KAMARAJ COLLEGE OF ENGINEERING & TECHNOLOGY

(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)

S.P.G.Chidambara Nadar - C.Nagammal Campus

S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATION – 2020

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM

V TO VI SEMESTER CURRICULUM AND SYLLABI

VISION:

To make the Department of Electronics and Communication Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

MISSION:

To impart highly innovative and technical knowledge in the field of Electronics and Communication Engineering to the urban and unreachable rural student folks through Total Quality Education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: To establish a strong foundation in Electronics and Communication Engineering necessary to formulate, model, analyze and solve real time problems.

PEO 2: To inculcate professional skills and life skills for placement or to pursue higher studies in the relevant fields.

PEO 3: To promote research and development activities and solve industrial problems with creative ideas.

PROGRAM OUTCOMES:

After going through the four years of study, the Electronics and Communication Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/Development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice

7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Ability to make use of attained technical knowledge in the field of Electronics and Communication Engineering for successful career and qualifying in competitive examinations at the national level.

PSO2 : Ability to develop workable solutions for real time challenges in Electronics and Communication Engineering

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	EC1501	Communication Networks#	PC	5	3	0	2	4
2	EC1502	Digital Communication	PC	3	3	0	0	3
3	EC1503	Electronic Circuits - II	PC	3	3	0	0	3
4	EC1504	Transmission Lines and RF Systems	PC	3	3	0	0	3
5		Professional Elective - I	PE	3	3	0	0	3
6		Open Elective – I*	OE	3	3	0	0	3
PRACTICALS								
7	EC1511	Circuits Design and Simulation Laboratory	PC	4	0	0	4	2
8	EC1512	Communication Systems Laboratory	PC	4	0	0	4	2
			TOTAL	**31**	**21**	**0**	**10**	**23**

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	EC1601	Antennas and Microwave Engineering	PC	3	3	0	0	3
2	EC1602	Microprocessors and Microcontrollers Interfacing	PC	3	3	0	0	3
3	EC1603	VLSI Design[#]	PC	5	3	0	2	4
4	EC1604	Wireless Communication	PC	3	3	0	0	3
5		Professional Elective - II	PE	3	3	0	0	3
6		Online Course - I	OL	3	3	0	0	3
PRACTICALS								
7	EC1611	Microprocessors and Microcontrollers Interfacing Laboratory	PC	4	0	0	4	2
8	EC1621	Mini Project	EEC	4	0	0	4	2
9	HS1521	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**28**	**18**	**0**	**12**	**24**

***** Course from the Curriculum of other UG programmes.

[#] Theory cum Laboratory Course

PROFESSIONAL ELECTIVES (PEs)

PROFESSIONAL ELECTIVE I (SEMESTER V)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	IT1371	Computer Organization and Architecture	PE	3	3	0	0	3
2	IT1301	Object Oriented Programming	PE	3	3	0	0	3
3	IT1402	Operating Systems	PE	3	3	0	0	3
4	EC1531	Human Rights	PE	3	3	0	0	3
5	EC1532	Medical Electronics	PE	3	3	0	0	3
6	EC1533	RF System Design	PE	3	3	0	0	3
7	EC1534	Signal Integrity for High Speed Design	PE	3	3	0	0	3
8	GE1571	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE II (SEMESTER VI)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	EC1631	Advanced Digital Signal Processing	PE	3	3	0	0	3
2	EC1632	Advanced Radiation Systems	PE	3	3	0	0	3
3	EC1633	Digital Image Processing	PE	3	3	0	0	3
4	EC1634	Electromagnetic Interference and Compatibility	PE	3	3	0	0	3
5	EC1635	Machine Learning Techniques	PE	3	3	0	0	3
6	EC1636	MEMS and NEMS	PE	3	3	0	0	3
7	EC1637	Nanotechnology and Applications	PE	3	3	0	0	3
8	ME1634	Operation Research Techniques	PE	3	3	0	0	3

OPEN ELECTIVE I (SEMESTER V)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	OEC151	Basics of Signals and Systems	PE	3	3	0	0	3
2	OEC152	Digital Audio Engineering	PE	3	3	0	0	3
3	OEC153	Electronics Packaging	PE	3	3	0	0	3
4	OEC154	Space Time Wireless Communication	PE	3	3	0	0	3
5	OEC155	Telecommunication Network Management	PE	3	3	0	0	3
6	OEC156	Wavelets and its Applications	PE	3	3	0	0	3

EC1501 **COMMUNICATION NETWORKS**

(Theory Cum Lab)

L	T	P	C
3	0	2	4

OBJECTIVES:

- To discuss the fundamental concepts of communication networking.
- To understand data link layer protocols and security issues.
- To implement the routing algorithms to identify routes in a given Network.
- To understand the concepts of Transport layer protocols and QoS.
- To describe some real network applications

UNIT I NETWORK FUNDAMENTALS 9

Overview of Data Communications, Network & its types, Performance, Networks Topologies& models - Protocol Layering, TCP / IP protocol suite, TCP / IP protocol suite, Layers in OSI model, Switching Network– Circuit, Packet & Message, Physical layer- Characteristics.

UNIT II DATA LINK LAYER 9

Introduction to Data Link Layer, Link layer Addressing –ARP, Flow Control Error Detection & Correction, Framing, Media access control, Wired LANs: Ethernet 802.3, Wireless LAN, Bluetooth, Connecting devices and Virtual LANs.

UNIT III NETWORK LAYER 9

Network Layer Services, Logical addressing:IPv4, Network Layer Protocols-IP,ICMP, Basic Internetworking DHCP, Unicast Routing, Multicast Address & routing–DVMRP and PIM, Overview of Intradomain and Interdomain Protocols, IPV6 Address, Transition from IPV4 to IPV6.

UNIT IV TRANSPORT LAYER 9

Introduction to Transport layer, Protocols –UDP, TCP–Services-Features, TCP connection-State Transition Diagram, Flow, Error and Congestion control, Congestion avoidance DECbit & RED, QoS – Application requirements.

UNIT V APPLICATION LAYER 9

Application Layer Paradigms-Client Server Programming, WWW – HTTP, Electronic Mail SMTP, POP3, IMAP, MIME, DNS, FTP, TELNET, Need for Network Security, Cryptography - Symmetric key and Public key algorithms, Firewalls.

TOTAL: 45 PERIODS

OUTCOMES (for Theory)

CO1: Explain the network fundamentals and various layers of OSI Model.

CO2: Interpret the media access control protocol standards and the concepts of Internetworking.

CO3: Apply the standard routing algorithms to identify routes in a given Network.

CO4: Explain the concepts of Transport Layer Protocols.

CO5: Classify the protocols for developing various applications in Application Layer.

TEXT BOOKS

1. Behrouz A. Forouzan, 2013, *Data communication and Networking*, Fifth Edition, Tata McGraw – Hill.

REFERENCE BOOKS

1. Kurose, J.F., 2005, *Computer networking: A top-down approach featuring the internet, 3/E*. Pearson Education India.
2. Mir, N.F., 2015, *Computer and communication networks*. Pearson Education.
3 Lin, Y.D., Baker, F. and Hwang, R.H., 2011, *Computer Networks: An Open Source Approach*. McGraw Hill.
4 Basagni, S. and Choi, Y., 2011, *In Praise of Computer Networks: A Systems Approach*, Fifth Edition.

LIST OF EXPERIMENTS

1. Implementation of Network Topology-Star, Bus, Ring
2. Implementation of Error Detection / Error Correction Techniques
3. Implementation of Stop and Wait Protocol and sliding window
4. Implementation of distance vector routing algorithm
5. Implementation of Link state routing algorithm

6. Simulation of TCP Congestion Control Algorithms using NS
7. Study of Socket Programming and Client –Server model
8. Implementation of Encryption and decryption algorithms

TOTAL: 30 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	C / Python / Java / Equivalent Compiler	-
2	Standard LAN Trainer Kits	4 Nos
3	Standalone Desktops	30 Nos

OUTCOMES (for Laboratory)

CO1: Model various network Topologies to analyze network Performance.

CO2: Examine the protocol performance used for different purposes like error control, flow control, logical addressing.

CO3: Apply the standard routing algorithms to identify routes in a given network.

CO4: Implement the various Transport layer protocols and congestion algorithms.

CO5: Apply the socket programming concepts and security algorithms for a given network application.

EC1502 **DIGITAL COMMUNICATION**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the limits set by Information Theory.
- To study the various waveform coding schemes.
- To learn the various baseband transmission schemes.
- To understand the various band pass signaling schemes.
- To know the fundamentals of channel coding.

UNIT I INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memoryless channels – Binary Symmetric Channel, Binary Erasure channel-Channel Capacity - Hartley - Shannon law - Source coding theorem - Shannon - Fano & Huffman codes.

UNIT II WAVEFORM CODING & REPRESENTATION 9

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ – Manchester.

UNIT III BASEBAND TRANSMISSION & RECEPTION 9

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding - Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization.

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals – Gram Schmit orthogonalization procedure- Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers - Principle of DPSK.

UNIT V ERROR CONTROL CODING 9

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Identify problems based on Information theory and coding.

CO2: Interpret different waveform coding techniques to model the pulse coding systems and the power spectral density of the different line coding schemes.

CO3: Infer about the different methods for ISI free transmission.

CO4: Illustrate the pass band modulation techniques with its performance and the need for carrier synchronization.

CO5: Solve problems on channel coding techniques.

TEXT BOOK

1. S. Haykin, 2005. *Digital Communications*, John Wiley.

REFERENCE BOOKS

1. J.G Proakis 2001. *Digital Communication*. 4th Edition, Tata McGraw Hill Company.
2. B. Sklar, 2009. *Digital Communication Fundamentals and Applications*, 2nd Edition, Pearson Education.

EC1503 **ELECTRONIC CIRCUITS-II**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits.
- To study about feedback amplifiers and oscillators principles.
- To design oscillators.
- To study about tuned amplifier.
- To understand the analysis and design of LC and RC oscillators, amplifiers, multi vibrators, Blocking oscillator and Time base generators.

UNIT I FEEDBACK AMPLIFIERS AND STABILITY 9

Feedback Concepts - gain with feedback - effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers - analysis of series-series, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

UNIT II OSCILLATORS 9

Barkhausen criterion for oscillation - phase shift, Wien bridge oscillator - Hartley &Colpitt'soscillators - Clapp oscillator-Ring oscillators and crystal oscillators - oscillator amplitude stabilization.

UNIT III TUNED AMPLIFIERS 9

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers - Analysis of capacitor coupled single tuned amplifier - double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth - Stagger tuned amplifiers - Stability of tuned amplifiers - Neutralization - Hazeltine neutralization method.

UNIT IV WAVE SHAPING AND MULTIVIBRATOR CIRCUITS 9

Pulse circuits - attenuators - RC integrator and differentiator circuits - diode clampers and clippers - Multivibrators - Schmitt Trigger- UJT Oscillator.

UNIT V BLOCKING OSCILLATORS AND TIMEBASE GENERATORS **9**

UJT saw tooth waveform generator - Astable Blocking Oscillators with base timing - Push-pull Astable blocking oscillator with emitter timing - Monostable blocking oscillator with base timing - Monostable blocking oscillator with emitter timing, Time base circuits - Voltage-Time base circuit, Current Time base circuit.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Identify the topology of feedback amplifiers.

CO2: Interpret the various types of oscillators with its frequency of oscillation.

CO3: Compare the performance of single, double and stagger tuned amplifiers.

CO4: Construct the different wave shaping circuits and Multivibrators.

CO5: Illustrate different types of blocking oscillators and time base generators.

TEXT BOOKS

1. Salivahanan and N. Suresh Kumar, 2017, *Electronic Devices and Circuits*, 4th Edition, McGraw Hill Education (India) Private Ltd.

REFERENCE BOOKS

1. Robert L. Boylestad & Louis Nasheresky, 2008. *Electronic Devices and Circuit Theory*, 10th Edition, Pearson Education / PHI.
2. David A. Bell, 2008. *Electronic Devices and Circuits*, Fifth Edition, Oxford University Press.
3. Millman J. & Taub H., 2000. *Pulse Digital and Switching Waveforms*, TMH.
4. Millman & Halkias. C., 2007. *Integrated Electronics*, TMH.
5. T-Sedra & Smith, 2011, *Micro Electronic Circuits*, Sixth Edition, Oxford UniversityPress.

EC1504 TRANSMISSION LINES AND RF SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the various types of transmission lines and its characteristics.
- To give thorough understanding about high frequency line, power and impedance measurements.
- To give thorough understanding about impedance matching.
- To impart technical knowledge about waveguides.
- To get acquaintance with RF system transceiver design.

UNIT I TRANSMISSION LINE THEORY 9

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in Z0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT II HIGH FREQUENCY TRANSMISSION LINE 9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

Impedance matching: λ/8, λ/4 & λ/2 lines – λ/4 Impedance transformers, A valuable graphical aid: the smith chart, derivation, types, The normalized impedance-Admittance (ZY) smith chart, Impedance matching by stubs - Single stub and double stub matching using Smith chart, Application of Impedance and Admittance chart.

UNIT IV WAVEGUIDES 9

General Wave behavior along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular

waveguides, TM and TE waves in rectangular waveguides, Bessel Functions, TM and TE waves in Circular waveguides.

UNIT V RF SYSTEM DESIGN CONCEPTS 9

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors. Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations. Microwave Filter Design.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Solve the problems based on fundamental transmission line concepts, distortion less line and their related parameters.

CO2: Develop the different constraints in high frequency transmission lines and its related parameters.

CO3: Utilize the smith chart to design Impedance matching networks for matching load impedances.

CO4: Apply Maxwell's equations to solve electromagnetic field equations in rectangular and circular waveguides.

CO5: Understand the RF System design concepts for developing a wireless communication system.

TEXT BOOKS

1. John D Ryder, 2015. *Networks, lines and fields*, second Edition, Prentice Hall India.
2. Mathew M. Radmanesh, 2002. *Radio Frequency & Microwave Electronics*, Pearson Education Asia, Second Edition.

REFERENCE BOOKS

1. Reinhold Ludwig & Powel Bretchko, 2001. *RF Circuit Design – Theory and Applications*, First Edition, Pearson Education Asia.
2. Misra D.K,2004. *Radio Frequency and Microwave Communication Circuits- Analysis and Design*, John Wiley & Sons.

3. Jordan E.C.& Balmain K.G, 2006. *Electromagnetic Waves and Radiating Systems,* Prentice Hall of India.
4. Raju G.S.N, 2005. *Electromagnetic Field Theory and Transmission Lines*, First edition, Pearson Education.

EC1511	CIRCUITS DESIGN AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To gain hands on experience in designing electronic circuits.
- To learn simulation software used in circuit design.
- To demonstrate the fundamental principles of amplifier circuits.
- To differentiate feedback amplifiers and oscillators.
- To know the operation of various multivibrators.

LIST OF EXPERIMENTS

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Frequency Response of CE, CB, CC and CS amplifiers
2. Series and Shunt feedback amplifiers -Frequency response, Input and output impedance
3. RC Phase shift oscillator and Wien Bridge Oscillator
4. Hartley Oscillator and Colpitts Oscillator
5. Single Tuned Amplifier
6. Wave shaping circuits – Integrator, Differentiator, Clippers, Clambers & UJT
7. Astable and Monostable multivibrators

SIMULATION USING SPICE (Using Transistor):

8. Tuned Collector Oscillator
9. Twin -T Oscillator and Wein Bridge Oscillator
10. Double tuned and Stagger tuned Amplifiers
11. Bistable Multivibrator
12. Schmitt Trigger circuit with Predictable hysteresis
13. Analysis of Power Amplifiers

TOTAL: 60 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	CRO (Min 30MHz)	15 Nos
2	Signal Generator /Function Generators (2 MHz)	15 Nos
3	Dual Regulated Power Supplies (0 – 30V)	15 Nos
4	Digital Multimeter	15 Nos
5	Digital LCR Meter	2 Nos
6	Standalone desktops PC with SPICE Circuit Simulation Software:	15 Nos
7	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	50 Nos
8	Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.	Sufficient quantity

OUTCOMES:

CO1: Identify the stability of feedback amplifiers and their steady state performance.

CO2: Construct different types of oscillator and multivibrator circuits operating at different frequencies.

CO3: Compare the working principles of various wave shaping circuits

CO4: Demonstrate the frequency response of tuned amplifier.

CO5: Simulate various types of oscillators, multivibrators, Schmitt trigger, tuned amplifiers and power amplifiers using PSPICE software.

EC1512 COMMUNICATION SYSTEMS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To visualize the effects of sampling and TDM.
- To Implement AM & FM modulation and demodulation.
- To implement PCM & DM.
- To simulate Digital Modulation schemes.
- To simulate Error control coding schemes.

LIST OF EXPERIMENTS

1. Signal Sampling and Reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line Coding schemes
8. ASK, FSK and BPSK generation and detection
9. Simulation of ASK, FSK, and BPSK generation and detection schemes (using LabView)
10. Simulation of QPSK and QAM generation schemes
11. Simulation of signal constellations of BPSK, QPSK and QAM
12. Simulation of Linear Block and Cyclic Error Control coding schemes
13. Simulation of Convolutional coding scheme
14. Communication Link Simulation

TOTAL: 60 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	Kits for Signal Sampling, TDM, AM, FM, PCM, DM, ASK, FSK and Line Coding Schemes	1 (each)
2	CROs/DSOs	15 Nos
3	Function Generators	15 Nos

4	PCs with MATLAB or equivalent software package for simulation experiments	15 Nos

OUTCOMES:

CO1: Make use of analog and digital representation of signals for the transmission and reception of information.

CO2: Demonstrate the concepts of AM and FM transmission and reception.

CO3: Experiment with the concepts of digital modulation transmission, reception and multiplexing.

CO4: Analyse the BER performance of various digital modulation techniques by using simulation.

CO5: Compare the various error control coding techniques in simulation.

EC1601 ANTENNAS AND MICROWAVE ENGINEERING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enable the student to understand the basic principles in antenna and microwave system design.
- To enhance the student knowledge in radiation mechanism and design aspects of antenna.
- To understand the antenna array and its applications.
- To enhance the student knowledge about active and passive microwave devices.
- To enhance the student knowledge in the area of microwave design principles.

UNIT I INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS **9**

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Antenna Noise Temperature and G/T, Impedance matching, Friis transmission equation, Link budget and link margin, Noise Characterization of a microwave receiver.

UNIT II RADIATION MECHANISMS AND DESIGN ASPECTS **9**

Radiation Mechanisms of Linear Wire and Loop antennas, Aperture antennas, Reflector antennas, Horn antenna, Microstrip antennas and Frequency independent antennas, Feeding structures, Slot antennas,Microstrip antennas – Rectangular, Circular and slot based patches, Radiation mechanism – Application.

UNIT III ANTENNA ARRAYS AND APPLICATIONS **9**

Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas.

UNIT IV PASSIVE AND ACTIVE MICROWAVE DEVICES **9**

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator, Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Microwave tubes: Klystron, TWT, Magnetron.

UNIT V MICROWAVE DESIGN PRINCIPLES 9

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Understand the basic principle of microwave systems and antennas.

CO2: Compute the radiation mechanism, performance and design aspects of various antennas.

CO3: Demonstrate the behaviour of an antenna array and its applications.

CO4: Understand the behaviour of active and passive microwave components at higher frequencies.

CO5: Design and implementation of microwave Amplifiers, filters and mixers for wireless communication systems.

TEXT BOOKS

1. John D Kraus, Ronald J Marhefka & Ahmad S. Khan, 2006. *Antennas and Wave Propagation,* Fourth Edition, Tata McGraw-Hill.
2. David M. Pozar, 2012. *Microwave Engineering*, Fourth Edition, Wiley India.

REFERENCE BOOKS

1. Prasad, K.D. and Handa, D, 2003. *Antenna and wave propagation*. Satya Prakashan.
2. Constantine A.Balanis, 2005. *Antenna Theory Analysis and Design*, Third edition, John Wiley India Pvt Ltd.
3. Thomas H Lee, 2004. *Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits*, First Edition, Cambridge University Press.

EC1602 **MICROPROCESSORS AND MICROCONTROLLERS INTERFACING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system.

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT III I/O INTERFACING 9

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display and Alarm Controller.

UNIT IV MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

UNIT V INTERFACING MICROCONTROLLER 9

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD &Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, Arduino controller, PIC and ARM processors.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Make use of 8086 processor architecture, addressing mode and instruction set to develop Assembly Language Programming.

CO2: Illustrate basic configurations and multi processor configurations of 8086.

CO3: Explain interfacing of I/O devices with 8086 processor.

CO4: Apply the knowledge of 8051 architecture, addressing modes and instruction set to develop Assembly Language Programming.

CO5: Construct 8051 based system by interfacing various I/O devices.

TEXT BOOKS

1. Yu-Cheng Liu, Glenn A.Gibson, 2007. *Microcomputer Systems: The 8086/8088 Family- Architecture, Programming and Design*, Second Edition, Prentice Hall of India.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, 2011. *The 8051 Microcontroller and Embedded Systems: Using Assembly and C*, Second Edition, Pearson education.

REFERENCE BOOKS

1. DoughlasV. Hall, 2012. *Microprocessors and Interfacing, Programming and Hardware*, TMH.
2. A.K.Ray, K.M.Bhurchandi, 2012. *Advanced Microprocessors and Peripherals*, 3rd edition, Tata McGrawHill.

EC1603 **VLSI DESIGN**

(Theory Cum Lab)

L	T	P	C
3	0	2	4

OBJECTIVES:

- To study the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational circuits.
- To familiarize with VLSI sequential circuits design.
- To understand the basic concept of Verilog coding.
- To learn the different FPGA architectures and SOC.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.

UNIT IV VERILOG HDL 9

VLSI Circuit Design Flow-Hierarchical modeling concepts – Basic concepts: Lexical conventions – Data types – Modules and ports. Gate level modeling – Dataflow modeling – Behavioural modeling – Design examples of Combinational and Sequential circuits – Tasks and Functions – UDP concepts.

UNIT V VLSI IMPLEMENTATION STRATEGIES 9

Introduction – Design of Adders: carry look ahead-carry select-carry save. Design of multipliers: Array multiplier – Braun array – Baugh-Wooley Array. FPGA Building block architecture, FPGA interconnect and routing procedure. Introduction to SoC:Driving Forces for SoC - Components of SoC - Design flow of SoC - Hardware/Software nature of SoC - Design Trade-offs - SoC Applications.

TOTAL: 45 PERIODS

OUTCOMES (for Theory)

CO1: Explain the basic CMOS circuits and its characteristics.

CO2: Design the combinational logic circuits using various logic styles using CMOS.

CO3: Model the sequential logic circuits using CMOS.

CO4: Implement combinational and sequential logic circuits using Verilog HDL.

CO5: Construct arithmetic building blocks, design FPGA architecture and interconnects and SoC concepts.

TEXT BOOKS

1. Douglas A. Pucknell, 2008. *Basic VLSI Systems and Circuits*, Prentice Hall of India, 3rd Edition.
2. Neil H.Weste, Harris, A. Banerjee, 2014. *CMOS VLSI Design, A circuits and System Perspective*, Fourth Edition, Pearson Education, Noida, India.
3. Samir Palnitkar, 2003. *Verilog HDL – Guide to Digital Design and Synthesis*, Pearson Education, 3rd Edition.

REFERENCE BOOKS

1. Michael J Flynn and Wayne Luk, 2011. *Computer system Design: System-on-Chip*, Wiley-India.
2. Jan M Rabaey, Anantha Chadrakasan, Borivoje Nikolic, 2014.*Digital Integrated Circuits: A Design Perspective*, Third Edition, Prentice Hall India, New Jersey, US.

3. John P. Uyemura, 2009. *Introduction to VLSI Circuits and Systems*, John Wiley & Sons, Reprint.
4. Weste & Eshraghian, 2008. *Principles of CMOS VLSI Design*, Addison Wesley, 2nd Edition.
5. John P Uyemura, 2010. *Chip Design for Submicron VLSI: CMOS layout and simulation*, Thomson India Edition.
6. Yogesh Chauhan, Darsen DuaneLu, Vanugopalan Sriram kumar, Sourabh Khandelwal,JuanDuarte, Navid Payvadosi,Ai Niknejad, Che nming Hu, 2015. *FinFET Modeling for IC Simulation and Design*, Academic Press, Elsevier .

List of Experiments

Design, Implementation, Verification & Analysis of the following

Digital System Design using HDL & FPGA

1. EDA tool Demo & Hands on Schematic
2. Design of 4bit / 8bit Adders using Verilog HDL
3. Design of Multiplier 4 x 4 array multiplier and Booth multiplier using Verilog HDL
4. Design of Memory (SRAM / DRAM)
5. Design of ALU
6. Design of Finite State Machine (Moore/Mealy)

Digital Circuit Design

7. Using Conventional MOS – Basic cell structure (NMOS & PMOS)
8. Design and Analysis of CMOS circuit
9. Design Combinational Logic Circuit
10. Design Sequential Circuit

Layout Design

11. Basic Layout CMOS
12. Layout & Post Layout Simulation
13. Simple Processor Design using Conventional CMOS

TOTAL: 30 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 User License
2	Xilinx/Altera/equivalent FPGA Boards	10 Nos
3	Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools	10 User License
4	Personal Computer	30 Nos

OUTCOMES (for Laboratory)

CO1: Build different combinational modules using Verilog HDL.

CO2: Construct various sequential modules using Verilog HDL.

CO3: Execute various logic modules on FPGA.

CO4: Experiment various digital circuit design using EDA platform.

CO5: Design simple processor using CMOS.

EC1604 WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the design of a cellular system.
- To study the characteristic of wireless channel.
- To study the various digital signaling techniques.
- To study the multipath mitigation techniques.
- To understand the concepts of multiple antenna techniques.

UNIT I CELLULAR ARCHITECTURE 9

Cellular concept: Frequency reuse - channel assignment- hand off- interference & system capacity- trunking& grade of service – Coverage and capacity improvement. Multiple Access techniques: FDMA, TDMA, CDMA – Capacity calculations.

UNIT II WIRELESS CHANNELS 9

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.

UNIT III DIGITAL SIGNALING FOR FADING CHANNELS 9

Structure of a wireless communication link, Principles of Offset-QPSK, pi/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT IV MULTIPATH MITIGATION TECHNIQUES 9

Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

UNIT V MULTIPLE ANTENNA TECHNIQUES 9

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

TOTAL: 45 PERIODS

OUTCOMES

CO1: Design a cellular system based on resource availability and traffic demands.

CO2: Characterize a wireless channel and evolve the system design specifications.

CO3: Identify suitable digital signaling scheme for fading channels.

CO4: Identify the multipath mitigation techniques for the wireless channel and system under consideration.

CO5: Illustrate the multi antenna techniques in fading and nonfading channels.

TEXT BOOKS

1. Rappaport, T.S, 2010. *Wireless communications*, Second Edition, Pearson Education.
2. Andreas.F. Molisch, 2006. *Wireless Communications*, John Wiley, India.

REFERENCE BOOKS

1. Andrea Goldsmith, 2011. *Wireless Communication*, Cambridge University Press.
2. Van Nee, R. & Ramji Prasad, 2000. *OFDM for wireless multimedia communications*, Artech House.
3. David Tse & Pramod Viswanath, 2005. *Fundamentals of Wireless Communication*, Cambridge University Press.
4. Upena Dalal, 2009. *Wireless Communication*, Oxford University Press.

EC1611	MICROPROCESSORS AND MICROCONTROLLERS INTERFACING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To introduce ALP concepts and features.
- To write ALP for arithmetic and logical operations in 8086 and 8051.
- To differentiate Serial and Parallel Interface.
- To interface different I/O s with Microprocessors.
- To gain hands on experience in Nodemcu/Arduino.

LIST OF EXPERIMENTS

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations
4. Floating point operations, string manipulations, sorting and searching
5. Password checking
6. Counters and Time Delay
7. Traffic light control
8. Stepper motor control
9. Key board and Display
10. Printer status
11. Serial interface and Parallel interface
12. A/D and D/A interface and Waveform Generation
13. Basic arithmetic and Logical operations
14. Square and Cube program, Find 2’s complement of a number
15. Unpacked BCD to ASCII
16. Flashing of LEDS using NODE MCU/Arduino
17. Monitoring Temperature using LM35 sensor in NODEMCU/Arduino

TOTAL: 60 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	8086 development kits	30 nos
2	Interfacing Units	Each 10 nos
3	Microcontroller	30 nos
4	Intel Desktop Systems with MASM 8086 Assembler 8051 Cross Assembler	30 nos

OUTCOMES:

CO1: Implement assembly language programs in 8086 kits.

CO2: Implement assembly language programs in 8051 kits.

CO3: Implement different I/Os with 8086 microprocessor.

CO4: Simulate 8086 programs using MASM Assembler.

CO5: Implement mini projects using NodeMCU/ Arduino.

EC1621 **MINI PROJECT**

L	T	P	C
0	0	4	2

OBJECTIVES:

- To impart required knowledge related to the project.
- To analyze the realtime problem with an indepth study from available literature in the selected domain.
- To understand the methodology used to solve the problem.
- To apply the engineering knowledge in the project domain.
- To discuss results with experimental outputs of hardware/ software implementation.

The Students in a group of 3 or 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The review progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report by the examiners constituted by the Head of the Department.

TOTAL: 60 PERIODS

OUTCOMES

CO1: Identify a potential problem based on literature survey and real time needs.

CO2: Categorize various solution methodologies to solve problem taken for study.

CO3: Design and develop solution for the proposed problem.

CO4: Infer the experimental results based on hardware & software implementation.

CO5: Analyse the results with the existing solutions.

HS1521 PROFESSIONAL COMMUNICATION

L	T	P	C
0	0	2	1

OBJECTIVES:

- To Enhance the Employability and Career Skills of students.
- To Orient the students towards grooming as a professional.
- To Make them Employable Graduates.
- To Develop their confidence and help them attend interviews successfully.

UNIT I SOFT SKILLS 6

Introduction to Soft Skills– Hard skills & soft skills – employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs- Error Spotting.

UNIT II EFFECTIVE PRESENTATIONS 6

Self-Introduction-organizing the material – Introducing oneself to the audience – introducing the topic – answering questions with clarity and appropriate pharases – individual presentation practice— presenting the visuals effectively – 5 minute presentations.

UNIT III GROUP DISCUSSION 6

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics – brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills.

UNIT IV INTERVIEW ETIQUETTE 6

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews.

UNIT V CAREER PLAN 6

Recognizing differences between groups and teams - managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes.

TOTAL: 30 PERIODS

OUTCOMES

CO1: Apply hard and soft skills to enhance their employability.

CO2: Utilize adequate presentation skills to present a PPT.

CO3: Demonstrate the proper usage of grammar in GD.

CO4: Make use of the acquired skills while attending interviews.

CO5: Develop adequate Soft Skills required for the workplace.

TEXT BOOKS

1. Butterfield, Jeff, 2015. *Soft Skills for Everyone* Cengage Learning: New Delhi.
2. E. Suresh Kumar, 2015. *Communication for Professional Success*. Orient Blackswan: Hyderabad.

REFERENCE BOOKS

1. OBS Exports, 2018. *Interact English Lab Manual for Undergraduate Students.*Orient Balck Swan: Hyderabad.
2. Raman, Meenakshi & Sangeeta Sharma, 2014. *Professional Communication*. Oxford University Press: Oxford.
3. S. Hariharan, 2010. *Soft Skills.* MJP Publishers:Chennai.

IT1371 **COMPUTER ORGANIZATION AND ARCHITECTURE**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide an overview of the basic structure, operations and instructions of a digital computer.
- To describe how fixed point and floating-point arithmetic operations are implemented.
- To discuss the basic processing unit and multiple functional units in a processor.
- To explore the hierarchical memory system and I/O organization.
- To expose the students to parallel processing.

UNIT I BASIC STRUCTURE OF COMPUTERS 9

Functional Units – Basic Operational Concepts – Bus Structures – Software– Performance: Processor Clock, Basic Performance Equation, Clock Rate – Instruction Set: CISC and RISC – Memory Locations and Addresses – Memory Operations – Instructions and Instruction Sequencing – Addressing Modes – Basic Input/output Operations.

UNIT II ARITHMETIC UNIT 9

Addition and Subtraction of Signed Numbers – Designof Fast Adders – Multiplicationof Positive Numbers – Signed Operand Multiplication – Fast Multiplication – Integer Division – Floating Point Numbers and Operations.

UNIT III PROCESSING UNIT 9

Basic Processing Unit: Fundamental Concepts – Execution of a complete instruction – Multiple-bus organization – Hardwired Control –Microprogrammed control – Pipelining: Basic Concepts –Data Hazards – Instruction Hazards – Data path and Control Considerations.

UNIT IV MEMORY SYSTEMS& INPUT / OUTPUT ORGANIZATION 9

Memory Systems: Basic Concepts –Cache Memories – Performance Considerations – Virtual Memories – Memory Management Requirements – Secondary Storage – Input / Output Organization: Accessing I/O Devices – Interrupts – Direct Memory Access – Buses – Synchronous Bus – Asynchronous Bus.

UNIT V PARALLEL PROCESSING 9

Instruction-Level Parallelism: Concepts and Challenges – Basic compiler techniques for exposing ILP – Overcoming Data Hazards with Dynamic Scheduling – Dynamic Scheduling: Examples and the Algorithm – Data-Level Parallelism: Introduction – Vector Architecture – Graphics Processing Units – Detecting and Enhancing Loop-Level Parallelism.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Summarize the functionalities of various parts, instruction sets and operations of a digital computer.

CO2: Utilize the logic design for fixed-point and floating point arithmetic.

CO3: Interpret the role of a processing unit and multiple functional units.

CO4: Explain the various elements in memory hierarchy and the basic and complex I/O structures.

CO5: Demonstrate how parallelism is used at instruction-level and data-level parallelism.

TEXT BOOKS

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, 2012. *Computer Organization and Embedded Systems*, Sixth Edition, Tata McGraw Hill.

REFERENCE BOOKS

1. David A. Patterson and John L. Hennessy, 2014. *Computer Organization and Design: The Hardware/Software Interface*", Fifth Edition, Morgan Kaufmann / Elsevier.
2. William Stallings, 2010. *Computer Organization and Architecture – Designing for Performance*, Eighth Edition, Pearson Education.
3. John P. Hayes, 2012. *Computer Architecture and Organization*, Third Edition, Tata McGraw Hill.

IT1301 OBJECT ORIENTED PROGRAMMING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of JAVA.
- To enhance the programming skill using inheritance and interfaces.
- To use exception handlers and generic programming for developing JAVA applications.
- To build a JAVA applications using event driven programming and I/O streams.
- To develop a JAVA application with multithreading programming.

UNIT I INTRODUCTION TO OBJECT ORIENTED CONCEPTS AND JAVA PROGRAMMING **9**

Introduction to Object Oriented Programming: Abstraction, Objects and Classes, Encapsulation, Inheritance, Polymorphism – Introduction to JAVA: Characteristics of Java, The Java Environment, Java Source File Structure, Compilation – Fundamental Programming Structures in Java: Data type and Variables, Operators, Decision making and Looping – Classes: Predefined class, User defined class, Access modifiers – Object: Object reference, Object cloning, Reflection – Methods: Types of method definition – Arrays – Strings – Constructor: Default constructor, Parameterized constructor – Package: Predefined package, util package, Understanding class path, User defined package – Javadoc comments.

UNIT II INHERITANCE AND POLYMORPHISM **9**

Inheritance: Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Super keyword– Interface – Polymorphism: Method overloading, Method overriding – Non-Access modifiers: Abstract class and method, Static key word, Final key word – Inner class: Nested classes, Static inner class, Anonymous class.

UNIT III EXCEPTION HANDLING AND GENERIC PROGRAMMING **9**

Exception Handling: Garbage collection, Finalize() method, Throwable interface, Types of exception, Exception handlers: Try, Catch, Finally, Throw, Throws, User define exception – Generic programming: Generic class, Generic method, Restrictions and limitations, Inheritance rule for generic types, Wildcard types, Reflections and generics – Collection framework: Map/List, Set, Array List / Linked List, Hash Set Collection Classes, Tree Map – Lambda expression.

UNIT IV STREAMS AND EVENT DRIVEN PROGRAMMING 9

Input and Output: Byte stream, Character stream, Reading and writing from console and files, Object Streams and Serialization – Java Database Connectivity (JDBC):Creating a database, Insertion operation, Deletion operation, Updation operation, Display operation – Event Driven programming: Introduction to Swing, MVC Framework, Frame, Components: Text field, Input, Choice, Text Area, Buttons, Checkboxes, Radio Buttons, Lists, Menus, Dialog Box, Windows, Mouse, Layout Management: Border layout, Flow layout, Card layout, Grid layout, Gridbag layout – Listeners: Action Listener, Item Listener, Mouse Listener, Keyboard Listener, Window Listener – Adapter classes.

UNIT V MULTITHREADING PROGRAMMING 9

Multithreading: Thread states, Thread life cycle, Thread properties, Thread priorities, Thread synchronization – Archive – Case study.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Demonstrate the basic concepts of object oriented programming using JAVA

CO2: Make use of the OOP concept and non-access modifiers to solve real world problems

CO3: Choose an appropriate exception handler and generic data type for writing a JAVA application

CO4: Select the appropriate features of event driven programming and I/O streams to give solution to real time problems

CO5: Apply multithreading programming to generate synchronized threads.

TEXT BOOKS

1. Cay S. Horstmann, Gary Cornell, 2015. *Core Java: Volume I – Fundamentals*, Prentice Hall, Tenth Edition.

2. Cay S. Horstmann, Gary Cornell, 2016. *Core Java: Volume II – Fundamentals*, Prentice Hall, Tenth Edition.

REFERENCE BOOKS

1. Herbert Schildt, 2014. *Java: The Complete Reference*, Eleventh Edition, McGraw Hill Education.
2. Paul Deitel, Harvey Deitel, 2014. *Java SE8 for Programmers*, Pearson Education, Third Edition.
3. P.J.Deitel & H.M.Deitel, *Java: How to Program Java 2*, Prentice Hall, Seventh Edition.

IT1402 **OPERATING SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire basic knowledge on operating system structures and its functions.
- To study the concept of process management and deadlock.
- To learn the basics of memory management and its techniques.
- To understand the structure of file, Directory and I/O systems.
- To familiar with some operating systems.

UNIT I INTRODUCTION 9

Introduction to operating systems - Computer system organization - architecture - Operating system structure - operations - Process, memory, storage management - Protection and security - Distributed systems OS services - User interface - System calls - System programs - Process concept - scheduling - Operations on processes - Cooperating processes - Inter process communication – Threads.

UNIT II PROCESS MANAGEMENT 9

Scheduling : Scheduling criteria - Scheduling algorithms - Multiple processor scheduling - Algorithm evaluation - The critical section problem - Synchronization hardware - Semaphores - Classic problems of synchronization - Critical regions - Monitors - Deadlocks - Deadlock characterization - Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection and Recovery.

UNIT III MEMORY MANAGEMENT 9

Introduction - Swapping - Contiguous memory allocation - Paging - Segmentation - Segmentation with paging - Virtual memory: Background - Demand paging - Page replacement - Allocation of frames – Thrashing.

UNIT IV FILE AND I/O SYSTEMS 9

File concept - Access methods - Directory structure - File system mounting - Protection - Directory implementation - Allocation methods - Free space management - Disk scheduling - Disk management - Swap space management - Protection. I/O Systems: I/O Hardware - Application I/O Interface - Kernel I/O subsystem.

UNIT V CASE STUDY 9

The Linux system: History - Design principles - Kernel modules - Process management - Scheduling - Memory management - File systems - Input and output - Inter Process Communication - Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Elucidate the evolution of operating system along with its structure and functions.

CO2: Demonstrate the various process management algorithms.

CO3: Illustrate the performance of various memory management techniques.

CO4: Describe file, Directory system and I/O Management techniques.

CO5: Summarize some popular operating systems like Linux, Mobile OS like iOS and Android.

TEXT BOOKS

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 2013. *Operating System Concepts*, John Wiley & Sons Inc., 9th Edition.

REFERENCE BOOKS

1. Andrew S. Tanenbaum, 2001. *Modern Operating Systems*, Addison Wesley, Second Edition.
2. William Stallings, 2011. *Operating Systems: Internals and Design Principles*, Prentice Hall, Seventh Edition.
3. Charles Crowley, 1996. *Operating Systems: A Design-Oriented Approach*, Tata McGraw Hill Education.
4. D M Dhamdhere, 2007. *Operating Systems: A Concept-based Approach*, Tata McGraw-Hill Education, Second Edition.
5. Neil Smyth,2011. *iPhone iOS 4 Development Essentials – Xcode*, Fourth Edition, Payload media.
6. Daniel P Bovet and Marco Cesati, 2005. *Understanding the Linux kernel*, 3rd edition, O‘Reilly.

EC1531 **HUMAN RIGHTS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the meaning, notion, classification of rights.
- To introduce the concepts of human rights.
- To understand the theories and perspectives of human rights.
- To know the various constitutional provisions of human rights.
- To educate with the various types of human rights for various people.

UNIT I HISTORY OF HUMAN RIGHTS 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II HUMAN RIGHTS DIFFERENT PERSPECTIVE 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III UN AND EXPANDING SCOPE OF HUMAN RIGHTS 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV HUMAN RIGHTS IN INDIA 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V MINORITY RIGHTS IN INDIA 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO‘s, Media, Educational Institutions, Social Movements.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the meaning, notion, classification of rights.

CO2: Outline the concepts of human rights.

CO3: Explain the theories and perspectives of human rights.

CO4: Compare the various constitutional provisions of human rights.

CO5: Relate the various types of human rights for various people.

TEXT BOOKS

1. Kapoor S.K, 2014. *Human Rights under International law and Indian Laws, Central Law Agency,* Allahabad.
2. Chandra U, 2014. *Human Rights, Allahabad Law Agency*, Allahabad.

REFERENCE BOOKS

1. Upendra Baxi, *The Future of Human Rights*, Oxford University Press, New Delhi.

EC1532 **MEDICAL ELECTRONICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To get the knowledge about the various physiological parameters both electrical and non-electrical.
- To gain the knowledge about the methods of recording and also the method of transmitting these parameters.
- To study about the various assist devices used in the hospitals.
- To understand the operation of the equipments used for physical medicine.
- To gain knowledge about the various recently developed diagnostic and therapeutic techniques.

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING **9**

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, Typical waveforms and signal characteristics - ECG, EEG, EMG, PCG.

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT **9**

PH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES **9**

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY **9**

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry and applications.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION **9**

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Know the human body electro- physiological parameters and recording of bio-potentials.

CO2: Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.

CO3: Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.

CO4: Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods.

CO5: Know about recent trends in medical instrumentation.

TEXT BOOKS

1. Leislie Cromwell, 2007. *Biomedical instrumentation and measurement*, Prentice Hall of India, New Delhi.

REFERENCE BOOKS

1. Khandpur, R.S, 2003. *Handbook of Biomedical Instrumentation*, TATA McGraw-Hill, New Delhi.
2. Joseph J.Carr and John M.Brown, 2004. *Introduction to Biomedical Equipment Technology*, John Wiley and Sons, New York.

EC1533 **RF SYSTEM DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To be familiar with RF transceiver system design for wireless communications.
- To be exposed to design methods of receivers and transmitters used in communication systems.
- To understand the impedance matching networks and amplifiers.
- To understand about feedback systems and power amplifiers.
- To provide insight into RF receiver design and measurements.

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES **9**

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter.

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS **9**

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS **9**

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations , Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearization Techniques, Efficiency boosting techniques, ACPR metric, Design considerations.

UNIT IV RECEIVER DESIGN STEPS **9**

Design and Integration of Building Blocks, DC Conditions, Scattering Parameters, Small-Signal Performance, Transient Performance, Noise Performance, Linearity Performance, Parasitic Effects, Process Variation, 50-Ω and Non-50-Ω Receivers.

UNIT V RECEIVER FRONT-END MEASUREMENTS 9

DC Test, Functionality Test, S-Parameter Test, Conversion Gain Test, Linearity Test, Noise Figure Test, I/Q Imbalance, DC Offset, Close Examination of Noise Figure and I/Q Imbalance, Comments on I/Q Imbalance.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the transceiver specifications and architectures.

CO2: Understand the impedance matching and amplifiers.

CO3: Determine the feedback systems and power amplifiers.

CO4: Explain the receiver design steps.

CO5: Understand the receiver front-end measurements.

TEXT BOOKS

1. Lee, T.H, 2003. *The design of CMOS radio-frequency integrated circuits*. Cambridge university press.

REFERENCE BOOKS

1. Laskar, J, Matinpour, B. and Chakraborty, S, 2004. *Modern Receiver Front Ends*. Wiley Interscience.
2. Radmanesh, M.M, 2001. *Radio frequency and microwave electronics illustrated* (Vol. 13). Upper Saddle River, NJ: Prentice Hall.
3. Razavi, B. and Behzad, R, 2012. *RF microelectronics* (Vol. 2, pp. 255-333). New York: Prentice Hall.
4. Gilmore, R. and Besser, L, 2003. *Practical RF Circuit Design for Modern Wireless Systems: Active Circuits and Systems, Volume 2* (Vol. 1). Artech House.
5. Losee, F, 2005. *RF systems, components, and circuits handbook*. Artech.

EC1534 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the fundamentals of electromagnetics for signal integrity.
- To provide the concepts of cross talk in coupled lines.
- To enhance the student knowledge in di electric materials.
- To study the fundamentals in differential signalling.
- To understand the concepts of model in physical transmission line.

UNIT I SIGNAL INTEGRITY 9

The importance of signal integrity - new realm of bus design - Electromagnetic fundamentals for signal integrity - Maxwell equations common vector operators - wave propagations - Electrostatics - magneto statics - Power flow and the poynting vector - Reflections of electromagnetic waves.

UNIT II CROSS TALK 9

Introduction - mutual inductance and capacitance-coupled wave equation - coupled line analysis - modal analysis - cross talk minimization signal propagation in unbounded conductive media - classic conductor model for transmission model.

UNIT III DIELECTRIC MATERIALS 9

Polarization of Dielectric - Classification of Dielectric material - frequency dependent dielectric material - Classification of Dielectric material Fiber - Weave effect - Environmental variation in dielectric behaviour Transmission line parameters for loose dielectric and realistic conductors.

UNIT IV DIFFERENTIAL SIGNALING 9

Removal of common mode noise - Differential Cross talk - Virtual reference plane- Propagation of model voltages common terminology - drawbacks of differential signalling.

UNIT V PHYSICAL TRANSMISSION LINE MODEL 9

Introduction - non ideal return paths - Vias - IO design consideration - Push-pull transmitter - CMOS receivers - ESSD protection circuits - On chip Termination.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Define the concept of signal integrity using electromagnetic theory and vector functions.

CO2: Explain crosstalk that affects the integration.

CO3: Explain the properties of dielectric materials.

CO4: Analyse differential signaling.

CO5: Explain a physical model for transmission lines.

TEXT BOOKS

1. Hall, S.H. and Heck, H.L, 2009. *Advanced signal integrity for high-speed digital designs*, Wiley IEEE Press.

REFERENCE BOOKS

1. James, E, Kovacek, J. and Cremin, A, 1996. *Signal and Power Integrity in Digital Systems: TTL, CMOS, and BiCMOS*, Mc Graw Hill.
2. Edlund, G, 2008. *Timing Analysis and Simulation for Signal Integrity Engineers*. Pearson Education.
3. Thierauf, S.C, 2011. *Understanding signal integrity. Artech House*.
4. Bo Bogatin, E, 2010. *Signal and Power Integrity-Simplified,* Second Edition. PHI.
5. Li, M.P, 2007. Jitter, *noise, and signal integrity at high-speed*. Pearson Education.

GE1571 INTELLECTUAL PROPERTY RIGHTS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give an idea about intellectual property rights.
- To introduce about the registration of intellectual property rights.
- To have an insight on various agreements and legislations on IPR.
- To introduce digital innovations and intellectual property laws.
- To introduce about the enforcement of intellectual property rights.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 9

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III AGREEMENTSAND LEGISLATIONS 9

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical IndicationAct.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENTOF IPRs 9

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Outline the concepts, need and nature of intellectual property.

CO2: Demonstrate the practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial design registration of IPR.

CO3: Outline the International Treaties, Conventions and agreements on IPRs.

CO4: Summarize the digital innovations and developments, meaning andrelationship between unfair competition.

CO5: Summarize the enforcement of IPRs.

TEXT BOOKS

1. V. Scople Vinod, 2012. *Managing Intellectual Property*, Prentice Hall of India Pvt Ltd.
2. S. V. Satakar, 2002. *Intellectual Property Rights and Copy Rights*,EssEss Publications, New Delhi.

REFERENCE BOOKS

1. Deborah E. Bouchoux, 2012. *Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning*, Third Edition.
2. PrabuddhaGanguli, 2011. *Intellectual Property Rights: Unleashing the Knowledge Economy*, McGraw Hill Education.
3. Derek Bosworth and Elizabeth Webster, 2013. *The Management of Intellectual Property*, Edward Elgar Publishing Ltd.

EC1631 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To comprehend mathematical description and modelling of discrete time random signals.
- To learn relevant figures of merit such as power, energy, bias and consistency.
- To familiarize with estimation, prediction and filtering concepts and techniques.
- To introduce the principles of optimum filters such as Wiener and Kalman filters.
- To conversant with important theorems and algorithms.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Wide sense stationary process – Ergodic process – Mean – Variance - Auto-correlation and Auto-correlation matrix - Properties - Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem– Finite Data records, Simulation of uniformly distributed/Gaussian distributed white noise – Simulation of Sine wave mixed with Additive White Gaussian Noise.

UNIT II SPECTRUM ESTIMATION 9

Bias and Consistency of estimators - Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation - Welch estimation.

UNIT III LINEAR ESTIMATION AND PREDICTION 9

Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method - Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion – Wiener filter - Discrete Wiener Hoff equations – Mean square error.

UNIT IV ADAPTIVE FILTERS 9

Recursive estimators - Kalman filter - Linear prediction – Forward prediction and Backward prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization - Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS – Sliding window RLS - Simplified IIR LMS Adaptive filter.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Outline the time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra.

CO2: Explain power spectrum estimation using parametric and non-parametric methods.

CO3: Summarize various linear estimation and prediction models.

CO4: Interpret recursive estimation algorithms for adaptive filters..

CO5: Elucidate multirate digital signal processing with its applications in FIR adaptive filters.

TEXT BOOKS

1. Monson H. Hayes, 2006. *Statistical Digital Signal Processing and Modeling*, John Wiley and Sons Inc, New York.
2. John G. Proakis, Dimitris G. Manolakis, 2005. *Digital Signal Processing*, Prentice Hall of India, New Delhi.

REFERENCE BOOKS

1. P. P. Vaidyanathan, 1992. *Multirate Systems and Filter Banks*, Prentice Hall.
2. Sophoncles J. Orfanidis, 2000. *Optimum signal processing*, McGraw Hill.
3. Simon Haykin, 1986. *Adaptive Filter Theory*, Prentice Hall, Englehood Cliffs, NJ.
4. S. Kay, 1998. *Modern spectrum Estimation theory and application*, Prentice Hall, EnglehoodCliffs, NJ.

EC1632 ADVANCED RADIATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand antenna radiation mechanism and its parameters.
- To enhance the student knowledge in the area of various antenna design.
- To impart the knowledge about design of array antenna and modern antennas.
- To make the students understand the antenna parameter measurements.
- To enhance the knowledge of students about the propagation of radio waves in free space.

UNIT I REVIEW OF ANTENNA RADIATION MECHANISM AND PARAMETERS **9**

Antenna parameters - Radiation mechanism, Radiation pattern, power density, radiation intensity, directivity, Gain, bandwidth, polarization, radiation efficiency, effective aperture, Return loss, Wireless applications.

UNIT II SINGLE ANTENNA ELEMENT **9**

High gain high power Dish antenna, Standard gain antenna, Feed mechanism, Multiple beam formation, Practical Design- High gain antenna for satellite applications, Ground plane effects,TV and Satellite Antennas.

UNIT III ARRAY ANTENNA **9**

Introduction-General structure of phased array, linear array theory, Adaptive array, Basic principle of antenna Synthesis-Binomial array, frequency scanned arrays, analog beamforming matrices-Active modules, digital beam forming, MEMS technology in phased arrays.

UNIT IV ANTENNA MEASUREMENTS **9**

Measurement system, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR Anechoic chamber, Gain and directivity measurement.

UNIT V PROPAGATION OF RADIO WAVES **9**

Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency, Maximum usable frequency – Skip distance, Fading , Multi hop propagation.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the behavior of antenna radiation mechanism and antenna Parameters.

CO2: Determine the design of various single antenna elements.

CO3: Explain the structure of various array antennas and modern antennas.

CO4: Determine the measurement of various antenna parameters.

CO5: Explain the propagation of radio waves in atmosphere.

TEXT BOOKS

1. Balanis.A, 2005. *Antenna Theory Analysis and Design*, Third edition, John Wiley and Sons, New York.
2. John D.Kraus, 2006. *Antennas and Wave Propagation*, Fifth Edition,Tata McGraw Hill.

REFERENCE BOOKS

1. Harish A.R.& M.Sachidananda, 2007. *Antenna and wave propagation*, Oxford University Press.
2. Stutzman W.L & Thiele G.A, 1998. *Antenna Theory and Design*, Second Edition, John Wiley and Sons.
3. Balanis C.A, 2016. *Antenna Theory and Design*, Fourth Edition, John Wiley and Sons.
4. Terman F.E, 1985. *Electronic and Radio Engineering*, Mc Graw Hill.
5. Prasad, K.D. and Handa, D, 2003. *Antenna and wave propagation*. Satya Prakashan.

EC1633 DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the basics and fundamentals of digital image processing, such as digitization, sampling, quantization and 2D transforms.

CO2: Utilize various concepts of image enhancement techniques in spatial & frequency domain for enhancing the quality of image.

CO3: Make use of noise models to recover the original images using restoration.

CO4: Use image segmentation for image analysis.

CO5: Apply the ideas of lossless & lossy compression technique, image representation, description and recognition for image analysis.

TEXT BOOK

1. Rafael C. Gonzalez, Richard E. Woods, 2010. *Digital Image Processing*, Pearson, Third Edition.

REFERENCE BOOKS

1. Anil K. Jain, 2002. *Fundamentals of Digital Image Processing*, Pearson.
2. Kenneth R. Castleman, 2006. *Digital Image Processing*, Pearson.
3. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 2011. *Digital Image Processing using MATLAB*, Pearson Education, Inc.
4. D,E. Dudgeon and R M. Mersereau, 1990. *Multidimensional Digital Signal Processing*, Prentice Hall Professional Technical Reference.
5. William K. Pratt, 2002. *Digital Image Processing*, John Wiley, New York.
6. Milan Sonka et al, 1999. *Image processing, analysis and machine vision*, Brookes/Cole, Vikas Publishing House, 2nd edition.

EC1634 **ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Electromagnetic Interference and Compatibility.
- To enhance the basic concepts of EMI Coupling.
- To enhance the idea of EMI controlling technique.
- To teach the importance of Electromagnetic Compatible designs.
- To explain the existing standards for Electromagnetic Compatibility.

UNIT I EMI/EMC CONCEPTS 9

EMI-EMC definitions, Sources and Victims of EMI, ESD and Transient EMI phenomena, Conducted and Radiated EMI Emission and Susceptibility with examples, Case Histories and Applications of EMI, Radiation Hazards to humans.

UNIT II EMI COUPLING PRINCIPLES 9

Conducted, radiated and transient coupling, Common ground impedance coupling and ground loop coupling, Common mode, and Differential mode coupling, Near field cable to cable coupling, Field to cable coupling, Power mains and Power supply coupling.

UNIT III EMI CONTROL 9

Shielding, EMI Filters, Grounding, Bonding, Isolation transformer, Transient suppressors, EMI Suppression Cables and EMI Gaskets.

UNIT IV EMC DESIGN FOR CIRCUITS AND PCBs 9

Noise from Relays and Switches, Nonlinearities in Circuits, Cross talk in transmission line and cross talk control, Component selection and mounting, PCB trace impedance, Routing, Power distribution decoupling, Zoning; Grounding; VIAs; Terminations.

UNIT V EMI MEASUREMENTS AND STANDARDS 9

Open area test site, TEM cell, EMI test shielded chamber and shielded ferrite lined anechoic chamber, Conducted EMI measurements: LISN (Line Impedance Stabilization Network), Current probe, Voltage probe and Power probe, EMI Rx and spectrum analyzer, Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Interpret the basics theories of EMI and EMC.

CO2: Identify the different coupling mechanism used in EMI and EMC.

CO3: Identify the type of EMI and Choose appropriate mitigation techniques.

CO4: Explain the different standards and regulation.

CO5: Illustrate the EMI testing methods and its instrumentation.

TEXT BOOK

1. Kodali, V.P, 1996. *Engineering EMC Principles, Measurements and Technologies***,** IEEE Press.

REFERENCE BOOKS

1. Ott, H.W, 1988. *Noise reduction techniques in electronic systems*, (Vol. 442, pp. p-4), Wiley, New York.
2. Paul, C.R, 1992. *Introduction to electromagnetic compatibility* (Vol. 184). John Wiley & Sons.
3. Bemhard Keiser, 1986. *Principles of Electromagnetic Compatibility*, 3rd Ed, Artech house, Norwood.
4. Don R. J, 1988. *Handbook of EMI/EMC, Vol I-V*, White Consultant Incorporate.

EC1635 MACHINE LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the need for machine learning for various problem solving.
- To study the various supervised, semi-supervised and unsupervised learning algorithms.
- To learn new approaches in machine learning.
- To design appropriate machine learning algorithms for problem solving.
- To build systems those learns and adapt using real-world applications.

UNIT I INTRODUCTION 9

Introduction to Machine Learning - Types of Machine learning - Supervised Learning – Unsupervised - Learning-Basic Concepts in Machine Learning -Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS 9

Neural Network Representation – Appropriate problems for neural network learning – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning – Parallelizing Genetic Algorithms.

UNIT III BAYESIAN AND COMPUTATIONAL LEARNING 9

Bayes Theorem – Concept Learning – Maximum likelihood and least squared error hypotheses, Maximum likelihood hypotheses for predicting probabilities – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naive Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

UNIT IV INSTANT BASED LEARNING 9

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions – Case Based Learning – Remarks on Lazy and Eager Learning.

UNIT V ADVANCED LEARNING 9

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Compare the foundational concepts in machine learning.

CO2: Apply the concepts of Neural Networks and Genetic Algorithms.

CO3: Make use of the various algorithms in Bayesian and computational learning.

CO4: Experiment with the various concepts of Instant based learning.

CO5: Demonstrate the types of various advanced learning methods in Machine Learning.

TEXT BOOK

1. Tom M. Mitchell, 2013, *Machine Learning*, McGraw-Hill Education (India) Private Limited.

REFERENCE BOOKS

1. Ethem Alpaydin, 2004, *Introduction to Machine Learning (Adaptive Computation and Machine Learning)*, The MIT Press.
2. Stephen Marsland, 2009, *Machine Learning: An Algorithmic Perspective*, CRC Press.
3. Stephen Marsland, 2014, *Machine Learning: An Algorithmic Perspective*, Second Edition, Taylor & Francis (CRC).

EC1636 **MEMS AND NEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concepts of micro and nano electromechanical devices.
- To understand the fabrication process of MEMS.
- To familiarize the design concepts of micro sensors.
- To know the design concepts of micro actuators.
- To learn the concepts of quantum mechanics and nano systems.

UNIT I INTRODUCTION TO MEMS AND NEMS 9

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester.

UNIT IV MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, RF MEMS Components: Case study 1: MEMS Switch, Example of RF MEMS switches and applications, Mechanical design , Electromagnetic modeling (Capacitance, Loss, Isolation), Current research Case Study 2: Tunable Capacitors and Inductors, Example of tunable capacitors and inductors and their applications in circuits, Effect of inductor layout, reduction of stray capacitance of planar inductor.

UNIT V NANO DEVICES 9

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Summarize the Concept of miniaturization, need for MEMS in various applications and also the need for packaging.

CO2: Generalize the Micro fabrication techniques.

CO3: Design the various types of Micro sensors.

CO4: Explain the concepts of various actuation mechanisms of MEMS.

CO5: Explain the concepts of quantum mechanics and nano systems.

TEXT BOOK

1. Marc Madou, 1997. *Fundamentals of Microfabrication*, CRC press.

REFERENCE BOOKS

1. Tai Ran Hsu, 2002. *MEMS and Microsystems Design and Manufacture,* Tata Mcraw Hill.
2. Chang Liu, 2006. *Foundations of MEMS,* Pearson education India limited.
3. Sergey Edward Lyshevski, 2002. *MEMS and NEMS: Systems, Devices, and Structures,* CRC Press.

EC1637 NANOTECHNOLOGY AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates.
- To explore the basics of nanomaterial synthesis and characterization.
- To learn the properties and measurement of nanomaterials.
- To study the structure of nanomaterials.
- To introduce the applications of nanotechnology.

UNIT I INTRODUCTION TO NANOTECHNOLOGY 9

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bio nano-particles.

UNIT II FABRICATION AND CHARACTERIZATION OF NANOMATERIALS 9

Types of Nanomaterials - Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes - Gas, liquid, and solid –phase synthesis of nanomaterials - Lithography techniques - Photolithography, Dip-pen and Electron beam lithography - Thin film deposition – Electrospinning - Bio-synthesis of nanomaterials.

UNIT III PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Optical Properties - Absorption, Fluorescence, Resonance - Methods for the measurement of nanomaterials - Microscopy measurements - SEM, TEM, AFM, STM - Confocal and TIRF imaging.

UNIT IV NANO STRUCTURES 9

Carbon Nanotubes – Fullerenes – Nanowires - Quantum Dots - Applications of nanostructures - Reinforcement in Ceramics - Drug delivery - Giant magneto resistance etc.,- Cells response to Nanostructures.

UNIT V APPLICATIONS OF NANOTECHNOLOGY 9

Nano electronics - Nano sensors - Nanotechnology in Diagnostics applications - Environmental and Agricultural Applications of nanotechnology - Nano technology for energy systems.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe the basic science behind the properties of materials.

CO2: Interpret the creation, characterization, and manipulation of nanoscale materials.

CO3: Comprehend the exciting applications of nanotechnology at the leading edge of scientific research.

CO4: Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

CO5: Apply the concept of nanoscience in Agricultural applications.

TEXT BOOK

1. Schodek, D.L, Ferreira, P. and Ashby, M.F, 2009. *Nanomaterials, nanotechnologies and design: an introduction for engineers and architects*. Butterworth-Heinemann.

REFERENCE BOOKS

1. Z.L. Wang, Y. Liu, Z. Zhang, 2003. *Handbook of Nanophase and Nanostructured Materials (in four volumes*), Kluwer Academic/Plenum Publishers.
2. Tseung-Yuen Tseng and Hari Singh Nalwa, 2005. *Handbook of Nanoceramics and their Based Nanodevices*, American Scientific Publishers.

ME1634 OPERATION RESEARCH TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.
- Formulate a real-world problem as a mathematical programming model.
- To provide idea for optimizing and approximating industrial problems to the Managers and decision makers.
- To devise appropriate measures for modeling and solving engineering problems of different fields.
- Apply scientific techniques to monitor the organizations ongoing activities such as production mix, transportation and assignment problem.

UNIT I LINEAR PROGRAMMING 9

Introduction – Basic concepts – Linear programming Formulation – Graphical method– Simplex algorithm –Sensitivity analysis.

UNIT II DUALITY,TRANSPORTATION AND ASSIGNMENTMODELS 9

Definition of dual problem –Primal –Dual relationships –Dual simplex methods –Post optimality analysis –Transportation problem– Assignment Models– Hungarian method, Traveling Salesman problem.

UNIT III INVENTORY MODELS 9

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 9

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V NETWORK MODELS 9

Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Develop a model for finding optimal solution during the given set of resources.

CO2: Develop an optimum solution for simple transportation/assignment problems.

CO3: Apply the different inventory models for solving simple problems.

CO4: Make use of the concept of different queuing models for solving simple problems.

CO5: Determine the shortest route in the production model using PERT & CPM.

TEXT BOOKS

1. Sharma J.K, 1997. *Operations Research – Theory and Applications*, Macmillan India Ltd.
2. Paneer Selvam, 2002. *Operations Research*, Prentice Hall of India.

REFERENCE BOOKS

1. Taha H.A, 2003. *Operations Research*, Sixth Edition, Prentice Hall of India.
2. AnandSarma, 2003. *Operation Research*, Himalaya Publishing House.
3. Hira, Gupta, 2010. *Problems in Operations Research*,3rd Edition, S.Chand and Co.
4. Hiller Frederick S.,GeraldJ.Lieberman, 2005. *Introduction to Operations Research*, 8th Edition,TMH (SIE).
5. Wayne L.Winston, 2007. *Operations Research Applications and Algorithms*, 4th Edition, Thomson learning.
6. Kanti Swarup, Gupta P.K., Man Mohan, 2015. *Operations Research*, 18th edition, S. Chand & Sons.

OEC151 BASICS OF SIGNALS AND SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic properties of signals & systems and characterization of LTI systems in time domain.
- To learn continuous time signals in the Continuous Time Fourier and Laplace domain.
- To analyze continuous time system in the Continuous Time Fourier and Laplace domain.
- To familiarize discrete time signals in the Discrete Time Fourier and Z transform domain.
- To analyze discrete time system in the Discrete Time Fourier and Z transform domain.

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_ Basic Operations on Signals, Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier Transform – properties- Laplace Transforms and properties, Inverse Laplace Transform.

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Impulse response - Differential Equation- Fourier and Laplace transforms in Analysis of CT systems.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties, Inverse Z Transform.

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Identify the different types of Continuous time and discrete time signals/systems.

CO2: Apply Continuous Time Fourier Transform and Laplace transform for the analysis of continuous time signals.

CO3: Make use of Fourier and Laplace transform to analyse continuous time systems.

CO4: Apply Discrete Time Fourier Transform and Z Transform for the analysis of discrete time signals.

CO5: Utilize Fourier and Z transform to analyze discrete time systems.

TEXT BOOK

1. Oppenhiem, A.V, Willsky, A.S. and Nawab, S.H, 2015. *Signals and Systems*, Pearson.

REFERENCE BOOKS

1. Lathi, B.P, 2009. *Principles of Linear Systems and Signals,* Oxford University Press.
2. Ziemer, R.E., Tranter, W.H. & Fannin, D.R, 1993. *Signals and systems: continuous and discrete*, Macmillan College.
3. John Alan Stuller, 2007. *An Introduction to Signals and Systems*, Thomson.

OEC152 **DIGITAL AUDIO ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concept of fundamentals of digital audio.
- To understand the concept of audio in digital TV broadcasting.
- To understand the various codes of digital coding.
- To understand the concept of digital audio tape recorder.
- To analyze the concept internet audio in digital audio engineering.

UNIT I FUNDAMENTALS OF DIGITAL AUDIO 9

Discrete time sampling - sampling theorem - Nyquist frequency – aliasing – prevention – quantization – signal to error ratio – distortion – other architectures – dithers – types of dither.

UNIT II RECORDING AND TRANSMISSION PRINCIPLES 9

PCM – record processing – recording oriented codes – transmission oriented codes – audio in digital TV broadcasting – DAB.

UNIT III DIGITAL CODING AND COMPRESSION 9

Block & convolutional codes – cyclic codes – Reed Solomon codes – interleaving – compression principles – lossless & perceptive coding – subband codes – transform coding – compression formats – MPEG audio – Dolby AC 3 – ATRAC.

UNIT IV DIGITAL AUDIO TECHNIQUES 9

Digital audio tape recorder – cassettes – modes – track format – digital audio editing – editing with random access media & recording media – editor structure – digital audio in optical disks – CD, MD, DVD, playing optical disk – Minidisk.

UNIT V APPLICATIONS OF DIGITAL AUDIO 9

Internet audio – MP3 – SDMI – audio MPEG 4 – PC – MIDI – sound cards.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the fundamental concepts of digital audio along with the types of dither.

CO2: Describe the recording and transmission principles of digital audio.

CO3: Elucidate the different digital coding techniques and digital compression techniques.

CO4: Explain the various steps in digital audio editing.

CO5: Outline the various applications of digital audio.

TEXT BOOKS

1. John Watkinson, 2013. *An Introduction to Digital Audio*, Second edition, Focal Press.
2. Ken C Pohlmann, 2010. *Principles of Digital audio*, Sixth edition, McGraw Hill.

REFERENCE BOOKS

1. Then Ballin, 2015. *Handbook for sound Engineers*, Fifth Edition, Taylor & Francis.
2. John Watkinson, 2013. *The art of Digital Audio*, Third Edition, Focal Press.

OEC153 **ELECTRONICS PACKAGING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study theory concept of Electronic Systems Packaging.
- To understand the various semiconductor packages.
- To study CAD for Printed Wiring Boards.
- To enhance the student knowledge in the area of surface mount technology and thermal considerations.
- To enhance the student knowledge in the area of Embedded Passives Technology.

UNIT I OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING 9

Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.

UNIT II SEMICONDUCTOR PACKAGES 9

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits; Electrical Design considerations in systems packaging, Resistive, Capacitive and Inductive Parasitics, Layout guidelines and the Reflection problem, Interconnection.

UNIT III CAD FOR PRINTED WIRING BOARDS 9

Benefits from CAD; Introduction to DFM, DFR & DFT, Components of a CAD package and its highlights, Beginning a circuit design with schematic work and component, layout, DFM check, list and design rules; Design for Reliability, Printed Wiring Board Technologies: Board-level packaging aspects, Review of CAD output files for PCB fabrication; Photo plotting and mask generation, Process flow-chart; Vias; PWB substrates; Surface preparation, Photoresist and application methods; UV exposure and developing; Printing technologies for PWBs, PWB etching; PWB etching; Resist stripping; Screen-printing technology, hrough-hole manufacture process steps; Panel

and pattern plating methods, Solder mask for PWBs; Multilayer PWBs; Introduction to, microvias, Microvia technology and Sequential build-up technology process flow for high-density, interconnects.

UNIT IV SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATION **9**

SMD benefits; Design issues; Introduction to soldering, Reflow and Wave Soldering methods to attach SMDs, Solders; Wetting of solders; Flux and its properties; Defects in wave soldering, Vapor phase soldering, BGA soldering and Desoldering/Repair; SMT failures, SMT failure library and Tin Whisker, Tin-lead and lead-free solders; Phase diagrams; Thermal profiles for reflow soldering; Lead freevAlloys, Lead-free solder considerations; Green electronics; RoHS compliance and e-waste recycling, Issues, Thermal Design considerations in systems packaging.

UNIT V EMBEDDED PASSIVES TECHNOLOGY **9**

Introduction to embedded passives; Need for embedded passives; Design Library; Embedded resistor processes, Embedded capacitors; Processes for embedding capacitors; Case study examples.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain Product and level of Packaging.

CO2: Describe the various packages in semiconductor.

CO3: Design the Printed Wiring Boards using CAD.

CO4: Explain the soldering technique for various circuits.

CO5: Describe embedded passive devices.

TEXT BOOK

1. Rao R. Tummala, 2001,*Fundamentals of Microsystems Packaging*, McGraw Hill, NY.

REFERENCE BOOK

1. William D. Brown, 1999, *Advanced Electronic Packaging*, IEEE Press.

OEC154 SPACE TIME WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concept of multiple antenna propagation.
- To learn the concept of capacity of frequency flat deterministic MIMO channel.
- To familiarize with the concept of transmitter and receiver diversity technique.
- To design the coding for frequency flat channel.
- To analyze the concept of micro multi user detection.

UNIT I MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL CHARACTERIZATION **9**

Wireless channel, Scattering model in macrocells, Channel as a ST random field, Scattering functions, Polarization and field diverse channels, Antenna array topology, Degenerate channels, reciprocity and its implications, Channel definitions, Physical scattering model, Extended channel models, Channel measurements, sampled signal model, ST multiuser and ST interference channels, ST channel estimation.

UNIT II CAPACITY OF MULTIPLE ANTENNA CHANNELS **9**

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter, Channel known to the transmitter, capacity of random MIMO channels, Influence of rician fading, fading correlation, XPD and degeneracy on MIMO capacity, Capacity of frequency selective MIMO channels.

UNIT III SPATIAL DIVERSITY **9**

Diversity gain, Diversity order and channel variability, Diversity performance in extended channels, Combined space and path diversity, Indirect transmit diversity, Diversity of a space-time- frequency selective fading channel.

UNIT IV MULTIPLE ANTENNA CODING AND RECEIVERS **9**

Coding and interleaving architecture, ST coding for frequency flat channels, ST coding for frequency selective channels, Iterative MIMO receivers, Exploiting channel knowledge at the transmitter: linear pre-filtering, optimal pre-filtering for maximum rate, optimal pre-filtering for error rate minimization, selection at the transmitter, Exploiting imperfect channel knowledge.

UNIT V ST OFDM, SPREADSPECTRUM AND MIMO MULTIUSER DETECTION **9**

SISO-OFDM modulation, MIMO-OFDM modulation, Signaling and receivers for MIMO OFDM, SISO-SS modulation, MIMO-SS modulation, Signaling and receivers for MIMO- SS. MIMO MAC, MIMO-BC, Outage performance for MIMO-MU, MIMO-MU with OFDM, CDMA and multiple antennas.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe the Space Time MIMO concepts of propagation and channel characterization.

CO2: Discuss the Calculation of capacity of MIMO systems.

CO3: Explain the receiver and transmitter diversity techniques.

CO4: Explain the space time coding and optimal pre-filter design in the absence of CSIT and presence of CSIT.

CO5: Illustrate the OFDM, SS and MU detection based MIMO systems.

TEXT BOOK

1. A. Paulraj, Rohit Nabar, Dhananjay Gore, 2003. *Introduction to Space Time Wireless Communication Systems*, Cambridge University Press.

REFERENCE BOOKS

1. Andre Viterbi, 1995. *Principles of Spread Spectrum Techniques* Addison Wesley.
2. Jafarkhani, Hamid, 2005. *Space-time coding: theory and practice*. Cambridge university press.
3. Sergio Verdu,1998. *Multi User Detection* Cambridge University Press.

OEC155 **TELECOMMUNICATION NETWORK MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concept of Telecommunication network management standards.
- To design the common management information service element model.
- To understand the various concept of information modelling.
- To analyze the concept of SNMPv1 and SNMPv2 protocol.
- To analyze the concept of examples of network management.

UNIT I FOUNDATIONS 9

Telecommunication Network management standards–network management model–organization model – information model abstract syntax notation 1 (ASN.1) – encoding structure – functional model. Network management application functional requirements: Configuration management – fault management – performance management – Error correlation technology – security management – accounting management – common management – report management – polity based management – service level management – management service – community definitions – capturing the requirements – simple and formal approaches – semi formal and formal notations.

UNIT II COMMON MANAGEMENT INFORMATION SERVICE ELEMENT 9

CMISE model – service definitions – errors – scooping and filtering features – synchronization – functional units – association services – common management information protocol specification.

UNIT III INFORMATION MODELING FOR TMN 9

Rationale for information modeling – management information model – object oriented modeling paradigm – structure of management information – managed object class definition – management information base.

UNIT IV SIMPLE NETWORK MANAGEMENT PROTOCOL 9

SNMPv1: managed networks – SNMP models – organization model – information model – SNMPv2 communication model – functional model – major changes in

SNMPv2 – structure of management information, MIB – SNMPv2 protocol – compatibility with SNMPv1 – SNMPv3 – architecture – applications – MIB security, remote monitoring – MIB – RMQN1 and RMON2.

UNIT V NETWORK MANAGEMENT EXAMPLES 9

ATM integrated local management interface – ATM MIB –M1– M2– M3 – M4 – interfaces – ATM digital exchange interface management – digita1 subscriber loop and asymmetric DSL technologies – ADSL configuration management – performance management Telecommunication Network management tools: Network statistics management – management system – management platform case studies: OPENVIEW – ALMAP.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the concepts of Telecommunication network management standards.

CO2: Elucidate the service element for common management information.

CO3: Describe the various concept of information modelling.

CO4: Elaborate the concepts of simple network management protocol.

CO5: Interpret the various types of network management tools.

TEXT BOOKS

1. Subramanian, M, 2010. *Network management: principles and practice*. Pearson Education India.
2. Raman, L.G, 1999. *Fundamentals of telecommunications network management* (Vol. 3). Wiley-IEEE Press.

REFERENCE BOOKS

1. Henry Haojin Wang, 1999. *Telecommunication Network Management*, McGraw Hill.
2. Salah Aidarous & Thomas Plevyak, 1997. *Telecommunication Network Management: Technologies and Implementations*. Wiley IEEE Press.

OEC156 WAVELETS AND ITS APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the concept of Fourier transform and short time Fourier transform.
- To understand the concepts of continuous time wavelet transform.
- To know the concept of interpolation and decimation.
- To understand the types of filter bank.
- To analyze the concept of image compression.

UNIT I FOURIER ANALYSIS 9

Fourier basis & Fourier Transform, failure of Fourier Transform – Need for Time-Frequency Analysis – Heisenberg's Uncertainty principle – Short time Fourier transform (STFT), short comings of STFT – Need for Wavelets.

UNIT II CWT AND MRA 9

Wavelet basis, Continuous time Wavelet Transform (CWT) - Need for scaling function – Multi Resolution Analysis – important wavelets - Haar, Mexican hat, Meyer, Shannon, Daubachies.

UNIT III CONSTRUCTION OF WAVELETS ANDINTRODUCTION TO MULTIRATE SYSTEMS 9

Necessary ingredients of wavelets, construction–semi orthogonal, orthogonal and biorthogonal wavelets– Decimation and Interpolation in Time domain - Decimation and Interpolation in Frequency domain – Multi rate systems for a rational factor.

UNIT IV FILTER BANKS AND DWT 9

Analysis and Synthesis of filter bank,Two channel filter bank – Perfect Reconstruction (PR) condition - Quadrature Mirror Filter (QMF)-Relationship between filter banks and wavelet basis – DWT – Filter banks for Daubachies wavelet function.

UNIT V APPLICATIONS 9

Feature extraction using wavelet coefficients– Image compression– interference suppression– Microcalcification cluster detection– Edge detection–Faulty bearing signature identification.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Summarize the Concept of need for time frequency analysis.

CO2: Illustrate the concept of continuous time wavelet transform and multi resolution analysis.

CO3: Explain the construction details of wavelets and the multirate systems for rational factor.

CO4: Interpret the relationship between the filter bank and wavelet.

CO5: Develop the application of wavelets.

TEXT BOOKS

1. Mallat, S, 1999. *A wavelet tour of signal processing*. Elsevier.
2. Soman, K.P, 2010. *Insight into wavelets: from theory to practice*. PHI Learning Pvt. Ltd.

REFERENCE BOOKS

1. Chui, C.K, 2016. *An introduction to wavelets*. Elsevier.
2. Goswami, J.C. and Chan, A.K, 2011. *Fundamentals of wavelets: theory, algorithms, and applications* (Vol. 233). John Wiley & Sons.
3. Misiti, M., Misiti, Y, Oppenheim, G. and Poggi, J.M. eds, 2013. *Wavelets and their Applications*. John Wiley & Sons.
4. Stark, H.G, 2005. *Wavelets and signal processing: an application-based introduction*. Springer Science & Business Media.
5. Vaidyanathan, P.P, 2006. *Multirate systems and filter banks*. Pearson Education India.