# Scheme & Syllabus of UG Engineering Program

## Bachelor of Technology

## (B.Tech.)

## Electronics & Communication Engineering

## 2022-23

**IPS ACADEMY**

**INSTITUTE OF ENGINEERING & SCIENCE, INDORE**

***(A UGC Autonomous Institute affiliated to RGPV)***

**IPS Academy, Institute of Engineering & Science**

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal**)**

Scheme Based on AICTE Flexible Curriculum

**Department of Electronics & Communication Engineering**

## Bachelor of Technology (B.Tech.) VII Semester

| S.No. | Subject Code | Category | Subject Name | Maximum Marks Allotted | | | | | Total Marks | Contact Hours per week | | | Total Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | | Practical | | | | | | |
| | | | | End Sem | Mid Sem Exam. | Quiz/ Assignment | End Sem | Term work Lab Work & Sessional | | L | T | P | |
| 1. | PCC-EC701 | PCC | Optical Fiber Communication | 70 | 20 | 10 | 60 | 40 | 200 | 3 | 0 | 2 | 4 |
| 2. | PEC-EC701 | PEC | Professional Elective Course-3 | 70 | 20 | 10 | - | - | 100 | 3 | 0 | 0 | 3 |
| 3. | PEC-EC702 | PEC | Professional Elective Course-4 | - | - | - | 60 | 40 | 100 | 0 | 0 | 2 | 1 |
| 4. | PEC-EC703 | PEC | Professional Elective Course-5 | 70 | 20 | 10 | - | - | 100 | 3 | 0 | 0 | 3 |
| 5. | OEC-EC701 | OEC | Open Elective Course-3 | 70 | 20 | 10 | - | - | 100 | 3 | 0 | 0 | 3 |
| 6. | PROJ-EC701 | PROJ | Project Phase I | - | - | - | 60 | 40 | 100 | 0 | 0 | 12 | 6 |
| 7. | PROJ-EC702 | PROJ | Evaluation of Internship | - | - | - | 60 | 40 | 100 | 0 | 0 | 4 | 2 |
| 8. | PROJ-EC703 | PROJ | Seminar II | - | - | - | - | 50 | 50 | 0 | 0 | 2 | 1 |
| | | | Total | 280 | 80 | 40 | 240 | 210 | 850 | 12 | 0 | 22 | 23 |

| Professional Elective Courses-3 | Professional Elective Courses-4 | Professional Elective Courses-5 | Open Elective Courses-3 |
|---|---|---|---|
| PEC-EC701 (A) Microwave Engineering | PEC-EC702 (A) Microwave Engineering Lab | PEC-EC703 (A) CMOS VLSI Design | OEC-EC701 (A) Digital Marketing & SEO |
| PEC-EC701 (B) Digital Image Processing | PEC-EC702 (B) CMOS VLSI Design Lab | PEC-EC703 (B) Fuzzy Logic and its Applications | OEC-EC701 (B) DBMS |
| PEC-EC701 (C) Wireless Sensor Network | PEC-EC702 (C) Digital Image Processing Lab | PEC-EC703 (C) Nano Electronics | OEC-EC701 (C) Data Science |
| PEC-EC701 (D) Quantum Computing & Communication | | PEC-EC703 (D) SDR & Cognitive Radio | |

| 1 Hr Lecture | 1 Hr Tutorial | 2 Hr Practical |
|---|---|---|
| **1 Credit** | **1 Credit** | **1 Credit** |

| | | | |
|---|---|---|---|
| **PCC-EC701** | **Optical Fiber Communication** | **3L: 0T: 2P (04 hrs.)** | **Credits: 04** |

**Recommended Prerequisite**: Engineering Mathematics, Electronics

**Course Objective:** To expose the students to the fundamentals of optical fibers, fiber impairments, components and devices and system design.

**MODULE I** **(8 hrs.)**
Overview of Optical Fiber Communications (OFC): Motivation, optical spectral bands, key elements of optical fiber systems. Optical fibers: basic optical laws and definitions, optical fiber modes and configurations, mode theory for circular waveguides, single mode fibers, graded- index fiber structure, fiber materials, photonic crystal fibers, fiber fabrication, fiber optic cables

**MODULE II** **(8 hrs.)**
Optical sources: Light emitting diodes (LED): structures, materials, quantum efficiency, LED power, modulation of an LED. Laser diodes: modes, threshold conditions, laser diode rate equations, external quantum efficiency, resonant frequencies, structure and radiation patterns, single mode lasers, modulation of laser diodes. Power launching and coupling: source to fiber power launching, fiber to fiber joints, LED coupling to single mode fibers, fiber splicing, optical fiber connectors

**MODULE III** **(8 hrs.)**
Photo detectors: pin photo detector, avalanche photodiodes, photo detector noise, detector response time, avalanche multiplication noise. Signal degradation in optical fibers: Attenuation: MODULE-s, absorption, scattering losses, bending losses, core and cladding losses. Signal distortion in fibers: overview of distortion origins, modal delay, factors contributing to delay, group delay, material dispersion.

**MODULE IV** **(8 hrs.)**
Wavelength division multiplexing (WDM) concepts: operational principles of WDM, passive optical star coupler, isolators, circulators, active optical components: MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, polarization controller, chromatic dispersion compensators. Optical amplifiers: basic applications and types of optical amplifiers, Erbium Doped Fiber Amplifiers (EDFA): amplification mechanism, architecture, power conversion efficiency and gain. Amplifier noise, optical SNR, system applications. Performance Measurement and monitoring: measurement standards, basic test equipment, optical power measurements, optical fiber characterization, optical time-domain reflectometer.

**MODULE V** **(8 hrs.)**

Wavelength assignment strategies: random, first fit, least used, most used. Routing strategies: fixed, fixed alternate, dynamic. Routing and wavelength assignment in optical networks, Elasticity in optical network, routing and spectrum assignment, Physical constraints: wavelength continuity, contiguity constraints, spectrum assignment, maximum capacity constraint etc..

**Assessment:** Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

**List of Experiments**:
1. To perform and analysis measure of 650 NM Fiber Optic Analog Link
2. To study of Optical Fiber connectors and splices
3. To study source of light for optical fiber
4. To perform and analysis intensity modulation of analog transmission
5. To perform and analysis propagation and attenuation loss
6. To measure frequency modulation using 650 nm fiber optic link
7. To perform and analysis measured pulse width modulation
8. To study EDFA
9. To perform and analysis optical power using optical power meter
10. To perform and analysis bending loss
11. To perform and analysis WDM
12. To perform and analysis numerical aperture(NA)

**Assessment:** Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

**Course Outcomes:**
Students earning credits will develop ability to:
1. Illustrate and Review Fundamentals of the basics of optical fibers.
2. Learn different types sources used for transmissions in fiber.
3. Understanding the working of photo detector in optical fiber communication.
4. Learning of different types of optical receivers.
5. Understanding of optical network components.

**Text /Reference Books:**
1. Keiser, "Optical Fiber Communications", 3rd Edition, TMH, 2008.
2. Senior, "Optical Fiber Communication- Principles and Practices", 3rd Edition, Pearson Education, 2010.
3. Agarwal, "Fiber Optic Communication Systems", 3$^{th}$ Edition, Wiley India, 2007.
4. Palais, "Fiber Optics Communications",5$^{th}$ Edition, Pearson Education, 2005.
5. SatishKumar, "Fundamentals of optical Communications", 2$^{th}$ Edition, PHI Learning, 2014.

| PEC-EC 701(A) | Microwave Engineering | 3L: 0T: 0P (03 hrs.) | Credits: 03 |
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**Prerequisite: Electromagnetic fields, Antenna and wave propagation.**

**Course Objective:** Objective of the subject is to have understanding of Microwave Circuits & Devices.

**MODULE I** **(7 hrs.)**

Introduction to Microwave, History of Microwave, Microwave Band Designation, Application, Advantages of Microwave and Review of Electromagnetic. Transmission Lines: Two Wire Parallel Transmission Lines, Voltage Current Relationship, Characteristic Impedance, Reflection Coefficient, Input Impedance, Standing Waves.

**MODULE II** **(8 hrs.)**

Microwave Transmission Lines: Multi conductor Transmission Lines like Coaxial Lines, Breakdown Power of a Coaxial Cable, Strip Lines, Micro Strip Line and Its types. Microwave Components using Strip Line: Design Consideration of a Micro Strip Line, Microwave waveguide, Rectangular waveguide and its analysis, Circular Waveguide, modes of propagation, dominant modes, cut off wavelength, mode excitation

**MODULE III** **(8 hrs.)**

Microwave Generators and Amplifiers: Limitations of conventional tubes at Microwave Frequency Reflex Klystron, two and Multi Cavity Klystron Amplifiers, Oscillators and their analysis, Basics of Magnetrons, Traveling Wave Tube and their applications.

**MODULE IV** **(8 hrs.)**

Microwave Solid-State Devices: Gunn diode and its modes of operation, Avalanche: IMPATT Diode, TRAPATT Diode, operations and V-I characteristics of Tunnel Diode, Schottky Diode, Backward Diode, Varactor Diode, PIN Diode and its applications.

**MODULE V** **(9 hrs.)**

Microwave Components: Scattering (S) Parameters, Analysis and design of Dielectric resonators; Design of RF and Microwave low noise, Power Amplifiers, Oscillators using S- parameter techniques, Microwave T Junctions, Directional Couplers, Scattering matrix, S- parameters & its applications in Network analysis. Microwave Measurements: Measurements of Standing Wave ratio, Wavelength, Frequency, Power and radiation pattern of Antenna, CST/ ADS/ AFHSS software.

**List of Experiments:**

1. To study the characteristics of the Reflex klystron Tube and to determine its electronic tuning range.
2. To study the V-I characteristics of Gunn Diode.
3. To determine the Standing Wave-Ratio and Reflection Coefficient.
4. To determine the operating frequency & guide wavelength in a rectangular waveguide working on TE10 mode.
5. To Study the function of multi-hole directional coupler by measuring the following parameters.
6. To Study the Isolator and Circulators.
7. To study the working of Magic Tee.
8. To measure unknown impedance with smith chart.
9. To Study the working of Resonant Cavity.
10. To measure the attenuation of attenuator.

**Assessment:** Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

**Course Outcome:**

1. Understanding of Microwave Signals and Transmission Line.
2. Understanding of various types of Microwave Transmission Line and its Design Consideration.
3. Understanding of various types of Microwave Generators and Amplifiers.
4. Understanding of various types of Microwave Solid State Devices.
5. Design and analyze of High Frequency Circuits and Systems.

**Text/Reference Books:**

1. Robert E. Collins, “Foundations for Microwave Engineering”, International student 2nd edition, McGraw Hill Publication, 1992.
2. David M. Pozar, “Microwave Engg”, 2nd Edition, Jhon Wily Publication, 1998.
3. M Kulkarni “Microwave Engg”, 3rd edition, Umesh Publication, 2003
4. Samuel Y Liao “Microwave Devices and Circuits”, 3rd edition“, Pearson, 2003

| PEC-EC 701(B) | Digital Image Processing | 3L: 0T: 0P (03 hrs.) | Credits: 03 |
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**Course Objective:** The purpose of this subject is to introduce the principles of digital image processing and to develop students' knowledge from basic signal processing techniques to advanced image processing and analysis systems.

**MODULE I** **(8 hrs.)**

**Digital Image Fundamentals:** What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

**MODULE II** **(8 hrs.)**

**Spatial Domain:** Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.

**Frequency Domain:** Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering, FFT, applications of Image processing, wavelet transform.

**MODULE III** **(8 hrs.)**

**Restoration:** Noise models, Restoration in the Presence of Noise only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

**MODULE IV** **(8 hrs.)**

**Color Image Processing:** Color Fundamentals, Color Models, Pseudocolor Image Processing. **Wavelets:** Background, Multiresolution Expansions. Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms.

**MODULE V** **(8 hrs.)**

**Segmentation:** Point, Line, and Edge Detection, thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds, image compression, DCT, JPEG Image compression standards.

**Representation and Description:** Representation, Boundary descriptors.

**Assessment:** Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

**Course outcome:**

Students earning credits will develop ability to:

1. Understand the need for image transforms different types of image transforms and their properties.
2. understand the need for image compression and to learn the spatial and frequency domain techniques of image compression.
3. Learn different feature extraction techniques for image analysis and recognition.
4. Learn different parameter of morphological Image Processing.
5. Understand different feature of segmentation.

**Text/Reference Books:**

1. Rafeal C.Gonzalez, Richard E.Woods ,"Digital Image Processing", 2nd Edition, Pearson Education/PHI.2004.
2. Alasdair McAndrew ,"A Computational Introduction to Digital Image Processing", CRC Press.2015.
3. 3.Adrian Low ,"Computer Vision and Image Processing", 2nd Edition, B.S.Publications.1991
4. RafealC.Gonzalez, Richard E.Woods, Steven L. Eddins," Digital Image Processing using Matlab" 2nd Edition ,Pearson Education.2009

| PEC-EC701 (C) | Wireless Sensor Network | 3L: 0T: 0P (03hrs.) | Credits: 03 |
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**Prerequisite:** Digital Signal Processing, Mobile Communication

**Course Objective:** Though this course student will learn in deep about Architecture and different MAC/ routing protocol and OS used in the field of WSN.

**MODULE I** **(8 hrs.)**

**Introduction to wireless sensor Networks –**Characteristic requirements for WSN Challenges for WSNs – WSN vs Adhoc Networks - Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, Mica Mote, EYES nodes, BT nodes, Telos B, Sunspot -Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations.

**MODULE II** **(8 hrs.)**

**Medium Access Control Protocols:** Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contention based protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

**MODULE III** **(9 hrs.)**

**Routing And Data Gathering Protocols-** Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping –Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS –Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN,APTEEN, SPEED, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

**MODULE IV** **(8 hrs.)**

**Embedded Operating Systems:** Introduction-Operating System Design Issues - Examples of Operating Systems Tiny OS, Magnet OS, MANTIS. Introduction to Tiny OS – Nes C – Interfaces and Modules- Configurations

**MODULE V** **(7 hrs.)**

**Applications Of WSN:** WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring – Nano scopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling, stochastic Geometry, specific library tools for WSN, security aspects of WSN & MANET.

**Assessment:** Internal Assessment for continuous evaluation, mid-term tests, Tutorials, Quizzes, Class Performance, etc. End semester Theory Exam.

**Course outcome:**

Students earning credits will develop ability to:

1. Understand the basis of Sensors node and their characteristic.
2. Understand the design issues of various MAC protocols
3. Develop the concepts of design issues of different routing protocols of WSN
4. Understand different embedded operating system used in WSN
5. To explore and implement solutions to real world problems using sensor devices, enumerating its principles of working.

**Text/ Reference Book:**

1. Holger Karl and Andreas Willey, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, 2005.
2. Zhao and L. Guibas, "Wireless Sensor Networks", Morgan Kaufmann, San Francisco, 2004
3. C. S. Raghavendra, K.M.Shivalingam and T.Znati, "Wireless Sensor Networks", Springer, New York, 2004
4. Anna Hac, "Wireless Sensor Network Designs", John Wiley & Sons, 2004.
5. KazemSohraby, Daniel Minoli and TaiebZnati, "Wireless Sensor Networks: Technology, Protocols, and Applications", Wiley Inter Science, 2007.

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| **PCC-EC701(D)** | **Quantum Computing & Communication** | **3L: 0T: 0P (03hrs.)** | **Credits: 03** |

**Recommended Prerequisite**: -Engineering Mathematics, Fundamental of quantum mechanics

**Course Objective:** To make the students understand the fundamental concepts and theories about Quantum Computing & Communication. Apply this knowledge for research in true fault-tolerant quantum computing. However, until that noise is reduced, quantum computing is still a significant factor in the next stage of cyber security and AI.

**MODULE I** **(6 hrs.)**
**Introduction and overview:** Global perspectives, Quantum bits, Quantum computation: Single qubit gates, Multiple qubit gates, Measurements in bases other than the computational basis, Quantum circuits, Quantum algorithms: Classical computations on a quantum computer, Quantum parallelism, Deutsch's algorithm, The Deutsch–Jozsa algorithm

**MODULE II** **(10 hrs.)**
**Introduction to quantum mechanics:** Linear algebra: Linear operators and matrices, The Pauli matrices, Inner products, Eigenvectors and eigenvalues, Adjoints and Hermitian operators, Tensor products, Operator functions, The commutator and anti-commutator, The polar and singular value decompositions, The postulates of quantum mechanics, State space Evolution, Quantum measurement, Distinguishing quantum states, Projective measurements, POVM measurements, Phase, Composite systems, Quantum mechanics: a global view, Application: superdense coding, The density operator.

**MODULE III** **(8 hrs.)**
**Quantum circuits:** Quantum algorithms, Single qubit operations, Controlled operations, Measurement, Universal quantum gates, Two-level unitary gates are universal, Single qubit and CNOT gates are universal, A discrete set of universal operations, approximating arbitrary unitary gates is generically hard, Quantum computational complexity

**MODULE IV** **(10 hrs.)**
**The quantum Fourier transform and its applications:** The quantum Fourier transform, Phase estimation: Performance and requirements, Applications: order-finding and factoring.

**Quantum search algorithms:** The quantum search algorithm, the oracle, the procedure, Geometric visualization, Performance

**MODULE V** **(6 hrs.)**
**Quantum noise and quantum operations:** Classical noise and Markov processes, Quantum operations: Overview, Environments and quantum operations, Operator-sum representation, Axiomatic approach to quantum operations, Examples of quantum noise and quantum operations.

**Assessment:** Mid Term tests, Assignments, Tutorial, Quiz and End semester exams.

**Course Outcomes**:
Students earned credits will develop ability to

1. Analyze the behavior of basic quantum algorithms.
2. Understand the concept of quantum mechanics
3. Illustrate quantum circuit model.
4. Understand quantum Fourier transform and its application.
5. Analyze quantum noise and quantum operations.

**Reference / Text Books:**

1. Michael A. Nielsen & Isaac L. Chuang, "Quantum Computation and Quantum Information",First Edition, Cambridge University Press,2000
2. Sandor Imre& Ferenc Balazs, "Quantum Computing and Communications: An Engineering Approach",First Edition ,Wiley,2005
3. P. Kaye, R. Laflamme, and M. Mosca "An Introduction to Quantum Computing" First Edition, OxfordUniversity Press,2006

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| **PEC-EC702(A)** | **Microwave Engineering Lab** | **0L: 0T: 2P (hrs.)** | **Credits: 01** |

**Prerequisite: -** Electromagnetic fields, Antenna and wave propagation.

**List of Experiments**:

1. To study the characteristics of the Reflex klystron Tube and to determine its electronic tuning range.
2. To study the V-I characteristics of Gunn Diode.
3. To determine the Standing Wave-Ratio and Reflection Coefficient.
4. To determine the operating frequency & guide wavelength in a rectangular waveguide working on TE10 mode.
5. To Study the function of multi-hole directional coupler by measuring the following parameters.
6. To Study the Isolator and Circulators.
7. To study the working of Magic Tee.
8. To measure an unknown impedance with smith chart.
9. To Study the working of Resonant Cavity.
10. To measure the attenuation of attenuator.

**Course Outcome:**

1. Understanding of Microwave Signals and Transmission Line.
2. Understanding of various types of Microwave Transmission Line and its Design Consideration.
3. Understanding of various types of Microwave Generators and Amplifiers.
4. Understanding of various types of Microwave Solid State Devices.
5. Design and analyze of High Frequency Circuits and Systems.

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| **PEC-EC702(B)** | **CMOS VLSI Design Lab** | **0L: 0T: 2P (hrs.)** | **Credits: 01** |

**Course Objective:** The course is designed to give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon and the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes.

**List of Experiments**:

1. Introduction to EDA Tool (LTSPICE/Microwind/Xillinx/FPGA Kit).
2. Simulation & analysis of CMOS inverter transient & DC characteristics.
3. Simulation & analysis of 2 input NAND/NOR gate using CMOS.
4. Simulation & analysis of 2:1 MUX using pass transistor.
5. Simulation & analysis CMOS logic for Half Adder/ Full Adder using CMOS.
6. Layout design of a 2-input CMOS Inverter using any layout design tool.
7. Layout design of a 2-input CMOS NOR gate using any layout design tool.
8. Study of the switching characteristics of CMOS Inverter and find out noise margins.
9. Simulation of MOS Inverter with different loads.
10. Simulate 1-bit full adder following behavioral and structural modeling using VHDL\Verilog.
11. Implement all the logic gates in FPGA using verilog HDL. (Xilinx/ FPGA Kit).
12. Implement using 1-bit half adder and1-bit Full adder in FPGA using verilog HDL (Xilinx/ FPGA Kit).

## Course outcome:

Students earning credits will develop ability to:

1. Explain the basic structure and principle of MOS and the working of various modes of MOS and IC fabrication basics.
2. Analyze the models of MOS in high frequency & small signals.
3. Formulate value of drain current with maximum accuracy using successive models.
4. Design various logic circuits using, standard circuits such as register, PLA etc. and method of designing a processors.
5. Explain IC fabrication techniques and production process constrains.

| PEC-EC703(A) | CMOS VLSI Design | 3L: 0T: 0P (03 hrs.) | Credits: 03 |
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**Course Objective:** The course is designed to give the student an understanding of the different design steps required to carry out a complete digital VLSI (Very-Large-Scale Integration) design in silicon and the fundamental concepts and structures of designing digital VLSI systems include CMOS devices and circuits, standard CMOS fabrication processes.

**MODULE I** **(8 hrs.)**
CMOS circuits: MOS Transistors: Operating principle of MOS transistor, Channel Length Modulation, CMOS logic, CMOS inverter- DC characteristics, Switching Threshold, Noise in MOS, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, power consumption, stick diagram, IC layout design.

**MODULE II** **(8 hrs.)**
Practical Consideration and Technology in VLSI Design: Introduction, Size and complexity of Integrated Circuits, The Microelectronics Field, IC Fabrication Process, Crystal Growth and wafer preparation, Epitaxial growth methods, oxidation, Metallization, Physical Vapor Deposition and Sputtering. Patterning: Lithography, Photo masking steps, Diffusion, Ion Implantation

**MODULE III** **(9 hrs.)**
CMOS Technology: Basic CMOS Technology, A Basic n-well CMOS Process, Twin Tub Processes, CMOS Process Enhancement, Interconnects and Circuit Elements, Layout Design Rules, Latch up, Physical Origin, Latchup Triggering, Latch up Prevention, Internal Latch up Prevention Techniques.

**MODULE IV** **(8 hrs.)**
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.

**MODULE V** **(7 hrs.)**

**Circuit Simulation:** Introduction, Circuit Simulation Using Spice, MOSFET Model, Level 1 Large signal model, Level 2 Large Signal Model, High Frequency Model, Noise Model of MOSFET, Large signal Diode Current, High Frequency BJT Model, BJT Noise Model, temperature Dependence of BJT, Designing of MOS Transistor on Simulator.

**Assessment:** Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

**Course outcome:**

**Students earning credits will develop ability to:**

1. Explain the basic structure and principle of MOS and the working of various modes of MOS and IC fabrication basics.
2. Analyze the models of MOS in high frequency & small signals.
3. Formulate value of drain current with maximum accuracy using successive models.
4. Design various logic circuits using, standard circuits such as register, PLA etc. and method of designing a processors.
5. Explain IC fabrication techniques and production process constrains.

**Text/References Books:**

1. Geiger, Allen and Strader, "VLSI Design Techniques for Analog and Digital Circuits", International Edition, TMH Publication, 1990.
2. Sorab Gandhi, "VLSI Fabrication Principles", 2nd Edition, Wiley-Interscience Publication, 1994.
3. Weste and Eshraghian, "Principles of CMOS VLSI design", 2nd Edition, Pearson Education, 1993.
4. Weste, Harris and Banerjee, "CMOS VLSI Design", 3rd Edition, Pearson Education, 2007.
5. Pucknell and Eshraghian, "Basic VLSI Design", 3rd Edition, PHI Learning, 1995.
6. R. Jacob Baker, "CMOS Circuit Design, Layout, and Simulation" 2nd Edition, Wiley India, 2011.
7. S. M. Sze, "VLSI Technology", 2nd Edition, TMH Publication, 2017.

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| **PEC-EC703(B)** | **Fuzzy Logic and its Applications** | **3L: 0T: 0P (03 hrs.)** | **Credits: 03** |

**Recommended Prerequisite**: Engineering Mathematics, Electronics

**Course Objective:** To master the various fundamental concepts of fuzzy logic and artificial neural networks. This will help you to get sufficient knowledge to analyze and design the various intelligent control systems.

**MODULE I** **(8 hrs.)**

Basics of Fuzzy sets: Fuzzy sets, operation on Fuzzy sets, and Extensions of Fuzzy set concepts, extension principle and its applications. Geometry of fuzzy sets, sets as points, counting with fuzzy sets.

**MODULE II** **(8 hrs.)**

Fuzzy Relations: Basics of fuzzy relations, operations on fuzzy relations, various types of Binary fuzzy relations, fuzzy relations equations.

**MODULE III** **(8 hrs.)**

Membership Functions: Features of the membership function, fuzzification, Membership Value assignments — in tuition, in science, Rank ordering, Neural Networks.

**MODULE IV** **(8 hrs.)**

Fuzzy — to — crisp: conversions: Defuzzification methods — Max-membership principle, Central method, weighted average method, mean-max membership, center of sums, center of Largest area, first (or last) of maxima.

**MODULE V** **(8 hrs.)**

Fuzzy Associative memories: Fuzzy systems as between — cube mappings, fuzzy and neural Function estimators, neural Vs Fuzzy representation of structured knowledge, FANS as Mappings, fuzzy Hebb FAMS, the bi-directional FAN theorem for correlation minimum Encoding, correlation — product exuding, superimposing FAM rules, recalled outputs and defizzifaction, FAM structure Architecture. Binary input — output FAMS, example of Invented pendulum — Fuzzy contains crane control.

**Assessment:** Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

**Course Outcomes:**

Students earning credits will develop ability to:

1. Illustrate and Review Fundamentals of the concepts of regular and fuzzy sets.
2. Learn different types of fuzzy sets used in different applications.
3. Understanding the design of membership functions and fuzzification process.
4. Learning of fuzzy to crips and defuzzification process.
5. Design of different neural and fuzzy memories

**Text/ Reference Books:**

1. C.T. Lin and C.S.George Lee, "Neural Fuzzy Systems", PHI, 1996.
2. Bant A KOSKO, "Neural Networks and Fuzzy Systems", PHI, 1994.
3. Altrock, C.V., "Fuzzy Logic and Neuro Fuzzy Applications explained", PHI, 1995.

| PEC-EC703 (C) | Nano Electronics | 3L: 0T: 0P (03 hrs.) | Credits: 03 |
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**Prerequisite:** Physics, Electronic Devices

**Course Objective:** The course is designed to give the fundamental knowledge of nano electronic devices and nano technology & also able to understand the characteristic & behavior of Nanostructures.

**MODULE I** **(8 hrs.)**

Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics, Mesoscopic physics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality, Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells.

**MODULE II** **(8 hrs.)**

Introduction to characterization of nanostructures, tools used for of nano materials characterization, microscope-optical, electron, and electron microscope. Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Specimen interaction. Transmission Electron Microscope,X-Ray Diffraction analysis, PL & UV Spectroscopy, Particle size

**MODULE III** **(8 hrs.)**

Two dimensional electronic system, two dimensional behaviour, MOSFET structures, Heterojunctions Quantum wells, modulation doped quantum wells, multiple quantum wells ,The concept of super lattices Kronig - Penney model of superlattice.

**MODULE IV** **(9 hrs.)**

Transport of charge in Nanostructures under Electric field – parallel mtransport, hot electrons, perpendicular transport.Quantum transport in nanostructures, Coulomb blockade,Transport of charge in magnetic field - Effect of magnetic field on a crystal. Aharonov-Bohm effect, the Shubnikov-de Hass effect, the quantum Hall effect.

**MODULE V** **(7 hrs.)**

Nanoelectonic devices- MODFETS, heterojunction bipolar transistors Resonant tunnel effect, RTD, RTT, Hot electron transistors Coulomb blockade effect and single electron transistor, CNT transistors , Heterostructure semiconductor laser Quantum well laser, quantum dot LED, quantum dot laser Quantum well optical modulator, quantum well sub band photo.

**Assessment:** Internal viva, Continuous evolution of experiments, Journal write-up, Quiz and End semester exam.

**Course outcome:**
Students earning credits will develop ability to:
1. Student will able to learn fundamental knowledge of the Nanotechnology &Nanoelectronic.
2. The students will be able to understand the characteristic & behavior of Nanostructures.
3. The students will be able to understand the structures of Nano Devices.
4. The students will be able to understand the electric & Magnetic Behavior of nanostructure.
5. The students will be able to understand the application of Nano Devices.

**Text/References Books:**

1. Chattopadhyay, Banerjee, "Introduction to Nanoscience& Technology", Eastern Economy Edition, PHI, 2009.
2. George W. Hanson, "Fundamentals of Nanoelectronics", 1st Edition, Pearson Education, 2009. 3. K. Goser, P. Glosekotter, J. Dienstuhl, "Nanoelectronics and nanosystems", 1st Edition, Springer-Verlag Berlin Heidelberg, New York, 2004.
3. Murty, Shankar, "Text book of Nanoscience and Nanotechnology", 1st Edition, Universities Press, 2013.
4. Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnology", 1st edition, Wiley-Interscience Publication, 2003.
5. Supriyo Dutta, "Quantum Transport- Atom to transistor", 6th Edition, Cambridge University Press, 2013.

| PEC-EC703(D) | SDR & Cognitive Radio | 3L: 0T: 0P (03 hrs.) | Credits: 03 |
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**Recommended Prerequisite**: Communication Networks, Mobile Communication.

**Course Objective:** To make the students understand the fundamental concepts Software Defined Radios (SDR) and Cognitive Radio. This Course provides Comprehensive coverage of hardware and software architecture of software defined radio .The Course deals with the design of the wireless networks based on the cognitive radios.

**MODULE I** **(8 hrs.)**
**Introduction to Software Defined Radio:** Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

**MODULE II** **(8 hrs.)**
**SDR Architecture:** Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

**MODULE III** **(8 hrs.)**
**Introduction to Cognitive Radios:** Marking radio self-aware, cognitive techniques– position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

**MODULE IV** **(8 hrs.)**
**Cognitive Radio Architecture:** Cognitive Radio - functions, components and design rules, Cognition cycle - orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

**MODULE V** **(8 hrs.)**
**Next Generation Wireless Networks:** The XG Network Architecture, Spectrum sensing, Spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross-layer design, channel modeling, RF front end design and applications.

**Assessment:** Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

**Course Outcomes:**
Students earning credits will develop ability to:
1. Describe the basics of the software defined radios.
2. Learn the hardware and software architecture of software defined radio.
3. Design the wireless networks based on the cognitive radios.
4. Gives an understanding of cognitive radio architecture.
5. Explain the concepts behind the wireless networks and next generation networks.

**Text/ Reference Books:**

1. Joseph Mitola III, "Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", JohnWiley & Sons Ltd. 2000.
2. Thomas W. Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH HOUSE .2009.
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009.
4. Ian F. Akyildiz, Won–Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, "Next generation / dynamic spectrum access /cognitive radio wireless networks: A Survey" Elsevier Computer Networks, May 2006.
5. Simon Haykin, "Cognitive Radio: Brain–Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005.
6. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications, Jan 2008.
7. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
8. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
9. Alexander M. Wyglinski, Maziarnekovee, Y. Thomas Hu, "Cognitive Radio Communication and Networks", Elsevier, 2010, www.nptel.ac.in.
10. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering" Pearson Education Low Price Edition.
11. Kwang Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd.

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| **OEC-EC701(B)** | **Database Management System** | **2L: 1T: 2P (5 hrs.)** | **4 credits** |

## Course Objective:

The main objective of this course is to understand fundamental of database management system.

## Course Contents: (45 hrs.)

**Module 1:** **(06 hrs.)**

Introduction to DBMS, File system vs DBMS, Advantages of database systems, Database System architecture, Data models, Schemas and instances, Data independence, Functions of DBA and designer, Design issues, Entity-Relationship model :Basic concepts, Design process, E-R diagrams, weak entity sets, extended E-R features –generalization, specialization and aggregation

**Module 2:** **(08hrs.)**

Structure of relational databases, Domains, Relations, Relation algebra – fundamental operators and syntax, relational algebra queries, . Types of relational calculus i.e. Tuple oriented and domain oriented relational calculus and its operations, Integrity constraints, Referential integrity, Keys.

**Module 3:** **(14 hrs.)**

Data definition in SQL, update statements and views in SQL: Data storage and definitions, Data retrieval queries and update statements, Query Processing & Query Optimization: Overview, measures of query cost, selection operation, sorting, join, evaluation of expressions, transformation of relational expressions, estimating statistics of expression results, evaluation plans. Case Study of ORACLE and DB2.

**Module 4:** **(09 hrs.)**

Functional Dependency –definition, trivial and nontrivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization –1NF, 2NF,3NF, Decomposition using FD-dependency preservation, lossless join, BCNF, Multi-valued dependency, 4NF, Join dependency and 5NF.

**Module 5:** **(08 hrs.)**

Introduction of transaction, transaction processing and recovery, Concurrency control:
Lock management, specialized locking techniques, concurrency control without locking,
Protection and Security Introduction to: Distributed databases, Basic concepts of object oriented data base system.

## Course Outcome:

1. Describe basic concepts of DBMS and Explain ER model.
2. Solve queries using Relational Algebra and Extended ER features
3. Analyze and renovate to use a DDL, DML, Data Retrieval Query and discuss the Query optimization methods.
4. Understanding of functional dependencies, normalization theory and apply knowledge to the design of a database.
5. Explain term like transaction processing, concurrency control and distributed database.

## List of Text / Reference Books:

1. Date C J, "An Introduction to Database System", Pearson Educations, 8th Edition,2003.
2. Korth, Silbertz,Sudarshan, "Fundamental of Database System", McGraw Hill,5th Edition,2006.
3. Peter Rob, " Data Base System:Design Implementation & Management", Cengage Learninig 4th Edition,2000.
4. Elmasri, Navathe, "Fundamentals of Database Systems", Pearson Educations,7th Edition2017.
5 . Atul Kahate ," Introduction to Database Management System", PearsonEducations,2004.
6. Oracle 9i Database Administration Fundamental-I, Volume I, Oracle Press, TMH.
7. Paneerselvam,"DataBase Management System", PHI Learning,3rd Edition,2018.
8. J. D. Ullman, "Principles of Database and Knowledge – Base Systems", Computer Science Press,2nd Edition 1988.
9. Serge Abiteboul, Richard Hull, Victor Vianu,"Foundations ofDatabases", Addison-Wesley,1995.

## List of Experiments:

1. Introduction to Oracle and SQL
2. Write the queries for Data Definition language( DDL)
3. Write the queries for Data manipulation language( DML)
4. Use of various types of Integrity Constraints
5. Write the queries for Data Control language( DCL)
6. Use of SELECT command with different clauses.
7. Write SQL queries using logical operation ( AND, OR, NOT)
8. Write SQL queries for aggregate functions ( Max, Min, Sum, Avg, Count)
9. Write SQL queries for group by and Having
10. Write SQL queries for sub queries and nested queries
11. Write an SQL query to implement JOINS
12. Write SQL queries to create views
13. Write program by the use of PL/SQL
14. Design and implementation of any Data base system (like Banking, Universityetc).