RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electronics & Communication Engineering VII-Semester

EC- 701 VLSI Design

Course Objective:

- To understand the fabrication process of CMOS technology.
- To teach fundamentals of VLSI circuit design and implementation using circuit simulators andlayout editors.
- To study various problems due to VLSI technology advancement.
- To study digital circuits using various logic methods and their limitations.
- To highlight the circuit design issues in the context of VLSI technology.

Course Contents:

UNIT I

Practical Consideration and Technology in VLSI Design

Introduction, Size and complexity of Integrated Circuits, The Microelectronics Field, IC ProductionProcess, Processing Steps, Packaging and Testing, MOS Processes, NMOS Process, CMOS Process,Bipolar Technology, Hybrid Technology, Design Rules and Process Parameters.

UNIT II

Device Modeling

Dc Models, Small Signal Models, MOS Models, MOSFET Models in High Frequency and small signal,Short channel devices, Sub threshold Operations, Modeling Noise Sources in MOSFET's, Diode Models,Bipolar Models, Passive component Models.

UNIT III

Circuit Simulation

Introduction, Circuit Simulation Using Spice, MOSFET Model, Level 1 Large signal model, Level 2Large Signal Model, High Frequency Model, Noise Model of MOSFET, Large signal Diode Current,High Frequency BJT Model, BJT Noise Model, temperature Dependence of BJT.

UNIT IV

Structured Digital Circuits and Systems

Random Logic and Structured Logic Forms, Register Storage Circuits, Quasi Static Register Cells, AStatic Register Cell, Micro coded Controllers, Microprocessor Design, Systolic Arrays, Bit-SerialProcessing Elements, Algotronix.

UNIT V

CMOS Processing Technology

Basic CMOS Technology, A Basic n-well CMOS Process, Twin Tub Processes, CMOS ProcessEnhancement, Interconnects and Circuit Elements, Layout Design Rules, Latch up, Physical Origin, Latchup Triggering, Latch up Prevention, Internal Latch up Prevention Techniques.

Course Outcome: Upon successful completion of this course, the student will be able to:

- Demonstrate a clear understanding of CMOS fabrication flow and technology scaling.
- Design MOSFET based logic circuit
- Draw layout of a given logic circuit
- Demonstrate an understanding of working principle of operation of different types of memories
- Demonstrate an understanding of working principles of clocking, power reduction and Distribution

References:

1. Geiger, Allen andStrader: VLSI Design Techniques for Analog and Digital Circuits, TMH.
2. Sorab Gandhi: VLSI Fabrication Principles, Wiley India.
3. Weste and Eshraghian:Principles of CMOS VLSI design, Addison-Wesley
4. Weste, Harris and Banerjee: CMOS VLSI Design, Pearson-Education.
5. Pucknell and Eshraghian: Basic VLSI Design, PHI Learning.
6. Botkar: Integrated Circuits, Khanna Publishers.
7. Sze:VLSI Technology, TMH.

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Electronics & Communication Engineering, VII-Semester

Departmental Elective EC- 702 (A) MICROWAVE ENGINEERING

Prerequisite:- Electromagnetic fields , Antenna and wave propagation.

Course Outcome:-

Students should be able to :

1. **Identify of various types of Microwave electronic components and systems.**
2. **Understand different modes of operation of various RF and Microwave circuits.**
3. **Design and analyze of high frequency circuits and systems.**
4. **Solving complex RF & Microwave communication network design problems S**

SYLLABUS

Unit 1. Features and applications of microwaves, Wave propagation in striplines and microstrip lines, Slot lines, Limitations of conventional vacuum tubes, Microwave tubes like Two cavity klystron and Reflex klystron, Magnetron, TWT, Backward wave oscillator etc.

Unit 2. Solid state microwave sources, transferred electron devices, Tunnel diode Gunn diode and oscillators, IMPATT diode, TRAPATT diode, Pin diode, Varactor diode, Schottky diode, Parametric amplifiers, Crystal diode, Frequency multipliers, Microwave BJT & FET,

Unit 3. Scattering matrix, S-parameters & its applications in Network analysis, Matching Network, Detector diodes, detector mounts, detector output indicator, slotted line, measurement of power, impedance & S-parameter, measurement of frequency & VSWR.

Unit 4. Impedance transformer, Microwave filters, Power dividers and directional couplers, E-plane Tee, H-plane tee, Matched hybrid Tee., Wave propagation in ferrite medium, Isolators, Circulators, YIG resonators, Simulation Techniques for design of **Microwave** Components.

Unit 5. Analysis and design of Dielectric resonators; Design of RF and microwave low noise and power amplifiers & oscillators using S-parameter techniques, Mixer and converter design, diode phase shifters, attenuators, Design of hybrid and monolithic, microwave and millimeter wave integrated circuits.

Text Books Recommended :

1. Liao S., Microwave Devices & Circuits''., 2nd ed. 2001,PHI.
2. Gupta K.C., Microwave Engg., 3rd ed. 2004,Wiley Easter Pub.
3. Watson, Solid State Microwave Devices, 5th ed. 2008,Wiley.
4. David M. Pozar, Microwave Engineering, 3rd edition, 2011 Willey India.

Reference Books Recommended :

1. Gandhi, Microwave Engineering & Application, 2^{nd} ed. 2005,McMillan Int. Ed.
2. Reich, Microwave Principles, 5^{th} ed. 2009,CBS Publ.
3. Collin, Foundations for microwave engineering, 4^{th} ed. 2001, Wiley Publ.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electronics & Communication Engineering, VII-Semester

Departmental Elective EC- 702 (B) INFORMATION THEORY AND CODING

Course Objective: The course aims to introduce information theory, fundamentals of error control coding techniques and their applications, importance of various communication channels, utilization of codes for error detection and correction as well as for practical applications.

Prerequisite: Digital communication and its applications, Probability theory

Course Description: This course will first introduce the basic concepts of information theory, leading to the different coding theorems and then various channel capacity theorem. Afterwards, the course will consider error control coding techniques and various codes for applications.

Course Outcomes: Upon completing this course, the student will be able to:

1. Acquire the knowledge in measurement of information and errors.
2. Know the application of coding theorem for efficient utilization of communication resources.
3. Understand the utilization of various communication channels for communication system.
4. Design the block and cyclic codes for error correction and detection in communication systems
5. Know the significance of source and channel codes in various applications.

SYLLABUS

UNIT1 Information Theory: Introduction to uncertainty, entropy and its properties, entropy of binary memoryless source and its extension to discrete memory-less source, Measure of information, Information content ofmessage, Average Information content of symbols. Self information, Mutualinformation and its properties,

UNIT 2 Coding theorem:Source coding theorem, prefix coding, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm,Huffman coding, Extended Huffman coding,Arithmetic Coding, Lempel-Ziv Coding, Run Length Encoding.

UNIT 3 Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Discrete memory less channels, Binary symmetric channeland its channel capacity, channel coding theorem, and its application to Binary Erasure Channel, Shannon's theorem on channel capacity, capacity of channel of infinite bandwidth, Continuous Channels.

UNIT 4 Error Control Coding:Introduction, Examples of Error control coding, methods of Controlling Errors, Typesof Errors, types of Codes, Linear Block Codes: matrix description of Linear BlockCodes, Error Detection and Error Correction Capabilities of Linear Block Codes, Probability of undetected error for linear block code in BSC, hamming Codes and their applications,

Cyclic Codes:Cyclic codes and its basic properties, Encoding using an (n-k) BitShift register, Generator & parity check matrix of cyclic codes, encoding & decoding circuits, syndrome computation, error detection and correction,

UNIT 5 Introduction to BCH codes, its encoding & decoding, error location & correction. Convolution Codes:Introduction to convolution codes, its construction, Convolution Encoder, Time domain approach, Transform domainapproach, Code Tree, Trellis and State Diagram, Viterbi algorithm: Introduction of theorem for maximum likelihood decoding.

Reference Books:

1. Digital Communication -by Haykins Simon Wiley Publ.
2. Error control Coding: Theory and Application, - by Shu Lin and Cosstlello, PHI
3. Digital Communication - by Sklar, Pearson Education
4. Error Correcting Codes - by Peterson W., MIT Press
5. Digital Communication - by Proakis,TMH
6. Information Theory, Coding and Cryptography – By Ranjan Bose, TMH
7. Communication Systems – By Singh and Sapre, TMH

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electronics & Communication Engineering, VII-Semester

Departmental Elective EC- 702 (C) Nano Electronics

Unit-I: Overview of semiconductor physics. Nanoscale band structure and Electron transport, Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super-lattices, band offsets, and electronic density of states, heavily doped semiconductors and low dimensional quantum devices.

Unit-II: Introduction to lithography- Contact, proximity printing and Projection Printing, Resolution Enhancement techniques, overlay-accuracies, Mask-Error enhancement factor (MEEF), Positive and negative photoresists, Electron Lithography, Projection Printing, Direct writing, Electron resists.

Unit-III: Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Coulomb Blockade, Coulomb blockade in nanocapacitor, Tunnel Junctions, Tunnel Junction Excited by a Current Source.

Unit-IV: Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode. Nanoscale MOSFET, Finfets, charge and energy quantization in Single electron devices.

Unit-V: Scaling of physical systems – Geometric scaling & Electrical system scaling, Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation).

Text Book:

1. Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques by WR Fahrner – Springe.
2. Fundamentals of Nanoelectronics, George W. Hanson, 1/e Pearson Education.
3. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology by T. Pradeep; Tata Mc.Graw Hill.
4. Nanotubes and nanowires by C.N.R. Rao and A. Govindaraj, RSC Publishing
5. Quantum-Based Electronic Devices and Systems by M. Dutta and M.A. Stroscio, World Scientific.

Suggested Reference Books:

1. Stephen D. Sentaria, Microsystem Design, Kluwer Academic Press
2. Marc Madou, Fundamentals of microfabrication & Nanofabrication.

3. T. Fukada&W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 1998.
4. Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices, 2001.
5. James R Sheats and Bruce w.Smith, “Microlithography Science and Technology”, Marcel Dekker Inc., New York, 1998.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electronics & Communication Engineering, VII-Semester

Open Elective EC- 703 (A) Cellular Mobile Communication

Course Outcomes

1. **Understand various communication standards and multiple accesses**
2. **Cellular concepts and basics and design**
3. **Frequency allocation, Reuse, and antennae for mobile communication**
4. **Various interferences and reduction techniques**
5. **Various cellular generation, standards and trends**

Unit-I

Introduction to cellular mobile system

A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, planning of cellular system

Elements of cellular radio system design

General description of problem, concept of frequency reuse channels, co-channel interference reduction factor, desired C/I in an omni-directional antenna system, hand off mechanism, cell splitting, components of cellular systems.

Unit-II

Cell coverage for signal and traffic

General introduction, mobile point-to-point model, propagation over water or flat open area, foliage loss, propagation in near- in distance, long distance propagation, path loss from point-to-point prediction model, cell site antenna heights and signal coverage cells, mobile-to-mobile propagation.

Cell site antennas and mobile antennas

Equivalent circuits of antennas, gain and pattern relationship, sum and difference patterns, antennas at cell site, unique situations of cell site antennas, mobile antennas.

Unit-III

Cochannel interference reduction

Cochannel interference, real time cochannel interference measurement at mobile radio transceivers, design of antenna systems - omni directional and directional, lowering the antenna height, reduction of cochannel interference, umbrella- pattern effect, diversity receiver, designing a system to serve a predefined area that experiences cochannel interference.

Types of Noncochannel interference

Adjacent channel interference, near-end-far-end interference, effect on near-end mobile units, cross-talk, effects of coverage and interference by applying power decrease, antenna height decrease, beam tilting, effects of cell site components, interference between systems, UHF TV interference, long distance
interference.

Unit-IV

Frequency management and Channel Assignment

Frequency management, frequency spectrum utilization, setup channels, channel assignment, fixed channel assignment, non-fixed channel assignment algorithms, additional spectrum, traffic and channel assignment, perception of call blocking from the subscribers

Handoffs and dropped calls

Value of implementing handoffs, initiation of handoff, delaying a handoff, forced handoff, queuing of handoff, power- difference handoff, mobile assisted handoff and soft handoff, cell-site handoff and intersystem handoff, dropped call rate formula.

Unit-V

Digital Cellular Systems

GSM- architecture, layer modeling, transmission, GSM channels and channel modes, multiple access scheme.CDMA- terms of CDMA systems, output power limits and control, modulation characteristics, call processing, hand off procedures.Miscellaneous mobile systems- TDD systems, cordless phone, PDC, PCN, PCS, non cellular systems.

References:

1. Lee: Cellular and Mobile Telecommunication- Analog & digital systems, TMH.
2.Rappaport: Wireless Communications- principles and practice, Pears3. Lee: Mobile communications design fundamentals, Wiley India.
4. Faher Kamilo: Wireless Digital Communication, PHI Learning.
5. Raj Kamal: Mobile Computing, Oxford University Press.

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA, BHOPAL

New Scheme Based On AICTE Flexible Curricula

Electronics & Communication Engineering, VII-Semester

Open Elective EC- 703 (B) Internet of Things (IoT)

Course Objectives (CEO):

The course provides basic knowledge of how to connect various devices through Internet and control them remotely. It will provide methods for different types of networking and data storage.The course aims at providing communication overview and protocols for safe and secure data access and transfer and maintain confidentiality and integrity.

Unit 1:Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural view, Physical design of IOT, Logical design of IOT, Application of IOT.

Unit 2: Machine-to-machine (M2M), SDN (software defined networking) and NFV(network function virtualization) for IOT, data storage in IOT, IOT Cloud Based Services.

Unit 3: Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, MQTT, CoAP, SOAP, REST, HTTP Restful and Web Sockets.
Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

Unit 4: Sensor Technology , Participatory Sensing, Industrial IOT and Automotive IOT , Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology.

Unit 5:IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi &arduino devices.IOT Case studies: smart city streetlights control & monitoring.

Reference Book:

1. Rajkamal,"Internet of Things", Tata McGraw Hill publication
2. Vijay Madisetti and ArshdeepBahga, "Internet of things(A-Hand-on-Approach)" 1st
   Edition ,Universal Press
3. Charless Bell "MySQL for the Internet of things",Apresspublicatons.
4. Francis dacosta "Rethinking the Internet otthings:A scalable Approach to connecting
   everything", 1st edition, Apresspublications .
5. HakimaChaouchi "The Internet of Things: Connecting Objects", Wiley publication.
6. Donald Norris"The Internet of Things: Do-It-Yourself at Home Projects for Arduino,Raspberry Pi and BeagleBone Black", McGraw Hill publication.

Course Outcomes (COs): After completion of the course the students should be able to

1. Understand in depth about Internet of things**.**
2. Establish secure communication for his network for his devices connected in IOT.
3. Store his data securely on cloud and access it when required
4. Design web based application using various internet protocols and services
5. Use sensor technology and RFID and wireless networking for maintaining privacy and security concern in smart city and housing environmental considerations.

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Electronics & Communication Engineering, VII-Semester

Open Elective EC- 703 (C) Probability Theory and Stochastic processing

Course objective

1. Understand the random experiments, sample space and event probabilities
2. Study the random variables, density and distribution functions, moments and transformation of random variables.
3. Understand the concept of random process and sample functions (signals)
4. Explore the temporal and spectral characteristics of random processes.

Course Outcomes

1. Simple probabilities using an appropriate sample space.
2. Simple probabilities and expectations from probability density functions (pdfs)
3. Likelihood ratio tests from pdfs for statistical engineering problems.
4. Least -square & maximum likelihood estimators for engineering problems.
5. Mean and covariance functions for simple random processes.

UNIT-I:

Probability and Random Variable

Probability: Probability introduced through Sets and Relative Frequency, Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bayes' Theorem, Independent Events. Random Variable: Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables

UNIT -II:

Distribution & Density Functions and Operation on One Random Variable – Expectations Distribution; Density Functions: Distribution and Density functions and their Properties - Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh and Conditional Distribution, Methods of defining Conditional Event, Conditional Density, Properties. Operation on One Random Variable – Expectations: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Non-monotonic Transformations of Continuous Random Variable, Transformation of a Discrete Random Variable.

UNIT-III:

Multiple Random Variables and Operations

Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem (Proof not expected), Unequal Distribution, Equal Distributions.

Operations on Multiple Random Variables: Expected Value of a Function of Random Variables: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

UNIT-IV:

Stochastic Processes – Temporal Characteristics: The Stochastic Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence, First-Order Stationary Processes, Second-Order and Wide-Sense Stationarity, Nth Order and Strict-Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance and its Properties, Linear System Response of Mean and Mean-squared Value, Autocorrelation Function, Cross-Correlation Functions, Gaussian Random Processes, Poisson Random Process.

UNIT-V:

Stochastic Processes – Spectral Characteristics: Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Spectral Density of Input and Output of a Linear System.

TEXT BOOKS:

1. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, 4Ed., 2001, TMH.
2. Probability and Random Processes – Scott Miller, Donald Childers, 2 Ed, Elsevier, 2012.

REFERENCE BOOKS:

1. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis and S. Unnikrishna Pillai, 4 Ed., TMH.
2. Theory of Probability and Stochastic Processes- Pradip Kumar Gosh, University Press
3. Probability and Random Processes with Application to Signal Processing – Henry Stark and John W. Woods, 3 Ed., PE
4. Probability Methods of Signal and System Analysis - George R. Cooper, Clave D. MC Gillem, 3 Ed., 1999, Oxford.
5. Statistical Theory of Communication - S.P. Eugene Xavier, 1997, New Age Publications.

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EC- 705 IOT LAB

List of Experiments

LAB INDEX Design, Developed and implement following using Arduino, Raspberry Pi compiler and Python language in Linux/Windows environment.

1. Study and Install IDE of Arduino and different types of Arduino.
2. Write program using Arduino IDE for Blink LED.
3. Write Program for RGB LED using Arduino.
4. Study the Temperature sensor and Write Program foe monitor temperature using Arduino.
5. Study and Implement RFID, NFC using Arduino.
6. Study and Configure Raspberry Pi.
7. WAP for LED blink using Raspberry Pi.
8. Study and Implement Zigbee Protocol using Arduino / Raspberry Pi.
9. Study and implement MQTT protocol using Arduino.
10. Study and implement CoAP protocol using Arduino.