Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VI Semester (Electronics & Tele Communication Engineering)

w.e.f. July 2023

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	EC61	PEC	Professional Elective Course-II	70	20	10	-	-	100	3	1	-	4
2	EC62	OEC	Open Elective Course-I	70	20	10	-	-	100	3	1	-	4
3	EC63	PCC	Digital Signal Processing	70	20	10	30	20	150	3	-	2	4
4	EC64	PCC	Analog & Digital VLSI Design	70	20	10	30	20	150	3	-	2	4
5	EC65	PCC	Microwave & Radar Engg.	70	20	10	30	20	150	3	-	2	4
6	EC66	PI	Minor Project	-	-	-	60	40	100	-	-	4	2
7		MC	Industrial Training	Minimum Four weeks Duration. Evaluation will be done in 7th semester.									
			Total	**350**	**100**	**50**	**150**	**100**	**750**	**15**	2	**10**	**22**
8	EC67	DLC	Self-Learning Presentation (SWAYAM/NPTEL/MOOC)	-	-	-	-	-	-	-	-		8
9	EC68	MC	NSS/NCC/Swatchhata Abhiyan/Rural Outreach	Qualifier									
Additional Course for Honours or Minor Specialization				Permitted to opt for maximum 8 credits against additional MOOC courses in subject code EC67 for the award of Honours (Minor Specialization).									

Note: 01. Departmental BOS will decide list of three/four optional subjects those are available in MOOC,OEC as well for PEC.

02. MOOC/NPTEL subjects shall be taken with permission of HOD/Coordinator.

03. Industrial training should be apart from laboratory work unertaken in the college rather it should have industrial orientation and practical aspects/field work. Report to be sbmitted at the beginning of 7th semester and students have to give a presentation in the Department. Evaluation will be done in 7th semester.

Professional Elective Course-II		
S.No.	**Subject Code**	**Subject Name**
1	EC61A	Data Comm. & Computer N/W
2	EC61B	Satellite Communication
3	EC61C	Mobile Standards

Open Elective Course-I		
S.No.	**Subject Code**	**Subject Name**
1	EC62A	Wireless Communication
2	EC62B	Information Theory & Coding
3	EC62C	Robotics

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

PEC: Professional Elective Course, OEC: Open Elective Course, PCC: Professional Core Course, PI: Project and Internship, DLC: Distance Learning Course, MC: Mandatory Course

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC61A	Data Communication & Computer N/W	70	20	10	-	-	100	3	1	-	4

Module-I
Data Communication: Introduction, Components, Data representation, Serial & Parallel transmission, Modes of data transmission, Networks-Protocols and standards, Standards organizations, Line configurations, Different Topologies, Transmission mode, Categories of networks- LAN,MAN,WAN, Network edge, End systems, clients, servers, connectionless and connection oriented services, Connecting devices. The OSI model, different layers in OSI model, TCP/IP protocol suite.

Module-II
Physical layer: Transmission media: Guided media, Unguided media, Transmission impairment, Performance. Line Coding: Line Coding Schemes, Unipolar, Polar, Bipolar, Block Coding, Scrambling. **Switching**: Circuit switched Networks, Datagram Networks, Virtual Circuit Networks, Structure of a Switch. **Multiplexing**: Frequency Division, Wavelength Division, Synchronous Time Division, Statistical Time Division Multiplexing. Dial-up Modems, Digital Subscriber Line.

Module-III
Data Link Layer: Data link control; Framing, flow and error control, ARQ protocols and reliable data transfer service, stop-and wait, Go-Back-N, selective repeat ARQ, HDLC, Point-to-Point Protocol. **Multiple Access**: Random access, ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Reservation systems, polling, token-passing, comparisons, Channelization, Delay performance of MAC. **Local area networks**: LAN protocols, Ethernet, token ring, wireless LAN and IEEE 802.11 standard, Bluetooth, ATM networks and x.25, Wi-Fi Standard.

Module-IV
Network Layer: Logical Addressing, Internetworking, IPv4, IPv6, fragmentation and reassembly, address resolution, reverse address resolution, CIDR, NAT, Address Mapping, ICMP, IGMP, DHCP, **Routing**: Unicast routing protocols, Multicast routing protocols. **TCP/IP**: Architecture and protocol, IP packet, addressing, subnet, IP routing, UDP, SCTP.

Module-V

Application Layer and Security: Domain name system, domain name space, DNS in the Internet, SMTP and FTP, WWW and HTTP, Network Management; SNMP, Multimedia, general application layer services. **Security**: Cryptography, Symmetric key cryptography; ciphers, Asymmetric key cryptography, Network security.

Text Books:

1. Communication Networks, 2 ed., A Leon-Garcia, I Widjaja, McGraw Hill Education India.
2. Computer Networking: A top down approach, 5 ed., J F Kurose, K W Ross, Pearson Education.
3. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill, 2004.

Reference Books:

1. Data Networks, 2 ed, DP Bertsekas, R G Gallagar, Prentice Hall.
2. Analysis of Computer and Communication Networks, F Gebali, Springer 2008.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Classify various type of data communication network.
CO2	Analyze design constraints of physical layer.
CO3	Study various data link layer protocols and multiple access techniques.
CO4	Design various addressing mechanism.
CO5	Analyze the concept of application layer and various network security mechanism.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC61B	Satellite Communication	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	-	-	100	3	1	-	

MODULE-I

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits - Look Angle Determination- Limits of visibility - eclipse-Sub satellite point -Sun transit outage-Launching Procedures launch vehicles andpropulsion.

MODULE II

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control. Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry. Tracking andcommand. Satellite uplink and downlink Analysis and Design, link budget. E/N calculation- performance impairments-system noise. inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.

MODULE III

Modulation and Multiplexing: Voice, Data, Video, Analog - digital transmission system, Digitalvideo Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression - encryption

MODULE-IV

Earth Station Technology- Terrestrial Interface, Transmitter and Receiver, Antenna SystemsTVRO, MATV, CATV, Test Equipment Measurements on G/T, C/No, EIRP. Antenna Gain.

MODULE V

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GPS, INMARSAT. LEO, MEO. Satellite Navigational System. Direct Broadcast satellites (DBS) Direct to home Broadcast (DTH), Digital broadcast (DAB)- Worldspace services, Business TV(BTV), GRAMSAT, Specialized services- E-mail, Video conferencing, Internet

TEXT BOOKS:

1. Dennis Roddy, 'Satellite Communication', McGraw Hill International, 4th Edition, 2006.

2. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, 'Satellite Communication Systems Engineering', Prentice

Hall/Pearson, 2007.

3. Satellite Communication by Dr. P. C. Agarwal, Khanna Publishers 2009

4. Design of Geo synchronous Space craft, PHI 1986

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Identify the fundamental concept of satellite communication, orbits and eclipses.
CO2	Acquire the knowledge to understand the importance of satellite subsystem for link budget analysis
CO3	To Evaluate the significance of various modulation techniques
CO4	To Learn the techniques for analysis of earth station technologies
CO5	To Analyze the working and functionalities of various satellites.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC61C	Mobile Standards	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	-	-	100	3	1	-	

MODULE-I:

Cellular Mobile Wireless Networks: Systems and Design Fundamentals, Propagation Models Description of cellular system, Frequency Reuse, Cochannel and Adjacent channel interference, Propagation Models for Wireless Networks, Multipath Effects in Mobile Communication, Models for Multipath Reception. Evolution of Modern Mobile Wireless Communication System - First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, 2.5G Wireless Networks, Third Generation 3G Wireless Networks, Wireless Local Area Networks (WLANs), Cellular-WLAN Integration, AIIIP Network: Vision for 4G

MODULE-II

GSM: Architecture and Protocols - Air Interface, GSM Multiple Access Scheme, GSM Channel Organization, Traffic Channel multiframe, Control (Signaling) Channel Multiframe, Frames, Multi-frames, Super-frames and Hyper-frames, GSM Call Set up Procedure, GSM Protocols and Signaling, Location Update Procedure, Routing of a call to a Mobile Subscriber

2.5G Networks: The General Packet Radio Services: (GPRS) - GPRS Networks Architecture, GPRS Interfaces and Reference Points, GPRS Logical Channel, GPRS Mobility Management Procedures, GPRS Attachment and Detachment Procedures, Session Management and PDP Context, Data Transfer Through GPRS Network and Rout, GPRS Location Management Procedures, GPRS Roaming, The IP Internetworking Model, GPRS Interfaces and Related Protocols, GPRS Applications

MODULE-III

Overview of CDMA systems: IS-95 Networks 3G- The Universal Mobile Telecommunication System (UMTS)- UMTS Network Architecture-Release 99, UMTS Interfaces, UMTS Network Evolution UMTS Release 5, UMTS FDD and TDD, UMTS Channels, Logical Channels, UMTS downlink transport and physical channels, UMTS uplink transport and physical channels UMTS Time Slots, UMTS Network Protocol Architecture, Mobility Management for UMTS Network

MODULE-IV

Overview Mobile Internet Protocol: Basic Mobile IP, Mobile IP Type-MIPV4 and MIPv6, Mobile IP: Concept, Four basic entities for MIPv4, Mobile IPv4 Operations, Registration, Tunneling, MIPv4 Reverse Tunneling, MIPv4 Triangular Routing, Problems and Limitations of MIP, MIPv4 Route Optimization

MODULE-V

Mobility Management Issues: Role of IP on Wireless Networks IP for GPRS and UMTS R99,Protocol Reference Model for UMTS PS domain, Packet Switched Domain Protocol Stacks:Role of Interfaces, The GTP Tunnel, The lu-PS Interface and Mobility Management, Packetrouting and transport of user data in UMTS network, Configuring PDP Addresses on Mobile&Stations, Mobility Management in Wireless Networks, Mobility Classification, Seamless Terminal Mobility Management, Limitations of current TCP/IP networks for mobility support, Mobility solution. Accessing External PDN through GPRS/UMTS PS Domain, Transparent Access, and Use of Mobile IP for Non-transparent access, dynamically accesses IP address from External Network.

References Books:

1. Lee: Cellular and Mobile Telecommunication- Analog & digital systems, TMH

2. Rappaport: Wireless Communications- principles and practice, Pearson Education.

3. Lee: Mobile communications design fundamentals, Wiley India.

Course Outcomes: Upon successful completion of course students will be able to:

CO1	To assess the cellular system capacity
CO2	To assess the performance of 2G and 2.5G cellular standards.
CO3	To learn the various modules of CDMA system.
CO4	Acquire various concepts related to mobile protocols
CO5	Learn the concepts require understanding of mobile management issues.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
EC62A	Wireless Communication	End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	-	-	100	3	1	-	

MODULE I

WIRELESS CHANNELS Large scale path loss - Path loss models: Free Space and Two-Ray models -Link Budget design - Small scale fading- Parameters of mobile multipath channels - Time dispersion parameters- Coherence bandwidth - Doppler spread & Coherence time, Fading due to Multipath time delay spread - flat fading - frequency selective fading - Fading due to Doppler spread-fast fading-slow fading.

MODULE II

CELLULAR ARCHITECTURE Multiple Access techniques FDMA, TDMA, CDMACapacity calculations-Cellular concept- Frequency reuse channel assignment- hand off-interference & system capacity- trunking& grade of service Coverage and capacityimprovement.

MODULE III

DIGITAL SIGNALING FOR FADING CHANNELS Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle - Cyclic prefix, Windowing.PAPR.

MODULE IV

Wireless Sensor Networks, Protocols, and technologies, Communication architecture and protocols for WSN (MAC, Link, Routing), Sensor data acquisition, processing and handling, Energy management.

MODULE V

MULTIPLE ANTENNA TECHNIQUES MIMO systems-spatial multiplexing -System model- Pre-coding-Beam forming - transmitter diversity, receiver diversity- Channel state information- capacity in fading and non-fading channels.

Reference Books:

1. Wireless Communications Hardcover – Illustrated, 2005, by Andrea Goldsmith, Cambridge University Press.
2. Wireless Communication Handbook by Sarhan M. Musa.
3. Wireless Sensor Networks by Ananthram Swami, Yao-Win Hong, and Lang Tong.
4. Wireless Communications The Future by William Webb.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	To characterize various Wireless Channels
CO2	To understand various encoding schemes for fading channels
CO3	To understand fundamental concepts related to digital signaling for fading channels
CO4	Compare multipath mitigation techniques and analyze their performance
CO5	To implement system consisting a transmitter/receiver segment of MIMO systems and analyze their performances.

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC62B	Information Theory & Coding	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	-	-	100	3	1	-	

MODULE-I

Source Coding: A logarithmic measure of information, Average mutual information and entropy, Information measures for continuous random variables, Noiseless coding theorem, Coding for discrete memoryless sources, Discrete stationary sources, The Lampel-Ziv algorithm, Coding for analog sources, rate distortion function.

MODULE-II Channel Capacity and Coding:The converse to the coding theorem, Channel models, Channelcapacity, Achieving channel capacity with orthogonal Signals, Channel reliability functions,Random coding based on M-ary Binary-coded signals, Practical Communication systems in lightof Shannon's equation.

MODULE-III

The Noisy-channel coding theorem: Linear Block codes. The generator matrix and the parity check matrix. Some specific linear block codes, Cyclic codes, Decoding of linear block codes, bounds on minimum distance of the linear block codes.

MODULE-IV

Convolutional Codes: Basic properties of the convolutional codes, The transfer function of a convolutional code, Optimum decoding of convolutional codes- The Viterbi algorithm, Distanceproperties of binary convolutional codes, Other decoding algorithms for convolutional codes,Practical considerations in the application of convolutional codes.

MODULE-V

Complex codes based on combination of simple codes: Product codes, Concatenated codes, Turbo codes, The BCJR algorithm. Coding for Bandwidth-constraint channels: Combined coding and modulation. Trellis codedmodulation.

References:

1. Simon Haykins: Communication Systems, 4th Edition, John Wiley.

2. J. G. Proakis: Digital Communications, McGraw Hills

3. B.P. Lathi: Modern Analog and Digital Communication System, Oxford University Press

4. R. G. Gallager: Information Theory and Reliable Communication, John Wiley and Sons

5. A. J. Viterbi and J. K. Omura: Principles of Digital Communications and Coding. McGraw Hill Series.

6. U. Madhow: Fundamentals of Digital Communication, Cambridge University Press.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand various source coding algorithms
CO2	Describe channel capacity
CO3	Translate the noisy channel coding theorems
CO4	Describe various convolution codes
CO5	Execute complex codes based on combination of simple codes

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC62C	Robotics	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	-	-	100	3	1	-	

Module I

Introduction: Historical development of robots; basic terminology and structure; robots in automated manufacturing, robot configuration space and its topology, degrees of freedom

Module II

Rigid Motions and Homogeneous Transformation: Rotations and their composition; Exponential coordinates; Screw theory; Twists; Euler angles; homogeneous transformations

Module III

Forward Kinematics: Common robot configurations; Product of Exponentials formula; Denavit-Hartenberg convention. Velocity kinematics: Angular velocity and acceleration; The Jacobian Inverse kinematics: Planar mechanisms; geometric approaches; pseudoinverse; spherical wrist;numerical approaches and Newton-Raphson method

Module IV

Statics of open chains: The use of the Jacobian; singular configurations; manipulabilityKinematics of closed-chains Robot dynamics: Lagrangian dynamics; Euler-Newton equations for open kinematic chains. Forward and inverse dynamics.

Module V

Trajectory generation: trajectories in space of homogeneous transformations; minimum time trajectoriesFeedback control: Actuators and sensors; velocity and torque control; PID control; linearization; feedback linearization Vision-based control: The geometry of image formation; feature extraction; feature tracking (lab)

Text Books:

1. Lynch and Park, Modern Robotics: Mechanics, Planning, and Control, Cambridge UniversityPress, 2017

2. Robotics, Vision, and Control, Peter Corke, Springer, 2011.

3. Introduction to Robotics, John J. Craig, Addison-Wesley Publishing, Inc., 1989.

4. Introduction to Robotics, P. J. McKerrow, ISBN: 0201182408

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand basic terminology structure of Robots and its topology
CO2	Analyze Rigid Motions and Homogeneous Transformation: Rotations and their composition;
CO3	Forward and Inverse kinematics of Common robot, numerical approaches and Newton-Raphsonmethod
CO4	Apply Statics of open chain, manipulability Kinematics of closed-chains, Robot dynamics, Forward and inverse dynamics
CO5	Implement trajectory planning algorithm for straight line motion and executing PID based

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC63	Digital Signal Processing	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	30	20	150	3	-	2	

Module-I.

Discrete-Time Signals and Systems: Discrete-Time Sequences and Systems, Sequence manipulation, System connectivity, Linear constant coefficient difference equations, Derivation of transfer function of LTI systems, Linearity, BIBO stability of the system, Frequency Domain Representation of discrete time signals & systems.

Module-II.

Z-Transform Applications: Introduction to direct z-transform and Inverse- Z transform sequences, Mapping of S-domain to Z- domain, Stability, Rational z-transforms, Chirp-Z transform.

Module-III.

Frequency Analysis of Discrete Time Signals: Introduction to DFT, Comparison of the DFS and Discrete Fourier Transform (DFT), Properties of DFT, Circular Convolution, Two dimensional DFT FFT algorithms, Radix-2 FFT Algorithm, Goertzel's Algorithm, Decimation in time, Decimation in frequency algorithm, Concept of Radix-N algorithm.

Module-IV.

Basic filter structures -Recursive and non -recursive networks, Basic structures of IIR and FIR filters, Determining of system response, Impulse response and transfer function of filters, finite word-length of digital filters.

Module-V.

Digital filters Design Techniques: Design of IIR and FIR digital filters, Impulse invariant and bilinear transformation, windowing techniques- rectangular and other windows, Application of MATLAB for design of digital filters, Concept of Adaptive filtering and applications.

Reference Books:

1. A.V. Oppenheim and R. W. Schafer: Digital Signal Processing, Prentice Hall.

2. L.R. Rabiner and B. Gold: Theory and Application of Digital Signal Processing, Prentice Hall

3. John. G. Proakis and Monolakis: Digital Signal Processing, Pearson Education

4. Salivahanan and Vallavraj: Digital Signal Processing, McGraw Hill.

5.S. K. Mitra: Digital Signal Processing- A Computer based Approach, McGraw Hill.

6. Schilling and Harris: Fundamentals of DSP using MATLAB, Cengage Learning.

Digital Signal Processing Lab

List of experiments:

The following practical should be performed using MATRAB/ any DSP software:

1. Generation, analysis and plots of discrete-time signals

2. Implementation of operations on sequences (addition, multiplication, scaling, shifting, folding etc).

3. Implementation of Linear time-invariant (LTI) systems and testing them for using polar diagram.

4. Computation and plots of z-transforms, verification of properties of z-transforms.

5 . Computation and plot of DFT of sequences, and FFT algorithms.

6. Computation and plots of linear/circular convolution of two sequences.

7. Design of windowing techniques of FIR Filter.

8. Design of Butterworth IIR filter.

9. Design of IIR Chebyshev filter.

10. Design of IIR elliptical filter.

COURSE OUTCOMES: At the end of the course the student will be able to:

CO1	Knowledge of discrete signals and systems.
CO2	Understand time-domain and frequency domain analysis for discrete systems.
CO3	Synthesize and analyze discrete system in frequency domain.
CO4	Design Filter structures.
CO5	Design various Digital Filters

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Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
EC64	Analog & Digital VLSI Design	End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	4
		70	20	10	30	20	150	3	-	2	

MODULE-I

Overview of VLSI Design: Overview of VLSI design methodologies, VLSI design flow, design hierarchy, concepts of regularity, modularity, and locality, VLSI design styles, design quality. Layout design rules, stick diagram, full-custom mask layout design.

Combination CMOS Logic Circuits: MOS logic circuits with depletion/enhancement loads, CMOS logic circuits, complex logic circuits, CMOS transmission gates (pass gates), ratioed, dynamic and pass transistor logic circuits.

Sequential MOS logic circuits: Behavior of bi-stable elements, SR latch circuits, clocked latch and flip-flop circuits, CMOS D-latch and edge-triggered flip-flop. Timing path, Setup time and hold time static, example of setup and hold time static, setup and hold slack, clock skew and jitter, Clock, reset and power distributions.

MODULE-II

Semiconductor Memories: Memory Design, SRAM, DRAM structure and implementations.

Programmable logic structure: reprogrammable gate arrays, Xilinx programmable gate array, Algotronix, concurrent logic, sea of gate and gate array design.

MODULE-III

Review: MOSFET Operation & MOS small signal Models, Device Structure & I/V characteristics.

Basic Analog blocks: Basic concepts of amplification and biasing, Current sources and sinks, Current mirrors: Simple current mirror, cascode current mirror, low voltage current mirror, Wilson and Widlar current mirrors.

MODULE-IV

Single stage amplifier: Common source stage with resistive load, diode connected load, triode load, CS stage with source degeneration, source follower, CG stage, Gain boosting techniques, cascode, folded cascode.

Differential amplifier: Significance of tail current source, errors due to mismatch, qualitative analysis, common mode response, differential amplifier with MOS loads, single ended conversion, Gilbert Cell.

MODULE-V

Frequency response of Amplifiers: Device high-frequency small-signal models; Device capacitances, cut off frequency calculation, Simplified high-frequency analysis of basic amplifiers, Miller's theorem.

Feedback Amplifier: Feedback concept, negative & positive feedback, voltage/ current, series/shunt feedback, Practical feedback circuits, Loop gain and stability, Design Procedure for the feedback amplifiers, Effect of Loading, Effect of Feedback on Noise.

Switched-Capacitor Circuits: General Consideration, Sampling Switches, Switched-Capacitor Amplifier, Switched-Capacitor Integrator.

Text Books: 1. N. H. E. Weste and C. Harris, "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007.
2. J. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Prentice Hall 2004.
4. Design of Analog CMOS Integrated Circuits, by Behzad Razavi, McGraw-Hill
5. Analysis and Design of Analog Integrated Circuit, Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, John Wiley & Sons

Reference Books/materials: 1. R.L.Geiger, Allen and Stradder, VLSI Design Techniques for Analog and Digital Circuits, McGraw-Hill Education, 2010.
2. CMOS: Circuit Design, Layout, and Simulation by R. Jacob Baker, Wiley-IEEE Press(2019)

Course Outcomes:
Upon Successful completion of course students will be able to:

CO1	Design and implementation of combinational and sequential circuits
CO2	Understand and design different Memory circuits
CO3	Draw the small signal models of MOS transistors and identify the various design metrics of analog Design.
CO4	Understand the basic Amplifier stages and Illustrate the operation of a Differential amplifier
CO5	Compute the frequency response of the amplifiers

List of Experiments: (Expandable)

1. To Study Lambda based and Micron Based Design Rules
2. To design a CMOS Inverter and verify its DC and Transient Characteristics using EDA Tools (Cadence/Mentor Graphics/Tanner/Microwind)
3. To design Logic Gates (AND,NAND,OR,NOR) using EDA Tools
4. To Design of Half Adder using EDA Tool
5. To Design of Full Adder using EDA Tool
6. To design Combinational Circuit implementing logic expressions
7. To design 6-T SRAM memory.
8. To design and simulate CS single stage amplifier and verify its frequency response characteristic.
9. To design and simulate CG single stage amplifier and verify its frequency response characteristics.
10. To Design Basic Differential amplifier

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Bachelor of Technology (B.Tech.) VI Semester (Electronics & Telecommunication Engg.)

COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
		Theory			Practical						
		End Sem.	Mid-Sem. Exam	Quiz/ Assignment	End Sem.	Lab work		L	T	P	
EC65	Microwave & Radar Engg.	70	20	10	30	20	150	3	-	2	4

MODULE I

Microwave Components: Rectangular cavity resonators; Q of a cavity resonator, Re-entrant cavities; Slow-wave structure; Microwave hybrid circuits; S-parameters and their properties; Waveguide tees; Hybrid ring: Waveguide corners bends and twists; Two hole directional coupler, S- Matrix; Circulators and Isolators; Hybrid couplers.

MODULE - II

Microwave Linear Beam and Crossed-Field Tubes: Failure of conventional tube at high frequency; Klystron-Velocity modulation; Bunching; output power and loading; Reflex klystron- Velocity modulation; power output and efficiency and electronic admittance; Helix travelling wave tubes; amplification process; Conventional current; Electric field wave modes; Basic principle of coupled cavity; Magnetron-Types and Principles of operation; Modes of oscillation; Strapping; pi-mode separation.

MODULE-III

Microwave Devices: Transistors, Tunnel Diodes and Microwave FETs: Structure; Operation; Characteristics and Power frequency limitations of microwave transistors; Tunnel diodes and Field- Effect Transistors. Transfer Electron Devices: Gunn diode; Gunn Effect; Principle and Mode of operation; Microwave generation and amplification Tunnel Diode; PIN diode and Crystal diode. Modulator, Switches, Avalanche Transit- Time Devices: Physical Structure; Principle of operation; Characteristics; Power output and Efficiency of IMPATT, TRAPATT and BARITT diodes,Parametric amplifiers.

MODULE-IV

Microwave Design Principles. Impedance transformation, Impedance Matching, Microwave FilterDesign, RF and Microwave Amplifier Design, Microwave Power amplifier Design. Low NoiseAmplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Measurement: Microwave bench; Precautions; Power measurement; Bolometricmethod; Attenuation; VSWR; Impedance, Frequency and Q of the Cavity.

MODULE-V

Principles and Applications of Radar: Basic Radar, Radar Block Diagram, Radar Frequencies, Applications of Radar, Radar Range Equation, MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, delay line cancellers, staggered PRF. Range gated Doppler filter, limitations to MTI performance. Tracking with Radar, Monopulse Tracking. Conical Scan and Sequential Lobing, Limitations to Tracking Accuracy, Low Angle Tracking, Tracking in range, Comparison of Trackers.

Text Books:

1. Microwave Devices and Circuits by Samuel Y. Liao, 3rd Ed., Pearson Education.
2. Foundations of Microwave Engineering by R.E. Collin, TMH Pub.
3. Introduction to Radar Systems by M.I Skolnik, TMH Pub. Co.

Reference Books:

1. Microwave Principles by Reich.
2. Microwaves, Gupta, New Age International Publishers.
3. Microwave and Radar Engg., M. Kulkarni, Umesh Publication.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Apply concepts of electromagnetic theory to calculate parameters ofwaveguides and transmission lines.
CO2	Design and analyze microwave components and tubes.
CO3	Design and analyze passive and active microwave devices.
CO4	Analyze the designing of microwave filter, microwave amplifier,microwave mixer and microwave oscillator.
CO5	Analyze the principle of radar.

List of Experiments:

1. Study of Microwave Test Bench
2. Study of Gunn Power Supply
3. Study of Klystron Power Supply
4. Study of Microwave VSWR meter.
5. Study of Two cavity Klystron
6. Study of Magic Tee
7. Calculation of parameter for a Given microwave waveguide
8. Calculation of unknown-Impedance using smith chart
9. Design and simulation of E plane Tee/H plane Tee on HFSS/CST

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COURSE CONTENTS **w.e.f. July 2023**

Subject Code	Subject Name	Maximum Marks Allotted					Total Marks	Hours/ Week			Total Credits
EC66	Minor Project	Theory			Practical						
		End Sem	Mid-Sem Exam	Quiz/ Assignment	End Sem	Lab work		L	T	P	2
		-	-	-	60	40	100	-	-	4	

Guidelines: The Minor project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design. The Minor project may be a complete hardware or a combination of hardware and software. Minor Project should cater to a small system required in laboratory or real life. It should encompass components, devices, analog or digital ICs, micro controllers with which functional familiarity is introduced. Based on comprehensive literature survey/ Industry requirements analysis, the student shall identify the title and define the aim and objectives of the Minor project. Students are expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within the first week of the semester. The student is expected to exert on design, development, and testing of the proposed work as per the schedule. Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirements of the system, mechanical aspects for enclosure and control panel design. Completed Minor project and documentation in the form of mini project report is to be submitted at the end of semester.

Course Outcomes:

At the end of the Minor project work, students will demonstrate the ability to

CO1. Identify a problem statement either from a rigorous literature survey or the industry requirements analysis.
CO2. Design a solution for the identified problem by applying acquired technical knowledge.
CO3. Simulate, Develop and Test the Prototype with a standard solution/ process.
CO4. Learn to work in a team and coordinate within the group for timely completion of targeted work.
CO5. Present project work orally and through a comprehensive report.

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