gate Arrays by Pak K. Chan/Samiha Mourad, Pearson Low Price Edition.
3. Digital Systems Design with FPGAs and CPLDs by Ian Grout, Elsevier, Newnes.
4. FPGA based System Design by Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

HARDWARE SOFTWARE CO DESIGN			
Course Code:	**EC663**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT –I:

Co- Design Issues:

Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

Co- Synthesis Algorithms:

Hardware software synthesis algorithms: hardware – software partitioning distributed system cosynthesis.

UNIT –II:

Prototyping and Emulation:

Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure

Target Architectures:

Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

UNIT –III:

Compilation Techniques and Tools for Embedded Processor Architectures:

Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

UNIT –IV:

Design Specification and Verification:

Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification

UNIT –V:

Languages for System – Level Specification and Design-I:

System – level specification, design representation for system level synthesis, system level specification languages,

Languages for System – Level Specification and Design-II:

Heterogeneous specifications and multi language co-simulation, the cosyma system and lycos system.

TEXT BOOKS:

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – 2009, Springer.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, 2002, Kluwer Academic Publishers

REFERENCE BOOKS:

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont - 2010 – Springer

ALGORITHM FOR VLSI DESIGN AUTOMATION			
Course Code:	**EC669**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: Introduction

Architectural Design , Logic Design, Physical Design , Full-custom Layout**,** Gate-array Layout, Standard-cell Layout Macro-cell Layout, Programmable Logic Arrays, FPGA layout**,** Difficulties in Physical Design, Problem Subdivision, Computational Complexity of Layout Subproblems, Solution Quality, Nets and Netlists, Connectivity Information, Weighted Nets, Grids, Trees, and Distances.

UNIT II: Circuit Partitioning and Floor planning

Cost Function and Constraints: Bounded Size Partitions, Minimize External Wiring, Approaches to Partitioning Problem: Kernighan-Lin Algorithm, Variations of Kernighan-Lin Algorithm, Fiduccia Mattheyses Heuristic, Simulated Annealing, Floorplanning Model, Approaches to Floorplanning, Cluster Growth ,Simulated Annealing ,Analytical Technique , Dual Graph Technique.

UNIT III: Placement

Complexity of Placement , Problem Definition , Cost Functions and Constraints: Estimation of Wirelength, Minimize Total Wirelength , Minimize Maximum Cut , Minimize Maximum Density, Maximize Performance, Other Constraints, Approaches to Placement: Partition-Based Methods, Limitation of the Min-cut Heuristic, Simulated Annealing , Numerical Techniques.

UNIT IV: Routing

Problem Definition, Cost Functions and Constraints: Placement Constraints , Number of Routing Layers Geometrical Constraints, Maze Routing Algorithms: Lee Algorithm, Limitations of Lee Algorithm for Large Circuits ,Connecting Multi-point Nets ,Finding More Desirable Paths, Further Speed Improvements, Line Search Algorithms, Other Issues: Multi Layer Routing , Ordering of Nets , Rip-up and Rerouting, Power and Ground Routing.

UNIT V: Advanced Topics

Cost Functions and Constraints , Routing Regions:Routing Regions Definition, Routing Regions Representation, Sequential global Routing: The Steiner Bee Problem, Global Routing by Maze Running, Integer Programming ,Global Routing by Simulated Annealing : The First Stage , The Second stage, Hierarchical Global Routing.

Text Books:

[1] VLSI physical design automation: theory and practice, By Sadiq M. Sait, Habib Youssef.
[2] Algorithm for VLSI physical design automation by Naveed A. Sherwani.

References:

[1] Essential Electronic Design Automation (EDA), Mark D Birnbaum.
[2] Physical Design Automation for VLSI systems, Bryan D Ackland.
[3] Practical Problems in VLSI Physical Design Automation, Sung Ku Lim.

ROBOTICS			
Course Code:	**CS699**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I THE KINEMATICS OF ROBOTICS

Forward and inverse kinematics, motion kinematics, low-level and high-level trajectory planning. static force and torque relations, internal sensory devices: position and velocity sensors, external sensory devices: force, tactile and proximity sensors, machine vision, robot programming: multi-level approach, programming techniques, world modeling, off-line programming and simulation.

UNIT II BASIC ROBOT FUNCTIONING

History of robots, types of robots, uses of robots, present status and future trends in robotics, overview of robot subsystems, Issues in designing and controlling robots: resolution, repeatability and accuracy, transmission, Robot configurations and concept of workspace, mechanisms and transmission, motion planning obstacle avoidance, configuration space, road map methods, graph search algorithms, potential field methods.

UNIT III SPATIAL DESCRIPTIONS

Descriptions, postings, orientations, and frames, mappings, operators : translations, rotations, and transformations, transformation arithmetic, transform equations, transformation of free vectors, computational considerations.

UNIT IV ROBOT ANATOMY

End effectors and actuators, Different types of grippers, vacuum and other methods of gripping. pneumatic, hydraulic and electric actuators, Sensors and controllers, internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder, camera, micro-controllers, centralized controllers, real time operating systems.

UNIT V TASK SPECIFICATION OF ROBOT

Point to point and continuous motion specifications for typical applications, joint interpolation, task space interpolation, executing user specified tasks, Robot analysis, position and orientation of rigid bodies, spatial mechanism description, Denavit-Hartenberg notation, homogenous transformation, forward and inverse position analysis, velocity mapping, static force analysis, singularities, acceleration mapping, robot control Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, issues in nonlinear control, force feedback, hybrid control, Case studies: Robot in assembly (Puma). Mobile robot (Nataraj)

Reference Books:

1. Introduction to Robotics, Mechanics and control, John J. Craig, Pearson Education publication, 2004.
2. Robotic moments, S Mujtaba and R. Goldman , PHI publication, 2003.
3. An Advance Robotic Programming, A. Gilbert, American Robot corporation 1984.
4. Design of an Interactive Manipulator Programming environment, UMI Research Press, 1985.
5. Mechanical Engineering design, J Shigley, 3rd edition, Mc, Graw hill, New York 1977.

EXPERT SYSTEM DESIGN			
Course Code:	**CS661**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION TO EXPERT SYSTEM

Block diagram of expert system, features of expert system, characteristics of expert system, components of expert system, applications of expert systems, some standard expert systems.

UNIT II COMPONENTS OF EXPERT SYSTEM

Block diagram of expert system, design issues of expert systems, concept of interface design, issue of knowledgebase design, learning module design, limitations of expert systems, rule based systems.

UNIT III HUMAN INTELLIGENCE VS EXPERT SYSTEM

Comparison of skills of human experts and artificially developed expert systems, characteristics of expert systems, knowledge acquisition in expert system, methods of knowledge acquisition in expert system.

UNIT IV DESIGN CRITERIA OF EXPERT SYSTEM

Elementary concepts about designing of an expert system, the issues involved in designing of knowledgebase, user interface module, inferencing information from knowledge base.

UNIT V KNOWLEDGE MANAGEMENT IN EXPERT SYSTEM

Knowledge management (KM) principles and purposes, dynamic nature of KM system, Knowledge system technologies, KM subsystems, knowledge management system development, selecting the system and / or its relevant components, implementing and maintain the knowledge management systems.

Reference Books:

1. Measuring and Managing Knowledge for Expert System , Mc. Graw- hill Boston, 2001.
2. Dendral: Expert System, Feigenbaum et al, by PHI publication, 1992.
3. Modal Operators in expert systems, Berners Lee, Mc Garw hill publication, 2002.
4. The Frame Based Knowledge Representation in Expert Systems, Mc Carthy and Hays, PHI publication, 2003.
5. Decision Theoretic Expert Systems, Russel, Wiley Eastern publication, 2002.

FUZZY SET THEORY			
Course Code:	**CS679**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT-I - Introduction to Fuzzy Sets
Overview of crisp sets; crispness, vagueness, fuzziness and uncertainty; Fuzzy-sets – basic types and basic concepts; α-cuts, strong α-cuts, Representation of fuzzy sets; extension of fuzzy sets.

UNIT-II - Fuzzy Set Operations and Fuzzy Arithmatic
Fuzzy Complement; Fuzzy interaction, t-norms; Fuzzy unions, t-conorms; Combination of operations; Aggregation operation; Fuzzy numbers; Linguistic variables; Arithmatic operations on intervals; Arithmatic Operations on Fuzzy numbers;

UNIT-III - Fuzzy Relations and Fuzzy Logic
Crisp vs Fuzy relations; Projections and Cylindrical extansions; binary fuzzy relations; Binary relations on a single set; Fuzzy equivalence relations; Fuzzy Compatibility Relations; Fuzzy ordering Relations; Fuzzy Morphisms.
Multivalued logics; Fuzzy propositions; Fuzzy quantifiers; Linguistic Hedges.

UNIT-IV - Possibility Theory and Uncertainity-Based Information
Fuzzy measures; Evidence Theory; Possibility Theory; Fuzzy Sets and Possibility Theory; Possibility Theory vs probability Theory.
Information and uncertainty; Nonspecificity of Crisp Sets; Nonspecificity of Fuzzy Sets; Fuzziness of Fuzzy sets.

UNIT-V - Fuzzy Systems and Applications
Membership Functions; Features of the Membership Functions; Fuzzification; Defuzzification to crisp sets; λ-cuts for Fuzzy Relations; Defuzzification to Scalars; Fuzzy inference systems; Mamdani's fuzzy models; Sugeno's fuzzy models; Tsukamoto's fuzzy models; other variants; Applications

Reference Books:

1. Fuzzy Sets and Fuzzy Logic: Theory and Applications – George J. Klir and Bo Yuan; PHI
2. Fuzzy Set Theory and Its Applications – H.J. Zimmermann; Kluwer Academic Publishers
3. Fuzzy Logic with Engineering Applications – T. J. Ross; Wiley

SOFTWARE MAINTENANCE			
Course Code:	**CS647/CS553**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I INTRODUCTION TO SOFTWARE MAINTENANCE

Evolution of software products, economics of maintenance, characteristics of software maintenance, product development life cycle, different type of software products, deployment model, adaptive maintenance, enhancement request, proactive defect prevention, maintenance process, problem reporting, problem resolution, fix distribution, software maintenance from customers' perspective, category of software maintenance.

UNIT II REVERSE ENGINEERING

Function abstraction, data abstraction, and process abstraction, levels of reverse engineering: re-documentation, design recovery, specification recovery, conditions for reverse engineering, supporting techniques: forward engineering, restructuring, re-engineering, benefits of reverse engineering.

UNIT III CONFIGURATION MANAGEMENT

Software configuration management process, patches, configuration management in global development teams, baseline, software configuration items, identification of objects in software configuration, version control, change control, configuration audit, status reporting, software configuration management standards, metrics for maintenance in configuration management. traditional process model: Code and Fix Model, Waterfall Model, Spiral Model; maintenance process model: Quick Fix Model, Boehm's Model, Osbornes' Model, Iterative Enhancement Model; process maturity model: Capability Maturity Model (CMM), Capability Maturity Model Integration (CMMI).

UNIT IV MAINTENANCE AND OTHER LIFE CYCLE ACTIVITIES

Design and maintenance, programming & maintenance, debugging and maintenance, testing and maintenance, maintenance management, maintenance management functions: planning, organizing, staffing, leading, controlling; maintenance management organizations: functional organization, project organization, matrix organization.

UNIT V MAINTENANCE MEASURES

Importance of integrity in measurement, software measure and metrics, objective of software measurement: evaluation, control, assessment, improvement, prediction, maintenance measures: size, complexity; quality: product and process quality, understandability and maintainability, impact analysis in creating maintainable system.

Reference Books:

1. Software Maintenance: Concept and Practice, Penny Grubb, Aramstrong A. Takang, International Thompson Publishing Inc., 1996.
2. Software Maintenance, Gopalaswamy Ramesh, Ramesh Bhattiprolu, Tata McGraw Hill, 2009.
3. Software Engineering: Software Reliability, Testing and Quality Assurance, Nasib S. Gill, Khanna Book Publishing Co (P) Ltd., New Delhi, 2002.
4. Software Engineering: Practitioner's Approach, Pressman Roger S., McGraw-Hill Inc., 2004.
5. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley and Sons Inc., and IEEE Computer Society Press, 2005.
6. Software Quality Assurance, Daniel Gain, Pearson Education, 2009.

MICROCONTROLLERS FOR EMBEDDED SYSTEM DESIGN			
Course Code:	**EC659**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT –I:
ARM Architecture:
ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families.

UNIT –II:
ARM Programming Model – I:
Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

UNIT –III:
ARM Programming Model – II:
Thumb Instruction Set: Register Usage, Other Branch Instructions, Data Processing Instructions, Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions

UNIT –IV:
ARM Programming:
Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

UNIT –V:
Memory Management:
Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation, Access Permissions, Context Switch.

TEXT BOOKS:

1. ARM Systems Developer's Guides- Designing & Optimizing System Software – Andrew N. Sloss, Dominic Symes, Chris Wright, 2008, Elsevier.

REFERENCE BOOKS:

1. Embedded Microcomputer Systems, Real

MICROCONTROLLER BASED SYSTEM DESIGN			
Course Code:	**EC671**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**45**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:		**End Sem Exam Hours:**	**3**

UNIT I: 8051 ARCHITECTURE

Architecture – memory organization – addressing modes – instruction set –Timers - Interrupts -I/O ports, Interfacing I/O Devices – Serial Communication.

UNIT II: 8051 PROGRAMMING

Assembly language programming – Arithmetic Instructions – Logical Instructions –Single bit Instructions – Timer Counter Programming – Serial Communication Programming Interrupt Programming – RTOS for 8051 – RTOSLite – FullRTOS – Task creation and run – LCD digital clock/thermometer using Full RTOS

UNIT III PIC MICROCONTROLLER

Architecture – memory organization – addressing modes – instruction set – PIC progrmming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming, MPLAB.

UNIT IV PERIPHERAL OF PIC MICROCONTROLLER

Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.

UNIT V SYSTEM DESIGN – CASE STUDY

Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency – Stand alone Data Acquisition System.

REFERENCES:

1. Muhammad Ali Mazidi, Rolin D. Mckinlay, Danny Causey ‘ PIC Microcontroller and Embedded Systems using Assembly and C for PIC18’, Pearson Education 2008.
2. John Iovine, ‘PIC Microcontroller Project Book ’, McGraw Hill 2000.
3. Myke Predko, “Programming and customizing the 8051 microcontroller”, Tata McGraw Hill 2001.
4. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, ‘The 8051 Microcontroller and Embedded Systems’ Prentice Hall, 2005.
5.Rajkamal,”.Microcontrollers-Architecture,Programming,Interfacing and System Design”, 2nd Edition Pearson,2012.
6. I Scott Mackenzie and Raphael C.W. Phan, “The Micro controller”, Pearson, Fourth edition 2012.

SENSORS AND ACTUATORS			
Course Code:	**EC 655**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT -I:

Sensors / Transducers: Principles – Classification – Parameters – Characteristics – Environmental Parameters (EP) – Characterization

Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors: – Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors

UNIT –II:

Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermosensors – Helium Low Temperature Thermometer – Nuclear Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors –Thermoemf Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors

Magnetic sensors: Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magnetoresistive Sensing – Semiconductor Magnetoresistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros –Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors

UNIT -III:

Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors

Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media .

UNIT -IV:

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation

Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors) – HomeAppliance Sensors – Aerospace Sensors — Sensors for Manufacturing –Sensors for environmental Monitoring

UNIT -V:

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves –Presure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection Electrical Actuation Systems-Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

TEXT BOOKS:

1. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.
2. W. Bolton – "Mechatronics" –Pearson Education Limited.

REFERENCE BOOKS:

1. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.