Scheme & Syllabus of UG

Engineering Program

Bachelor of Technology

(B.Tech.)

Electronics & Communication Engineering

2020-21

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.	EC701	DC	VLSI Design	70	20	10	30	20	150	2	1	2	4
2.	EC702	DE	Departmental Elective	70	20	10	-	-	100	3	1	-	4
3.	EC703	OE	Open Elective	70	20	10	-	-	100	3	-	-	3
4.	EC704	D Lab	Microwave Lab	-	--	-	30	20	50	-	-	6	3
5.	EC705	O/E lab	I.O.T. Lab	-	-	-	30	20	50	-	-	6	3
6.	EC706	P	Major Project-I	-	-	-	100	50	150	-	-	8	4
7.	EC707		Evaluation of Internship - III	-	-	-	-	100	100	-	-	6	3
8.	Additional Credits#	*#Additional credits can be earned through successful completion of credit based MOOC's Courses available on SWAYAM platform (MHRD) at respective UG level.*											
			Total	210	60	30	190	210	700	8	2	28	24

Departmental Electives	Open Electives
702 (A) Microwave Engineering	703 (A) Cellular Mobile Communication
702 (B) Information Theory & Coding	703 (B) Internet of Things
702 (C) Nano Electronics	703 (C) Probability Theory & Stochastic Processor

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

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Department of Electronics & Communication Engineering

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC701	VLSI Design	2:1:2 (40 Hrs.)	4

Prerequisite: Electronics Devices

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.

<u>THEORY:</u>

Module 1 **(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 2 **(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 3 **(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 4 **(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 5 **(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, VI characteristics & power dissipation.
2. Explain IC fabrication unit processes and production process constrains.
3. Explain about CMOS fabrication techniques & latchup problem & prevention
4. Analyze the models of MOS in high frequency & small signals.
5. Formulate value of drain current with maximum accuracy using successive models

PRACTICAL:

Experiments List:

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).

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.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC702 (A)	Microwave Engineering	3:1:0 (40 Hrs.)	4

Prerequisite: Electromagnetic fields, Antenna and wave propagation.

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

THEORY:

Module 1 **(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 2 **(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 3 **(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 4 **(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 5 **(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.

PRACTICALS

Experiments List:
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.

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, Mc Graw 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.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC702 (B)	Information Theory and Coding	3:1:0 (40 Hrs.)	4

Prerequisite: Mathematics, Digital communication and its applications, Probability Theory

Course objective: To make the students understand the fundamental concepts of information theory and coding, that provides quantitative measures of information and allows us to analyze and characterize the fundamental limits of communication systems.

THEORY:

Module 1 **(6 Hrs.)**

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 of message, Average Information content of symbols. Self-information, Mutual information and its properties.

Module 2 **(8 Hrs.)**

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.

Module 3 **(8 Hrs.)**

Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Discrete memory less channels, Binary symmetric channel and 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.

Module 4 **(12 Hrs.)**

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, 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) Bit Shift register, Generator & parity check matrix of cyclic codes, encoding & decoding circuits, syndrome computation, error detection and correction,

Module 5 **(6 Hrs.)**

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

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

Course outcome:

Students earning credits will develop ability 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.

Text/Reference Books:

1. Simon Haykin, “Communication Systems”, 4th edition, John Wiley and Sons, 2001.
2. Peterson W., “Error Correcting Codes”, 2th edition, MIT Press, 1991.
3. John G. Proakis, “Digital Communication”, 5th edition, TMH, 2016.
4. Ranjan Bose, “Information Theory, Coding and Cryptography”, 2th edition, TMH, 2008.
5. Singh and Sapre, “Communication Systems”, 2nd edition, TMH, 2007
6. A. Thomas, Thomas M. Cover, “Elements of information theory”, 2nd edition Wiley-Interscience, 2006.
7. S. Gravano, “Introduction to Error Control Codes” OUP Oxford, 2001.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC702 (C)	Nano Electronics	3:1:0 (40 Hrs.)	4

Prerequisite: Physics, Electronic Devices

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

THEORY:

Module 1 **(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 2 **(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 3 **(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 4 **(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 5 **(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.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC703(A)	Cellular Mobile Communication	3:0:0 (40 Hrs.)	3

Prerequisite: Communication engineering, wireless communication, digital Communication

Course Objective: To understand the basic cellular system concepts & co channel interferences and also study of different multiple access techniques, Frequency management and Channel Assignment techniques in cellular mobile communication.

Theory:

Module 1 **(8 Hrs)**
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, Hand off mechanisms, Cell splitting, Consideration of the components of cellular systems.

Module 2 **(8 Hrs)**
Co-channel Interference, real time co-channel interference measurement at mobile radio transceivers, Design of antenna system - Omni directional and directional, lowering the antenna height, Reduction of co-channel interference, Umbrella- Pattern effect, Diversity receiver, designing a system to serve a predefined area that experiences Co- Channel Interference. Types of Non co-channel interference- adjacent channel Interference, Near-End-Far-End interference, Effects on Near-End mobile MODULEs, Cross- Talk, Effects on 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.

Module 3 **(8 Hrs)**
Cell coverage for signal and traffic: General introduction, obtaining the mobile point-to- point model, Propagation over water or flat open area, foliage loss, propagation in near in distance, long distance propagation, 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, mobile antennas.

Module 4 **(8 Hrs)**

Frequency management and Channel Assignment: Frequency management, Frequency spectrum utilization, Setup channels, Fixed channels assignment, Non-fixed channel assignment algorithms, Traffic and channel assignment. Handoffs and Dropped Calls: Types of Handoff, 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.

Module 5 **(8 Hrs)**
Digital Cellular System: 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, Mobile Integrated Radio Systems, Mobile Satellite Communication.

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

Course outcome:

Students earning credits will develop ability to:

1. Understand the basic Concept of mobile system and its design, frequency reuse, channels, Co channel interference, reduction factor, Hand off mechanisms, Cell splitting concept.
2. Illustrate the basic concept of Co-channel Interference, real time co-channel interference measurement at mobile radio transceivers
3. Analyze Cell coverage for signal and traffic
4. Analyze Frequency management and Channel Assignment: Frequency spectrum utilization
5. Understand Digital Cellular System: GSM, Architecture, Layer Modeling, Transmission, GSM channels and Channel Modes, Multiple Access Scheme

Text/ References Books:

1. Lee, "Cellular and Mobile Communication", 2nd edition, McGraw Hill.
2. D. P. Agrawal and Q. An Zeng, "Wireless and Mobile Systems", Cengage Learning, 2006.
3. Faher Kamilo, "Wireless Digital Communication", Prentice Hall of India, New Delhi, 2006.
4. G. J. Mullet, "Introduction to Wireless Telecommunication Systems and Networks", Cengage Learning.
5. Raj Kamal, "Mobile Computing", Oxford University Press.

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Scheme Based on AICTE Flexible Curriculum

Department of Electronics & Communication Engineering

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC703 (B)	Internet of Things	3:0:0 (40 Hrs.)	3

Prerequisite:-Embedded C, Microcontroller Programming.

Course Objective: The purpose of this subject is to understand principles and foundations of IOT in electronics and communication.

THEORY:

Module 1 **(8 Hrs.)**

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

Module 2 **(8 Hrs.)**

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

Module 3 **(8 Hrs.)**

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.

Module 4 **(8 Hrs.)**

Sensor Technology, Industrial IOT and Automotive IOT, Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology. 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.

Module 5 **(8 Hrs.)**

Introduction to R, python, LORAWAN and IOT WIFI modules like ESP8266 series, AT Commands, Interfacing with microcontroller, server, data transfer in IOT, Design of IOT systems like temperature logger, actuator etc.

Assessment: Internal viva, Continuous evolution of experiments, Quiz and End semester exam.

Course outcome:

Students earning credits will develop ability 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.

Text/Reference Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of things (A-Hand-onApproach)"1st Edition , Universal Press 2014.
2. Francis dacosta "Rethinking the Internet otthings:A scalable Approach to connecting everything", 1st edition, Apress publications 2013.
3. HakimaChaouchi "The Internet of Things: Connecting Objects", 1st edition, Wiley publication 2010.
4. Donald Norris"The Internet of Things: Do-It-Yourself at Home Projects for Arduino,Raspberry Pi and BeagleBone Black", 1st edition, McGraw Hill publication 2015.

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Department of Electronics & Communication Engineering

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC703 (C)	Probability Theory and Stochastic Processor	3:0:0 (40 Hrs.)	3

Prerequisite: Probability Theory, Random Processes

Course Objective: The objective is to understand basics concepts of probability theory, random variables, density & distribution functions and stochastic processes.

THEORY:

Module 1 **(6 Hrs.)**

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

Module 2 **(8 Hrs.)**

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.

Module 3 **(9 Hrs.)**

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 distributes, 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.

Module 4 **(8 Hrs.)**

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.

Module 5 **(6 Hrs.)**

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, CrossPower Spectral Density of Input and Output of a Linear System.

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

Course outcome:

Students earning credits will develop ability to:

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. Study operations on Multiple Random variables, Joint Distribution Function.
4. Understand Mean and covariance functions for simple random processes.
5. Explore the spectral characteristics of random processes.

Text/Reference Books:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", 4Ed., TMH, 2001.
2. Scott Miller, Donald Childers, "Probability and Random Processes", 2 Ed, Elsevier, 2012.
3. Athanasios Papoulis and S.Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes, 4 Ed., TMH.
4. Pradip Kumar Gosh, "Theory of Probability and Stochastic Processes", University Press
5. Henry Stark and John W. Woods, "Probability and Random Processes with Application to Signal Processing", 3 Ed., PE.
6. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis", 3 Ed., Oxford, 1999.
7. S.P. Eugene Xavier, "Statistical Theory of Communication", New Age Publications, 1997.

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC704	Microwave Lab	0:0:6	3

Prerequisite: - Electromagnetic fields, Antenna and wave propagation.

PRACTICALS

Experiments List:

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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Scheme Based on AICTE Flexible Curriculum

Department of Electronics & Communication Engineering

Subject Code	Name of the Subject	L: T: P (Hrs.)	Credits
EC705	IOT Lab	0:0:6	3

Prerequisite:-Embedded C, Microcontroller Programming.

Course Objective: The purpose of this lab is to learn and implement use of various IOT based communication using IOT modules and web server.

PRACTICALS

Experiments List:-

1. To study & Familiarize with the Internet and its data transfer environment.
2. Study different pins of ESP8266 and write a program using AT commands to reset and initialize ESP8266 in AP mode.
3. Write a program using AT commands to reset and initialize ESP8266 in AP mode.
4. Write a program forESP8266to scan available WIFI hotspot present and connect it using SSID and password.
5. Write a program for ESP8266 to initialize connection to a webserver and close connection to a webserver.
6. Write a program for ESP8266 to read a webpage and get data from it.
7. Write a program for ESP8266 to send data to a webpage.
8. Write a program in HTML on web server to design a webpage.
9. Write a program on webserver to receive and send data to embedded system through ESP8266 and WIFI connection.
10. Write a program using HTML, PHP and MYSQL to store data in database of webserver.

Assessment: Internal viva, Continuous evolution of experiments, Quiz and End semester exam.

Course outcome:

Students earning credits will develop ability 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