K.L.N. COLLEGE OF ENGINEERING

Pottapalayam, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd: 1994

THIRD YEAR

CURRICULUM & SYLLABUS

REGULATION 2024

For Under Graduate Program

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted from the academic year 2024-2025 onwards)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry**.**

VISION OF THE DEPARTMENT

To promote as a center of excellence in educational and research activities related to electronics and communication engineering and its allied areas.

MISSION OF THE DEPARTMENT

To create educational and research environment to meet ever changing and ever demanding needs of electronics and communication industry along with IT and other interdisciplinary fields.

To mould the students to become ethically upright and recognized as responsible engineers

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: To prepare graduates with a strong foundation in Engineering science and Technology with more emphasis in Electronics and Communication Engineering and its allied areas.

PEO 2: To prepare the students to pursue successful career in industry and to motivate them for higher education.

PEO 3: To prepare the graduates to sustain as good professional, researcher and to practice them in emerging technologies through lifelong learning.

PEO 4: To impart students with ethical standards, professional excellence through effective communication skills, team work, multi disciplinary projects and social responsibility.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO 1: Design and analyse the basic analog and digital electronic circuits.

PSO 2: Design and analyse the spectral components of communication signals and systems.

PSO 3: Develop the modules in VLSI and embedded systems.

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai)

KNOWLEDGE AND ATTITUDE PROFILE

WK1 A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2 Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3 A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4 Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5 Knowledge, including efficient resource use, environmental impacts, whole-life cost, re- use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6 Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7 Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8 Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9 Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM OUTCOMES (POs)

PO 1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, and engineering fundamentals, and an engineering specialization as specified in WK1 to WK4, respectively, to develop solutions to complex engineering problems.

PO 2: Problem Analysis: Identity, formulate, research literature, and analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences with holistic considerations for sustainable development* (WK1 to WK4).

PO3: Design/development of solutions: Design creative solutions for Complex engineering problems and design systems, components, or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon, as well as resource, cultural, societal, and environmental considerations as required (WK5).

PO 4: Investigation: Conduct investigations of complex engineering problems using research methods, including research-based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions (WK8).

PO 5: Tool Usage: Create, select and apply, and recognize limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering problems (WK2 and WK6).

PO 6: The Engineer and the World: When solving complex engineering problems, analyze and evaluate sustainable development impacts to society, the economy, sustainability, health and safety, legal frameworks, and the environment (WK1, WK5, and WK7).

PO 7: Ethics: Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion (WK9).

PO 8: Individual and Collaborative Team work: Function effectively as an individual and as a member or leader in diverse and inclusive teams and in multidisciplinary, face- to-face, remote, and distributed settings (WK9).

PO 9: Communication: Communicate effectively and inclusively 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, taking into account cultural, language, and learning differences.

PO 10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO 11: Lifelong learning: Recognize the need for and have the preparation and ability for (i) independent and life-long learning (ii) adaptability to new and emerging technologies and (iii) critical thinking in the broadest context of technological change (WK8).

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

REGULATIONS 2024

For Under Graduate Program

B.E. ELECTRONIC

S AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS**) **Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory (MC) Courses** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS 2024

CURRICULUM
SEMESTER V

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		THEORY						
1.	24EC501	Transmission lines and RF Systems	PC	3	3	0	0	3
2.	24EC502	Digital Communication Techniques	PC	3	3	0	0	3
3.	24EC503	Digital Signal Processing	PC	4	3	1	0	4
4.		Professional Elective - I	PE	3	3	0	0	3
5.		Professional Elective - II	PE	3	3	0	0	3
THEORY CUM PRACTICAL								
6.	24EC504	Embedded and Real time systems	PC	5	3	0	2	4
PRACTICAL								
7.	24EC5L1	Communication Systems Laboratory	PC	3	0	0	3	1.5
8.	24EC5L2	Digital Signal Processing Laboratory	PC	3	0	0	3	1.5
9.	24HS5L1	Programming Skills – I	EEC	2	0	0	2	1*
TOTAL				**29**	**18**	**1**	**10**	**23**
FOR HONOURS DEGREE								
1.		Capstone Design Project – Level I	EEC	12	0	0	12	6
OR								
2.		Honours Elective – I		3	3	0	0	3
3.		Honours Elective – II		3	3	0	0	3
FOR MINOR DEGREE								
4.		Minor Elective – I		3	3	0	0	3
5.		Minor Elective – II		3	3	0	0	3

*** The grades earned by the students will be recorded in the grade sheet, however the same shall not be considered for the computation of CGPA**

KLNCE UG ECE R2024 (AY 2024-2025 Admitted)

SEMESTER - VI

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
		THEORY						
1.	24EC601	Antenna and Wave Propagation	PC	3	3	0	0	3
2.	24EC602	Standards in Electronics and Communication Engineering	PC	1	1	0	0	1
3.		Professional Elective – III	PE	3	3	0	0	3
4.		Professional Elective – IV	PE	3	3	0	0	3
5.		Open Elective	OE	3	3	0	0	3
6.	24MC601	Disaster Management	MC	2	2	0	0	-
		THEORY CUM PRACTICAL						
7.	24EC603	Machine Learning for Communication Systems	PC	4	2	0	2	3
8.	24EC604	Digital VLSI Design	PC	5	3	0	2	4
		PRACTICAL						
9.	24EC6L1	Design Thinking	EEC	2	0	0	2	1
10.	24HS6L1	Programming Skills - II	EEC	2	0	0	2	1*
TOTAL				**28**	**20**	**0**	**8**	**21**
For Honours Degree								
1.		Capstone Design Project – Level II	EEC	12	0	0	12	6
OR								
1.		Honours Elective – III		3	3	0	0	3
2.		Honours Elective – IV		3	3	0	0	3
For Minor Degree								
1.		Minor Elective – III		3	3	0	0	3
2.		Minor Elective – IV		3	3	0	0	3

*** The grades earned by the students will be recorded in the grade sheet, however the same shall not be considered for the computation of CGPA**

 # mandatory Summer internship (2 weeks – 1 credit)

KLNCE UG ECE R2024 (AY 2024-2025 Admitted)

Vertical - 1	Vertical - 2	Vertical - 3	Vertical - 4	Vertical - 5	Vertical - 6	Vertical - 7
Semiconductor Technology	**Wireless and Cellular Communication**	**Signal and Image Processing**	**Computational Technologies**	**Embedded and IOT**	**Biomedical and Sensor Technologies**	**RF and Space Communication**
Analog VLSI design	MIMO and Multi carrier System	Advanced Digital Signal Processing	Artificial Intelligence and Cloud Applications	IoT Enabled Systems Design	Electronic Measurements and Instrumentation	RF Transceivers
VLSI signal processing	Advanced Wireless Communication Techniques	DSP Architecture and Programming	Deep Learning Techniques	Mixed C and Assembly Language Programming	Sensor Concepts and Techniques	Radar Technologies
Physical Design for VLSI Circuits	Cognitive radio Networks	Digital Imaging and Computer Vision	Natural Language Processing	Embedded Processors	Wireless Sensor Networks	Electromagnetic Interference compatibility
System-on-Chip Design	Optical Wireless Communications	Speech Processing	Exploratory Data Analysis	Communicating Embedded Systems	Foundations for Nano Engineering	Satellite Communication
Network-on-Chip Design	4G and 5G Communication networks	Video Analytics	Soft Computing and Intelligent Systems	Robotics and Automation	Human Assist Devices	Remote sensing
FPGA-Based System Design	Massive MIMO Networks	Software Defined Radio	Extended Reality (XR) Systems	IoT for Industrial Process Optimization	Biomedical Imaging Systems	MICs and RF System Design
Multi-Core Programming	Quantum Communication and Information Theory	VLSI signal processing	Multimedia Data Compression	Real Time Operating Systems	Wireless Body Area Networks	Avionics Systems
			Digital Promotion using Electronic Media		Brain Computer Interface and Applications	

Vertical I : Semiconductor Chip Design and Testing

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV11	Analog VLSI design	PE	3	3	0	0	3
2.	24ECV21	VLSI signal processing	PE	3	3	0	0	3
3.	24ECV31	Physical Design for VLSI Circuits	PE	3	3	0	0	3
4.	24ECV41	System-on-Chip Design	PE	4	2	0	2	3
5.	24ECV51	Network-on-Chip Design	PE	3	3	0	0	3
6.	24ECV61	FPGA-Based System Design	PE	3	3	0	0	3
7.	24ECV71	Multi-Core Programming	PE	4	2	0	2	3

Vertical II : Wireless and Cellular Communication

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV12	MIMO and Multi carrier System	PE	3	3	0	0	3
2.	24ECV22	Advanced Wireless Communication Techniques	PE	3	3	0	0	3
3.	24ECV32	Cognitive radio Networks	PE	3	3	0	0	3
4.	24ECV42	Optical Wireless Communications	PE	3	3	0	0	3
5.	24ECV52	4G and 5G Communication networks	PE	3	3	0	0	3
6.	24ECV62	Massive MIMO Networks	PE	3	3	0	0	3
7.	24ECV72	Quantum Communication and Information Theory	PE	3	3	0	0	3

Vertical III : Signal and Image Processing

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV13	Advanced Digital Signal Processing	PE	4	2	0	2	3
2.	24ECV23	DSP Architecture and Programming	PE	3	3	0	0	3
3.	24ECV33	Digital Imaging and Computer Vision	PE	3	3	0	0	3
4.	24ECV43	Speech Processing	PE	3	3	0	0	3
5.	24ECV53	Video Analytics	PE	3	3	0	0	3
6.	24ECV63	Software Defined Radio	PE	3	3	0	0	3
7.	24ECV73	VLSI signal processing	PE	3	3	0	0	3

Vertical IV : Computational Technologies

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV14	Artificial Intelligence and Cloud Applications	PE	3	3	0	0	3
2.	24ECV24	Deep Learning Techniques	PE	3	3	0	0	3
3.	24ECV34	Natural Language Processing	PE	3	3	0	0	3
4.	24ECV44	Exploratory Data Analysis	PE	3	3	0	0	3
5.	24ECV54	Soft Computing and Intelligent Systems	PE	3	3	0	0	3
6.	24ECV64	Extended Reality (XR) Systems	PE	3	3	0	0	3
7.	24ECV74	Multimedia Data Compression	PE	3	3	0	0	3
8.	24ECV84	Digital Promotion using Electronic Media	PE	4	2	0	2	3

Vertical V : Embedded and IOT

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV15	IoT Enabled Systems Design	PE	3	3	0	0	3
2.	24ECV25	Mixed C and Assembly Language Programming	PE	3	3	0	0	3
3.	24ECV35	Embedded Processors	PE	3	3	0	0	3
4.	24ECV45	Communicating Embedded Systems	PE	3	3	0	0	3
5.	24ECV55	Robotics and Automation	PE	3	3	0	0	3
6.	24ECV65	IoT for Industrial Process Optimization	PE	3	3	0	0	3
7.	24ECV75	Real Time Operating Systems	PE	3	3	0	0	3

Vertical VI : Biomedical and Sensor Technologies

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV16	Electronic Measurements and Instrumentation	PE	3	3	0	0	3
2.	24ECV26	Sensor Concepts and Techniques	PE	3	3	0	0	3
3.	24ECV36	Wireless Sensor Networks	PE	3	3	0	0	3
4.	24ECV46	Foundations for Nano Engineering	PE	3	3	0	0	3
5.	24ECV56	Human Assist Devices	PE	3	3	0	0	3
6.	24ECV66	Biomedical Imaging Systems	PE	3	3	0	0	3
7.	24ECV76	Wireless Body Area Networks	PE	3	3	0	0	3
8.	24ECV66	Brain Computer Interface and Applications	PE	3	3	0	0	3

Vertical VII : RF And Space Communication

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECV17	RF Transceivers	PE	3	3	0	0	3
2.	24ECV27	Radar Technologies	PE	3	3	0	0	3
3.	24ECV37	Electromagnetic Interference compatibility	PE	3	3	0	0	3
4.	24ECV47	Satellite Communication	PE	3	3	0	0	3
5.	24ECV57	Remote sensing	PE	3	3	0	0	3
6.	24ECV67	MICs and RF System Design	PE	3	3	0	0	3
7.	24ECV77	Avionics Systems	PE	3	3	0	0	3

Open electives offered to other Departments

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24OE301	Image Processing	OE	3	3	0	0	3
2.	24OE302	Consumer Electronics	OE	3	3	0	0	3
3.	24OE303	Satellite Communication Systems	OE	3	3	0	0	3
4.	24OE304	VLSI Technology	OE	3	3	0	0	3

MINOR DEGREE in VLSI DESIGN

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	24ECM01	Semiconductor Physics	MD	3	3	0	0	3
2.	24ECM02	Digital System Design and Microprocessor	MD	3	3	0	0	3
3.	24ECM03	System Design using Verilog	MD	4	2	0	2	3
4.	24ECM04	Advanced Digital Design using Verilog	MD	4	2	0	2	3
5.	24ECM05	Digital Integrated Circuit	MD	3	3	0	0	3
6.	24ECM06	VLSI Testing and Testability	MD	3	3	0	0	3

24EC501 TRANSMISSION LINES AND RF SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To explain the characteristics of transmission lines and its losses.
- To Write about the standing wave ratio and input impedance in high frequency transmission lines.
- To analyze impedance matching by stubs using smith charts
- To analyze the characteristics of TE and TM waves
- To explain the concepts of RF parameters and RF devices

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 Z_0 - Reflection coefficient - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

UNIT - II HIGH FREQUENCY TRANSMISSION LINES 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- Measurement of VSWR and wavelength, power in dB,dBm,dBmw.

UNIT - III IMPEDANCE MATCHING IN HIGH FREQUENCY LINE 9

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching – Smith chart – Solutions of problems using Smith chart – Single and double stub matching using Smith 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 PARAMETERS AND DEVICES 9

RF parameters: RF spectrum and applications, low frequency parameter and its measurement difficulties at high frequency, formulation of S-parameter for 2-port network, S-parameter for n port device – properties of S – parameter – reciprocal and lossless network

RF devices: RF Bipolar junction transistor, High electron Mobility transistor (HEMT), Mixer, Low Noise Amplifier, Power amplifier.

TOTAL: 45 PERIODS

TEXT BOOKS:

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

REFERENCES:

1. Jerry C.Whitaker, “The RF Tramsmission Systems Handbook”, CRC Press, Taylor & Francis Group, 2010.
2. Reinhold Ludwig and Powel Bretchko,” RF Circuit Design – Theory and Applications”, Pearson Education Asia, First Edition,2001.
3. D. K. Misra, “Radio Frequency and Microwave Communication Circuits- Analysis and Design”, John Wiley & Sons, 2004.
4. E.C.Jordan and K.G. Balmain, —Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2006.
5. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, First edition 2005.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : TRANSMISSION LINES AND RF SYSTEMS		**Course code: 24EC501**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Derive the characteristics of transmission lines and its losses.	I	K3
CO2	Derive the standing wave ratio and input impedance in high frequency transmission lines and Classify various types of measurements in high frequency lines.	II	K3
CO3	Analyze the parameters of the stub for impedance matching using smith charts.	III	K4
CO4	Analyze TE and TM waves characteristics for parallel planes, rectangular waveguide and circular waveguide..	IV	K4
CO5	Derive the RF parameters for the given RF devices.	V	K3

24EC502 DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand and apply information theory principles for efficient data transmission with source coding, and maximizing communication channel capacity.
- To study the various waveform coding schemes.
- To study pulse shaping techniques to eliminate ISI, focusing on the Nyquist pulse.
- To understand the various bandpass signaling schemes.
- To know the fundamentals of channel coding.

UNIT – I INFORMATION THEORY 9

Introduction- Entropy -Source-coding Theorem - Lossless Data Compression Algorithms- Huffman code - Shannon fano code - Discrete Memoryless Channels - Mutual Information - Channel Capacity - Channel-coding Theorem - Differential Entropy and Mutual Information for Continuous Random Ensembles- Information Capacity Law

UNIT - II CONVERSION OF ANALOG WAVEFORMS INTO CODED PULSES 9

Introduction Sampling Theory Pulse-Amplitude Modulation - Quantization and its Statistical Characterization - Pulse-Code Modulation - Noise Considerations in PCM Systems - Prediction-Error Filtering for Redundancy Reduction - Differential Pulse-Code Modulation - Delta Modulation - Line Codes

UNIT - III SIGNALING OVER BAND-LIMITED CHANNELS 9

Introduction - Error Rate Due to Channel Noise in a Matched-Filter Receiver- Intersymbol Interference- Signal Design for Zero ISI -Ideal Nyquist Pulse for Distortion less Baseband- Data Transmission - Raised-Cosine Spectrum - Post-Processing Techniques: The Eye Pattern. Equalisation– Adaptive equalization -LMS Algorithm.

UNIT - IV SIGNALING OVER AWGN CHANNELS 9

Introduction -Geometric Representation of Signals -Conversion of the Continuous AWGN Channel into a Vector Channel - Optimum Receivers Using Coherent Detection - Probability of Error - Phase-Shift Keying Techniques Using Coherent Detection - Frequency-Shift Keying Techniques Using Coherent Detection

UNIT – V ERROR CONTROL CODING 9

Channel coding theorem, Linear block codes, Repetition Codes, Syndrome Decoding, Hamming Codes - Cyclic codes- Calculation of Syndrome - Convolutional codes, Code Tree, Trellis state diagram, Viterbi decoder- Introduction to LDPC codes

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Simon Haykin, “Digital Communication”, John Wiley& Sons Inc., First Edition,2013
2. Sam Shanmugam, “Digital and Analog Communication Systems”, John Wiley, Fourth Edition, 2010.

REFERENCES:

1. Simon Haykin and Michael Moher, “ Digital Communication systems” John Wiley & Sons, Special Edition,standard Edition 1, 2013.
2. K. Vasudevan, “Digital Communications and Signal Processing”, CRC Press Inc,1st edition,24 January, 2008.

3. Leon W. Couch, “Digital and Analog Communication Systems”, Prentice Hall,1997.
4. B.Carlson, “Introduction to Communication systems”, McGraw Hill, Third Edition,1989.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL COMMUNICATION TECHNIQUES		**Course code: 24EC502**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Calculate information, Entropy, Mutual Information and Channel capacity for the given channel and compute the coding using source coding schemes.	I	K3
CO2	Illustrate the principle of pulse modulation techniques and waveform coding techniques.	II	K3
CO3	Apply the baseband pulse for ISI free transmission over finite bandwidth channels.	III	K3
CO4	Implementdetection techniques in the design of various digital Modulation systems for the analysis of bit error rate performance.	IV	K4
CO5	Apply the given error control coding techniques to detect and correct the errors present in the communication channel.	V	K3

24EC503	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To learn Discrete Fourier Transform, its properties and its application to linear filtering.
- To understand the characteristics of digital filters, design of FIR and IIR filters and its realization.
- To understand the effects of finite precision representation on digital filters.
- To learn the fundamental concepts of Multirate signal processing.

UNIT – I DISCRETE FOURIER TRANSFORM 9 + 3

Review of DTFT – Frequency Domain sampling: The Discrete Fourier Transform – Properties of DFT – Linear filtering methods based on the DFT – Efficient computation of the DFT: Radix 2 FFT Algorithms.

UNIT - II FINITE IMPULSE RESPONSE FILTERS 9 + 3

Characteristics of practical frequency selective filters - Design of FIR filters: symmetric and Anti-symmetric FIR filters - Design of linear phase FIR filters using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. Structures for FIR systems - linear phase structure, direct form realizations.

UNIT - III INFINITE IMPULSE RESPONSE FILTERS 9 + 3

Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters: Impulse invariance method, Bilinear transformation. Structure of IIR systems – Direct form structures, Cascade and parallel structures.

UNIT - IV FINITE WORD LENGTH EFFECTS 9 + 3

Fixed point and floating point Number Representation – The Quantization process and Errors – Quantization of Fixed Point Numbers - Quantization of Floating Point Numbers – Analysis of Coefficient Quantization Effects – A/D Conversion Noise Analysis – Analysis of Arithmetic Round-Off Errors – Dynamic Range Scaling – Limit Cycle in IIR Digital Filters.

UNIT – V MULTIRATE DIGITAL SIGNAL PROCESSING 9 + 3

Introduction - Decimation by a factor D - Interpolation by a factor I - Sampling rate conversion by a rational factor I/D - Multistage implementation of sampling rate conversion- Applications of Multirate signal Processing – Design of Phase shifters, Implementation of Digital filter banks, Implementation of Narrowband Low pass filters, Oversampling A/D and D/A Conversion.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, Fifth Edition, Pearson Education, 2013.
2. Sanjit K.Mitra,”Digital Signal Processing: A Computer – Based Approach”, Fourth Edition, McGraw Hill Education (India), 2017.

REFERENCES:

1. Emmanuel C. Ifeachor and Barrie W. Jervis, “Digital Signal Processing”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. A.V.Oppenheim, R.W.Schafer and J.R.Buck, “Discrete-Time Signal Processing”, Eight Indian Reprint, Pearson, 2004.
3. Vinay K. Ingle and John G. Proakis, “Digital Signal Processing using MATLAB”, Third Edition, Cengage Learning Custom Publication, 2011.

4. Andreas Antoniou, “Digital Signal Processing”, Tata McGraw-Hill, 2006.
5. Li-Tan, “Digital Signal Processing: Fundamentals and Applications”, Fourth Edition, Elsevier, Academic press, 2008.

.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL SIGNAL PROCESSING		**Course code: 24EC503**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Compute DFT and IDFT coefficients of a discrete time sequences using FFT algorithms and output of the discrete time system.	I	K3
CO2	Construct and realize FIR digital filters.	II	K4
CO3	Construct and realize IIR digital filters.	III	K4
CO4	Analyze finite word effects by evaluating quantization error, round off noise, dynamic range scaling and linit cycles in digital filters	IV	K4
CO5	Design the sampling rate converter for the given specifications.	V	K3

		L	T	P	C
24EC504	**EMBEDDED AND REAL TIME SYSTEMS**	**3**	**0**	**2**	**4**

OBJECTIVES:

- To learn the architecture of 32 bit RISC Processor.
- To expose the students to the fundamentals of embedded Programming
- To study different peripheral interfacing using ARM microcontroller.
- To discuss on memory management, application development in RISC processor.
- To learn the basic concepts of RTOS Embedded Programming.

UNIT – I ARM ARCHITECTURE **9**

Architecture - memory organization - addressing modes - The ARM Programmer's model - Registers - Pipeline - Interrupts - Coprocessors - Interrupt Structure.

LAB COMPONENT

1. Flashing of LEDS. **6**
2. Interfacing 4*4 matrix keypad and LCD

UNIT – II ARM MICROCONTROLLER PROGRAMMING 9

ARM general Instruction set - Thumb instruction set - Assembly Language Programming - Embedded C Programming

LAB COMPONENT

3. Interfacing Seven Segment LED, **6**
4. Interfacing Stepper Motor, DC Motor..

UNIT – III PERIPHERALS OF ARM MICROCONTROLLER **9**

ARM: I/O Memory - EEPROM - I/O Ports - SRAM -Timer - ADC - DAC - PWM - RTC

LAB COMPONENT

5. Interfacing ADC, DAC **6**
6. Interfacing PWM, UART

UNIT – IV COMMUNICATION INTERFACES **9**

On board communication interfaces - I^2C, SPI, UART, USB 2.0. External communication interfaces- RS232 and RS485, Bluetooth, Wi-Fi, Zigbee

LAB COMPONENT

7. I Interfacing RTC/EEPROM using I^2C **6**
8. Interfacing Wi-Fi

UNIT – V REAL-TIME OPERATING SYSTEM (RTOS) BASED EMBEDDED SYSTEM DESIGN **9**

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication – context switching- interrupt latency - shared memory-message passing-Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: Free RTOS**,** uC/OS-II, Keil RTX.

LAB COMPONENT

9. Task scheduling using RTOS.
10. Mini Project

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Steve Furber, ARM system on chip architecture, Addison Wesley, 2nd Edition, 2015
2. Shibu K. V., Introduction to Embedded Systems, McGraw-Hill India, 2nd Edition, 2016

REFERENCES:

1. NXP Semiconductors, UM10139: LPC214x User Manual, Rev. 4, April 2012.
2. Muhammad Ali Mazidi; Sarmad Naimi; Sepehr Naimi; Shujen Chen, ARM Assembly Language Programming & Architecture, Microdigitaled.com,2016
3. Andrew N Sloss, Dominic System and Chris Wright, “ARM System Developers Guide”, Elsevier, Morgan Kaufman publisher, 1st Edition, 2008.
4. Trevor Martin, The Insider's Guide To The Philips ARM7-Based Microcontrollers, Hitex (UK) Ltd.
5. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : EMBEDDED AND REAL TIME SYSTEMS		**Course code: 24EC504**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply ARM architecture concepts, addressing modes and interrupt structures in embedded system development.	I	K3
CO2	Develop ARM assembly and Embedded C programs using ARM and Thumb instruction sets for basic I/O device interfacing.	II	K3
CO3	Apply ARM microcontroller peripherals such as I/O ports, EEPROM, SRAM, Timer, ADC, DAC, PWM, and RTC for embedded interfacing applications.	III	K3
CO4	Apply serial communication protocols including I^2C, SPI, UART, RS232, RS485, Bluetooth, Wi-Fi, and Zigbee for interfacing embedded devices.	IV	K3
CO5	Analyze RTOS-based embedded applications using task scheduling, inter-process communication, and synchronization mechanisms.	V	K4

24EC5L1 **COMMUNICATION SYSTEMS LABORATORY**

L	T	P	C
0	0	3	1.5

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 source coding techniques and Error control coding schemes

LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction.
2. AM Modulator and Demodulator.
3. Pulse Code Modulation and Demodulation.
4. Delta Modulation and Demodulation.
5. Generation and Detection of BASK ,BPSK signal.
6. Generation and Detection of BFSK signal
7. Simulation of Source Coding Techniques
8. Time division multiplexing
9. FM modulator and demodulator
10. Line coding schemes
11. Simulation of linear block and cyclic error control coding schemes
12. Simulation of convolutional coding scheme.

TOTAL: 45 PERIODS

LAB REQUIREMENTS FOR BATCH OF 30 STUDENTS (3 STUDENTS PER EXPERIMENT):

1. Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes
2. CROs/DSOs – 15 Nos.
3. Function Generators – 15 Nos.
4. MATLAB or equivalent software package for simulation experiments
5. PCs - 15 Nos.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMMUNICATION SYSTEMS LABORATORY		**Course code: 24EC5L1**	
CO	**COURSE OUTCOMES**	**EXPT**	**K- CO**
CO1	Construct various functional modules of a communication system.	1,8	K3
CO2	Design and Implement Analog modulation schemes.	2,9	K4
CO3	Demonstrate various Pulse modulation schemes.	3,4,10	K3
CO4	Construct a digital modulation schemes.	5,6	K3
CO5	Simulate various source coding and channel coding schemes.	7,11,12	K3

24EC5L2 DIGITAL SIGNAL PROCESSING LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To learn characteristics of Discrete Fourier Transform.
- To understand the characteristics of digital filters, design of FIR and IIR filtering operations.
- To understand the effects of finite precision representation on digital filters.
- To learn the fundamental concepts of Multirate signal processing.

LIST OF EXPERIMENTS:

1. Generation of elementary Discrete-Time sequences
2. Sampling and Aliasing
3. Linear and Circular convolution
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) using windowing method
6. Design of Butterworth/ Chebyshev IIR filters (LPF/HPF)
7. Fixed and Floating Point Representation
8. Quantization of a sinusoidal signal
9. Time domain and frequency domain analysis of Up-sampling and Down-sampling operation
10. Mini Project (Any one project: Maximum 4 per team)
    - DTMF Decoder
    - ECG Signal Denoising
    - Audio Equalizer
    - Function Generator
    - Sound Recorder With Different Sampling Rate And Quantizer levels

LAB REQUIREMENTS

1. MATLAB / Equivalent software package

TOTAL: 45 PERIODS

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL SIGNAL PROCESSING LABORATORY		**Course code: 24EC5L2**	
CO	**COURSE OUTCOMES**	**EXPT**	**K- CO**
CO1	Apply DFT for the analysis of discrete signals.	1,2,3,4	K3
CO2	Design FIR filters and analyzing its filtering operations.	5	K4
CO3	Design IIR filters and analyzing its filtering operations.	6	K4
CO4	Analyze the effect of sampling rate conversion of a signal.	9	K4
CO5	Characterize the effects of finite precision representation on digital filters and quantization of a signal.	7,8	K4

24HS5L1	PROGRAMMING SKILLS - I	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To understand the fundamental data structures (stack, queue, heap, binary tree) and their applications in problem solving.
- To Apply searching and traversal algorithms to solve problems efficiently under time and memory constraints.
- To Analyze real-world problem statements and map them to suitable data structures and algorithms.
- To Evaluate algorithmic solutions for correctness, performance, and optimality in competitive coding scenarios.
- To Create modular, efficient programs by combining multiple algorithmic concepts

Sample problems to be solved

1. Story Book Stack

Arun reads lot of story books and he keeps all the story books piled as asingle stack. He wants to write a program to keep the order of the booksin the pile. The program must implement the following functionalities.

- Add a book to the top of the pile when 1 is followed by the name of the book.
- Remove a book from the top of the pile when -1 is given as the input (provided the pile has atleast one book).
- Print the name of the book on the top of the pile when 2 is given as the input (provided the pile has atleast one book).
- The program must exit when 0 is given as the input.

Boundary Condition(s):

The maximum number of story books in the pile will be 100. The name of the book will not exceed 100 characters.

2. Shorter left wind mill

There are N wind mills in a straight line from left to right. The height of all N wind mills is passed as the input. For each wind-mill M, the program must print the number of wind-mills which are shorter than the current wind-mill present to the left of M.

Note: If private test cases fail implement the logic using an algorithm which is efficient - complexity is less than O(n2)

Boundary Condition(s):

1 <= N <= 10^6,1 <= Height of wind mill <= 10^5

3. First K Largest Integer

The program must accept N integers and an integer K as the input. The program must print the first K largest integers among theN integers as the output.

Hint: The value of N will be large, so sorting N integers and printing the first K integers gives the timeout for this program.

Boundary Condition(s):

1 <= N <= 10^5, 1 <= Each integer value <= 10^8, 1 <= K <= N

4. There are N baskets with different number of balls. The number of balls in each basket is passed as input to the program. The program must make all the baskets with at least B balls based on the following condition.

Note: Additional balls will be supplied as needed from the store.

The value of B is also passed as the input to the program. The program must print the number of times T the baskets can be combined to make all the baskets with atleast B ball.

Boundary Condition(s):

1 <= N <= 10^6 <= Number of balls in each basket <= 10^6,1 <= B <= 10^9

5. There are N queues maintained in a railway station to process customer's query. Each customer will take different time to process his/her query. The customer id and the timetaken to process the customer's query of each customer in each queue are given as the input. The program must print the customer id of Kth serviced customer as the output Ifmore than one customer has serviced at the same time as the Kth customer then print the customer id having the minimum value among those customer ids

Boundary Condition(s):

1 <= N <= 100

1 <= Size of each queue <= 100

1 < = K < = Total number of customers in all the queues

1 <= Customer id, Time taken to process the customer's query <= 1045

6. In an organization chart, the team members are represented using a binary tree. A team member can have a maximum of two junior team members under him/her. It is possible that a team member does not have any juniors under him/her. Annual performance allowance is to be paid and the allowance amount that can be paid to the team member on the top of the hierarchy is passed as the input. A junior will get half the amount of the allowance of his/her senior if two juniors are under the senior. Else the junior will get the same amount as allowance as the senior. Fill in the missing lines of code to complete the implementation for the function find Min Allowance so that it returns the least possible allowance paid to a team member.

Note:

- currNode which is passed as the argument is the root node of the binary tree.
- networth is the allowance amount receivable by the team member represented by the currNode
- currMinAllowance is the currently payable minimum allowance amount to an team member at currNode

The struct Node is as given below (Here data is not needed for calculation but represents a positive integer)

```
struct Node
 {
int data;
struct Node "left, "right;
 };
```

You can create and implement additional functions (methods) as per your requirement

Boundary Condition(s):

1 <= Value of a Node <= 1000

7. Fill in the missing lines of code to complete the implementation for the function mirror so that it mirrors the given binary tree

Note:

Current Node which is passed as the argument is the root node of the binary tree. The struct Node is as given below

The struct Node is as given below.

```
struct Node
{
int data;
struct Node *left, *right;
};
```

You can create and implement additional functions (methods) as per your requirement.

Boundary Condition(s):

1 <= Value of a Node <= 1000

8. The program must accept a string S as the input. The program must print the first occurring vowel in the string S as the output. If there is no vowel in the string S then the program must print -1 as the output.

Boundary Condition(s):

1 <= Length of S <= 1000

9. The program must accept two string values S1 (may contain space) and S2 (one word) as the input. The words in S1 are sortedlexicographically and separated by exactly one space. The program must insert the the string 52 in S1 such that all the words inthe modified $1 are also in sorted order.

Note: The string values contain only lower case alphabets

Boundary Condition(s):

1 <= Length of S1 <= 1000,1 <= Length of S2 <= 100

10. A maze is given as an NxN matrix containing only 0s and 1s. In the maze matrix, 0 represents a blocked cell and 1 represents an open cell. The program must accept the maze matrix of size NxN as the input. There are a rabbit and a carrot inside the maze whose positions R(x, y) and C(x, y) are also passed as input to the program. The rabbit can move inside the maze based on the following condition.

The rabbit can move along any row or column in any direction until it reaches the edge of the maze or a blocked cell.

The program must print the minimum number of straight-line traversals T along a row or a column required for the rabbit to reach the carrot as the output.

Note: The maze matrix is always having at least a path from the rabbit to the carrot.

Boundary Condition(s):

1 <= N <= 100

TOTAL: 30 PERIODS

REFERENCES

1. https://skillrack.com/faces/candidate/codeprogram.xhtml

2. https://www.geeksforgeeks.org/blogs/how-to-approach-a-coding-problem/

3. https://leetcode.com/

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROGRAMMING SKILLS - I		**Course code: 24HS5L1**	
CO	**COURSE OUTCOMES**	**EXPT**	**K- CO**
CO1	Use stack, queue, heap, and binary tree operations in solving structured problems.	1,2,3,4	K3
CO2	Apply efficient algorithms to searching, sorting, and traversal problems.	5	K3
CO3	Analyze computational complexity of algorithms and optimize program performance.	6	K4
CO4	Evaluate different problem-solving approaches and select the most suitable data structure or algorithm	9	K5
CO5	Design and develop programs that integrate multiple data structures to solve real- world and competitive programming challenges.	7,8	K6

24EC601	ANTENNA AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give insight of the radiation phenomena and antenna fundamentals.
- To give a thorough understanding of radiation characteristics of different types of antenna arrays.
- To analyze the antenna characteristics and working principles of various types of apertures antenna and antenna measurement methods.
- To be aware of various types of antenna wireless application particularly patch antenna.
- To create awareness about the radio wave propagation in the atmosphere.

UNIT – I ANTENNA FUNDAMENTALS 9

Definition of antenna - Need of an antenna - Antenna parameters: Gain, Directivity, Effective aperture, Radiation Resistance, Radiation pattern, Band width, Beam width, Input Impedance - retarded vector potential - Dipole and mono pole - Power radiated and radiation resistance (Rr) of a half wave dipole.

UNIT – II ANTENNA ARRAYS 9

Definition of antenna array - Need of an antenna array - Broad side array - End fire array - collinear array - Binomial array - Pattern multiplication – Array of two point sources with equal amplitude and equal phase - Equal amplitude and opposite phase, Yagi Uda Antenna, Log periodic Dipole Array.

UNIT - III APERTURE ANTENNAS AND ANTENNA MEASUREMENT 9

Huygens's principle - Horn Antenna: types and application - Reflector Antenna: Parabolic dish antenna - Aperture blockage - Feeding structures.

Antenna measurement technique: Near-Field and Far-Field, Measurement Ranges: Elevated Ranges, Ground-Reflection Ranges, Anechoic Chambers and Absorbing Materials, Anechoic Chamber Types. Compact Antenna Test Ranges, Near-Field Ranges, Gain and Radiation pattern measurement.

UNIT - IV ANTENNAS FOR WIRELESS APPLICATIONS 9

Antennas for mobile communication systems: Base station antennas, mobile station antennas. Antennas for handheld devices – External and internal antennas,

Microstrip Patch antenna: Basic characteristics, Feeding methods, Rectangular patch antenna: Transmission line model, Fringing effects, Design of rectangular patch antenna. Circular patch antenna: Resonant frequency, Design of Circular patch antenna.

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

TEXT BOOKS:

1. John D. Kraus, Ronald J. Marhefka and Ahamed S. Khan, "Antennas and wave propagation", Mc Graw Hill Education (India) Private limited, Fifth Edition, 2018.
2. Costantine A. Balanis, "Antenna Theory Analysis and Design, Wiley Publication, Third Edition, 2016.

REFERENCES:

1. S. Drabowitch, “Modern Antennas”, Springer Publications, Second Edition, 2010.
2. K.D. Prasad, “Antennas and Wave Propagation”, Sathya Prakashan, 2009
3. Edward C. Jordan and Keith G.Balmain, “Electromagnetic Waves and Radiating Systems”, Pearson Education, Second Edition, 2015.
4. R.E. Collin, “Antennas and Radiowave Propagation”, Mc Graw Hill, Fourth Edition, 1985.
5. H.Sizun, “Radio Wave Propagation for Telecommunication Applications”, Springer Publications, First Indian Reprint, 2007.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ANTENNA AND WAVE PROPAGATION		**Course code: 24EC601**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the behavior of antenna in terms of its parameter.	I	K2
CO2	Describe the need and mathematically derive the equations for antenna arrays.	II	K3
CO3	Classify microwave antennas and various antenna measurement techniques.	III	K3
CO4	Illustrate types of antennas for wireless applications and design of patch antenna.	IV	K3
CO5	Identify various factors involved in the propagation of radio waves.	V	K3

24EC602	STANDARDS IN ELECTRONICS AND COMMUNICATION ENGINEERING	L	T	P	C
		1	0	0	1

OBJECTIVES:

- To understand the need for standards.
- To be exposed to both National & International standards and Regulations.

UNIT–I INTRODUCTION TO STANDARDS **6**

Definition, Need and importance of standards- Types of engineering standards- Standardization process and life cycles-Bureau of Indian standards: Objectives-roles-functions- BIS act- Rules and Regulations-International Organization for Standardization(ISO)- International Electro technical Commission (IEC)-IEEE-ITU-World Trade Organization(WTO) Good Practices for standardization

UNIT - II NATIONAL, INTERNATIONAL STANDARDS & TECHNICAL REGULATIONS **9**

Communication standards: IEEE 802.3-IEEE 802.11-IEEE 802.15.1- 3GPP-ITU **Networking & Internet Standards**: Internet Engineering Task Force- IEEE-World Wide Web Consortium (W3C)-Internet society (ISOC)-TCP/IP-IPv6-HTTP/HTTPS- Domain Name system(DNS)-Simple Mail Transmission Protocol(SMTP)-**Embedded systems Standards**: PCI SIG- JEDEC(Global standards for micro electronics industries)-DRC& LVS –CAN, **IoT protocols**-MQTT, LoRaWAN-**EMC**: CISPR-ISO9001- ISO 14001-IEC-**Image and signal Processing**-JPEG, MPEG, PNG, GIF,BMP-VLSI-IEEE 1364-Marking and Certification of articles - ISI Mark -BIS Conformity Assessment Regulation 2018

TOTAL:15 PERIODS

TEXTBOOKS:

1. Owen R.Greulich and MaanH.Jawad, “Primer on Engineering Standards”, Wiley, ASME Press 2018.
2. Dr.Manju, R,P.Devi, R.Sarath et.al, “ Introduction to standards in Electronics and Communication”

REFERENCES:

1. Paul Horowitz & Winfield Hill, “The Art of Electronics”, Cambridge University Press, 3rd Edition, 2015.
2. Annabel Z. Dodd, “The Essential Guide to Telecommunications”, Pearson,6th edition, 2019
3. Miroslav Popovic, “Communication Protocol Engineering”, CRC Press, 2018
4. Wei Jiang,Bin Han, “CellularCommunication Networks and Standards: The Evolution from 1G to 6G”, springer,2024

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : STANDARDS IN ELECTRONICS AND COMMUNICATION ENGINEERING		**Course code: 24EC602**
CO	**COURSE OUTCOMES**	**K- CO**
CO1	Explain the basic concepts, need, and types of Engineering standards.	K2
CO2	Describe the roles of BIS, ISO, IEC, IEEE, ITU, and WTO in standardization.	K2
CO3	Apply communication and networking standards in engineering applications.	K3
CO4	Apply Embedded system, IoT and VLSI standards in Electronic systems.	K3
CO5	Analyze technical regulations, certification processes, and quality standards used in Engineering.	K4

24MC601	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	--

OBJECTIVES:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

UNIT – I INTRODUCTION 6

Disaster: Definition, Factors and Significance, Difference between Hazard and Disaster.
Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT – II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches.

Man-made Disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Out breaks of Disease and Epidemics, War and Conflicts.

UNIT – III DISASTER PRONE AREAS IN INDIA 6

Disaster Prone are as in India: Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference
to Tsunami; Post – Disaster Diseases and Epidemics.

UNIT – IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard.

Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies.

Media Reports: Governmental and Community Preparedness.

UNIT – V RISK ASSESSMENT 6

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co - Operation In Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

TOTAL: 30 PERIODS

REFERENCES:

1. Nishith Rai and A.K. Singh, "Disaster Management in India: Perspectives, Issues and Strategies", New Royal Book Company, 2007.
2. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster Mitigation: Experiences and Reflections", Prentice Hall India Learning Private Limited, 2001.

3. S.L.Goel,"Disaster Administration and Management: Text and Case Studies",Deep & Deep Publication Pvt.Ltd., 2007

24EC603 MACHINE LEARNING FOR COMMUNICATION SYSTEMS

L	T	P	C
2	0	2	3

OBJECTIVES:

- To understand the need for machine learning for various problem solving.
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning.
- To understand the latest trends in machine learning.
- To design appropriate machine learning algorithms for problem solving.

UNIT-I SUPERVISED LEARNING CLASSIFICATION 6

Paradigms of Machine Learning -Examples- Types of Learning - Types of supervised learning - K-Nearest Neighbour Classification - Introduction to Decision Trees - Entropy and Information Gain-boosting and bagging - Perceptron and its learning algorithm.

LAB COMPONENT

1. Build KNN Classification model for a given dataset. Vary the number of k values as follows and compare the results. **6**
2. Implement the standard Decision Tree Class used for classifying data into various classes using a tree-like model of decision.

UNIT-II REGRESSION 6

Introduction to Regression - Linear regression - Geometrical Interpretation - Iterative solution: Gradient descent - Ridge regression - Lasso regression - Performance metrics of machine learning.

LAB COMPONENT

3. Develop and implement a Standard Linear Regression model in Python for predicting the target parameter using the given dataset.
4. Implement the Lasso Regression for the given dataset for predicting the values. **6**

UNIT-III UNSUPERVISED LEARNING 6

K-means Clustering - Llyod's Algorithms - Dimensionality Reduction - Principal Component Analysis (PCA) - covariance matrix - Eigen decomposition.

LAB COMPONENT

6. Write a python program to implement K-Means clustering Algorithm. **6**
7. Implement Dimensionality reduction using Principle component Analysis for a given dataset.

UNIT-IV REINFORCEMENT LEARNING 6

The Reinforcement Learning problem - Types of Reinforcement learning - Bellman Equation - Markov Decision Process - Q learning algorithm - SARSA - Applications.

LAB COMPONENT

8. Implementation of Q-Learning for Optimal Transmission Power Control Using a Communication Dataset **6**

UNIT-V FEDERATED LEARNING 6

Introduction to Federated Learning - Overview of Federated Learning - Distributed Machine

Learning - Data Valuation - Horizontal Federated Learning (HFL) - Vertical Federated Learning (VFL).

LAB COMPONENT

9. Implementation of Horizontal Federated Learning (HFL) using Federated Averaging on a Split Dataset. **6**

TOTAL: 60 PERIODS

TEXTBOOKS:

1. L. Liang, X. Zhang and Y. Shi, “Machine Learning for Wireless Communications and Networking”, Wiley-IEEE Press, 2024.
2. J. Smith, R. Kumar and A. Patel,” Federated Learning: Strategies for Improving Communication Efficiency” Springer, 2023.
3. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press, 2020.

REFERENCES:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, July 2017.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, CRC Press, 2014., 2004.
3. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press,2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MACHINE LEARNING FOR COMMUNICATION SYSTEMS		**Course code: 24EC603**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the classification algorithms like KNN, Decision Tree to classify the dataset.	I	K3
CO2	Identify the category of the learning problem, and measure it’s performance like recall, precision etc.	II	K3
CO3	Apply unsupervised algorithms namely K-means and PCA to cluster the given dataset.	III	K3
CO4	Analyze different types of Reinforcement Learning, including model-based, model-free, Q-learning, and SARSA, and their applications.	IV	K4
CO5	Describe Horizontal Federated Learning (HFL) and Vertical Federated Learning (VFL), including their working principles and practical applications.	V	K4

		L	T	P	C
24EC604	**DIGITAL VLSI DESIGN**	**3**	**0**	**2**	**4**

OBJECTIVES:

- To describe the integrated circuit design process and VLSI circuit design techniques.
- To learn the MOS transistor theory, CMOS processing technology, VLSI design methodologies and various CMOS circuit design techniques.
- Integrated digital systems are designed and simulated throughout the course using VLSI design tools.
- To understand and experience the conventional VLSI design flow, and gain sufficient background for more advanced courses in the field.

UNIT-I INTRODUCTION TO MOS TRANSISTOR **9**

Basic MOS Transistors - IC production process - MOS and CMOS Fabrication processes - PVT Characteristics - Pass Transistor Logic - CMOS Inverter - I-V Characteristics - DC Transfer characteristics - RC Delay Model - Elmore Delay - Logical effort - Scaling – Layout-Design Rules.

LAB COMPONENT

1. Design and simulate an inverter. **6**
2. Design and simulate an AND gate.

UNIT-II SEQUENTIAL CIRCUIT DESIGN **9**

Static latches and Registers - The bistability principle - Multiplexer based latches - Master- slave edge triggered register - Dynamic latches and Registers - Dynamic transmission gate edge triggered register - Clocked CMOS - True single-phase clocked register - Pipelining - Schmitt Trigger - Monostable Sequential Circuits - Astable Sequential Circuits.

LAB COMPONENT

3. Design and simulate counters.

(Pre-Layout and Post-Layout Analysis, Synthesis, Simulation and Layout generation) **6**

UNIT-III DESIGN OF ARITHMETIC BUILDING BLOCKS **9**

Data Paths - Adders - Ripple carry adder - Static adder circuit - Carry Bypass adder - Carry select adder - Carry look ahead adder - Multipliers - partial product generation - Modified Booth recoding - Partial product accumulation - Array multiplier - Carry save multiplier - Wallace tree multiplier - Shifters - ALUs.

LAB COMPONENT

4. Design and Testing of an Adder. **6**
5. Design and Testing of a Multiplier.
6. Design and Testing of an ALU.

(Simulation, Synthesis and Implementation using FPGA design flow)

UNIT-IV ASIC DESIGN FLOW **9**

Introduction of Application Specific Integrated Circuit (ASIC) Design Flow: An overview of Backend VLSI Design Flow — Libraries, Floor-planning, Placement, Routing, Verification, Testing. Specifications and Schematic cell Design, Spice simulation Analysis of analog and digital circuits, Circuit Extraction, Electrical rule check, Layout Vs. Schematic (LVS), Post- layout Simulation and Parasitic extraction, Design format, Timing analysis, Back notation and Post layout simulation,

ASIC design implementation.

LAB COMPONENT

7. Design and Testing of an ALU. **6**

(Simulation, Synthesis and Implementation using Cadence design flow)

UNIT-V FPGA ARCHITECTURE **9**

FPGA Building Block Architectures - Configurable Logic Blocks - LUT based structures - FPGA Interconnect Routing Procedures - Digital clock Managers - Block RAM - Distributed RAM. Case Study: Xilinx Zynq SoC Architecture.

LAB COMPONENT

8. Design and Testing of Memories – RAM **6**

(Simulation, Synthesis and Implementation using FPGA design flow)

TOTAL: 75 PERIODS

TEXTBOOKS:

1. Jan M. Rabaey, Anantha Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: A Design perspective”, Pearson, Second Edition, 2016.
2. Neil H.E. Weste and David Money Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, Pearson, Fourth Edition, 2017.

REFERENCES:

1. Scott Hauck, André DeHon, “Reconfigurable computing: the theory and practice of FPGA-based computation”, Morgan Kaufmann, 2007.
2. Vaibbhav Taraate, “ASIC Design and Synthesis”, Springer, 2021.
3. Jean-Pierre Deschamps, GéRy Jean Antoine Bioul and Gustavo D. Sutter, “Synthesis of Arithmetic Circuits”, A John Wiley & Sons, Inc., Publication, 2006.
4. Khosrow Golshan, “Physical Design Essentials”, Springer, 2007.
5. Stuart Sutherland, “RTL Modeling with System Verilog for Simulation and Synthesis”, Sutherland HDL, Inc., 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL VLSI DESIGN		**Course code: 24EC604**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the detailed analysis of static CMOS inverters & complementary circuit variants such as pseudo-nMOS and XOR/XNOR networks, and make use of Lambda-based design rules to construct and illustrate the layout of simple MOS circuits.	I	K3
CO2	Construct the sequential circuits using CMOS transistors.	II	K3
CO3	Design arithmetic circuits like Adders, Multipliers, Shifter and ALU by using different methods.	III	K3
CO4	Apply the ASIC design flow to design, simulate, verify & implement digital and analog circuits.	IV	K3
CO5	Apply FPGA building block architectures and demonstrate their use in the Xilinx Zynq SoC.	V	K3

		L	T	P	C
24EC6L1	**DESIGN THINKING**	**0**	**0**	**2**	**1**

OBJECTIVES:

- To introduce students to the principles and stages of design thinking.
- To develop problem identification and solution framing skills in ECE domain.
- To encourage creativity, ideation, prototyping, and testing with real-world ECE problems.
- To integrate technical knowledge with human-centered design approaches.
- To build teamwork, communication, and innovation skills through case studies and mini-projects.

UNIT - I Foundation of Learning & Thinking **6**

An Insight to Learning

- Kolb's Learning Cycle & learning styles.
- Assessing & interpreting one's own style.
- Activity: Identify your learning style (quiz/worksheet).

Remembering & Memory

- Memory process: encoding → storage → retrieval.
- Barriers/problems in retention.
- Memory enhancement techniques (mnemonics, spaced repetition, visualization).
- Activity: Try 2 different memory techniques and compare results.

UNIT - II Understanding Human Side of Creativity **6**

Emotions – Experience & Expression

- Emotional awareness & empathy.
- Role of emotions in peer interaction & teamwork.
- Activity: Peer role play to assess empathy.

Being Ingenious & Fixing Problems

- Creative thinking process.
- Problem-solving frameworks.
- Testing creative solutions.
- Activity: Group problem-solving challenge.

UNIT - III Core of Design Thinking **6**

Basics of Design Thinking

- Definition, need & objectives.
- Brainstorming concepts.
- Five Stages (with examples): Empathize, Define, Ideate, Prototype, Test.
- Activity: Mini case study (redesign a classroom experience).

Process of Product Design

- Engineering product design process.
- Design Thinking approach vs. traditional design.
- Best product design examples (Apple, Dyson, Tesla, etc.).
- Assignment: Document a chosen product design process.

UNIT - IV Building & Testing Ideas **6**

Prototyping & Testing

- Rapid prototyping methods (paper models, 3D, digital).
- Testing: collecting user feedback.
- Activity: Create a low-fidelity prototype for a small problem.

Feedback, Re-Design & Re-Create

- Feedback loops.
- Ergonomic challenges & user-focused redesign.
- Final product development → presentation.
- Activity: Iterative redesign project.

UNIT - V Human & Customer Centric Perspective **6**

Celebrating the Difference

- Understanding individual differences & uniqueness.
- Group activities for acceptance & appreciation.
- Activity: Diversity & inclusivity brainstorming session.

Design Thinking & Customer Centricity

- Practical customer challenge examples.
- Mapping customer journey.
- Aligning product design with expectations.
- Activity: Interview real users & present insights.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. E.Balaguruswamy, “Developing Thinking Skills (The way to Success)”, Khanna Publishing House, 2022.
2. Tim Brown, “Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation”, Harper Business, First edition, 2009.
3. Tom, “Harper Collins India Creative Confidence: Unleashing The Creative Potential Within Us All”, William Collins, 2014.

REFERENCES:

1. Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia Business School Publishing, 2011.
2. Hasso Plattner, Christoph Meineland Larry Leifer, “Design Thinking Research: Building Innovators”, Springer, 2016.
3. Karl T. Ulrich, Steven D. Eppinger and Maria C. Yang, “Product Design and Development”, McGraw Hill, Seventh Edition, 2020.
4. Nigel Cross, “Design Thinking: Understanding How Designers Think and Work”, Bloomsbury Publishing India Private Limited, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DESIGN THINKING		**Course code: 24EC6L1**
CO	**COURSE OUTCOMES**	**K- CO**
CO1	Compare and classify the various learning styles and memory techniques and apply them in their engineering education.	K4
CO2	Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products.	K4
CO3	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.	K4
CO4	Analyze real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development.	K4
CO5	Examine individual differences and its impact on everyday decisions and further create a better customer experience.	K4

24HS6L1	PROGRAMMING SKILLS - II	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To Develop logical reasoning and problem-solving ability to break down real-world tasks into structured computational steps.
- To Strengthen programming fundamentals including loops, conditionals, recursion, string manipulation, and mathematical operations.
- To Enhance algorithmic thinking for designing efficient solutions under given boundary conditions and time limits.
- To Promote analytical skills to handle diverse problem domains like number theory, text processing, and data structures.
- To Encourage optimization and performance awareness by working within strict execution time and memory constraints.

Sample problems to be solved

1. A positive integer N is passed as the input. If we print all the numbers from 1 to N continuously, the program must find the number of characters (digits) C printed and print the count C as the output.
2. Given a string S as input which consists of multiple words separated by a space, the program must print the count C of the words which are repeated exactly N times. The comparison of the words is case sensitive.
3. The program must accept the score of N players in a cricket match. The program must print the number of combinations with exactly 4 players and total runs scored by the 4 players is greater than or equal to 100as the output.

   Boundary Condition(s): 4 <= N <= 250
4. Given N numbers, the program must print the first number F of the last non-decreasing subset sequence present.
5. Given a string S with only alphabets, print the alphabet and it's count as shown in the Example
6. The program must accept two integers N and X as the input. The program must print the number of subsets of N divisible by X as the output.

   Boundary Condition(s):1<=N X=10^18
7. A set of space separated integers are passed as the input. The program must replace the alternate duplicate integer values with zero. Then the program must print the revised set of integers as the output.

   Boundary Condition(s):1 <= Each integer value <= 10^5
8. Lalitha has three children. She wants to distribute N candies among all three in such a way that exactly one child gets the maximum number of candies among all three and each child gets at least one candy. The task is to find the total number of ways to distribute the N candies among the three children.

9. The program must accept a string $ as the input. The program must split the given string S into three substrings FRONT, MIDDLE and END based on the following conditions If the length of S is a multiple of 3, then each substring will contain 1/3 characters. If the remainder when the length of 5 is divided by 3 is 1, then the MIDDLE substring will contain that one extra character, If the remainder when the length of 5 is divided by 3 is 2, then each of the FRONT and END substrings will contain that one extra character .Finally, the program must print the three substrings of S as the output
10. The program must accept N integers as the input. The program must print the maximum length of the subset whose sum of integers is a composite integer.

Boundary Condition(s):1<=N<=10,1 <= Each integer value <= 10^5

TOTAL: 30 PERIODS

REFERENCES

1. https://skillrack.com/faces/candidate/codeprogram.xhtml
2. https://www.geeksforgeeks.org/blogs/how-to-approach-a-coding-problem/
3. https://leetcode.com/

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PROGRAMMING SKILLS - II		**Course code: 24HS6L1**
CO	**COURSE OUTCOMES**	**K- CO**
CO1	Design and implement algorithms to solve problems with varying levels of complexity.	K2
CO2	Analyze constraints and select appropriate techniques (brute force, modular arithmetic, etc.)	K4
CO3	Apply logical reasoning to handle edge cases and ensure correctness under all input conditions	K3
CO4	Develop an efficient code for problem requirements into using standard programming constructs. Deduce optimized solutions under strict execution time and memory constraints.	K3
CO5	Design and implement algorithms to solve problems with varying levels of complexity.	K6

24ECV11	ANALOG VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand MOS device physics, modeling, and sub-threshold behavior for analog circuit design.
- To develop fundamental CMOS building blocks such as current sources, mirrors, and voltage/current references.
- To analyze and design CMOS amplifier topologies and operational amplifiers withcompensation techniques.
- To evaluate and apply comparators and other analog sub-circuits for high-performance mixed-signal applications.

MOS Devices and Modeling The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

UNIT-II CMOS BUILDING BLOCKS 9

Analog CMOS Sub-Circuits MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

UNIT-III DIFFERENTIAL AMPLIFIERS 9

CMOS Amplifiers Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

UNIT-IV OPERATIONAL AMPLIFIER 9

CMOS Operational Amplifiers, Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp

UNIT-V COMPARATORS 9

Comparators Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, DiscreteTime Comparators.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits”, 2nd Edition, McGraw Hill Edition2016.
2. Paul. R.Gray& Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley, 5th Edition, 2009.

REFERENCES:

1. T. C. Carusone, D. A. Johns & K. Martin, “Analog Integrated Circuit Design”, 2nd Edition,Wiley, 2012.
2. P.E.Allen&D.R. Holberg, “CMOS Analog Circuit Design”, 3rd Edition, Oxford

University Press, 2011.
3. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition, Wiley, 2010.
4. Recent literature in Analog IC Design.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ANALOG VLSI DESIGN		**Course code: 24ECV11**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Design and know the basic concepts of MOS device physics and MOS models.	I	K4
CO2	Analyze and design current mirrors, voltage and current reference circuits.	II	K4
CO3	Analyze CMOS differential amplifiers and high-gain amplifier architectures for efficient analog circuit design.	III	K4
CO4	Design CMOS operational amplifiers and measurement techniques for performance verification of op amps.	IV	K4
CO5	Design and explain the working principle of various comparators and apply basic techniques to enhance the performance of open-loop comparators.	V	K4

24ECV21	VLSI SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn DSP algorithm representation, pipelining, and parallel processing.
- To understand iteration bounds and retiming techniques.
- To study folding and unfolding for resource optimization.
- To design systolic arrays for parallel computation.
- To apply fast convolution and explore DSP processor features.

UNIT-I DSP SYSTEMS AND ALGORITHMS 9

Introduction to DSP systems: Introduction, Overview of typical DSP Algorithms, Representation of DSP Algorithms: Block Diagrams, Signal-Flow Graph, Data-Flow Graph, Dependence Graph.

Pipelining and parallel processing: Introduction, Pipelining of FIR Digital Filters, Parallel Processing.

UNIT-II ITERATION BOUND AND RETIMING 9

Introduction to Iteration bound, Data-Flow Graph Representations, Loop Bound and Iteration Bound, Algorithms for Computing Iteration Bound, Iteration Bound of Multirate Data-Flow Graphs. Introduction to retiming, Definitions and Properties, Solving Systems of Inequalities, Retiming Techniques.

UNIT-III FOLDING AND UNFOLDING 9

Unfolding: Introduction, an Algorithm for Unfolding, Properties of Unfolding, Critical Path, Unfolding and Retiming.**Folding:** Introduction, Folding transformation, Register Minimization Techniques, Register Minimization in Folded Architectures.

UNIT-IV SYSTOLIC ARCHITECTURE DESIGN 9

Introduction, systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix-Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations Containing Delays.

UNIT-V CONVOLUTION AND DIGITAL SIGNAL PROCESSORS 9

Fast Convolution: Cook-Toom Algorithm, Winograd Algorithm, Iterated Convolution and Cyclic Convolution. Programmable Digital Signal Processors: Introduction, Evolution of Programmable Digital Signal Processors, Features of DSP Processors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Keshab K. Parhi, VLSI Digital signal processing systems, design and implementation, Wiley, Inter Science, 1999.

REFERENCES:

1. Mohammad Isamail and Terri Fiez, Analog VLSI signal and information processing, McGraw Hill, 1994
2. S.Y. Kung, H.J. White House, T. Kailath, VLSI and Modern Signal Processing, Prentice Hall, 1985.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VLSI SIGNAL PROCESSING		**Course code: 24ECV21**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain DSP algorithms, its DFG representation, pipelining and parallel processing approaches.	I	K2
CO2	Illustrate iteration bound, retiming techniques.	II	K3
CO3	Develop the folding and unfolding algorithms.	III	K3
CO4	Model the systolic architecture design.	IV	K3
CO5	Illustrate different convolution techniques and features of DSP Processors.	V	K3

24ECV31 PHYSICAL DESIGN FOR VLSI CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts and techniques involved in VLSI physical design, including floorplanning, placement, routing, and timing analysis.
- To apply various algorithms to partition circuits and optimize floorplanning.
- To implement placement strategies to minimize wirelength and maximize performance.
- To design efficient routing and clock distribution using various algorithms.

UNIT-I VLSI PHYSICAL DESIGN 9

VLSI design cycle, new trends in VLSI design cycle, Physical design cycle, Design styles, System packing styles- Die packing and attachment styles

UNIT-II LAYOUT COMPACTION 9

Standard cell layout, Layout compaction, Design rules, symbolic layout, problem formulation, Algorithms for constraint-graph compaction.

UNIT-III GLOBAL PLACEMENT 9

Design style placement problems; Classification of placement algorithms, Simulation based placement algorithms and Partitioning based placement algorithms. Timing-driven placement.

UNIT-IV GLOBAL ROUTING 9

Design Style specific global routing problems, classification of global routing algorithms, Maze routing algorithms, Line-Probe algorithms. Via Minimization- Constrained and unconstrained via minimizations.

UNIT-V CELL ROUTING 9

Single layer and two-layer routing, Clock Routing: clocking schemes, Design consideration for the clocking systems, problem formulation, Clock routing algorithms, Skew and delay reduction by pin assignment, multiple clock routing. Power Routing, Compaction algorithms- Design style specific compaction problem, classification of compaction algorithms, one-dimension compaction.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. H. Gerez, Algorithms for VLSI Design Automation, WILEY student edition, John wiley& Sons (Asia) Pvt. Ltd. 1999.
2. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Springer International Edition 3 rd edition, 2005

REFERENCES:

1. Sadiq M. Sait, and Habib Youssef, “VLSI physical design automation: theory and practice”, Vol. 6. World Scientific.
2. Hill &Peterson, Computer Aided Logical Design with Emphasis on VLSI, John Wiley,1993
3. Wayne Wolf, Modern VLSI Design: Systems on silicon, Pearson Education Asia, 2nd Edition,1998.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PHYSICAL DESIGN FOR VLSI CIRCUITS		**Course code: 24ECV31**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Illustrate and explain different VLSI design styles, including their respective challenges and notation	I	K3
CO2	Demonstrate Layout compaction and Design rules	II	K3
CO3	Develop and enhance the existing algorithms and computational techniques for Physical design	III	K3
CO4	Illustrate new trends in global routing algorithms	IV	K3
CO5	Develop efficient routing schemes using various algorithms to ensure signal integrity and minimize delays	V	K3

24ECV41 SYSTEM ON CHIP DESIGN

L	T	P	C
2	0	2	3

OBJECTIVES:

- To design, optimize, and program a modern System-on-a-Chip.
- To decompose the task into parallel components that cooperate to solve the problem.
- To characterize and develop real-time solutions.
- To implement both hardware and software solutions, and perform hardware/software co-design.
- To understand and estimate key design metrics and requirements.

UNIT - I INTRODUCTION TO THE SYSTEM APPROACH **6**

System Architecture – Components of the system – Hardware and Software – Processor Architectures – Memory and Addressing – System level interconnection – An approach for SOC Design – System Architecture and Complexity.

LAB COMPONENT

1. Installation of GEM 5 software.
2. Demonstration of GEM 5 software. **6**

UNIT - II PROCESSORS **6**

Introduction – Processor Selection for SOC – Basic concepts in Processor Architecture – Basic concepts in Processor Micro Architecture – Basic elements in Instruction handling – Buffers – minimizing Pipeline Delays – Branches – More Robust Processors – Vector Processors and Vector Instructions extensions – VLIW Processors – Superscalar Processors.

LAB COMPONENT

1. Design of a data processing system architecture. **6**

UNIT - III MEMORY DESIGN FOR SOC **6**

Overview of SOC external memory – Internal Memory – Size – Scratchpads and Cache memory – Cache Organization – Cache data – Write Policies – Strategies for line replacement at miss time – Types of Cache – Split – I, and D – Caches – Multilevel Caches – Virtual to real translation – SOC Memory System – Models of Simple Processor – memory interaction.

LAB COMPONENT

2. Design of a SOC memory system and pipelining set-up. **6**

UNIT - IV INTERCONNECT CUSTOMIZATION AND CONFIGURATION **6**

Inter Connect Architectures – Basic Bus Architectures – SOC Standard Buses – Analytic Bus Models – Using the Bus model – Effects of Bus transactions and contention time – Overview of SOC Customization – Customizing Instruction Processor – Reconfiguration Technologies – Mapping design onto Reconfigurable devices – Instance Specific design – Customizable Soft Processor – Overhead analysis on Reconfiguration – trade-off analysis on reconfigurable Parallelism.

LAB COMPONENT

3. Design of a SOC bus system and pipelining set-up. **6**

UNIT - V APPLICATION STUDIES / CASE STUDIES **6**

SOC Design approach – AES algorithms: Design and evaluation - Image compression: JPEG compression.

LAB COMPONENT

4. Implementation of AES algorithm in the SOC. **6**

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”, Wiley India Pvt. Ltd., First Edition, 2011.
2. Steve Furber, “ARM System on Chip Architecture”, Addison-Wesley, Second Edition, 2000.

REFERENCES:

1. Ricardo Reis and Jochen A.G. Jess, “Design of System on a Chip: Devices and Components”, Springer, First Edition, 2004.
2. Jason Andrews, “Co-Verification of Hardware and Software for ARM SoC Design”, Newnes, Pap/Cdr Edition, 2004.
3. Peter Marwedel, “Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems”, Springer, Second Edition, 2011.
4. Michael Keating, “The Simple Art of SoC Design: Closing the Gap between RTL and ESL”, Springer, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SYSTEM ON CHIP DESIGN		**Course code: 24ECV41**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply system approach concepts to analyze processor architectures, memory, interconnections, and SoC design. (K3)	I	K3
CO2	Apply the concepts of processor architectures and micro-architectures to analyze instruction handling, pipeline optimization, and advanced processor designs in SoC. (K3)	II	K3
CO3	Apply memory system concepts in SoC by analyzing cache organization, memory hierarchy, and processor–memory interactions. (K3)	III	K3
CO4	Apply interconnect and reconfiguration concepts to analyze bus architectures, customization, and design trade-offs in SoC. (K3)	IV	K3
CO5	Apply SoC design approaches to implement and evaluate AES algorithms and JPEG image compression. (K3)	V	K3

24ECV51	NETWORK ON CHIP DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the relationship between semiconductor technology, computer architecture and computer networking in the design of the communication network for a MPSoC or a many-core design.
- To learn the basic concepts of Network-on-Chip design by studying the topologies, router design and MPSoC styles.
- To learn sample routing algorithms on a NoC with deadlock and live lock avoidance.
- To understand the role of system-level design and performance metrics in choosing a NoC design.

UNIT - I INTRODUCTION TO NOC **9**

Introduction to NOC - OSI layer rules in NOC - Interconnection networks in Network-on-Chip Network topologies - Switching techniques - Routing strategies - Flow control protocol quality-of-service support.

UNIT - II ARCHITECTURE DESIGN **9**

Switching techniques and packet format - Asynchronous FIFO design - GALS style of communication - Wormhole router architecture design - VC router architecture design - Adaptive router architecture design.

UNIT - III ROUTING ALGORITHM **9**

Packet routing - QOS - Congestion control and flow control - Router design - Network link design - Efficient and deadlock-free tree-based multicast routing methods - Path-based multicast routing for 2D and 3D mesh networks - Fault-tolerant routing algorithms - Reliable and adaptive routing algorithms.

UNIT - IV FAULT TOLERANCE OF NOC **9**

Design-security in Networks-on-Chips - Formal verification of communications in Networks-on Chips - Test and fault tolerance for Networks-on-Chip infrastructures - Monitoring services for Networks-on-Chips.

UNIT - V THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP **9**

Three-dimensional Networks-on-Chips architectures - A novel dimensionally-decomposed router for on-Chip communication in 3D architectures - Resource allocation for QoS on-Chip communication - Networks-on-Chip protocols - on-Chip processor traffic modeling for Networks-on-Chip.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Santanu Chattopadhyay and Santanu Kundu, "Network-on-Chip: The Next Generation of System-on-Chip Integration", CRC Press, First Edition, 2014.
2. Maurizio Palesi and Masoud Daneshtalab, "Routing Algorithms in Networks-on-Chip", Springer Nature, 2014.

REFERENCES:

1. Chita R. Das, Chrysostomos Nicopoulos and Vijaykrishnan Narayanan, "Network-on-Chip Architectures: A Holistic Design Exploration", Springer, 2010.
2. Fayez Gebali, Haytham Elmiligi and Mohamed Watheq El-Kharashi, "Networks-on-Chips: Theory and Practice", CRC Press, First Edition, 2017.
3. Konstantinos Tatas, Kostas Siozios, Dimitrios Soudris and Axel Jantsch, "Designing 2D and 3D Network-on-Chip Architectures", Springer, 2016.
4. Sheng Ma, Libo Huang, Mingche Lai, Wei Shi and Zhiying Wang, "Networks-on-Chip: From Implementations to Programming Paradigms", Morgan Kaufmann, 2014.
5. Fayez Gebali, Haytham Elmiligi and Mohamed Watheq El-Kharashi, "Networks-on-Chips: Theory and Practice", CRC Press, First Edition, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : NETWORK ON CHIP DESIGN		**Course code: 24ECV51**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply NoC concepts to analyze topologies, routing, switching, flow control, and QoS mechanisms.	I	K3
CO2	Apply switching techniques and router architectures to design efficient communication in NoC systems.	II	K3
CO3	Apply routing and flow control techniques to design reliable, congestion-free, and fault-tolerant NoC communication.	III	K3
CO4	Apply design-security, verification, and fault-tolerance techniques to ensure reliable NoC infrastructures.	IV	K3
CO5	Apply 3D NoC architectures, routing, and QoS protocols to optimize on-chip communication.	V	K3

3 0 0 3

OBJECTIVES

- Introduce students to Verilog HDL coding styles and their applications in digital circuit design.
- Provide knowledge of FPGA architectures, technologies, and vendor-specific design considerations.
- Develop the ability to model and design combinational and sequential circuits using Verilog HDL.
- Familiarize students with the design and implementation of state machines and sequential circuit design methodologies.
- Enable students to design, implement, and interface hardware systems using Xilinx FPGA platforms for real-time applications.

UNIT–I VERILOG HDL CODING STYLES 9

Verilog HDL Coding Style: Lexical Conventions - Ports and Modules – Operators - Gate Level Modeling - System Tasks &Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling - Tasks & Functions

UNIT–II OVERVIEW OF FPGA ARCHITECTURESANDTECHNOLOGIES 9

FPGA Architectural options, coarse vs fine grained, vendor specific issues (emphasis on Xilinx FPGA),Anti-fuse, SRAM and EPROM based FPGAs, FPGA logic cells, interconnection network and I/O Pad.

UNIT–III MODELING OF COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Verilog Modelling of Combinational and Sequential Circuits: Behavioral, Data Flow and Structural Realization–Adders–Multipliers-Comparators-Flip Flops-Realization of Shift Register- Realization of a Counter- Synchronous and Asynchronous FIFO –Single port and Dual port RAM – Pseudo Random LFSR – Cyclic Redundancy Check

UNIT–IV VERILOG HDL MODELING OF SEQUENTIAL CIRCUIT DESIGN AND STATE MACHINES 9

Synchronous Sequential Circuit: State diagram-state table –state assignment-choice of flip- flops – Timing diagram –One hot encoding Mealy and Moore state machines – Design of serial adder using Mealy and Moore state machines - State minimization – Sequence detection- Design examples: Sequence detector, Serial adder, Vending machine using One Hot Controller.

UNIT– V SYSTEM DESIGN AND HARDWARE INTERFACING WITH XILINX FPGAS 9

System Design Examples using Xilinx FPGAs–Traffic light Controller, RealTime Clock- Interfacing using FPGA: VGA, Keyboard, LCD, Embedded Processor Hardware Design.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Wayne Wolf, “FPGA Based System Design”, Prentices Hall Modern Semiconductor Design Series
2. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis” Prentice Hall, Second Edition, 2003

REFERENCES:

1. M.J.S. Smith, “Application Specific IntegratedCircuits”, Pearson,2000.
2. PeterAshenden, “DigitalDesignusingVHDL”, Elsevier,2007.
3. CliveMaxfield, “The DesignWarriors’sGuidetoFPGAs”, Elsevier, 2004
4. T.R. Padmanabhan, B.Bala Tripura Sundari, “Design through Verilog HDL” Wiley Interscience, 2004. S. Ramachandran, “Digital VLSI System Design: A Design Manual for implementation of Projects on FPGAs and ASICs Using Verilog” Springer Publication, 2007.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FPGA BASED SYSTEM DESIGN		**Course code: 24ECV61**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain Verilog HDL coding styles	I	K2
CO2	Apply FPGA architecture technologies to design and implement a suitable FPGA-based system.	II	K3
CO3	Model Combinational and sequential digital circuits by Verilog HDL	III	K4
CO4	Design and model digital circuits with Verilog HDL at behavioural, structural, and RTL Levels	IV	K4
CO5	Implementation of the combinational and sequential digital circuits in FPGA	V	K4

24ECV71	**MULTI-CORE PROGRAMMING**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

OBJECTIVES:

- To understand the need for multi-core processors and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms.
- To develop multicore programs and design parallel solutions

UNIT- I MULTI-CORE PROCESSORS 6

Single core to multi-core architectures–SIMD and MIMD systems–Interconnection networks–Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design

LABCOMPONENT 6

1. Controlling the Number of Threads on Multiple Nesting Levels

UNIT-II PARALLEL PROGRAM CHALLENGES 6

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes,locks,semaphores,barriers)–deadlocks and livelocks–communication between threads(condition variables,signals, message queues and pipes).

LABCOMPONENT 6

2. Create a program that computes a simple matrix vector multiplication b=Ax,InC/C++. Use Open MP directives to make it run in parallel.

UNIT-III SHARED MEMORY PROGRAMMING WITH OPEN MP 6

Open MP Execution Model – Memory Model– Open MP Directives–Work- sharing Constructs– Library functions–Handling Data and Functional Parallelism–Handling Loops–Performance Considerations

LABCOMPONENT 6

3. Create a program that computes the sum of all the elements in an array A in C/C.

UNIT-IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 6

MPI program execution–MPI constructs–libraries–MPI send and receive–Point-to-point and Collective communication–MPI derived data types–Performance evaluation.

LABCOMPONENT 6

4. Implement a parallel version of the Jacobi algorithm using Open MP.

UNIT-V PARALLEL PROGRAM DEVELOPMENT 6

Casestudies: n-Bodysolvers–Tree Search–Open MP and MP Implementations and comparison.

LABCOMPONENT 6

5. Create a program that computes the adjusted prefix sumbelow for 4 different arrays and after that adds all of them up. Use OpenMP directivesto make it run in parallel.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Thomas Rauber and Gudula Rünger,“Parallel Programming”,Springer Berlin,Heidelberg, 2013.
2. Darryl Gove,“Multicore Application Programming for Windows, Linux and Oracle Solaris”, Pearson, 2011.

REFERENCES:

1. Michael Quinn,“Parallel programming in C with MPI and OpenMP”,McGraw-Hill Education, 2003.
2. Victor Alessandrini, “Shared Memory Application Programming: Concepts and Strategies in Multicore Application Programming”, Morgan Kaufmann, First Edition, 2015.
3. Yan Solihin, “Fundamentals of Parallel Multicore Architecture”, Chapman and Hall/CRC, First Edition, 2015.
4. Peters. Pacheco, “An Introduction to Parallel Programming”,Morgan-Kauffman/Elsevier, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MULTI-CORE PROGRAMMING		**Course code: 24ECV71**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Describe multicore architectures and identify their Characteristics and challenges	I	K2
CO2	Determine the issues in programming Parallel Processors.	II	K3
CO3	Develop the programs using Open MP.	III	K4
CO4	Develop the programs for data-level parallelism and thread- level parallelism	IV	K4
CO5	Design the parallel programming solutions to common problems	V	K4

24ECV12 MIMO AND MULTI CARRIER SYSTEM L T P C

3 0 0 3

OBJECTIVES:

1. To understand the fundamentals of MIMO wireless communication
2. Toapply diversity schemes and to understand Space Time coding techniques.
3. To study the importance of OFDM and PAPR reduction
4. To understand the Multiuser MIMO.

UNIT-I MIMO WIRELESS COMMUNICATION 9

Introduction MIMO wireless communication-MIMO system model-MIMO Zero forcing receiver-MIMO- MMSE receiver-Singular value decomposition (SVD) of the MIMO channel-Alamouti and Space-Time Codes-Non-linear MIMO receiver

UNIT-II ANTENNA DIVERSITY AND SPACE TIME CODING TECHNIQUES 9

Antenna Diversity: Transmit & Receive Diversity- Space Time Coding Overview: System model-Pairwise error probability- Space Time code design- Space Time Block Code: Alamouti space time code- Generalization of space time block coding-Decoding for space time block codes-Space time trellis codes.

UNIT-III OFDM 9

Single carrier transmission-Multi carrier Transmission- Basic Principles of OFDM: Modulation and demodulation-OFDM Guard interval- OFDM Guard band- BER of OFDM Scheme-Water filling algorithm for Frequency Domain Link adaptation-Coded OFDM-Multiple access extensions of OFDM (OFDMA)- Duplexing.

UNIT-IV PAPR REDUCTION 9

Introduction to PAPR: Definition- Distribution of OFDM signal- PAPR and oversampling-Clipping and SQNR- PAPR reduction Techniques: Clipping and filtering-PAPR reduction code-Selective mapping-Partial transmit sequence-Tone reservation-Tone injection-DFT spreading.

UNIT-V MULTIUSER MIMO 9

Mathematical model for multiuser MIMO system- Channel capacity of Multiuser MIMO system: capacity of MAC- capacity of BC-Transmission methods for broadcast channel: Channel Inversion-Block diagonalization-Dirty Paper coding-Tomlinson-Harashima precoding- Space Division Multiple Access system.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Aditya.K.Jegannathan, "Principles of Modern wireless communication systems- Theory and Practice",Mc.Graw Hill Education(India) private Limited, 2016
2. Y-Cho,J.Kim,W.Y.Yang,C.G.Kang, "MIMO- OFDM Wireless communication with MATLAB", IEEE Press,2010.

REFERENCES:

1. Ahamed R.S. Bahai, Burton R.Saltzberg, Mustafa Ergen "Multi Carrier Digital Communications Theory and Applications of OFDM", Springer, 2004
2. David Tse, Pramod, Viswanath, "Fundamentals of Wireless Communication", Cambridge

University Press,2005.
3. Jerry R Hampton, “Introduction to MIMO Communications”, Cambridge University Press,2014
4. Tzi-Dar Chiueh Pei-Yun Tsai, “OFDM Baseband Receiver Design for wireless communication”, John Wiley, 2007.

OUTCOMES:

THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MIMO AND MULTI CARRIER SYSTEMS		**Course code: 24ECV12**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Design wireless communication receiver for the given MIMO system model	I	K4
CO2	Explain the diversity schemes for MIMO systems.	II	K2
CO3	Apply the principles of single-carrier and multi-carrier transmission to analyze different communication scenarios	III	K3
CO4	Apply signal processing techniques to reduce PAPR	IV	K3
CO5	Apply the various techniques to mitigate the effect of Multiple users in MIMO technology.	V	K3

24ECV22	**ADVANCED WIRELESS COMMUNICATION TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand the evolving paradigm of cooperative communication and green wireless communication
- To enable the student to understand the different power saving strategies and energy efficient signal, system and network design.
- To expose the student to the energy saving techniques adopted in existing wireless components
- To provide understanding on protocols and networks related to green future wireless communication technologies.

UNIT-I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes.

UNIT-II COOPERATIVE TECHNIQUES 9

Cooperative techniques for energy efficiency, Cooperative base station techniques for cellular wireless networks; Turbo base stations; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced, Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT-III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks.

UNIT-IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment, Cooperative multi cell processing techniques for energy-efficient cellular wireless communications.

UNIT-V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava , “Cooperative Cellular Wireless Networks”,Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “Green Communication Networks”, Cambridge University Press, 2012.

REFERENCES:

1. Richard Yu, Yu, Zhang and Victor C. M. Leung “Green Communications and Networking”, CRC press, 2012.
2. FRamjee Prasad and Shingo Ohmori, Dina Simunic, “Towards Green ICT”, River Publishers,2010.
3. Jinsong Wu, SundeepRangan and Honggang Zhang, “Green Communications: Theoretical Fundamentals, Algorithms and Applications”, CRC Press, 2012.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ADVANCED WIRELESS COMMUNICATION TECHNIQUES		**Course code: 24ECV22**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the design aspects of cooperative communication	I	K3
CO2	Discuss the necessity and the design aspects of green wireless communication	II	K2
CO3	Use new techniques in wireless communication	III	K3
CO4	Demonstrate the feasibility of using mathematical models using simulation tools.	IV	K3
CO5	Demonstrate the impact of the green engineering solutions in a global, economic, environmental and societal context	V	K3

24ECV32	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution, benefits, and architecture of Software Defined Radio, including hardware, software, and modular interfaces.
- To learn the principles, functions, and architectural design of Cognitive Radios built on SDR platforms
- To study spectrum sensing techniques, detection methods, and trade-offs in spectrum opportunity identification
- To analyze cognitive behaviors, spectrum sharing strategies, and theoretical limits of interference management
- To explore cooperative communication techniques, relay channels, and multihop networks in cognitive radio systems

UNIT-I SOFTWARE DEFINED RADIO AND ITS ARCHITECTURE 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications. Essential functions of the software radio, SDR, hardware architecture, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT-II COGNITIVE RADIOS AND ITS ARCHITECTURE 9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture

UNIT-III SPECTRUM SENSING AND IDENTIFICATION 9

Primary Signal Detection: Energy Detector, Cyclostationary Feature Detector, Matched Filter ,Cooperative Sensing , Definition and Implications of Spectrum Opportunity, Spectrum Opportunity Detection , Fundamental Trade-offs: Sensing Accuracy versus Sensing Overhead.

UNIT-IV INFORMATION THEORETICAL LIMITS ON CR NETWORKS 9

Types of Cognitive Behavior, Interference-Avoiding Behavior: Spectrum Interweave, Interference-Controlled Behavior: Spectrum Underlay, Underlay in Small Networks: Achievable Rates, Underlay in Large Networks: Scaling Laws, Interference-Mitigating Behavior: Spectrum Overlay, Opportunistic Interference Cancellation

UNIT-V USER COOPERATIVE COMMUNICATIONS 9

User Cooperation and Cognitive Systems , Relay Channels: General Three-Node Relay Channel, Wireless Relay Channel , User Cooperation in Wireless Networks: Two-User Cooperative Network, Cooperative Wireless Network , Multi hop Relay Channel

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Alexander M. Wyglinski, MaziarNekovee, And Y. Thomas Hou, “Cognitive Radio Communications and Networks - Principles And Practice”, Elsevier Inc. , 2010.
2. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons, Ltd, 2009.

REFERENCES:

1. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, “Cognitive Radio Networks - From Theory to Practice”, Springer Series, Analog Circuits and Signal Processing, 2009.
2. Mitola, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology, thesis, Royal Inst. Technology, Sweden 2000.
3. Simon Haykin, “Cognitive Radio: Brain –empowered wireless communications”, IEEE Journal on selected areas in communications, Feb 2005.
4. F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, ShantidevMohanty, “Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks”, May 2006

OUTCOMES:

THE END OF THE COURSE, LEARNERS WILL BE ABLE TO

Course Name : COGNITIVE RADIO NETWORKS		**Course code: 24ECV32**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the basics of SDR and cognitive radio	I	K3
CO2	Use the architecture of cognitive radio and SDR	II	K3
CO3	Explain spectrum sensing and dynamic spectrum access	III	K2
CO4	Apply the concept of cognitive radio in wireless networks for capacity enhancements	IV	K3
CO5	Apply the cooperative communication in CR system	V	K3 K3

24ECV42 **OPTICAL WIRELESS COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the fundamentals of optical wireless communication
- To Explore modulation techniques for OWC systems
- To analyze free space optical (fso) link performance under turbulence
- To Understand and apply diversity techniques for outdoor OWC systems
- To Study visible light communication (VLC) systems and applications

UNIT-I OPTICAL WIRELESS COMMUNICATION SYSTEMS 9

Introduction – Indoor Optical Wireless Communication Channel : LOS & Non-LOS Propagation Model Ceiling Bounce Model - Artificial Light Interference - Outdoor Channel : Atmospheric Channel Loss, Fog and Visibility, Beam Divergence, Optical and Window Loss, Pointing Loss , Atmospheric Turbulence effects.

UNIT-II MODULATION TECHNIQUES 9

Analogue Intensity Modulation - Digital Baseband Modulation Techniques - Pulse Position Modulation and Variants - Pulse Interval Modulation - Dual-Header PIM (DH-PIM) - Comparisons of Baseband Modulation Schemes - Subcarrier Intensity Modulation - Orthogonal Frequency Division Multiplexing - Optical Polarization Shift Keying.

UNIT-III FSO LINK PERFORMANCE UNDER TURBULENCE 9

On–Off Keying Performance in Poisson and Gaussian Atmospheric Optical Channel, Pulse Position Modulation, Subcarrier Intensity Modulation : Generation and Detection, SIM-FSO Performance in Log-Normal Atmospheric Channel, BER of SIM-FSO and Outage Probability in Log-Normal Atmospheric Channels - Atmospheric Turbulence-Induced Penalty.

UNIT-IV OUTDOOR OWC LINKS WITH DIVERSITY TECHNIQUES 9

Atmospheric Turbulence Mitigation Techniques - Receiver Diversity in Log-Normal Atmospheric Channels : Maximum Ratio Combining, Equal Gain Combining, Selection Combining, Effect of Received Signal Correlation on Error Performance & Outage Probability – Transmit Diversity & Transmit – Receive Diversity - Terrestrial Free Space Optical Links with Subcarrier Time Diversity – Aperture Averaging.

UNIT-V VISIBLE LIGHT COMMUNICATIONS 9

Introduction - System Description: VLC System Model, SNR Analysis, Channel Delay Spread - System Implementations: Bit Angle Modulation, Pulse Modulation Schemes, PWM with Discrete Multitone Modulation, Multilevel PWM-PPM, PWM with NRZ-OOK - Multiple-Input–Multiple-Output VLC - Home Access Network.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Z. Ghassenlooy, W.Popoola and S. Rajbhandari, “Optical Wireless Communications – System and Channel Modelling with MATLAB”, CRC Press, Taylor & Francis Group, 2013.

REFERENCES:

1. Ivan B. Djordjevic, “Advanced Optical and Wireless Communication Systems”, Springer, 2018.
2. Murat Uysal, Carlo Capsoni, Zabih Ghassemlooy, Anthony Boucouvalas, Eszter dvary,” Optical Wireless Communications, An Emerging Technology”, Springer, 2018

OUTCOMES:
THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : OPTICAL WIRELESS COMMUNICATION		**Course code: 24ECV42**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the characteristics of optical wireless communication systems to analyze suitable communication scenarios	I	K3
CO2	Describe the different modulation techniques involved with OWC systems	II	K3
CO3	Understand and analyze the free space optical link performance	III	K2
CO4	Apply the characteristics of various diversity techniques to select suitable techniques for outdoor optical wireless communication (OWC) systems	IV	K3
CO5	Analyze VLC systems and their modulation techniques for different communication requirements	V	K4

24ECV52	4G AND 5G COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study multi-access edge computing.
- To learn the security features in 5G networks.

UNIT-I EVOLUTION OF WIRELESS NETWORKS **9**

Networks evolution: 2G,3G,4G, evolution of radio access networks,4G data connection establishment, need for 5G. 4G versus 5G, Next Generation core(NG-core), visualized Evolved Packet core(vEPC).

UNIT-II 5G CONCEPTS AND CHALLENGES **9**

Fundamentals of 5G technologies, Characteristics of 5G, overview of 5G core network architecture,5G new radio andcloud technologies, Radio Access Technologies (RATs), EPC for 5G, 5GC internetworking with EPC, Mobility and data connectivity.

UNIT-III NETWORK ARCHITECTURE AND THE PROCESSES **9**

5G architecture and core, network slicing, multi access edge computing(MEC)visualization of 5G components, end-to-end system architecture, service continuity, relation to EPC,and edge computing. 5G protocols: 5G NAS,NGAP, GTP-U, IPSec and GRE.

UNIT-IV MULTI-ACCESS EDGE COMPUTING(MEC) **9**

Need for MEC, MEC architecture, MEC deployment modes, MEC deployment scenarios in 5G network, Integrating MEC with 5G netwoks.

UNIT-V SECURITYIN 5G NETWORKS **9**

Security features in 5G networks, network domain security, Network access security, user domain security, Lawful intercept, flow based QoS framework, QoS parameters and characteristics, mitigating the threats in 5G.

TOTAL: 45 PERIODS

TEXT BOOKS:

1.5G Core networks:Powering Digitalization,Stephen Rommer,Academic Press,2019
2. An Introductionto5GWirelessNetworksTechnology,ConceptsandUsecases,SaroVelrajan,First Edition, 2020.

REFERENCES:

1. 5GSimplified:ABCsofAdvancedMobileCommunicationsJyrki.T.J.Penttinen,Copyrighted Material.
2. 5GsystemDesign:An end to end Perspective,WanLeeAnthony,Springer Publications,2019.

OUTCOMES
THE END OF THE COURSE, LEARNERS WILL BE ABLE TO

Course Name : 4G AND 5G COMMUNICATION NETWORKS		**Course code: 24ECV52**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Describe the evolution of wireless networks.	I	K3
CO2	Demonstrate how 5G technology improves wireless communication and analyze the practical challenges encountered in its deployment	II	K3
CO3	Determine the 5G architecture and its protocol.	III	K3
CO4	Explain multi-access edge computing architecture in 5G networks.	IV	K3
CO5	Identify the security aspects needed for 5G networks.	V	K2

24ECV62	MASSIVE MIMO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of MIMO wireless communication
- To apply diversity schemes and to understand Space Time coding techniques.
- To study the importance of OFDM and PAPR reduction
- To understand the Multiuser MIMO.

UNIT-I INTRODUCTION **9**

Point to Point MIMO-Multiuser MIMO-Massive MIMO: Definition of massive MIMO-Correlated Rayleigh fading-System model for uplink and downlink-Basic Impact of spatial channel correlation-Channel hardening and Favourable propagation-Local scattering Spatial correlation model.

UNIT-II THE MASSIVE MIMO PROPAGATION CHANNEL **9**

Favorable Propagation and Deterministic Channels-Capacity Upper Bound-Distance from Favorable Propagation-Favorable Propagation and Linear Processing-Singular Values and Favorable Propagation, Favorable Propagation and Random Channels-Independent Rayleigh Fading-Uniformly Random Line-of-Sight (UR-LoS)-Independent Rayleigh Fading versus UR-LoS - Finite-Dimensional Channels

UNIT-III SINGLE-CELL SYSTEMS **9**

Uplink Pilots and Channel Estimation - Orthogonal Pilots- De-Spreading of the Received Pilot Signal-MMSE Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission-Linear Precoding - Zero-Forcing - Maximum-Ratio, Discussion Interpretation of the Effective SINR Expressions-Implications for Power Control-Scaling Laws and Upper Bounds on the SINR - Near-Optimality of Linear Processing when M >> K - Net Spectral Efficiency - Limiting Factors: Number of Antennas and Mobility.

UNIT-IV MULTI-CELL SYSTEMS **9**

Uplink Pilots and Channel Estimation, Uplink Data Transmission - Zero-Forcing -Maximum-Ratio, Downlink Data Transmission -Zero-Forcing - Maximum-Ratio, Discussion -Asymptotic Limits with Infinite Numbers of Base Station Antennas - The Effects of Pilot Contamination - Non-Synchronous Pilot Interference.

UNIT-V POWER CONTROL PRINCIPLES **9**

Preliminaries- Power control with Given SINR targets- single cell systems-Multi cell system-Max-min Fairness Power Control: single cell systems- Multi cell systems-Negligible Coherent Interference and full power- **Case study**: single cell deployment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016.
2. Emil Björnson, JakobHoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017.

REFERENCES:

1. Ahamed R.S. Bahai, Burton R.Saltzberg, Mustafa Ergen “Multi Carrier Digital Communications Theory and Applications of OFDM”, Springer, 2004
2. DavidTse, Pramod, Viswanath, “Fundamentals of Wireless Communication”, Cambridge

University Press,2005.
3. Jerry R Hampton, “Introduction to MIMO Communications”, Cambridge University Press,2014
4. Tzi-Dar Chiueh Pei-Yun Tsai, “OFDM Baseband Receiver Design for wireless communication”, John Wiley, 2007.

OUTCOMES:

THE END OF THE COURSE, LEARNERS WILL BE ABLE TO

Course Name : MASSIVE MIMO NETWORKS		**Course code: 24ECV62**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the basic principles of Massive MIMO	I	K2
CO2	Analyze massive MIMO propagation channels and their capacity bounds the diversity schemes for MIMO systems.	II	K4
CO3	Examine channel estimation techniques for single cell systems.	III	K3
CO4	Analyze channel estimation techniques for multi cell systems.	IV	K4
CO5	Apply power control techniques to single-cell and multicell communication systems	V	K3

24ECV72	QUANTUM COMMUNICATION AND INFORMATION THEORY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To present the core mathematical concepts and theory behind the principles of Quantum Communication
- To discuss the working principle behind quantum communication systems
- To study some fundamental limits of quantum communication through classical and quantum channels.

UNIT - I MATHEMATICAL TOOLS 9

Introduction to vector spaces, inner-product spaces, linear independence, basis, Finite dimensional Hilbert spaces, linear operators, projectors, Eigenvalue decomposition, Tensor products; Analysis and probability, limit, infimum, supremum, continuity, compact sets, convexity, dual function, probability distributions.

UNIT - II ELEMENTS OF QUANTUM MECHANICS 9

The notion of qubits, axioms of a closed quantum system, quantum dynamical systems, quantum measurements and POVM

UNIT - III INTRODUCTION TO QUANTUM DECISION THEORY 9

Analysis of a quantum communication system, introduction to the Helstrom decision theory of quantum binary communication systems, decision theory of K-ary Quantum communication systems, Holevo's theorem, constellation of quantum states

UNIT - IV INTRODUCTION TO QUANTUM COMMUNICATION SYSTEMS 9

Introduction to Glauber's representation of coherent quantum states, Quantum binary communication systems and different modulation schemes: OOK, BPSK, QAM, PSK, PPM, overview of quantum squeezed states.

UNIT - V INTRODUCTION TO QUANTUM INFORMATION THEORY 9

Notion of density operators, partial trace, reduced density operator, Schmidt rank, purification of mixed states, entanglement, quantum teleportation. Introduction to classical information theory: Shannon entropy, classical channels and channel coding. Notion of von Neumann entropy, quantum channels, accessible information and Holevo bound, transmission through a noisy quantum channel. Introduction to Quantum Cryptography and Quantum Key Distribution.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Gianfranco Cariolaro, "Quantum Communications", Springer, 2015.
2. Ivan B. Djordjevic, "Quantum Communication, Quantum Networks, and Quantum Sensing", Academic Press, 2022.

REFERENCES:

1. Sumeet Khatri, and Mark M. Wilde,“Principles of Quantum Communication Theory: A Modern Approach”Pre-release version, available freely at https://www.markwilde.com/teaching/2021-fall-qit/.
2. Michael Nielsen and Isaac Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2010.
3. A Pathak,” Elements of Quantum Computation and Quantum Communication”, CRC Press, 2015.

OUTCOMES:

THE END OF THE COURSE, LEARNERS WILL BE ABLE TO

Course Name : QUANTUM COMMUNICATION AND INFORMATION THEORY		**Course code: 24ECV72**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Relate the mathematical tools required for Quantum mechanics.	I	K4
CO2	Identify the fundamental elements in quantum mechanics.	II	K2
CO3	Analyze the basic decision theory applicable for Quantum Communication systems.	III	K3
CO4	Explain the physical quantum systems and their operating principles which can be used for quantum communication.	IV	K3
CO5	Apply quantum information theory in quantum Cryptography.	V	K3

24ECV13 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
2	0	2	3

OBJECTIVES:

- To learn the concepts of stationary and non-stationary random signals and characterization of discrete time random process.
- To estimate power spectral density of random process.
- To derive adaptive filter algorithm.
- To analyze multi rate signal processing.

UNIT-I DISCRETE TIME RANDOM PROCESS **6**

Review of Random Variables: Definitions- Ensemble averages-Jointly distributed random variables-Joint moments-Independent, uncorrelated and orthogonal random variables Review of Random Process: Definitions- Ensemble averages- Gaussian Processes-Stationary processes- Auto covariance and auto correlation matrices- ergodicity - White noise Power spectrum. Filtering of random process-Spectral factorization.

LAB COMPONENT

1. Estimation of statistical parameters for a given random signal **6**
2. Estimation of Auto correlation matrix, Power spectral density, and cross power spectral density.

UNIT-II SPECTRUM ESTIMATION – NON-PARAMETRIC METHODS **6**

Non parametric methods: The periodogram - performance of the periodogram-The modified periodogram-Bartlett's method-Welch's method-Blackman-Tukey approach -Performance comparisons.

LAB COMPONENT

3. Finding PSD using periodogram MATLAB/SCILAB
4. Finding PSD using modified periodogram MATLAB/SCILAB **6**

UNIT-III SPECTRUM ESTIMATION – PARAMETRIC METHODS **6**

Parametric methods: Auto regressive spectrum estimation- BURG method- moving average spectrum estimation-ARMA spectrum estimation. Frequency estimation: Eigen decomposition of the auto correlation matrix.

.

LAB COMPONENT

5. Finding PSD-BURG method for AR model using MATLAB/SCILAB **6**
6. Estimation of frequency using Eigen decomposition MATLAB/SCILAB

UNIT-IV OPTIMUM LINEAR FILTERS **6**

Wiener filters for filtering and prediction: FIR Wiener filter-Orthogonality principle in Linear mean Square estimation-IIR Wiener filter - Non causal wiener filter - Discrete Kalman filter

LAB COMPONENT

7. Finding PSD-BURG method for AR model using MATLAB/SCILAB **6**
8. Signal Separation with Wiener filtering using MATLAB/SCILAB

UNIT-V ADAPTIVE FILTERS **6**

Adaptive Direct Form FIR filter: Minimum Mean square error Criterion- LMS algorithm-RLS algorithm-Applications of adaptive filters: adaptive channel equalization-Adaptive noise cancelling

LAB COMPONENT

9. Adaptive noise cancellation using MATLAB/SCILAB.
10. Adaptive channel equalization of LMS adaptive filter using MATLAB/SCILAB **6**

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Monson H. Hayes, “Statistical Digital signal Processing and Modeling”, Wiley, 2012.
2. John G. Proakis and Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms and Applications”, Pearson Education, Fourth Edition, 2016.

REFERENCES:

1. Vinay K. Ingle and John G. Proakis, “ Digital signal Processing using MATLAB” Cengage Learning, Third Edition,2012.
2. Simon Haykin, “Adaptive Filter Theory”, Pearson Education, Fifth Edition, 2014.
3. Emmanuel C. Ifeacher and Barrie W. Jervis, “DSP-A Practical approach”, Pearson Education ,Second Edition, 2002.
4. S.M .Kay, “Modern Spectral Estimation: Theory & Applications”, PHI, 1999
5. Dr. Shaila D Apte, “Advanced Digital Signal Processing”, Wiley, 2021.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ADVANCED DIGITAL SIGNAL PROCESSING		**Course code: 24ECV13**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the fundamental concept of random process and random variable to derive the statistical parameters while filtering the random process	I	K3
CO2	Compute spectrum estimation using parametric.	II	K3
CO3	Compute prediction error using Wiener filter method.	III	K3
CO4	Explain the LMS algorithm for optimum linear filtering applications.	IV	K2
CO5	Apply adaptive filter algorithms to compute the filter coefficients for the given applications	V	K3

24ECV23	DSP ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basics on Digital Signal Processors
- Programmable DSP‘s Architecture, On-chip Peripherals and Instruction set
- Programming for signal processing applications
- Advanced Programmable DSP Processors

UNIT-I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Introduction to Programmable DSPs, Architectural Features of PDSPs - Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On-chip Peripherals, Applications of Programmable DSPs.

UNIT-II TMS320C5X PROCESSOR 9

Architecture of C5X Processor – Addressing modes – Assembly language Instructions – Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK On-board peripherals, Application Programs for processing real-time signals.

UNIT-III TMS320C6X PROCESSOR 9

Architecture of the C6x Processor - Instruction Set – Addressing modes, Assembler directives, On-chipperipherals, DSP Development System: DSP Starter Kit - Code Composer Studio (CCS)– Support Files – Introduction to AIC23 CODEC and other on-board peripherals, Real-Time Programming Examples for Signals and Noise generation, Frequency analysis, Filter design.

UNIT-IV ADSP PROCESSORS 9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, Fast Fourier Transform (FFT) calculation.

UNIT-V ADVANCED PROCESSORS 9

Study of TI‘s advanced processors - TMS320C674x and TMS320C55x DSPs, ADSP‘s Blackfin and Sigma DSP Processors, NXP‘s DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP, NXP DSP, ST Microelectronics and Analog devices processors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
2. V. Udayashankara, “Modern Digital Signal Processing includes Signals and Systems, MATLAB programs, DSP architecture with Assembly and C programs”, PHI publications, 3rd edition, 2015

REFERENCES:

1. B. Venkataramani and M. Bhaskar, —Digital Signal Processors – Architecture, Programming and Applications‖ – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).
3. User guides Texas Instruments, Analog Devices and NXP

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DSP ARCHITECTURE AND PROGRAMMING		**Course code: 24ECV23**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Discuss the fundamental concepts of Digital signal processors	I	K2
CO2	Analyze the fundamental concepts of architecture, addressing modes, assembly language instructions of TMS320C5X processors.	II	K4
CO3	Analyze the architecture, addressing modes of TMS320CX processors.	III	K4
CO4	Apply the architecture, addressing modes, and assembly language instructions of ADSP processors to solve digital signal processing problems.	IV	K3
CO5	Outline the architecture of different advanced Digital signal processors based on its features	V	K4

24ECV33 DIGITAL IMAGING AND COMPUTER VISION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To become familiar with digital image fundamentals.
- Understand the fundamentals of digital images and video.
- Learn image processing, analysis, and feature extraction techniques.
- Apply computer vision algorithms for object recognition, tracking, and scene understanding.
- Explore real-world applications such as surveillance, autonomous vehicles, and medical imaging

UNIT-I FUNDAMENTALS OF IMAGE PROCESSING 9

Image Representation and Image Processing Paradigm - Elements of digital image processing-Components of Image Processing System -Image model digital image, its representations Sampling and quantization-Relationships between pixels Connectivity, Distance Measures between pixels - Color images-Various image formats – BMP, JPEG, TIFF, PNG, GIF, etc.

UNIT-II IMAGE ENHANCEMENT IN THE SPATIAL AND FREQUENCY DOMAIN 9

Image enhancement by point processing, Image enhancement by neighbourhood processing, Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic and Logic operations, Zooming, Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters Enhancement. Frequency Domain Filtering, Smoothing and Sharpening, Homomorphic Filtering.

UNIT-III IMAGE RESTORATION AND IMAGE COMPRESSION 9

Image Degradation model, Noise Models, Restoration in the presence of Noise Only Spatial Filtering, Estimation of Degradation Function, Inverse filtering, Wiener filtering, Constrained Least Square Filtering. **Image Compression**: Data Redundancies, Image Compression models, Lossless and Lossy compression, Huffman Coding, Shanon-Fano Coding, Arithmetic Coding, LZW Coding, Run Length Coding, Bit Plane Coding.

UNIT-IV IMAGE SEGMENTATION AND MORPHOLOGICAL IMAGE PROCESSING 9

Discontinuity based segmentation, similarity based segmentation, Edge linking and boundary detection, Threshold, Region based Segmentation, Morphological image processing, Dilation, Erosion, Some basic Morphological Algorithms.

UNIT-V COMPUTER VISION TECHNIQUES 9

Introduction to Computer vision, Image Formation: Geometric image formation, Feature extraction and detection, and matching; object detection and tracking, motion estimation, Object Modeling, Model-based Object Recognition, Scene and Object Recognition, Shape based Object Recognition and video processing. Real time applications of computer vision.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez & Richard E. Woods, “Digital Image Processing”, 2nd edition, Pearson Education.
2. David A. Forsyth, Jean Ponce, “Computer Vision: A Modern Approach”, Prentice Hall .
3. A.K. Jain, “Fundamental of Digital Image Processing”, PHI.

REFERENCES:

1. Anil K. Jain, “Fundamental of Digital Image Processing”, Prentice-Hall of India Pvt. Ltd., 2015. W.K. Pratt, “Digital Image Processing”, A John Wiley & Sons Inc., 2007.

2. John C. Russ and F. Brent Neal, “The Image processing Handbook”, CRC Press, Seventh Edition,2017.

3. Wesley E. Snyder and Hairong Qi, “Fundamentals of Computer Vision”, Cambridge University Press, First Edition, 2017.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL IMAGING AND COMPUTER VISION		**Course code: 24ECV33**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the fundamentals of digital image processing techniques.	I	K2
CO2	Analyze the effectiveness of image enhancement techniques in the spatial and frequency domains for various image processing applications.	II	K4
CO3	Analyze the various filtering methods for image restoration and image compression.	III	K4
CO4	Apply image segmentation and morphological image processing techniques to extract and enhance objects in digital images.	IV	K3
CO5	Apply image representation techniques to extract and represent image features for digital image processing applications.	V	K4

24ECV43	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire the fundamentals of digital signal processing that allow them to assimilate the concepts related to speech processing.
- To present basic principles of speech analysis.
- To give an overview of speech processing applications, including speech enhancement, speech recognition, and speaker recognition.
- To give the fundamentals of Pattern recognition and the application of ANN

UNIT-I FUNDAMENTALS OF SPEECH PROCESSING 9

Introduction to speech processing – Speech communications – anatomy and physiology of the speech production system – Phonemics and Phonetics – Acoustic theory of speech production – Discrete time modeling Single lossless tube analysis – two tube lossless model of the vocal tract – Fast Discrete time transfer function calculation.

UNIT-II SPEECH ANALYSIS TECHNIQUES 9

Short-term processing of speech - Short-term measures from long-term concepts – Examples of short-term features and applications

Long-term LP analysis by system identification – Short–term LP analysis – Ideal, almost ideal, and non-ideal cases – Alternative representations of the LP coefficients – Applications of LP in Speech analysis.

Cepstral analysis: real cepstrum and complex cepstrum – Critical analysis of the cepstrum

UNIT-III SPEECH CODING, ENHANCEMENT AND QUALITY ASSESSMENT 9

Speech Coding and Synthesis: Optimum scalar and vector quantization – Waveform coding – Vocoders – Measuring the quality of speech compression

Speech Enhancement: Classification of Speech Enhancement methods – Short–term spectral amplitude techniques – Speech modeling and Wiener filtering – Adaptive noise canceling – systems based on fundamental frequency tracking – performance evaluation

Speech quality assessment: subjective and objective quality measures

UNIT-IV SPEECH RECOGNITION AND HIDDEN MARKOV MODELS 9

Dimensions of difficulty in recognition – speaker recognition and verification – Dynamic time warping: dynamic programming (DTW) – DTW applied to isolated word recognition (IWR) – DTW applied to continuous speech recognition (CSR).

Hidden Markov Models: Theoretical developments – practical Issues – IWR without syntax – CSR by the connected-word strategy without syntax – language modeling using HMM.

UNIT-V PATTERN CLASSIFICATION AND ANN 9

Feature extraction – classification methods – support vector machines – unsupervised clustering – Class related probability functions – minimum error classifications – likelihood based MAP classification – Bayes classifier – statistically based linear discriminants – iterative training: EM algorithm.

Network principles and paradigms - Applications of ANNs in speech recognition

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Speech and Audio signal processing, Ben Gold Nelson, Morgan and Dan Ellis, A John Wiley &Sons, Inc., Publication, 2nd edition, 2011.

2. Discrete Time processing of speech signals by Joh R. Deller, John H.L.Hanse, John G. Proakis, IEEE Signal Processing Society, A John wiley &Sons, Inc., Publication, 2000

REFERENCES:

1. Fundamentals of speech recognition, Lawrence Rabiner and Biing–Hwang Juang, Pearson Education, 2000.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SPEECH PROCESSING		**Course code: 24ECV43**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the fundamental concept of speech processing	I	K2
CO2	Describe the analysis techniques of the speech signal with its applications	II	K3
CO3	Illustrate the coding and enhancement of the speech signal with its quality assessment	III	K3
CO4	Analyze speech recognition techniques and Hidden Markov Models to evaluate their performance in speech recognition applications.	IV	K4
CO5	Apply the fundamental concepts of speech processing to analyze and process speech signals in practical applications.	V	K3

24ECV53	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamental concepts, techniques, and applications of video analytics.
- To understand the methods of video acquisition, preprocessing, and feature extraction for meaningful analysis.
- To learn various algorithms for motion detection, object detection, classification, and tracking in videos.
- To familiarize students with real-time video surveillance, intelligent monitoring, and automated decision-making systems.
- To develop problem-solving and project skills using industry-standard tools and platforms for video analytics.
- To encourage research and innovation in emerging areas like behavior analysis, activity recognition, and video summarization.

UNIT-I INTRODUCTION IMAGE SEGMENTATION, AND COLOR IMAGE PROCESSING 9

Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement-Histogram Processing, Spatial filtering, Frequency Domain filtering. Image Segmentation –Detection of Discontinuities. - Edge Linking and Boundary Detection. - Thresholding. - Region-Based Segmentation. Colour Image Processing – Colour Models, Color Transformations Color Image.

UNIT-II FEATURE EXTRACTION AND TEXTURE ANALYSIS & OBJECT RECOGNITION AND IMAGE RETRIEVAL 9

Feature Extraction - Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction, PCA - SIFT – SURF. Texture Analysis - Concepts and classification, statistical, structural and spectral analysis. Object Recognition -Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template- Matching. Content Based Image Retrieval - Feature based image retrieval, Object Based Retrieval.

UNIT-III DIGITAL VIDEO PROCESSING, VIDEO SEGMENTATION AND TRACKING 9

Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Rate control and buffering, MPEG, H.264, Inter frame Filtering Techniques, Fundamentals of Motion Estimation and Motion Compensation Change Detection, Background modelling, Motion Segmentation, Simultaneous Motion Estimation and Segmentation, Motion Tracking, Multi-target/Multi-camera tracking

UNIT-IV VIDEO ANALYSIS ACTION RECOGNITION AND FOREGROUND EXTRACTION 9

Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance - Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations-erosion-Dilation- Tracking in a multiple camera environment.

UNIT-V VIDEO ANALYTICS FOR SECURITY AND TRAFFIC MONITORING AND ASSISTANCE 9

Abandoned object detection- human behavioral analysis -human action recognition- perimeter security-crowd analysis and prediction of crowd congestion. Customer behavior analysis - people counting-Traffic rule violation detection- traffic congestion identification for route planning- Advanced Driver Assistance System- lane change warning.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Ed., Prentice-Hall, 2008
2. Murat Tekalp, “Digital Video Processing”, Second Edition, Prentice Hall, 2015.
3. NilanjanDey (Editor), AmiraAshour (Editor) and SuvojitAcharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016.

REFERENCES:

1. Oge Marques, ”Practical Image and Video Processing Using MATLAB”, Wiley-IEEE Press,2011
2. Yu Jin Zhang, “Image Engineering: Processing, Analysis and Understanding”, Tsinghua University Press, 2009.
3. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VIDEO ANALYTICS		**Course code: 24ECV53**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the requirements of image and color image processing.	I	K2
CO2	Illustrate the principle to extract image features and implement content-based image retrieval.	II	K3
CO3	Demonstrate digital video concepts and motion tracking.	III	K3
CO4	Describe the concept of video processing and multi-camera tracking.	IV	K3
CO5	Elaborate the applications of video processing analysis.	V	K4

24ECV63	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of SDR
- To apply Digital signal Processing algorithm for SDR
- To study the implementation of Smart Antennas
- To study the applications of SDR

UNIT-I INTRODUCTION **9**

Need for software defined Radios-Concept of SDR- Software requirements and Reconfigurability-Networking and SDR-RF architectures for SDR-Processing architecture for SDR- Characteristics and benefits of SDR

UNIT-II DIGITAL SIGNAL PROCESSING TECHNIQUES FOR SDR **9**

Review of signals and systems- sampling Theorem Revisited-Signal representation- Signal metrics and visualization- receive techniques for SDR: Nyquist Zones-Fixed point quantization- Design trade off for Number of Bits, cost, Power- Discrete convolution-Correlation-Z-Transform-Digital filtering

UNIT-III DIGITAL GENERATION OF SIGNALS **9**

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digitalsynthesis, Analysis of spurious signals, Performance of direct digital synthesis systems,Applications of direct digital synthesis. Hybrid DDS -PLL systems- Generation of random sequences-ROM compression Techniques-Sine-Phase Difference algorithm approach-Modified Sine-Phase Difference algorithm approach

UNIT-IV SMART ANTENNAS **9**

Vector Channel modelling- Benefits of smart antennas-Structures for beamforming systems-Smart antenna Algorithms-Diversity and space time adaptive signal processing-Algorithms for Transmit STAP- hardware implementation of Smart Antennas-Array calibration

UNIT-V HARDWARE CHOICES AND APPLICATIONS OF SDR **9**

Key hardware elements-DSP Processors-DSP core-DSP Architectures-Numeric representation-Addressing-Pipelining-Peripherals and additional features- Multi processing using a real time Operating Systems -The software design cycle- Maximizing performance-FPGA- Operation of an SRAM based FPGA cell- Implementing DSP functions in FPGA-FPGA Architecture- Applications of FPGA in software Radios- Design Principles using FPGA- Tradeoffs- Power management Issues-Network resources-Applications of SDR: Cognitive Radio-Vehicular networking

TOTAL: 45 PERIODs

TEXT BOOKS:

1. Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering,” Prentice hall Professional,2002
2. Travis F.Collins, Robin Getz, Di Pu, Alexander M. Wyglinski, “Software defined radio for Engineers”,Artechouse, 2018.

REFERENCES:

1. Tony J Rouphael, “RF and DSP for SDR,” Elsevier Newnes Press, 2008.
2. P. Kenington, “RF and Baseband Techniques for Software Defined Radio,” Artech House,2005
3. Paul Burns, “Software Defined Radio for 3G,” Artech House, 2002.
4. Behrouz. F. Bourjney“ Signal Processing for Software defined Radios”, Lulu 2008.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOFTWARE DEFINED RADIO		**Course code: 24ECV63**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the RF Architecture of SDR	I	K2
CO2	Apply the Digital signal Processing algorithms for the implementation of SDR	II	K3
CO3	Generate Digital signals using SDR	III	K4
CO4	Develop algorithms for implementation of smart antennas	IV	K4
CO5	Implement SDR using DSP and FPGA	V	K3

24ECV31 PHYSICAL DESIGN FOR VLSI CIRCUITS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamental concepts and techniques involved in VLSI physical design, including floorplanning, placement, routing, and timing analysis.
- To apply various algorithms to partition circuits and optimize floorplanning.
- To implement placement strategies to minimize wirelength and maximize performance.
- To design efficient routing and clock distribution using various algorithms.

UNIT-I VLSI PHYSICAL DESIGN 9

VLSI design cycle, new trends in VLSI design cycle, Physical design cycle, Design styles, System packing styles- Die packing and attachment styles

UNIT-II LAYOUT COMPACTION 9

Standard cell layout, Layout compaction, Design rules, symbolic layout, problem formulation, Algorithms for constraint-graph compaction.

UNIT-III GLOBAL PLACEMENT 9

Design style placement problems; Classification of placement algorithms, Simulation based placement algorithms and Partitioning based placement algorithms. Timing-driven placement.

UNIT-IV GLOBAL ROUTING 9

Design Style specific global routing problems, classification of global routing algorithms, Maze routing algorithms, Line-Probe algorithms. Via Minimization- Constrained and unconstrained via minimizations.

UNIT-V CELL ROUTING 9

Single layer and two-layer routing, Clock Routing: clocking schemes, Design consideration for the clocking systems, problem formulation, Clock routing algorithms, Skew and delay reduction by pin assignment, multiple clock routing. Power Routing, Compaction algorithms- Design style specific compaction problem, classification of compaction algorithms, one-dimension compaction.

TOTAL: 45 PERIODS

TEXT BOOKS:

3. S. H. Gerez, Algorithms for VLSI Design Automation, WILEY student edition, John wiley& Sons (Asia) Pvt. Ltd. 1999.
4. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, Springer International Edition 3 rd edition, 2005

REFERENCES:

2. Sadiq M. Sait, and Habib Youssef, “VLSI physical design automation: theory and practice”, Vol. 6. World Scientific.
4. Hill &Peterson, Computer Aided Logical Design with Emphasis on VLSI, John Wiley,1993
5. Wayne Wolf, Modern VLSI Design: Systems on silicon, Pearson Education Asia, 2nd Edition,1998.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PHYSICAL DESIGN FOR VLSI CIRCUITS		**Course code: 24ECV31**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Illustrate and explain different VLSI design styles, including their respective challenges and notation	I	K3
CO2	Demonstrate Layout compaction and Design rules	II	K3
CO3	Develop and enhance the existing algorithms and computational techniques for Physical design	III	K3
CO4	Illustrate new trends in global routing algorithms	IV	K3
CO5	Develop efficient routing schemes using various algorithms to ensure signal integrity and minimize delays	V	K3

24ECV14 ARTIFICIAL INTELLIGENCE AND CLOUD APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the various characteristics of Intelligent agents.
- To study the different search strategies in AI.
- To learn techniques in solving AI problems.
- To understand the different ways of designing software agents.
- To learn the various applications of AI.

UNIT – I INTRODUCTION **9**

Introduction to AI - Definition - Compare with human intelligence and traditional information processing - strengths and limitations - Future of AI - Characteristics of Intelligent Agents -Typical Intelligent Agents - Problem Solving Approach to Typical AI problems.

UNIT – II PROBLEM SOLVING METHODS **9**

Problem-solving Methods - Search Strategies - Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems - Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games - Alpha - Beta Pruning - Stochastic Games.

UNIT – III KNOWLEDGE REPRESENTATION **9**

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering - Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT – IV UNCERTAIN KNOWLEDGE AND REASONING **9**

Acting under Uncertainty – Basic Probability Notation – Inference using Full Joint Distribution – Independence – Bayes' Rule and its use, Representing knowledge in an uncertain domain – Semantics of Bayesian Networks – Efficient representation of conditional distribution – Relational and First Order Probability models

UNIT-V ARTIFICIAL INTELLIGENCE ON THE CLOUD **9**

Cloud migration - Cloud providers - Conversational agents - Natural language processing -Image and video processing - Translation - Machine learning platform -Transcription -Document analysis.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.Russell and P.Norvig, "Artificial Intelligence: A Modern Approach", Pearson Publishers, Fourth Edition, 2021.
2. Alberto Artasanchez and Prateek Joshi, "Artificial Intelligence with Python", Packt Publishing, Second Edition, 2020.

REFERENCES:

1. Ivan Bratko, "Prolog Programming for Artificial Intelligence", Addison-Wesley, Fourth Edition, 2011.
2. M.Tim Jones, "Artificial Intelligence: A Systems Approach", Jones & Bartlett Learning, First Edition, 2009.
3. Nils J. Nilsson, "The Quest for Artificial Intelligence: A History of Ideas and Achievements", Cambridge University Press, 2009.
4. Zoltán Somogyi, "The Application of Artificial Intelligence", Springer Nature, 2021.
5. S.Kanimozhi Suguna, M.Dhivya and Sara Paiva, "Artificial Intelligence (AI): Recent Trends

and Applications", CRC Press, 2021.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ARTIFICIAL INTELLIGENCE AND CLOUD APPLICATIONS		**Course code: 24ECV14**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the fundamentals of Artificial Intelligence	I	K2
CO2	Apply the appropriate searching algorithms for the given Artificial Intelligence problems	II	K3
CO3	Formulate a problem using first-order and predicate logic	III	K4
CO4	Identify the uncertain knowledge representation using probabilistic methods	IV	K3
CO5	Solve the Artificial Intelligence problems using the facilities of cloud systems	V	K3

24ECV24	DEEP LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of big data and statistical data analysis.
- To familiarize the student with the image processing facilities like tensor flow and keras.
- To learn to use deep learning tools and framework for solving real-life problems.
- To use Python for deep learning.

UNIT – I INTRODUCTION TO NEURAL NETWORKS 9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT – II INTRODUCTION TO DEEP LEARNING 9

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – RelU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT – III CONVOLUTIONAL NETWORKS 9

Convolution operation – Motivation – Pooling – Convolution and Pooling as strong prior – Efficient convolution algorithms – Unsupervised features – Sequence Modeling: Recurrent and Recursive Nets – LSTM Networks – Applications – Computer Vision – Speech Recognition – Natural Language Processing.

UNIT – IV DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive - Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM.

UNIT-V DEEP LEARNING WITH PYTHON 9

Introduction to Keras and Tensorflow – Deep Learning for computer vision – convnets – Deep Learning for Text and Sequences – Generative Deep Learning – Text Generation with LSTM – Deep Dream – Neural Style Transfer – Generating images with variational autoencoders – Generative Adversarial Networks (GAN).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, The MIT Press, 2016.
2. Nikhil Buduma and Nicholas Lacascio, “Fundamentals of Deep Learning”, O.Reilly, First Edition, 2017

REFERENCES:

1. Laura Graesser and Wah Loon Keng, “Foundations of Deep Reinforcement Learning: Theory and Practice in Python”, Addison-Wesley Professional, 2020.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
3. Jon Krohn, Grant Beyleveld and Aglaé Bassens, “Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”, Addison-Wesley Professional, First Edition,
4. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DEEP LEARNING TECHNIQUES		**Course code: 24ECV24**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the basic concepts of neural network.	I	K2
CO2	Identify the deep learning algorithms for various domains.	II	K3
CO3	Explain about basics of Convolutional Neural Networks.	III	K2
CO4	Apply appropriate deep learning models for analyzing the data.	IV	K3
CO5	Illustrate the concept of Tensor Flow/Keras and develop an application using deep learning.	V	K3

24ECV34	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the steps involved in Natural Language Processing
- To learn about the lexical, syntactic, and semantic analysis of natural language processing
- To explore the various parsing techniques for natural languages
- To understand the statistical models for Natural language processing
- To learn about the various applications involved in Natural Language Processing

UNIT-I LEXICAL ANALYSIS 9

Lexical Analysis –Regular expression and Automata for string matching – Words and Word Forms – Morphology fundamentals – Morphological Diversity of Indian Languages – Morphology Paradigms – Finite State Machine / Transducers Based Morphology –Automatic Morphology Learning – Parts of Speech – N-gram Models – Hidden Markov models

UNIT-II SPEECH PROCESSING 9

Biology of Speech processing – Place and manner of Articulation – Word Boundary Detection – Argmax-based computations – HMM and speech recognition – Text to Speech Synthesis – Rule-based–Concatenative-based approach

UNIT-III PARSING 9

Theories of Parsing – Parsing Algorithms – Early Parser – CYK Parser –Probabilistic Parsing – CYK – Resolving attachment and structural ambiguity – Shallow Parsing – Dependency Parsing – Named Entity Recognition – Maximum Entropy Models – Conditional Random Fields

UNIT-IV LEXICAL KNOWLEDGE NETWORKS 9

Meaning: Lexical knowledge Networks – Wordnet Theory – Indian Language Wordnets and Multilingual Dictionaries – Semantic Roles – Word Sense Disambiguation – WSD and Multilinguality – Metaphors – Conference and Anaphora resolution

UNIT-V APPLICATIONS 9

Applications: Sentiment Analysis – Text Entailment – Machine Translation – Question Answering system – Information Retrieval – Information Extraction – Cross-Lingual Information Retrieval (CLIR)

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jurafsky Daniel, Martin James, " Speech and Language Processing", second edition, Tenth impression, Pearson Education, 2018
2. Christopher Manning, Schutz Heinrich, "Foundations of statistical Natural Processing", MIT press 1999.

REFERENCES:

1. Allen James, "Natural Language Understanding", Second Edition, Benjamin Cumming, 1995
2. Charniack Eugene, "Statistical Language Learning", MIT press,1993.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : NATURAL LANGUAGE PROCESSING		**Course code: 24ECV34**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Justify the various steps necessary for processing natural language.	I	K4
CO2	Develop appropriate lexical and parsing techniques for a given natural language.	II	K3
CO3	Apply appropriate statistical models for a given natural language application.	III	K3
CO4	Modify existing algorithms to suit any natural language for processing	IV	K4
CO5	Apply appropriate pre-processing steps essential for the various applications involving natural language processing	V	K3

		L	T	P	C
24ECV44	EXPLORATORY DATA ANALYSIS	3	0	0	3

OBJECTIVES:

- To understand the basic concepts of data analytics and handling the missing data in the real world data sets by choosing appropriate methods.
- To learn data analysis methods.
- To learn stream computing.
- To understand and apply data analysis techniques.
- To gain knowledge on Hadoop related tools.

UNIT-I DATA REPRESENTATION 9

Knowledge domains of Data Analysis – Understanding structured and unstructured data – data analytic tools – applications of data analytics – various phases of data analytics lifecycle: discovery, data preparation, model planning, model building, communicating results, operationalization.

UNIT-II DATA PREPROCESSING 9

Data Preprocessing: Data Cleaning – Data Integration – Data Reduction – Data Transformation. Handling Missing Data: Introduction to Missing data – Traditional methods for dealing with missing data. Maximum Likelihood Estimation – Basics, Missing data handling, improving the accuracy of analysis.

UNIT-III CLASSIFICATION AND CLUSTERING 9

Statistical Methods: Regression modelling – Multivariate Analysis – Classification: SVM & Kernel Methods – Rule Mining – Cluster Analysis – Types of Data in Cluster Analysis – Partitioning Methods – Hierarchical Methods – Density Based Methods – Grid Based Methods – Model Based Clustering Methods – Clustering High Dimensional Data – Predictive Analytics.

UNIT-IV INTELLIGENT DATA ANALYSIS 9

Analysis of Time Series: Linear and Non Linear Systems Analysis, Neural Networks : Fundamentals – Back Propagation Neural Network – Fuzzy Logic : Basics of Fuzzy Sets and Fuzzy Logic, Genetic Algorithms

UNIT-V HADOOP FRAMEWORKS 9

HADOOP: HDFS concepts, Algorithms using MapReduce. Introduction to NoSQL, Cassandra, Pig – Hive.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. EMC Education Services (Editor), “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, John Wiley & Sons, 2015.
2. Craig K. Enders, “Applied Missing Data Analysis”, The Guilford Press, 2010.
3. Michael Berthold and David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.

REFERENCES:

1. Sadiq M. Sait, and Habib Youssef, “VLSI physical design automation: theory and practice”, Vol. 6. World Scientifi.
2. Hill &Peterson, Computer Aided Logical Design with Emphasis on VLSI , John Wiley, 1993
3. Wayne Wolf, Modern VLSI Design: Systems on silicon , Pearson Education Asia, 2 nd Edition,1998.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DATA ANALYTICS		**Course code: 24ECV44**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Describe the Data Analysis preprocessing Techniques	I	K3
CO2	Explain about how missing data will be handled during preprocessing	II	K3
CO3	Apply the Classification and Clustering algorithms for real time applications	III	K3
CO4	Apply intelligent analytics techniques like neural networks, fuzzy and genetic algorithms for real time analytics applications	IV	K3
CO5	Explain the Hadoop related tools such as Pig and Hive for big data analytics	V	K3

24ECV54	SOFT COMPUTING AND INTELLIGENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about soft computing techniques and their applications.
- To analyze various neural network architectures.
- To understand perceptron and counter propagation networks.
- To understand the fuzzy systems.
- To analyze the genetic algorithms and their applications.

UNIT – I INTRODUCTION TO SOFT COMPUTING 9

Introduction of soft computing and characteristics - learning methods - taxonomy - Evolution of neural networks - basic models - important technologies - applications. Fuzzy logic: Introduction, crisp sets, fuzzy sets. Crisp relations and fuzzy relations: Cartesian product of relation, classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets.

UNIT – II NEURAL NETWORKS 9

McCulloch-Pitts neuron - linear reparability - hebb network - supervised learning network - perceptron networks - adaptive linear neuron - multiple adaptive linear neuron - BPN - RBF - TDNN - associative memory network - auto-associative memory network - hetero-associative memory network - BAM - hopfield networks - iterative auto associative memory network - iterative associative memory network - unsupervised learning networks - Kohonen self-organizing feature maps - LVQ - CP networks - ART network.

UNIT – III FUZZY LOGIC 9

Fuzzy Sets - Properties - Membership functions - Fuzzy operations - Applications - Classification and Regression tree - Data clustering algorithms - Rule-based structure identification and Regression trees - neuro fuzzy systems.

UNIT – IV GENETIC ALGORITHM 9

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators - Encoding scheme - Fitness evaluation - crossover - mutation - genetic programming - multilevel optimization - real life problem- advances in GA.

UNIT – V HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS 9

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, Optimization of traveling salesman problem using genetic algorithm approach, Soft computing based hybrid fuzzy controllers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S.N. Sivanandam and S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt., Ltd., 2011.
2. J.S.R. Jang, C.T. Sun and E. Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI/Pearson Education, 2004.

REFERENCES:

1. S. Rajasekaran and G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications”, Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair and Bo Yuan, “Fuzzy Set Theory: Foundations and Applications”, Prentice Hall, 1997.

3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning”, Pearson Education India, 2013.
4. James A. Freeman and David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOFT COMPUTING AND INTELLIGENT SYSTEMS		**Course code: 24ECV54**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply various soft computing concepts for practical applications.	I	K4
CO2	Choose and design suitable neural networks for real time problems	II	K3
CO3	Use fuzzy rules and reasoning to develop decision making and expert system.	III	K3
CO4	Explain the importance of optimization techniques and genetic programming.	IV	K2
CO5	Apply Genetic algorithms in multimedia application processing.	V	K3

24ECV64	EXTENDED REALITY (XR) SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn rapidly evolving and commercially viable field of computer science.
- To become familiar with geometric modeling and computer graphics.
- To learn various types of Hardware and Software in virtual Reality systems.
- To understand the concepts, challenges and applications of Augmented Reality.
- To explore the role of Virtual and Augmented Reality in real-world engineering and entertainment domains.

UNIT-I INTRODUCTIONTOVIRTUALREALITY 9

Virtual Reality and Virtual Environment: Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environment requirement – benefits of virtual reality – Historical development of VR – Scientific Landmark.

UNIT-II AUGMENTEDREALITY 9

Taxonomy–technology and features of augmented reality–difference between AR and VR– Challenges with AR – AR systems and functionality – Augmented reality method – visualization techniques for augmented reality – enhancing interactivity in AR environments – evaluating AR systems.

UNIT-III COMPUTERGRAPHICSANDGEOMETRICMODELING 9

Introduction – The Virtual world space – positioning the virtual observer – The perspective projection – Human vision – Stereo perspective projection – Colour theory. Geometrical Transformations: Introduction – frames of reference – Modeling transformations – scaling the VE – Collision detection.

UNIT-IV DEVELOPMENTTOOLSANDFRAMEWORK 9

Human factors – Hardware – Software – The somatic senses – Sensor hardware – Head coupled displays – Acoustic hardware – Integrated VR systems – Modeling virtual world – Physical simulation.

UNIT-V AUGMENTEDANDVIRTUALREALITYAPPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment – Education. The Future: Introduction – Virtual environments – modes of interaction. Case study on Oculus Rift – Head mounted display.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jernej Barbic, Mirabelle D'Cruz, Marc Erich Latoschik, Mel Slater and Patrick Bourdot, “Virtua and Augmented Reality”, 14th EuroVR International Conference, EuroVR 2017, Laval, France, D 12–14, 2017, Proceedings: 10700 (Lecture Notes in Computer Science).
2. TimothyJung and M.Claudia tom Diek, “Augmented Reality and Virtual Reality”, Progress in IS (PROIS), 2018.

REFERENCES:

1. Grigore C.Burdeaand PhilippeCoiffet,“Virtual RealityTechnology”,Wiley-IEEE Press, Second Edition, 2017.
2. Alan B.Craig,“Understanding Augmented Reality,Concepts and Applications”, Morgan Kaufmann, First Edition, 2013.
3. AlanB.CraigDr.,William R.Sherman Dr.and JeffreyD.Will,“DevelopingVirtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.
4. JohnVince,“Virtual Reality Systems”,Pearson Education Asia,2007.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : EXTENDED REALITY (XR) SYSTEMS		**Course code: 24ECV64**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the virtual reality and environment, virtual reality requirements and benefits.	I	K2
CO2	Illustrate the visualization techniques for augmented reality.	II	K3
CO3	Discuss the concept of computer graphics and geometric modeling.	III	K3
CO4	Use various types of hardware and software in virtual reality systems.	IV	K3
CO5	Analyze and design a system or process to meet given specifications with realistic engineering constraints.	V	K4

24ECV74	MULTIMEDIA DATA COMPRESSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic ideas of compression algorithms related to multimedia components – Text, speech, audio, image and Video.
- To understand the principles and standards and their applications with an emphasis on underlying technologies, algorithms, and performance.
- To appreciate the use of compression in multimedia processing applications
- To understand and implement compression standards in detail.

UNIT-I FUNDAMENTALS OF COMPRESSION **9**

Introduction To multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression –Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression– Lossy Compression.

UNIT-II TEXTCOMPRESSION **9**

Huffman coding–Adaptive Huffman coding–Arithmetic coding–Shannon-Fanocoding–Dictionary techniques–LZW family algorithms.

UNIT-III IMAGE COMPRESSION **9**

Image Compression: Fundamentals –– Compression Standards – JPEG Standard – Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG2000standards–JBIGandJBIG2 standards.

UNIT-IV AUDIO COMPRESSION **9**

Audio compression Techniques– μ law,A-Law companding–Frequency domain and filtering–Basic sub-band coding – Application to speech coding – G.722 – MPEG audio – progressive encoding–Silence compression, Speech compression–Formant and CELP vocoders.

UNIT-V VIDEO COMPRESSION **9**

Video compression techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding:MPEG-3 and MPEG-4 – Motion estimation and compensation techniques–H.261 Standard–DVI technology–DVI real time compression–Current Trends in Compression standards.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Khalid Sayood: Introduction to Data Compression", Morgan Kauffman Harcourt India, Fifth Edition,2017.
2. David Solomon, "Data Compression – The Complete Reference", Fifth Edition, SpringerVerlog,NewYork,2009.

REFERENCES:

1. Yun Q.Shi, Huifang Sun, “Image and Video Compression for Multimedia Engineering,Algorithms and Fundamentals”,CRC Press, third edition2019.
2. Mark S.Drew,Ze-NianLi,“Fundamentals of Multimedia”,PHI, third edition,2021.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MULTIMEDIA DATA COMPRESSION		**Course code: 24ECV74**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Implement basic compression algorithms familiar with the use of MATLAB and its Equivalent open source environments.	I	K3
CO2	Design and implement some basic compression standards.	II	K3
CO3	Critically analyze different approaches of compression algorithms in multimedia related Mini projects.	III	K4
CO4	Understand the various audio, speech Compression techniques	IV	K2
CO5	Implement MPEG video coding techniques.	V	K3

		L	T	P	C
24ECV84	**DIGITAL PROMOTION USING ELECTRONIC MEDIA**	**2**	**0**	**2**	**3**

OBJECTIVES:

- The primary objective of this module is to examine and explore the role and importance of digital marketing in today's rapidly changing business environment.
- It also focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

UNIT-I INTRODUCTION TO ONLINE MARKET 9

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT-II SEARCH ENGINE OPTIMISATION 9

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting

UNIT-III E- MAIL MARKETING 9

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting

UNIT-IV SOCIAL MEDIA MARKETING 9

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT-V DIGITAL TRANSFORMATION 9

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

PRACTICAL EXERCISES:

1. Subscribe to a weekly/quarterly newsletter and analyze how its content and structure aid with the branding of the company and how it aids its potential customer segments.
2. Perform keyword search for a skincare hospital website based on search volume and competition using Google keyword planner tool.
3. Demonstrate how to use the Google WebMasters Indexing API
4. Discuss an interesting case study regarding how an insurance company manages leads.

5. Discuss negative and positive impacts and ethical implications of using social media for political advertising.
6. Discuss how Predictive analytics is impacting marketing automation

TOTAL:**30 PERIODS**

TEXT BOOKS:

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia;Publisher: Pearson Education;
2. First edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373.
3. Digital Marketing by Vandana Ahuja ;Publisher: Oxford University Press (April 2015). ISBN10: 0199455449

REFERENCES:

1. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; 1st edition (April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
2. Ryan, D. (2014). Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited..
3. Barker, Barker, Bormann and Neher(2017), Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning.
4. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL PROMOTION USING ELECTRONIC MEDIA		**Course code: 24ECV84**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Examine and explore the role and importance of digital marketing in today's rapidly changing business environment	I	K3
CO2	Explain the digital marketing can be utilized by organizations and how its effectiveness can be measured.	II	K3
CO3	Understand the key elements of a digital marketing strategy.	III	K2
CO4	Analyze the effectiveness of a digital marketing campaign can be measured	IV	K4
CO5	Demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.	V	K3

24ECV15	IOT ENABLED SYSTEMS DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of the Internet of Things (IoT).
- To study the hardware for IoT.
- To understand the technologies, system architecture, and communication architecture that drive the growth of IoT systems.
- To develop IoT infrastructure for popular applications.
- To learn and implement IoT protocols and Arduino programming.

UNIT-I INTRODUCTION TO INTERNET OF THINGS (IOT) 9

Vision, Definition, IoT architecture: Layers and protocols, technology behind IoT, Sources of the IoT, M2M Communication, IoT Examples. Sensing, Actuation. IoT communication models: Device-to-device, device-tocloud, device-to-gateway, Challenges and opportunities in IoT

UNIT-II HARDWARE FOR IOT 9

Sensors, Digital sensors, actuators, radio frequency identification (RFID) technology, microcontrollers, and single-board computers, Embedded Platforms for IoT: Embedded computing basics, Overview of IOT supported Hardware platforms such as Arduino, Raspberry pi, Jetson nano Beagle Bone, and Intel Galileo boards.

UNIT-III IOT PROTOCOLS AND ARDUINO PROGRAMMING 9

Wi-Fi, Bluetooth, CoAP, LPWAN protocol. Sensor Networks: Sensor deployment & Node discovery, Introduction to Arduino Programming: Arduino Platform Boards Anatomy, Arduino IDE, coding, using emulator, using libraries, additions in Arduino, programming the Arduino for IoT, Integration of Sensors and Actuators with Arduino.

UNIT-IV IOT DATA MANAGEMENT AND ANALYTICS 9

Data generation and collection in IoT systems, IoT data storage, Cloud-based and local storage, Data preprocessing and analysis, Basics of analytics for IoT data, IoT dashboards, Visualization and interpretation of data, Role of machine learning and AI in IoT.

UNIT-V CHALLENGES IN IOT DESIGN CHALLENGES: IOT APPLICATIONS 9

Smart homes, smart cities, healthcare, agriculture, Smart Metering, City Automation, Automotive Applications, home automation, smart cards, and industry, IoT and automation: Role in industrial IoT (IIoT), Emerging technologies: AIoT, Blockchain for IoT, and 5G integration IoT, Development Challenges, Security Challenges.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Olivier Hersent, David Boswarthick, Omar Elloumi “The Internet of Things key applications and protocols”, willey.
2. Jeeva Jose, Internet of Things, Khanna Publishing House.

REFERENCES:

1. Michael Miller “The Internet of Things” by Pearson.
2. Raj Kamal “INTERNET OF THINGS”, McGraw-Hill, 1ST Edition, 2016.
3. Arshdeep Bahga, Vijay Madisetti “Internet of Things (A hands on approach)” 1ST edition, VPI publications, 2014.
4. Adrian McEwen, Hakin Cassimally “Designing the Internet of Things” Wiley India.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : IOT ENABLED SYSTEMS DESIGN		**Course code: 24ECV15**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the basic concepts, principles, and challenges of IOT	I	K2
CO2	Describe the functioning of hardware devices and sensors used for IOT	II	K3
CO3	Analyze network communication aspects and protocols used in IOT	III	K4
CO4	Apply IOT for developing real life applications using Arduino programming.	IV	K3
CO5	Develop IOT infrastructure for popular applications	V	K4

		L	T	P	C
24ECV25	**MIXED C AND ASSEMBLY LANGUAGE PROGRAMMING**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand microprocessor architecture, instruction sets, memory organization, and subroutine handling.
- To integrate C with inline assembly for low-level operations.
- To understand the C compilation process and assembly code generation.
- To learn techniques for calling assembly routines from C and managing cross-language data
- To understand C++ constructs and their assembly translation.

UNIT–I INTRODUCTION TO MICROPROCESSORS AND ASSEMBLY LANGUAGE PROGRAMMING 9

Microprocessor Architecture, Machine Language execution sequence in a Microprocessor, Memory in a microprocessor, Addressing Schemes,Instruction Set, Data transfer, Arithmetic and Logical Instructions, Flag Register, Stack Instructions, CALL and RET Hardware Loops and subroutines

UNIT–II INTRODUCTION TO C AND INLINE ASSEMBLY 9

Data types and their sizes, Simple examples of Inline assembly, ALU operations, String length, Multiplication using repeated addition, Swap two variables in C, Swap two variables in inline Assembly, Function to swap two variable in C, Inline code to swap the two variables using a function

UNIT–III COMPILING C TO ASSEMBLY LANGUAGE 9

Compilation process (preprocessor, compiler, assembler, linker), C code's assembly output-translation of C constructs, Parameter passing mechanisms (stack, registers), Function prologue and epilogue in assembly, Handling local variables in assembly.

UNIT–IV INTERFACING C AND ASSEMBLY LANGUAGE: 9

Calling assembly routines from C code, Passing arguments and return values between C and assembly, Managing memory and data structures across C and assembly, Techniques for creating and linking separate assembly files with C code.

UNIT– V C++ AND SOME SPECIAL FUNCTIONS 9

C and C++ at assembly language level Recursion vs Loops with factorial as example Special functions, memcpy, strlen, Inline functions and macros, Function overloading and operator overloading in C++, Classes, objects, and constructors, Templates and their translation at assembly level, Exception handling mechanisms in C++

TOTAL: 45 PERIODS

TEXT BOOKS:

1. "The C Programming Language" by BRIAN W. KERNIGHAN and DENNIS M. RITCHIE, Second Edition
2. "The INTEL Microprocessors – Architecture, Programming and Interfacing", by Barry B. Brey 8th Edition

REFERENCES:

1. "C with Assembly language", Steven Holzner, BPB Publications,1990

2. "Introduction to Assembly Language Programming:From 8086 to Pentium Processors", by Sivarama P. Dandamudi, Springer- Newyork 2013

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MIXED C AND ASSEMBLY LANGUAGE PROGRAMMING		**Course code: 24ECV25**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply microprocessor architecture concepts to develop assembly programs.	I	K2
CO2	Demonstrate equivalence of C functions and inline assembly implementations.	II	K3
CO3	Analyze assembly output of C programs to understand loops, conditions, and function calls	III	K4
CO4	Create modular programs by linking separate assembly and C files	IV	K3
CO5	Demonstrate the use of classes, objects, constructors, inline functions, operator overloading, and templates in solving programming problem	V	K4

		L	T	P	C
24ECV35	**EMBEDDED PROCESSORS**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce the fundamentals of embedded processors, System-on-Chip (SoC) architecture, processor selection, and memory organization.
- To explain on-chip peripherals such as memory, interrupts, timers, communication interfaces, and analog modules used in embedded systems.
- To provide knowledge of ARM7 architecture, programming model, instruction sets, memory organization, and development tools.
- To equip students with practical skills in real-world interfacing of peripherals using ARM processors and develop Embedded C programming with assembler, compilers, IDE usage, memory access, lookup tables, debugging, and build systems.

UNIT–I INTRODUCTION TO EMBEDDED PROCESSORS 9

Introduction to embedded processors– System on Chip (SoC)-Introduction to SoC Architecture, An approach for SOC Design, System Architecture and Complexity. Processor Selection for SOC, Basic concepts in Processor Architecture, Overview of SOC external memory, Internal Memory, Scratchpads and Cache memory, SOC Memory System, Models of Simple Processor – memory interaction, SOC Standard Buses

UNIT–II EMBEDDED PROCESSORS ON CHIP PERIPHERALS 9

Memory - Interrupts - I/O Ports-Timers & Real Time Clock (RTC), Watch dog timer -CCP modules - Capture Mode - Compare Mode-PWM Mode - Serial communicationmodule - USART - SPI interface - I2C interface, Analog Comparator, Analog interfacing and data acquisition.

UNIT–III ARM 7 ARCHITECTURE AND PROGRAMMING 9

Architecture - Programmer's Model - Development Tools - Memory Organization – Addressing Modes - Registers - Pipeline - Interrupts - Coprocessors - Interrupt Structure - Instruction Sets -I/O Ports - Assembly Language Programming - Embedded C Programming.

UNIT–IV REAL WORLD INTERFACING USING ARM PROCESSOR 9

Interfacing the peripherals to LPC2148: GSM and GPS using UART, on-chip ADCusing interrupt (VIC), EEPROM using I2C, SD card interface using SPI, on-chip DAC for waveform generation.

UNIT– V EMBEDDED C PROGRAMMING 9

Assembler, Compilers and interpreter. Data types and its syntax, preprocessors. IDE and refereeing to its manuals. Startup code. Continuous while loop. Accessing of internal, external memory of code and data memory. Look up tables. Debugging techniques. Build system

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Raj Kamal, "Embedded Systems - Architecture, Programming and Design", McGraw Hill Education, Third Edition, 2017.
2. Steve Furber, “ARM System on Chip Architecture “, 2nd Edition, 2000, Addison Wesley Professional

REFERENCES:

1. F. Vahid and T. Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, Wiley India Pvt. Ltd., 2002.
2. Michael J. Flynn and Wayne Luk, “Computer System Design System-on-Chip”, Wiley India Pvt. Ltd.
3. S. Pascricha and N. Dutt, Morgan Kaufmann, On-Chip Communication Architectures, System on Chip Interconnect, -Elsevier Publishers 2008
4. James K. Peckol, "Embedded Systems: A Contemporary Design Tool", Wiley, 2008.
5. Trevor Martin, "The Insider's Guide To The Philips ARM7-Based Microcontrollers", Hitex (UK) Ltd., 2005.
6. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, “The 8051 Microcontroller and Embedded Systems”, 2nd Edition, Pearson Education 2008. 12th impression 2018.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : EMBEDDED PROCESSORS		**Course code: 24ECV35**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Analyze the features of various embedded processors	I	K4
CO2	Identify an appropriate on chip peripherals for serial and parallel communication	II	K3
CO3	Examine the functions of ARM processors	III	K3
CO4	Design real time applications by using the ARM processors	IV	K3
CO5	Apply the concepts of assemblers, compilers, and interpreters to translate and execute embedded	V	K3

24ECV45	COMMUNICATING EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn basics of CAN bus and its OSI models
- To understated various frames in CAN
- To learn the principles, operation, and programming of MCP2515 CAN Controller
- To learn various CAN development tools
- To learn built-in functions in STM32 for CAN controller

UNIT-I CAN BUS AND ITS OSI MODEL 9

Vehicle Network Systems - CAN Bus - LIN - MOST – Byteflight - Intellibus - A Brief History of CAN Bus - CAN in Automotive Industry - The Basic Structure of a CAN Automotive System - Advantages of CAN Bus - Disadvantages of CAN Bus - Properties of CAN Bus - The ISO/OSI Reference Model and CAN - CAN Bus ISO/OSI Model – CANopen - CAN Bus Termination - CAN Bus Data Rate - Cable Stub Length - CAN Bus Node - CAN Bus Signal Levels - CAN_H Voltage - CAN_L Voltage - CAN Signal Waveform - Bus Arbitration - Bus Transceiver - CAN Connectors - CAN Repeaters - CAN PC Interface.

UNIT-II CAN BUS FRAMES 9

Data Frame - Start Of Frame (SOF) - Arbitration Field - RTF Field - Control Field - Data Field - CRC Field - ACK Field - End of Frame Field - Remote Frame - Error Frame - Overload Frame - Extended CAN Frames - Bit Stuffing - Bus Error Detection - Bit Error - Bit Stuffing Error - CRC Error - Frame Error - ACK Error - CAN Bus Fault Confinement - Data Exchange With Data Frames - Remote Frames on the Bus.

UNIT-III CAN BUS TIMING AND CONTROLLER 9

Bit Timing - Selection of Bit Timing Segments - The Prop_Seg - Oscillator Tolerance - The Basic Structure of a CAN Transceiver - The Basic Structure of a CAN Controller - The MCP2515 CAN Controller (Without Built-in Transceiver) - The MCP2515 CAN Controller (With Built-in Transceiver).

UNIT-IV CAN BUS DEVELOPMENT TOOLS 9

Hardware Development Tools - CAN MicroMOD Development Kit - mikroElektronika CAN Communication Kit - The RCDK8C CAN Development Kit - mikroElektronika CAN SPI Click Board - mikroElektronika CAN-1 board - CAN Bus Monitor Demo Board - CAN Bus Analyzers - Microchip Inc CAN Bus Analyzer - CANdo - PCAN Explorer - CAN-Bus-Tester 2 (CBT2) - BitScope Logic - LAP-C Logic Analyzer - CAN Bus Software Development Tools - Keil Real-Time Library (RL-ARM) - mikroElektronikamikroC Pro for ARM - STM32F2xx Standard Peripheral Library

UNIT-V STM32 BUILT-IN CAN BUS FUNCTIONS 9

The STM32 Family of ARM Microcontrollers - The STM32F107VCT6 Microcontroller - Basic Features of the STM32F407VCT6 - Internal Block Diagram - The Power Supply - Low Power Modes - The Clock Circuit-STM32F407VGT6 Microcontroller Built-in CAN Controller Module - Message Transmission - Message Reception - mikroC Pro for ARM CAN Bus Functions - Using a Logic Analyzer as a CAN Bus Analyzer - Using the Microchip Inc CAN Bus Analyzer (APGDT002) - Connecting the CAN BUS Analyzer to the PC and CAN BUS.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ibrahim Dogan, “Controller Area Network Projects with ARM and Arduino”, PublitrElektor, August 15, 2011

2. Wilfried F. Voss, “A Comprehensible Guide to Controller Area Network”, Copperhill Media, August 2005

REFERENCES:

1. Marco Di Natale, HaiboZeng, Paolo Giusto and ArkadebGhosal, “Understanding and Using the Controller Area Network Communication Protocol Theory and Practice”, Springer New York, 2012.
2. Ibrahim Dogan, “Controller Area Network Projects with ARM and Arduino”, PublitrElektor, 2016

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMMUNICATING EMBEDDED SYSTEMS		**Course code: 24ECV45**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the CAN bus and its OSI model	I	K3
CO2	Describe various frames, its error detection and correction	II	K3
CO3	Use MCP2515 CAN controller as trans receiver	III	K3
CO4	Apply different CAN development tools and utilize the built-in functions of the STM32 CAN controller in embedded applications	IV	K3
CO5	Discuss the CAN bus analyzer to connect with PC and CAN	V	K3

24ECV55	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots
- To study the various kinematics and robot dynamics.
- To study the trajectory planning and control for robot
- To study the control of robots for some specific applications.

UNIT-I BASIC CONCEPTS OF ROBOTS 9

Introduction of robots – Classification of robots – Present status and future trends – Basic components of robotic system – Mechanisms and transmission – End effectors – Grippers – different methods of gripping – Specifications of robot.

UNIT-II DRIVE SYSTEMS AND SENSORS 9

Drive system – hydraulic, pneumatic and electric systems – Sensors in robot: Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors

UNIT-III KINEMATICS AND DYNAMICS OF ROBOTS 9

2D & 3D Transformation – Scaling – Rotation – Translation – Homogeneous coordinates – multiple transformations – Simple problems – Matrix representation – Forward and Reverse Kinematics of Three Degree of Freedom – Homogeneous Transformations – Inverse kinematics of Robot – Robot Arm dynamics – Basics of Trajectory Planning.

UNIT-IV ROBOT CONTROL 9

Robot controls – Point to point control – Continuous path control – Intelligent robot – Control system for robot joint – Control actions – Feedback devices – Encoder – Resolver – LVDT – Motion Interpolations – Adaptive control.

UNIT-V ARTIFICIAL INTELLIGENCE IN ROBOTICS 9

Application of Machine learning – Artificial Intelligence – Expert systems – Tele-robotics and Virtual Reality – Micro and Nanorobots – Unmanned vehicles – Cognitive robotics – Evolutionary robotics – Humanoids.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mikell P. Groover, Nicholas G. Odrey, Mitchel Weiss, Roger N. Nagel and AshishDutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2017.
2. 2. J.J.Craig, “Introduction to Robotics - mechanics and control”, Addison-Wesley, Fourth Edition, 2008.

REFERENCES:

1. S.R.Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education, 2009.
2. Richard D. Klafter, A.Thomas, ChriElewski and Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2009.
3. R.K. Mittal and I J Nagrath, “Robotics and Control”, Tata McGraw Hill, 24th Reprint 2017.
4. Saeed B. Niku,'' Introduction to Robotics: Analysis, Control, Applications '', Wiley; 3rd edition (17 December 2019)

5. Spong, Mark W., Seth Hutchinson, and MathukumalliVidyasagar. Robot Modelling and Control. Vol. 3. New York: Wiley, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ROBOTICS AND AUTOMATION		**Course code: 24ECV55**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the basic concepts of robotics	I	K2
CO2	Classify the various sensors used in robotics	II	K3
CO3	Discuss about the differential kinematic and various dynamics in robotics	III	K3
CO4	Demonstrate the use of different robot control techniques in real-world scenarios	IV	K3
CO5	Apply Artificial Intelligence in the field of robotics	V	K3

		L	T	P	C
24ECV65	**IOT FOR INDUSTRIAL PROCESS OPTIMIZATION**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To introduce IoT Nodes and Sensors.
- To study the hardware for IoT Gateways.
- To understand IoT Cloud Systems.
- To study and develop IoT Cloud Dashboards.
- To analyze and address the challenges in IoT system design – both hardware and software.

UNIT-I UNDERSTANDING IOT CONCEPT AND DEVELOPMENT PLATFORM 9

Introduction ,IOT Definition, Importance of IoT, Applications of IOT, IoT architecture, Understanding working of Sensors, Actuators, Sensor calibration, Study of Different sensors and their characteristics

UNIT-II ANALYZING & DECODING OF COMMUNICATION PROTOCOL USED IN IOT DEVELOPMENT PLATFORM 9

.UART Communication Protocol, I2C Protocol device interfacing and decoding of signal, SPI Protocol device interfacing and decoding of signal, WIFI and Router interfacing, Ethernet Configuration, Bluetooth study and analysis of data flow, Zigbee Interfacing and study of signal flow.

UNIT-III IOT PHYSICAL DEVICES AND ENDPOINTS AND CONTROLLING 9

HARDWARE AND SENSORS IoT Physical Devices and Endpoints- Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins. Controlling Hardware- Connecting LED, Buzzer, Switching High Power devices with transistors, Controlling AC Power devices with Relays, Controlling servo motor, speed control of DC Motor, unipolar and bipolar Stepper motors; Sensors- Light sensor, temperature sensor with thermistor, voltage sensor, ADC and DAC, Temperature and Humidity Sensor DHT11, Motion Detection Sensors, Wireless Bluetooth Sensors, Level Sensors, USB Sensors, Embedded Sensors, Distance Measurement with ultrasound sensor.

UNIT-IV CLOUD SERVICES USED IN IOT DEVELOPMENT PLATFORM 9

.

Configuration of the cloud platform, Sending data from the IOT nodes to the gateways using different communication options; Transferring data from gateway to the cloud; Exploring the web services like mail, Messaging (SMS) and Twitter etc.;Tracking of cloud data as per the requirement; Google Cloud service architect; AWS clod Services architect; Microsoft Azure cloud services Architect; OEN source Cloud Services; Initial State Iot Dashboard & Cloud Services

UNIT-V CHALLENGES IN IOT SYSTEM DESIGN – HARDWARE & SOFTWARE 9

Antenna design and placement, Chip-package system development, Power electronics, electromagnetic interference/compatibility (EMI/EMC), Electronics reliability; Battery simulation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547

2.Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759

REFERENCES:

1. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk, O'Reilly (SPD), 2016, ISBN 7989352133895
2. N. Ida, Sensors, Actuators and Their Interfaces, SciTech Publishers, 2014.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : IOT FOR INDUSTRIAL PROCESS OPTIMIZATION		**Course code: 24ECV65**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the building blocks of IoT technology to develop solutions for various real-world IoT applications	I	K3
CO2	Use processors & peripherals to design & build IOT hardware	II	K3
CO3	Assess, select and customize technologies for IOT applications	III	K3
CO4	Demonstrate the use of IoT applications in addressing real-world human and environmental challenges	IV	K3
CO5	Design and implement IOT applications that manage big data	V	K4

24ECV75	REAL TIME OPERATING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamentals and types of RTOS along with task concepts.
- To explain processor dependencies, task parameters, and resource constraints in RTOS.
- To describe the different scheduling algorithms and their optimality for real-time tasks.
- To illustrate the inter-process communication mechanisms and I/O subsystem organization
- To provide practical insight into RTOS through real-world embedded system case studies.

UNIT-I INTRODUCTION TO RTOS 9

History of real time operating systems, applications, characteristics of real time systems, types of RTOS, Hard real time systems, soft real time systems, Temporal parameters of real –time, jobs and processors, Task, Task states, threads.

UNIT-II PROCESSORS DEPENDENCY 9

Processors and resources, parameters of real time workload, periodic, Aperiodic and Sporadic tasks, data dependency, Functional parameters, Precedence constraints and data dependency, Other types of dependencies, resource parameters of jobs and parameters of resources.

UNIT-III SCHEDULING ALGORITHMS 9

Uses of scheduling, Clock driven approach, weighted round-robin approach, Priority driven approach, dynamic and static systems, Effective release times and deadlines, EDF algorithm,LST algorithm, Offline and online scheduling, Fixed priority vs dynamic priority algorithms, optimality of the RM and DM algorithms.

UNIT-IV INTER PROCESS COMMUNICATION 9

Messages, queues, Pipes, semaphores, signals, other building blocks, component configuration,basic i/o configuration, i/o subsystem.

UNIT-V CASE STUDIES 9

Embedded systems in automobile, Automatic Vending Machine, camera hardware and software architecture, Adaptive Cruise Control (ACC) System in Car, Smart Card, Mobile Phone.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jane W.S. Liu, Real Time System, 6th Edition, Pearson Education, 2000.
2. Chowdary Venkateswara Penumuchu, Simple Real-time Operating System, 1st Edition, Trafford Publishing, 2007.
3. Raj Kamal Embedded Systems, 3rd Edition, TMH, 2003.

REFERENCES:

1. Doug Abbott, Linux for Embedded and Real-Time applications, 3rd Edition,Newnes Publications, 2013.
2. Qing Li, Caroline Yao, Real-Time Concepts for Embedded Systems, 1st Edition,CRC Press, 2003.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : REAL TIME OPERATING SYSTEMS		**Course code: 24ECV75**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Describe the concepts of operating systems.	I	K3
CO2	Illustrate the dependencies of the processor and different parameters.	II	K3
CO3	Demonstrate the different algorithms in RTOS.	III	K3
CO4	Analyze the inter process communication.	IV	K4
CO5	Apply RTOS with different case studies.	V	K3

24ECV16	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the fundamental concepts and characteristics of measurement and errors
- To impart the knowledge on the functional aspects of measuring instruments
- To infer the importance of various bridge circuits used with measuring instruments
- To educate the fundamental working of sensors and transducers and their applications
- To emphasis the principles of A/D and D/A conversion, data acquisition& logging and virtual instrumentation

UNIT - I CONCEPTS OF MEASUREMENT 9

Instruments: classification, applications – Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.

UNIT - II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9

Classification of instruments – moving coil and moving iron meters – Attraction type and Repulsion type Moving iron instruments-Electro-dynamometer type Wattmeter– Energy meter – Megger.

UNIT - III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT - IV TRANSDUCERS FOR MEASUREMENT OF NON- ELECTRICAL PARAMETERS 9

Classification of transducers – Resistive Transducer – Strain guage, Measurement of Temperature - RTD, thermister& thermocouple, Capacitive transducer - Inductive Transducers – Linear Variable Differential Transducer, Piezoelectric, Hall effect, optical and digital transducers –– Smart sensors

UNIT - V DIGITAL INSTRUMENTATION 9

A/D converters: types and characteristics – Sampling, Errors- D/A converters: types and characteristics – Digital Storage Oscilloscope - Elements of data acquisition system - Data Loggers –Introduction to Virtual Instrumentation - Instrument standards.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2017.
2. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, 4th Edition 2019.

REFERENCES:

1. E.O. Doebelin, Dhanesh N Manik, 'Measurement Systems' 7th Edition, McGraw Hill publishing company, 2019.
2. R.K. Rajput, 'Electrical and Electronics Measurements and Instrumentation', S. Chand Publications, New Delhi, 4th Edition, 2016.
3. Alan. S. Morris, 'Measurement and Instrumentation: Theory and Application', Prentice Hall of India, 2nd Edition, 2015.
4. Jovitha Jerome ,'Virtual Instrumentation using LabVIEW',PHI learning private Ltd,2nd edition 2011

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ELECTRONIC MEASUREMENTS AND INSTRUMENTATION		**Course code: 24ECV16**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the knowledge of Engineering fundamentals to compute the different statistical parameters.	I	K3
CO2	Explain the principles of Electrical and Electronic measuring instruments	II	K3
CO3	Apply the knowledge of Engineering fundamentals to formulate balance equation for DC and AC bridges and to calculate the unknown quantity.	III	K3
CO4	Identify the various transducers and their basic construction.	IV	K2
CO5	Apply the knowledge of Engineering fundamentals to compute the different statistical parameters.	V	K3

24ECV26	SENSOR CONCEPTS AND TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge in physical principles, classifications, and performance analysis of sensors and transducers.
- To understand the principles, types, and characteristics of optical, radiation, and electrochemical sensors
- To study the principles, types, communication, and standard interfaces of smart sensors
- To understand the working principles, construction of electromechanical and fluid-mechanical actuatorsand devices such as solenoids, relays, and stepper motors.
- To study different types of actuators and controller design methods for automatic temperature control

UNIT – I INTRODUCTION TO MEASUREMENTS AND SENSORS 9

Sensors: Functions- Classifications- Units and standards - Calibration methods- Classification of errors- Limiting error- Probable error -Error analysis-Propagation of error- Odds and uncertainty- principle of transduction-Classification - mathematical model of transducers- Zero, First and Second order transducers- characteristics of first and second order transducers for standard test inputs.

UNIT – II RADIATION AND ELECTRO ANALYTICAL SENSORS 9

Introduction - Basic Characteristics - Types of Photosensistors/Photo detectors – X ray and Nuclear Radiation Sensors – Fiber Optic Sensors, the Electrochemical Cell- The Cell Potential - Standard Hydrogen Electrode (SHE) - Liquid Junction and Other Potentials - Polarization – Concentration Polarization - Reference Electrodes - Sensor Electrodes - Electro ceramics in Gas Media.

UNIT – III SMART SENSORS 9

Introduction - Primary Sensors - humidity sensors - proximity sensors - fluid velocity sensors - Excitation - Amplification - Filters - Converters - Compensation - Information Coding Process - Data Communication - Standards for Smart Sensor Interface.

UNIT – IV AUTOMOTIVE ACTUATORS 9

Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines. Working principles, construction and location of actuators viz. Solenoid, relay, stepper motor etc.

UNIT – V AUTOMATIC TEMPERATURE CONTROL ACTUATORS 9

Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ernest O. Doebelin Dhanesh N.Manik, 'Measurement Systems: Application and Design' 7th Edition (SIE), McGraw Hill Publishers, 2019.
2. Bosch 'Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007

REFERENCES:

1. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013
2. William Ribbens, "Understanding Automotive Electronics -An Engineering
3. Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SENSOR CONCEPTS AND TECHNIQUES		**Course code: 24ECV26**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Describe sensor and transducer principles, error analysis, and dynamic characteristics	I	K3
CO2	Explain the principle of photo, radiation, fiber-optic, and electrochemical sensors, and the role of electroceramics	II	K3
CO3	Demonstrate the working of primary sensors and the associated signal conditioning circuits along with smart sensor interface standards.	III	K3
CO4	Identify the electromechanical and fluid-mechanical	IV	K2
CO5	Design and analyze controllers for fixed and variable displacement type air conditioning systems.	V	K3

24ECV36	WIRELESS SENSOR NETWORK	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of wireless sensor network
- To gain knowledge on the MAC and Routing Protocols of WSN
- To get exposed to 6LOWPAN technology
- To acquire knowledge on the protocols required for developing real time applications using WSN and 6LOWPAN.
- To gain knowledge about operating system related to WSN and 6LOWPAN

UNIT-I INTRODUCTION **9**

Principle of Wireless Sensor Network -Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design Principles, Service interfaces,Gateway, Short range radio communicationstandards-IEEE802.15.4,Zigbeeand Bluetooth. Overview of physical layer and transceiver.

UNIT-II MAC AND ROUTING PROTOCOLS **9**

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols -SMAC Routing protocols – Requirements,Classification - SPIN,DirectedDiffusion,LEACH,PEGASIS

UNIT-III 6LOWPAN **9**

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh- Under - Route-Over, Header Compression - Stateless header compression, Fragmentation and Reassembly , Mobility – types, Mobile IPv6, Proxy Home Agent, NEMO –Routing – MANET, Border routing.

UNIT-IV APPLICATION **9**

Protocol Paradigms – End to end, Real time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQtelemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP),Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions.

UNIT-V TOOLS **9**

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator

TOTAL: 45 PERIODS

TEXT BOOKS:

1. HolgerKarl, Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
2. Anna Forster, “Introduction to Wireless Sensor Networks”, Wiley, 2017.

REFERENCES:

1. ZachShelbySensinodeandCarstenBormann,"6LoWPAN: The Wireless Embedded Internet" John Wiley and Sons, Ltd, Publication, 2009.
2. Philip Levis, "TinyOS Programming", 2006–www.tinyos.net.
3. The Contiki Operating System.http://www.sics.se/contiki.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : WIRELESS SENSOR NETWORK		**Course code: 24ECV36**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Determine solutions for WSNs applications	I	K3
CO2	Identify efficient MAC and Routing Protocols	II	K2
CO3	Design solutions for 6LOWPAN applications	III	K3
CO4	Develop efficient layered protocols in 6LOWPAN	IV	K3
CO5	Determine tools for wireless sensor networks applications.	V	K3

24ECV46	FOUNDATIONS FOR NANO ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To introduce quantum mechanics concepts, approximations and statistical mechanics for understanding nano systems.

UNIT – I INTRODUCTION TO QUANTUM MECHANICS 9

Particles – waves – probability amplitudes – Schrodinger equation – wave packets solutions – operators – expectation values – eigen functions – piecewise constant potentials.

UNIT – II SIMPLE HARMONIC OSCILLATORS AND APPROXIMATIONS 9

SHM Operators – SHM wave packet solutions – Quantum LC circuit – WKB approximations – variational methods.

UNIT – III SYSTEMS WITH TWO AND MANY DEGREES OF FREEDOM 9

Two level systems with static and dynamic coupling – problems in more than one dimensions – electromagnetic field quantization – density of states.

UNIT – IV STATISTICAL MECHANICS 9

Basic concepts – microscopic – quantum systems in equilibrium – statistical models applied to metals and semiconductors.

UNIT – V APPLICATIONS 9

Hydrogen and Helium atoms – electronic states – Atomic force microscope – Nuclear Magnetic Resonance – Carbon nanotube properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS:

3. Rainer Waser, “Nano electronics and Information Technology”, Wiley, Third Edition, 2012.
4. Hagelstein L. Peter, Stephen D. Senturia and Terry P. Orlando, “Introduction to Applied Quantum and Statistical Physics”, Wiley, New York, 2004.

REFERENCES:

1. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2000.
2. Neil Gershenfeld, “The Physics of Information Technology”, Cambridge University Press, 2000.
3. Adrian Ionesu and Kaustav Banerjee, “Emerging Nanoel electronics Life with and after CMOS”, Vol I, II, and III, Kluwer Academic, 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FOUNDATIONS FOR NANO ENGINEERING		**Course code: 24ECV46**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply mathematical tools to solve the problems of quantum mechanics.	I	K3
CO2	Apply the principles of simple harmonic oscillators to solve engineering problems.	II	K3
CO3	Apply the fundamentals of quantum mechanics to solve the one or two dimensional problems.	III	K3
CO4	Apply the fundamental knowledge of statistical mechanics to develop statistical models in metals and semiconductors.	IV	K3
CO5	Explain the application of Nano Electronics in the area of Helium & Hydrogen atoms, atomic force microscope, Nuclear magnetic resonance and Carbon nano tube.	V	K2

24ECV56	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the role and importance of machines that takes over the functions of the heart and lungs.
- To study various mechanical techniques that helps a non-functioning heart.
- To learn the functioning of the unit which does the clearance of urea from the blood.
- To understand the tests to assess the hearing loss and development of electronic devices to compensate for the loss.
- To study about recent techniques used in modern clinical applications.

UNIT - I HEART LUNG MACHINE AND ARTIFICIAL HEART 9

Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart, Schematic for temporary bypass of left ventricle.

UNIT - II CARDIAC ASSIST DEVICES 9

Assisted through Respiration, Right and left Ventricular Bypass Pump, Auxiliary ventricle, Open Chest and Closed Chest type, Intra Aortic Balloon Pumping, Prosthetic Cardiac valves, Principle of External Counter pulsation techniques.

UNIT - III ARTIFICIAL KIDNEY 9

Indication and Principle of Haemodialysis, Membrane, Dialysate, types of filter and membranes, Different types of hemodialyzers, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT - IV RESPIRATORY AND HEARING AIDS 9

Ventilator and its types - Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters. Types of Deafness, Hearing Aids, SISI, masking techniques, wearable devices for hearing correction.

UNIT - V RECENT TRENDS 9

Transcutaneous electrical nerve stimulator, bio-feedback, Diagnostic and point-of-care platforms.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. R.S.Khandpur, “Handbook of Bio Medical Instrumentation”, Tata McGraw Hill, Second Edition, 2003.
2. Dr.M.Arumugam, “Bio Medical Instrumentation”, Anuradha Agencies, 2003.

REFERENCES:

1. Andreas F. Von Recum, “Hand book of bio material evaluation”, McGraw-Hill Professional, 1986.
2. Gray E. Wnek and Gray L. Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering”, Marcel Dekker Inc., New York, 2004.

3. D.S.Sunder, “Rehabilitation Medicine”, Third Edition, Jaypee Medical Publication, 2010.
4. Gray E. Wnek and Gray L. Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering”, Marcel Dekker Inc., 2004.
5. Joseph D. Bronzino, “The Biomedical Engineering Handbook”, Third Edition: Three Volume Set, CRC Press, 2006.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : HUMAN ASSIST DEVICES		**Course code: 24ECV56**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the principles and construction of artificial heart	I	K2
CO2	Discuss the various mechanical techniques that improve therapeutic technology.	II	K2
CO3	Apply the principles of hemodialysis and modern renal assistive technologies to select appropriate dialysis systems and components for effective renal replacement therapy.	III	K3
CO4	Apply respiratory support systems and hearing assistive technologies to address clinic healthcare needs.	IV	K3
CO5	Apply therapeutic and diagnostic assistive technologies for healthcare applications.	V	K3

24ECV66	BIOMEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- A study of the principles and design of medical imaging systems such as X-ray, ultrasound, nuclear medicine, and nuclear magnetic resonance.
- The rapidly growing field of biomedical imaging enables one to visualize physiological structures.
- Provide an overview of physical processes of imaging biological tissues.
- Provide the students with mathematical and computational tools to analyse and interpret a range of biomedical images.

UNIT-I FUNDAMENTALS OF MEDICAL IMAGING SYSTEMS 9

Medical imaging with x-rays, CT, MRI and ultrasound.X-ray radiography, ultrasound, radionuclide imaging, and magnetic resonance imaging (MRI). Biological effects of each modality. Topographical reconstruction principles, including X-ray computed tomography (CT), position emission tomography (PET), and single-photon emission computed tomography (SPECT).

UNIT-II X-RAY IMAGING 9

The EM spectrum, interactions of EM radiation with tissue, ionizing radiation, x-ray production, photo-electric effect, Compton scatter. X-ray imaging - planar imaging: characterizing x-ray beams, Beer's law, linear attenuation coefficients, radiation dose, filtering and collimation, projection radiography, blurring and resolution, SNR. Basic concepts, evolution of x-ray CT scanners, hardware. CT measurement, CT numbers, line integrals and Radon transform. Projection slice theorem. Image reconstruction by filtered back prXojection for parallel and fan beam data. Conbeam CT. Sampling issues; resolution and noise in CT, beam hardening and scatter

UNIT-III NUCLEAR MEDICINE 9

Radioactive decay and radioisotopes. Types of radioactive decay, gamma rays and positrons.Common sources in nuclear medicine. Radio Pharmacy and kinetic modeling. The Anger camera and planar imaging. Collimators and imaging equations. Resolution and SNR. SPECT imaging basics, imaging equation, reconstruction. Resolution and noise properties. Quantitation: scatter, background, sensitivity. PET imaging basics, imaging equation, reconstruction. Resolution and noise properties.

UNIT-IV ULTRASOUND IMAGING 9

Wave equation, reflections and refractions, attenuation and absorption. Ultrasound transducer design, A, M and B mode display. Imaging signal model for pulse echo imaging, Image formation, and resolution and noise characteristics.

UNIT-V MAGNETIC RESONANCE IMAGING 9

MR hardware, spin physics, Bloch equations, Signal detection, spectroscopy, noise, RF excitation, Spin echoes, relaxation, contrast. Spatial encoding, image reconstruction, resolution, Artefacts', Fmri, diffusion MRI.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas Martin Deserno , "Biomedical Image Processing", March 2011, springer.
2. Karen M.Mudry, Robert Plonsey, Joseph D. Bronzino, "Biomedical Imaging", ISBN 9780849318108, Published March 26, 2003 by CRC Press.
3. Sinha G. R, 2014.Patel, B. C., "Medical Image Processing: Concepts And Applications", Prentice Hall

REFERENCES:

1. Foundations of Medical Imaging , Z. H. Cho, J. P. Jones, and M. Singh , Wiley , 1993
2. Rangayyan R M, “Biomedical Image Analysis”, Fifth Edition, CRC Press, 2005
3. Kayvan Najarian, Robert Splinter, “Biomedical Signal and Image Processing”, Second Edition, CRC Press, 2014.
4. Deserno T M, “Biomedical Image Processing”, Springer, 2011

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BIOMEDICAL IMAGING SYSTEMS		**Course code: 24ECV66**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Describe how biomedical imaging systems are used in biological and medical research	I	K3
CO2	Analyze the x ray imaging systems used for needed biomedical applications.	II	K4
CO3	Explain about Nuclear medicine used in SPECT and PET imaging basics	III	K3
CO4	Use electrical stimulation and biofeedback techniques to improve rehabilitation and physiotherapy outcomes.	IV	K
CO5	Apply the principles of ultrasound imaging, ultrasound transducer design, and MRI systems in biomedical imaging applications	V	K3

24ECV76	WIRELESS BODY AREA NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the hardware requirement of BAN
- To understand the communication and security aspects in the BAN
- To know the applications of BAN in the field of medicine

UNIT-I INTRODUCTION 9

Definition, BAN and Healthcare, Technical Challenges- Sensor design, biocompatibility, Energy Supply, optimal node placement, number of nodes, System security and reliability, BAN Architecture – Introduction

UNIT-II HARDWARE FOR BAN 9

Processor-Low Power MCUs, Mobile Computing MCUs ,Integrated processor with radio transceiver, Memory ,Antenna-PCB antenna, Wire antenna, Ceramic antenna, External antenna, Sensor Interface, Power sources- Batteries and fuel cells for sensor nodes

UNIT-III WIRELESS COMMUNICATION AND NETWORK 9

RF communication in Body, Antenna design and testing, Propagation, Base Station-Network topology-Stand –Alone BAN, Wireless personal Area Network Technologies-IEEE 802.15.1,IEEE P802.15.13, IEEE 802.15.14, Zigbee

UNIT-IV COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Counter measures- on physical layer and data link layer, Regulatory issues-Medical Device regulation in USA and Asia, Security and Self-protection-Bacterial attacks, Virus infection, Secured protocols, Self-protection.

UNIT-V APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Sports Medicine, Electronic pill.

TOTAL: 45 PERIODS

TEXT BOOKS

1. SandeepK.S.Gupta,TridibMukherjee,KrishnaKumarVenkataSubramanian,“BodyArea Networks Safety, Security, and Sustainability’’, Cambridge University Press, 2013
2. Mehmet R. Yuce, JamilY.Khan, “Wireless Body Area Networks Technology,Implementation,andApplications”,PanStanford Publishing Pvt.Ltd.,Singapore,2012

REFERENCES:

1. Zhang, Yuan-Ting, “WearableMedicalSensorsandSystems’’, Springer, 2013.
2. Guang-ZhongYang (Ed.),“BodySensorNetworks’’, Springer,2006.
3. Annalisa Bonfiglio,DaniloDeRossi,"Wearable Monitoring Systems",Springer,2011

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : WIRELESS BODY AREA NETWORKS		**Course code: 24ECV76**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the need for body area networks.	I	K2
CO2	Design a BAN for appropriate application in medicine.	II	K3
CO3	Determine the efficiency of wireless communication and networks.	III	K2
CO4	Classify the need for medical device regulation and regulations followed in various regions	IV	K3
CO5	Apply the concepts of BAN for medical applications.	V	K3

24ECV86 BRAIN COMPUTER INTERFACE AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basic concepts of brain computer interface.
- To study the various signal acquisition methods.
- To study the signal processing methods used in BCI.

UNIT-I INTRODUCTION TO BCI 9

Fundamentals of BCI - Structure of BCI system - Classification of BCI - Invasive, Non-invasive and Partially invasive BCI - EEG signal acquisition - Signal Preprocessing - Artifacts removal.

UNIT-II ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity - Mu rhythm, Movement Related Potentials - Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

UNIT-III FEATURE EXTRACTION METHODS 9

Time/Space Methods - Fourier Transform, PSD - Wavelets - Parametric Methods - AR, MA, ARMA models - PCA - Linear and Non-Linear Features.

UNIT-IV FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis - Support Vector Machines - Regression - Vector Quantization-Gaussian Mixture Modeling - Hidden Markov Modeling - Neural Networks.

UNIT-V APPLICATIONS OF BCI 9

Functional restoration using Neuroprosthesis-Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rajesh P.N. Rao, "Brain-Computer Interfacing: An Introduction", Cambridge University Press, 2013.
2. Guido Dornhege, José del R. Millán, Thilo Hinterberger, Dennis J. McFarland and laus-Robert Müller, "Toward Brain-Computer Interfacing", The MIT Press, 2007.

REFERENCES:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller,“Brain Computer Interfaces:Revolutionizing Human-Computer Interaction”, Springer, 2010.
2. R.Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
3. Arnon Kohen, “Biomedical Signal Processing”, Vol. I and II, CRC Press Inc., Boca Rato, Florida, 1986.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : BRAIN COMPUTER INTERFACE AND APPLICATIONS		**Course code: 24ECV86**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply BCI fundamentals to analyze system structures, classifications, and EEG signal Preprocessing with artifact removal.	I	K3
CO2	Apply knowledge of sensor motor activity and neural potentials to analyze brain signal mechanisms in BCI.	II	K4
CO3	Apply time–frequency methods, parametric models, and feature extraction techniques for signal analysis in BCI.	III	K4
CO4	Apply machine learning techniques such as LDA, SVM, regression, clustering, and neural networks for pattern analysis.	IV	K3
CO5	Apply neuroprosthesis concepts and brain-actuated control techniques for functional restoration and external device operation.	V	K4

24ECV17	RF TRANSCEIVERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of RF system design
- To acquaint with the various components of RF system for wireless communications
- To know the basic techniques needed for analysis of RF systems
- To enable the students to verify the basic principles and design aspects involved in RF
  systems components
- To conduct experiments to analyze and interpret data to produce meaningful conclusion and match with theoretical concepts

UNIT-I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes

UNIT-II IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS 9

Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs

UNIT-III FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

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

UNIT-IV FILTERS, OSCILLATORS AND MIXERS 9

Overview - basic resonator and filter configuration, special filter realizations, filter implementation -

Basic oscillator model, high-frequency oscillator configuration, Colpitt’s oscillator - basic

UNIT-V PLL AND FREQUENCY SYNTHESIZERS 9

PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps-Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004
2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012

REFERENCES:

1. Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, 2000
2. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017
3. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : RF TRANSCEIVERS		**Course code: 24ECV17**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply the concepts of nonlinear effects to analyze the performance of RF circuits.	I	K3
CO2	Design RF circuits	II	K4
CO3	Analyze the performance of RF circuit	III	K4
CO4	Apply knowledge to identify a suitable architecture and systematically design an RF System	IV	K3
CO5	Comprehensively record and report the measured data, and would be capable analyzing, interpreting the experimentally measured data and produce the conclusions	V	K4

24ECV27	RADAR TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Radar and Radar equation.
- To understand the types of Radar.
- To understand tracking Radar.
- To understand the various signal processing in Radar.
- To understand the subsystems in Radar.

UNIT-I INTRODUCTION TO RADAR EQUATION 9

The Origins of Radar, Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio, Probabilities of Detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System losses.

UNIT-II CW, MTI AND PULSE DOPPLER RADAR 9

CW and Frequency Modulated Radar, Doppler and MTI Radar - Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance, MTI from a Moving Platform (AMIT), Pulse Doppler Radar.

UNIT-III TRACKING RADAR 9

Tracking with Radar, Monopulse Tracking, Conical Scan, Sequential Lobing, Limitations to Tracking Accuracy, Low-Angle Tracking - Comparison of Trackers, Track while Scan (TWS) Radar- Target prediction, state estimation, Measurement models, alpha - beta tracker, Kalman Filtering, Extended-Kalman filtering.

UNIT-IV RADAR SIGNAL PROCESSING 9

Radar Signal Processing Fundamentals, Detection strategies, Optimal detection, Threshold detection, Constant False alarm rate detectors, Adaptive CFAR, pulse compression waveforms, compression gain, LFM waveforms matched filtering, Binary phase coded pulse compression; Barker codes; Quadriphase code; Polyphase codes; Costas codes; radar ambiguity functions, radar resolution, Detection of radar signals in Noise and clutter, detection of non-fluctuating target in noise.

UNIT-V RADAR TRANSMITTERS AND RECEIVERS 9

Radar Transmitter, Linear Beam Power Tubes, Solid State RF Power Sources, Magnetron, Crossed Field Amplifiers, Other RF Power Sources. The Radar Receiver, Receiver noise power, Super heterodyne Receiver, Duplexers and Receiver Protectors - Radar Displays. Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas -

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Habibur Rahman, “Fundamental Principles of Radar”, CRC press, Taylor and Francis, 2019
2. M.R.Richards, J.A.Scheer and W.A.Holm, “Principles of Modern Radar: Basic Principles”, SciTech Publishing, 2012.

REFERENCES:

1. Nathansan, “Radar design principles, Signal processing and environment”, PHI, Second Edition, 2007.
2. M.I.Skolnik , “Introduction to Radar Systems”, Tata McGraw Hill, 2006.
3. Mark A. Richards, “Fundamentals of Radar Signal Processing”, McGraw-Hill, 2005

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : RADAR TECHNOLOGIES		**Course code: 24ECV27**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Identify the different Radar parameters and derive the Radar equation.	I	K2
CO2	Differentiate various Radar types.	II	K3
CO3	Explain different tracking and filtering schemes.	III	K2
CO4	Apply Signal Processing in target detection.	IV	K3
CO5	Develop Radar transmitters and Receiver blocks.	V	K3

24ECV37	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism
- To explain the mitigation techniques
- To impart comprehensive insight about the current EMC standards
- To illustrate various Measurement techniques

UNIT-I BASIC THEORY 9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories, EMC Engineering Application.

UNIT-II COUPLING MECHANISM 9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radiative coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT-III EMI MITIGATION TECHNIQUES 9

Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

UNIT-IV STANDARDS AND REGULATION 9

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications,

UNIT-V EMI TEST METHODS AND INSTRUMENTATION 9

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber, Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL-STD test methods, Civilian STD test methods.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley

Interscience, 2006

REFERENCES:

1. V Prasad Kodali, “Engineering Electromagnetic Compatibility”, IEEE Press, Newyork, 2001.
2. Henry W. Ott, “Electromagnetic Compatibility Engineering”, John Wiley & Sons Inc, Newyork, 2009.
3. Daryl Gerke and William Kimmel, “EDN‟s Designer‟s Guide to Electromagnetic Compatibility”, Elsevier Science & Technology Books, 2002.
4. W Scott Bennett, “Control and Measurement of Unintentional Electromagnetic Radiation”, John Wiley & Sons Inc., (Wiley Interscience Series) 1997.
5. Dr Kenneth L Kaiser, “The Electromagnetic Compatibility Handbook”, CRC Press 2005.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY		**Course code: 24ECV37**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the basics of EMI/EMC, sources, effects, and hazards.	I	K2
CO2	Analyze different EMI coupling mechanisms and their impacts.	II	K4
CO3	Apply shielding, grounding, filtering, and protection techniques for EMI mitigation.	III	K3
CO4	Illustrate national and international EMI/EMC standards and regulations.	IV	K3
CO5	Illustrate EMI/EMC test methods, instruments, and compliance procedures.	V	K3

24ECV47	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of satellite orbital parameters and different orbits
- To study spacecraft structure with different subsystems
- To apply satellite link design through link budget calculations, atmospheric effects.
- To understand modulation, multiplexing, multiple access methods in satellite communication.
- To Study satellite mobile service and navigational service

UNIT-I SATELLITE ORBITS **9**

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

UNIT-II SPACE SEGMENT **9**

Spacecraft Technology: Structure, Primary power, Attitude and Orbit control - Thermal control and Propulsion - communication Payload and supporting subsystems - Telemetry - Tracking and command-Transponders-The Antenna Subsystem.

UNIT-III SATELLITE LINK DESIGN **9**

Basic link analysis - Link budget calculations -Uplink and Downlink of a satellite link - Atmospheric Losses-Interference analysis - Rain induced attenuation and interference - Ionospheric characteristics -Ionospheric Effects - Link Design with and without frequency reuse

UNIT-IV SATELLITE ACCESS AND CODING METHODS **9**

Modulation and Multiplexing: Voice, Data, Video - Analog and digital transmission system - Digital video Broadcast. Multiple accesses: FDMA, TDMA, CDMA, DAMA Assignment Methods - compression - encryption - Coding Schemes.

UNIT-V SATELLITE APPLICATIONS **9**

INTELSAT Series - INSAT - VSAT - Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles - Differential GPS - Direct Broadcast satellites (DBS/DTH) -Indian Regional Navigation Satellite System (IRNSS).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dennis Roddy,Jones Linwood and David G.Long —Satellite Communication, 5th Edition, McGraw Hill International, 2024.

2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication‖,2nd Edition, Wiley Publications,2002

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.
2. Dennis Roddy, “Satellite Communication”, McGraw Hill International, Fourth Edition, 2006.
3. Timothy Pratt, Charles W. Bostain and Jeremy E. Allnutt, “Satellite Communication”, John Wiley & Sons, Second Edition, 2003.
4. M. Richharia, “Satellite Communication Systems: Design Principles”, Mac Millan, 2003.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SATELLITE COMMUNICATION		**Course code: 24ECV47**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply orbital parameters and launching procedures to determine suitable satellite trajectories.	I	K3
CO2	Explain about the satellite space segment with various satellite subsystems	II	K2
CO3	Derive the satellite Link design with uplink, downlink, rain effects	III	K3
CO4	Apply accessing schemes such as TDMA, FDMA and CDMA for satellite communication	IV	K3
CO5	Illustrate various satellite applications such as Navigational and Mobile services	V	K3

24ECV57 REMOTE SENSING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation.
- To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing.
- To acquire skills in storing, managing digital data for planning and development.
- To acquire skills in advance techniques such as hyper spectral, thermal and LiDAR scanning for mapping, modeling and monitoring.

UNIT-I REMOTE SENSING AND ELECTROMAGNETIC RADIATION 9

Definition – components of RS – History of Remote Sensing – Merits and demerits of Data Collation between conventional and remote sensing methods – Electromagnetic Spectrum – Radiation principles – Wave theory, Planck‘s law, Wien’s Displacement Law, Stefan’s Boltzmann law, Kirchhoff‘s law – Radiation

UNIT-II EMR INTERACTION WITH ATMOSPHERE AND EARTH 9

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows – Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance– Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface

UNIT-III ORBITS AND PLATFORMS 9

Motions of planets and satellites – Newton‘s law of gravitation – Gravitational field and potential – Escape velocity – Kepler‘s law of planetary motion – Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms – Ground based, Air borne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites –

UNIT-IV SENSING TECHNIQUES 9

Classification of Remote Sensors – Resolution concept: spatial, spectral, radiometric and temporal resolutions – Scanners – Along and across track scanners – Optical-infrared sensors – Thermal sensors – Microwave sensors – Calibration of sensors – High Resolution Sensors – LIDAR, UAV – Orbital and sensor characteristics of live Indian earth observation satellites.

UNIT-V DATA PRODUCTS AND INTERPRETATION 9

Photographic and Digital products – Types, levels and open-source satellite data products – selection and procurement of data – Visual interpretation: basic elements and interpretation keys – Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Thomas M. Lillesand, Ralph W. Kiefer and Jonathan W. Chipman, Remote Sensing and Image interpretation, John Wiley and Sons, Inc., New York, 2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing, Third Edition Universities Press (India) Private limited, Hyderabad, 2018

REFERENCES:

1. Stanley A Morain; Amelia M Budge; Michael S Renslow. Manual of Remote Sensing. Vol. I, American Society for Photogrammetry and Remote Sensing, Virginia, USA, 4th edition, 2019
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, First edition, 2022.
3. Paul Curran P. J. Principles of Remote Sensing Longman, RLBS, 1996.
4. Introduction to Physics and Techniques of Remote Sensing, Charles Elachi and Jacob Van Zyl, 3rd Edition , Wiley Publication, 2021.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, Third edition, 2020.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : REMOTE SENSING		**Course code: 24ECV57**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Analyze the basic principles and concepts of remote sensing and electromagnetic (EM) waves.	I	K4
CO2	Develop the structure of the atmosphere, and the interaction of electromagnetic radiation with	II	K4
CO3	Describe the laws governing planetary and satellite motion	III	K3
CO4	Discuss the various types of remote sensors and orbital characteristics of operational Indian Earth observation satellites.	IV	K3
CO5	Illustrate the fundamentals of photographic and digital remote sensing products	V	K3

24ECV67 MICs AND RF SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To study the characteristics of Active components and applications.
- To design the RF filter and analyze the circuits operated at millimeter wavelength
- To understand the basics of Microwave integrated circuits
- To learn the concepts of non reciprocal components for MICs
- To design the antenna and analyze its performance using measurement techniques

UNIT-I ACTIVE RF COMPONENTS AND APPLICATIONS 9

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networks-
impedance matching using discrete components, microstripline matching networks, amplifier classes of operation and biasing networks.

UNIT-II RF FILTER DESIGN 9

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.

UNIT-III INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS 9

Overview of ABCD and S parameters - Overview of Planar transmission lines (Stripline, Microstripline, Slotline, CPW, Finline)-Design Parameters for Strip Line And Microstripline-Active

UNIT-IV NON RECIPROCAL COMPONENTS FOR MICs 9

Microstrip on Ferrimagnetic substrates, Microstrip circulators. Isolators and phase shifters, Design of microstrip circuits – high power and low power circuits.

UNIT-V INTEGRATED ANTENNA DESIGN AND MEASUREMENTS 9

Integrated Antenna Design- Photonic Band Gap Antennas - Micro Machined Antenna - Micro Electro Mechanical System Antennas - Test Fixture Measurements - Probe Station Measurements - Thermal and Cryogenic Measurements- Experimental Field Probing Techniques.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.(Unit – I, II)
2. Bharathi Bhat, Shiban K. Koul, "Stripline-like Transmission Lines for Microwave Integrated Circuits", New Age International Pvt Ltd Publishers, 2007.(Unit –III ,V)
3. Gupta KC and Amarjit Singh, "Microwave Integrated circuits", Wiley Eastern, 1974.(Unit – IV)

REFERENCES:

1.MathewM. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.
2. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.
3. RolandE. Best, Phase –
Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003
4. David Pozar ,Microwave Engineering, John Wiley& Sons Inc., 4th Edition, 2012
5. Ravender Goyal, “Monolithic MIC; Technology & Design”, Artech House, First Edition 1989

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MICS AND RF SYSTEM DESIGN		**Course code: 24ECV67**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply knowledge of S parameter theory to any RF active component design circuit for	I	K3
CO2	Analyze microwave circuits for filters design.	II	K4
CO3	Apply suitable performance parameters to analyze the operation of a practical Microwave Integrated Circuit.	III	K3
CO4	Create communication circuits and subsystems with practical design parameters for non- reciprocal components in MICs.	IV	K3
CO5	Design microwave integrated antenna design circuit for the required Performance using professional software tools	V	K3

24ECV77	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic of avionics and its need for civil and military aircrafts
- To impart knowledge about the avionic architecture and various avionics data buses
- To gain more knowledge on various avionics subsystems
- To understand the concepts of navigation systems.
- To gain knowledge on auto pilot system

UNIT-I INTRODUCTION TO AVIONICS 9

Need for avionics in civil and military aircraft and space systems – integrated avionics and weapon systems – typical avionics subsystems, design, technologies – Introduction to digital computer and memories.

UNIT-II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.

UNIT-III FLIGHT DECKS AND COCKPITS 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT-IV INTRODUCTION TO NAVIGATION SYSTEMS 9

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT-V AIR DATA SYSTEMS AND AUTO PILOT 9

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
2. Collinson.R.P.G. “Introduction to Avionics”, Chapman and Hall, 1996.

REFERENCES:

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", Longman Group UK Ltd., England, 1989

2. Pallet.E.H.J., "Aircraft Instruments and Integrated Systems", Pearsons, Indian edition 2011.
3. Spitzer, C.R. "Digital Avionics Systems", Prentice-Hall, Englewood Cliffs, N.J.,U.S.A. 1993.
4. Spitzer. C.R. "The Avionics Hand Book", CRC Press, 2000

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : AVIONICS SYSTEMS		**Course code: 24ECV77**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply suitable design principles to develop a Digital Avionics Architecture.	I	K3
CO2	Design Navigation system	II	K3
CO3	Integrate avionics systems using data buses	III	K3
CO4	Analyze the performance of various cockpit display technologies.	IV	K4
CO5	Design autopilot for small aircrafts using MATLAB.	V	K3

24OE301	FUNDAMENTALS OF IMAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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 methods.

PRE-REQUISITE: NIL

UNIT - I DIGITAL IMAGE FUNDAMENTALS **9**

Steps in Digital Image Processing - 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.

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.

UNIT - V IMAGE COMPRESSION **9**

Fundamentals of image compression - Compression methods - Huffman Coding, Arithmetic Coding, LZW Coding, Run-Length coding, Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding, Predictive Coding, Wavelet Coding.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Pearson, Third Edition, 2010.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson, 2002.

REFERENCES:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, “Digital Image Processing

using MATLAB", Pearson Education, Inc., 2011.
3. D.E. Dudgeon and R.M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : FUNDAMENTALS OF IMAGE PROCESSING		**Course code: 24OE301**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the fundamentals of digital image processing techniques.	I	K2
CO2	Apply the various transforms and its properties for 2D signals.	II	K3
CO3	Apply the various filters for image restoration.	III	K3
CO4	Examine feature extraction methods for segmentation.	IV	K4
CO5	Apply the different coding methods for image compression.	V	K3

24OE302	CONSUMER ELECTRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To give students an in depth knowledge of various electronic audio and video devices and systems.
- To introduce the consumer electronic gadgets/goods/devices like audio-systems, CD systems.
- To give organization structure and principles of working of various other components like visual display, keyboard drives and printers.
- To find employment in computer industry, repair and maintenance field.

PRE-REQUISITE: - NIL -

UNIT - I AUDIO SYSTEMS **9**

Microphones, their types: Carbon, velocity, crystal, condenser, cordless etc. Loud Speaker: Direct radiating, horn loaded woofer, tweeter, mid-range, multi-speaker system, baffles and enclosures. Sound recording on magnetic tape, its principles, block diagram and tape transport mechanism, Digital sound recording on tape and disc, CD system, Hi- Fi system, pre-amplifier, amplifier and equalizer system, stereo amplifiers, public address systems, Graphics Equalizer, speed Synthesizer, Electronic tuning.

UNIT - II VIDEOSYSTEMS **9**

B&W TV, color TV and HD TV systems, LCD, LED, PLASMA Systems, Electronic cameras, VCR, VCP, CD systems, Memory diskettes, Discs and drums. Dolby noise reduction digital and analog recording. Digital projection systems (LCD, DLP, SVGA to UXGA system) Block diagram and principles of working of cable TV and DTH, cable TV using internet.

UNIT - III COMPUTER SYSTEM **9**

Different types of mother boards - Single Board Based System - Different types of Buses PCI, ISA, SCSI & Serial and Parallel Ports, USB - Hard Disk Device (HDD) - Computer Monitor - Video Display Adopters - Keyboard - Mouse - Scanner - Printer - digitizer.

UNIT - IV MOBILE PHONE **9**

Architecture - Connectivity - RF Transceiver - Antennas - Tx/Rx switch - Baseband part - System-on-chip - ADC/DAC - Memory and storage - Camera - Sensors - Operating system - Microphone and Speaker - Display and Keypad - Battery.

UNIT - V HOUSEHOLD APPLIANCES **9**

Microwaves: Microwave Oven Block Diagram, LCD Timer with Alarm, Types of Microwave Ovens Washing Machines: Electronic controller for Washing Machines, Washing Machine Hardware, Air Conditioning: Components of Air Conditioning Systems, Remote Control-buttons, Unitary and Central Air Conditioning Systems, Split Air Conditioners. Refrigeration: Refrigerants, Refrigeration Systems, Dish Washers.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jim Ledin, “Modern Computer Architecture and Organization: Learn x86, ARM, and RISC-V architectures and the design of Smartphones, PCs, and cloud servers”, Packt Publishing, Illustrated Edition, 2020.
2. S.P.Bali, “Consumer Electronics”, Pearson Education, 2007.

REFERENCES:

1. R.G. Gupta, “Audio and Video Systems: Principles, Maintenance and Troubleshooting”, McGraw Hill Education, Second Edition, 2017.
2. Jacob Beckerman, “How to Build a Computer: Learn, Select Parts, Assemble, and Install: A Step by Step Guide to Your First Homebuilt”, JIBB Publishing, First Edition, 2014.
3. R.R. Gulati, “Modern Television Practice: Transmission, Reception and Applications”, New Age International Private Limited, 2015.
4. Nick Vandome, “Android Phones for Seniors in easy steps: Updated for Android v7 Nougat”, In Easy Steps Limited, Second Edition, 2019.
5. Sajid Umair and Muhammad Yousaf Shah, “Mobile Devices and Smart Gadgets in Human Rights”, IGI Global, 2018.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CONSUMER ELECTRONICS		**Course code: 24OE302**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the fundamentals of digital image processing techniques.	I	K2
CO2	Implement various image enhancement techniques used in digital image processing.	II	K3
CO3	Apply the various filters for image restoration.	III	K3
CO4	Examine feature extraction methods for segmentation.	IV	K4
CO5	Apply the different coding methods for image compression.	V	K3

24OE303	SATELLITE COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of satellite orbits.
- To analyze the geo stationary and non geo stationary orbits.
- To acquire the knowledge about launching procedures.
- To study the satellite system engineering, orbital mechanism and effects.
- To study and analysis of multiplexing and multiple access techniques.
- To study and analysis of earth station antenna and equipment.

PRE-REQUISITE: NIL

UNIT - I SATELLITE ORBITS 9

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

UNIT - II SPACE SEGMENT 9

Spacecraft Technology: Structure, Primary power, Attitude and Orbit control - Thermal control and Propulsion - communication Payload and supporting subsystems - Telemetry - Tracking and command - Transponders - The Antenna Subsystem.

UNIT - III SATELLITE LINK DESIGN 9

Basic link analysis - Link budget calculations - Uplink and Downlink of a satellite link - Atmospheric LossesInterference analysis - Rain induced attenuation and interference - Ionospheric characteristics - Effects - Link Design with and without frequency reuse.

UNIT - IV SATELLITE ACCESS AND CODING METHODS 9

Modulation and Multiplexing: Voice, Data, Video - Analog and digital transmission system - Digital video Broadcast - Multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods - compression - encryption.

UNIT - V SATELLITE APPLICATIONS 9

INTELSAT Series: INSAT, VSAT. - Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles - Direct Broadcast satellites (DBS/DTH) - Indian Regional Navigation Satellite System (IRNSS).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Dennis Roddy, "Satellite Communication", Mc Graw Hill International, Fourth Edition, 2006.
2. Timothy Pratt, Charles W. Bostain and Jeremy E. Allnutt, "Satellite Communication", John Wiley & Sons, Second Edition, 2003.

REFERENCES:

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/Pearson, 2007.
2. N.Agarwal, “Design of Geosynchronous Space Craft”, Prentice Hall, 1986.
3. Bruce R. Elbert, “The Satellite Communication Applications”, Hand Book, Artech House Bostan, London, 1997.
4. Tri T. Ha, “Digital Satellite Communication”, McGraw-Hill Communications Series, Second Edition, 1990.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SATELLITE COMMUNICATION SYSTEMS		**Course code: 24OE303**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Elaborate the Extended and reusable satellite launching vehicles and launching procedures of satellite systems.	I	K3
CO2	Apply the knowledge of the satellite space segment and various satellite subsystems in satellite communication systems.	II	K3
CO3	Analyze the satellite link design considering uplink, downlink, rain effects, and ionospheric characteristics.	III	K4
CO4	Examine feature extraction methods for segmentation.	IV	K3
CO5	Analyze various satellite applications such as Intelsat series and Mobile Satellite Services.	V	K4

24OE304	INTRODUCTION TO VLSI TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the VLSI era.
- To introduce the fundamental concepts relevant to VLSI fabrication.
- To enable the students to understand the various VLSI fabrication technique.

PRE-REQUISITE: NIL

UNIT - I LOGIC DESIGN WITH MOSFETS **9**

Ideal Switches and Boolean Operations - MOSFETs as Switches- Basic Logic Gates in CMOS - Complex Logic Gates in CMOS - Transmission Gate Circuits - Clocking and Dataflow Control.

UNIT - II PHYSICAL STRUCTURE OF CMOS INTEGRATED CIRCUITS **9**

Integrated Circuit Layers - Interconnect Resistance and capacitance – MOSFETs - Electrical Conduction in silicon - nFETs and pFETs - Current flow in a FET - driving the gate capacitance - CMOS Layers - Designing FET Arrays.

UNIT - III FABRICATION OF CMOS INTEGRATED CIRCUITS **9**

Overview of Silicon Processing - Material Growth and Deposition - Silicon dioxide - Silicon Nitride - polycrystal silicon – metals - doped silicon layers - chemical mechanical polishing – Lithography - The CMOS Process Flow - Design Rules.

UNIT - IV ELECTRICAL CHARACTERISTICS OF MOSFETS **9**

MOS Physics - derivation of threshold voltage - nFET Current - Voltage Equations - SPICE level 1 equation - body bias effects - derivation of the current flow equation - The FET RC Model - pFET Characteristics - Modeling of Small MOSFET.

UNIT - V ELECTRONIC ANALYSIS OF CMOS LOGIC GATES **9**

DC Characteristics of the CMOS Inverter - Inverter Switching Characteristics - Power Dissipation - DC Characteristics: NAND and NOR Gates - NAND and NOR Transient Response - Analysis of Complex Logic Gates - Gate Design for Transient Performance - Transmission Gates and Pass Transistors.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John P. Uyemura, “Introduction to VLSI Circuits and Systems”, John Wiley& sons, 2001.
2. S.K. Gandhi, “VLSI Fabrication Principles”, John Willey & Sons, Second Edition, 2008.

REFERENCES:

1. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems”, PHI, 2005.

2. Neil H.E. Weste and K. Eshraghian, “Principles of CMOS VLSI Design: A System Perspective”, McGraw Hill, 2010.
3. Sung-Mo Kang, Yusuf Lablebici and Chulwookim, “CMOS Digital Integrated Circuits, Analysis and Design”, McGraw Hill, Fourth Edition, 2019.
4. Neil H.E. Weste, “CMOS VLSI Design: A Circuit and System Perspective”, Pearson Education, 2011.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INTRODUCTION TO VLSI TECHNOLOGY		**Course code: 24OE304**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the introduction of MOSFET as simple logic-controlled switches and the design of CMOS static logic gates at the Boolean level.	I	K2
CO2	Apply the concepts of integrated circuit patterned material layers to control the flow of signals.	II	K3
CO3	Analyze the satellite link design considering uplink, downlink, rain effects and ionospheric characteristics.	III	K3
CO4	Analyze the switch-level description down to the physical level.	IV	K4
CO5	Develop the electrical properties of CMOS logic circuits.	V	K3

24ECM01	SEMICONDUCTOR PHYSICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- This course will develop a student to learn the fundamental physics of semiconductor material.
- The course also covers the working and applications fundamentals semiconductor devices.
- To comprehend the characteristics of the diode and transistors.
- To realize the physics of special semiconductor devices.

UNIT - I BAND THEORY OF SOLIDS 9

Introduction, Bloch theorem, E-k diagram, Kronig penny model, Classification of solids based on electrical properties and energy band gap, band structure of semiconductors, Types of semiconductor sIntrinsic & extrinsic semiconductor, Majority and minority charge carriers. Concentration of electrons and holes in intrinsic semiconductors, law of mass action, Relation between Fermi level and Energy gap in an Intrinsic semiconductor.

UNIT - II ELECTRICAL CONDUCTIVITY OF A SEMICONDUCTORS 9

Electrical Conductivity in an intrinsic semiconductor. Impurities level and Femi level in P-type and N-type semiconductor (qualitative and derivation), Variation of carrier concentration with temperature, conductivity of extrinsic semiconductor, Minority carrier life time, Mobility of current carriers, drift and diffusion (qualitative). The continuity equations (derivation). Hall effect, determination of Hall coefficient (derivation), Applications of Hall effect.

UNIT - III TRANSISTORS 9

Junction Transistor, types and their working, Transistor Current components, Detailed study of the current in a transistor, Common Base (CB), Common Collector (CC), Common Emitter (CE) configuration characteristics and its graphical analysis, Current gains α and β, Relations between α and β. Load line(ac & dc), Operating Point, hybrid parameters Transistor amplifier in CE mode for both NPN & PNP transistor, hybrid equivalent of CE, Emitter follower, impedance matching (qualitative) Numericals.

UNIT - IV FIELD EFFECT TRANSISTOR(FET) & SPECIAL DIODES 9

Construction of JFEET, idea of channel formation, pinch- off voltage, Transfer and output characteristics. MOSFET: MOS Diode, Basic construction of MOSFET and working, I-V characteristics, enhancement and depletion modes, Complimentary MOS (CMOS). Zener Diode - VI Characteristics – Zener diode as peak clipper, Tunneling Effect-Tunnel diode, Varactor Diode, –Point Contact Diode-Shcottkey Diode, PIN Diode,

UNIT - V SEMICONDUCTOR DEVICES FABRICATION 9

Semiconductor device fabrication process: Oxidation, Diffusion, Ion implantation, Lithography, Thin film deposition technique, Epitaxy, Examples: P-N junction device fabrication.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Modern Physics, R.Murugeshan & Er.K.Shivaprasath, S.Chand (2015).
2. Semiconductor Device Fundamentals, Robert F. Pierret, Pearson education.

REFERENCES:

1. Solid state Physics,S. O. Pillai, New age International Publishers.
2. Hand Book of Electronics, Gupta and Kumar, Pragati Prakasan, Meerut
3. Physics for degree students, C L Arora and P. S. Hemme, S Chand Publications.
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning.
5. Introduction to Solid State Physics, Charles Kittel, Wiley India Pvt. Ltd.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SEMICONDUCTOR PHYSICS		**Course code: 24ECM01**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the fundamentals of band theory and semiconductor materials.	I	K2
CO2	Use the concepts of electrical conductivity and Hall effect in semiconductors.	II	K3
CO3	Demonstrate the characteristics and operation of transistor configurations.	III	K3
CO4	Utilize FETs, MOSFETs, and special diodes in electronic circuit applications.	IV	K3
CO5	Implement semiconductor fabrication techniques for semiconductor device realization.	V	K3

24ECM02 DIGITAL SYSTEM DESIGN & MICROPROCESSOR

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce fundamental digital concepts including number systems, binary codes, and the principles of Boolean algebra.
- To teach systematic methods for simplifying Boolean functions using Karnaugh Maps and universal gates.
- To design and analyze various standard combinational and sequential logic circuits.
- To understand the architectural details, memory organization, and operating modes of the 8086 microprocessors.
- To develop proficiency in 8086 assembly language programming, focusing on instruction sets and addressing modes.
-

UNIT - I NUMBER SYSTEMS AND CODES 9

Decimal, binary, octal and hexadecimal Number System, Number System conversions, Signed binary numbers: Sign Magnitude Approach, 1's complement Approach, and 2's Complement Approach, Binary codes: Weighted and Non-weighted codes, Alphanumeric codes, Reflective codes, digital logic gates, Boolean algebra, basic theorems & properties, Boolean functions, canonical and standard forms.

UNIT - II LOGIC GATE LEVEL IMPLEMENTATION 9

Gate level minimizations, K-Map – two variable, three variable, four variable and five variables, SOP, POS simplifications, NAND and NOR implementation and other two-level implementation.

UNIT - III COMBINATIONALCIRCUITS 9

Combinational circuits for code converters, Binary adders: half adder, full adder,N-bit parallel binary adder, Binary subtractor: half subtractor, full subtractor, N-bit Parallel Binary Subtractor, Binary Multiplier (2x2), comparator (1 and 2 bit only), decoder, encoder, priority encoder, multiplexers, demultiplexers.

UNIT - IV SEQUENTIAL CIRCUITS 9

Memory Elements: latches and flipflops, Overview of clock.
Latches: SR latch, Gated SR latch, Gated D latch. Flip-flops: SR flip flop, JK flipflop, D flipflop, and T flipflop. Excitation Table for flip flops, flipflop conversion.
Counters: Asynchronous Counters: ripple, modulo, BCD or decade, and divide by N counter. Ring Counter, Twisted Tail Ring Counter.
Synchronous Counters**:** n-bit synchronous counter, synchronous counter as sequence generator. Shift Registers.

UNIT - V INTRODUCTION TO 8086 MICROPROCESSOR 9

Features, Architecture and Register Organization, Memory Organization & Segmentation, 8086 flag register, Signal description of 8086 common function signals, operating modes, Addressing Modes of 8086, Overview of various types of instruction set.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. John Wakerly, “Digital Design: Principles and Practices”, Pearson Education
2. D.V. Hall, “Digital Circuits and Systems”, Tata McGraw Hill, 1989

REFERENCES:

1. R.P. Jain, “Modern digital Electronics”, TataMcGrawHill,4thedition,2009.
2. Morris Mano and Michael Ciletti, “Digital Design”, Pearson Education

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SYSTEM DESIGN USING VERILOG		**Course code: 24ECM03**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Explain the concepts of number systems, binary codes, Boolean algebra, and logic gates.	I	K2
CO2	Simplify Boolean functions using Karnaugh maps and implement logic circuits using universal gates.	II	K3
CO3	Construct combinational circuits using arithmetic, coding, and data routing components.	III	K3
CO4	Implement sequential circuits using flip-flops, counters, and shift registers.	IV	K3
CO5	Use the 8086 microprocessor architecture, addressing modes, and instruction set in basic programming applications.	V	K3

24ECM03 SYSTEM DESIGN USING VERILOG

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know the basic language features of Verilog HDL and the role of HDL in digital logic design.
- To know the behavioural modelling of combinational and simple sequential circuits.
- To know the behavioural modelling of algorithmic state machines.
- To know the synthesis of combinational and sequential descriptions.
- To know the architectural features of programmable logic devices.

UNIT - I INTRODUCTION TO VERILOG 9

Structural models of combination logic, logic simulation, design verification, test methodology, propagation delay, truth table models of combinational and sequential logic with Verilog modules, ports, gate types, gate delays, dataflow modelling, continuous assignments delays, expressions, operators, operands, operator.

UNIT - II VERILOG COMBINATIONAL & SEQUENTIAL CIRCUITS MODULES 9

Behavioral modeling, data types for behavioral modeling, behavioral models of combinational logic, propagation delay and continuous assignments, lathes and level sensitive circuits in Verilog, cyclic behavioral models of flip flops and latches, cyclic behavior and edge detection, a comparison of styles for behavioral modeling.

UNIT - III BEHAVIORAL DESIGN OF SEQUENTIAL LOGIC CIRCUITS 9

Behavioral models of multiplexers, encoders and decoders data flow model of a LFSR machines with multicycle operations, algorithmic state machine charts for behavioral modeling, asmd charts, behavioral models of counters, shift registers and register files, switch debounce, metastability, synchronizers for asynchronous signals.

UNIT - IV INTRODUCTION TO SYNTHESIS 9

synthesis of combinational logic, synthesis of sequential logic with latches, synthesis of three state devices and bus interfaces, synthesis of sequential logic with flip flops, synthesis of explicit state machines registered logic. Synchronous Counters: n-bit synchronous counter, synchronous counter as sequence generator.

UNIT - V PROGRAMMABLE LOGIC DESIGN 9

Programmable logic devices, storage devices, programmable logic array programmable array logic, programmability of PLDs ,CPLDs.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Michael D Ciletti - Advanced Digital Design with the VERILOG HDL, 2ND Edition, PHI, 2009.
2. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003.

REFERENCES:

1. Stephen Brown and Zvonko Vranesic - Fundamentals of Digital Logic with Verilog, 2nd Edition, TMH, 2008.
2. Z Navabi - Verilog Digital System Design, 2nd Edition, McGraw Hill, 2005.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SYSTEM DESIGN USING` VERILOG		**Course code: 24ECM03**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Develop Verilog HDL models for combinational and sequential logic circuits using structural and dataflow modeling.	I	K3
CO2	Implement behavioral models of combinational and sequential circuits using Verilog HDL.	II	K3
CO3	Construct behavioral models for sequential logic circuits, counters, shift registers, and ASMD-based designs.	III	K3
CO4	Apply synthesis techniques to design combinational, sequential, and finite state machine circuits using Verilog HDL.	IV	K3
CO5	Describe the architecture and programmability of PLDs, PLAs, PALs, and CPLDs.	V	K3

24ECM04 ADVANCED DIGITAL DESIGN USING VERILOG

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study Finite state machines and its realization.
- To study asynchronous Sequential machine.
- To learn Designing of Digital logic using PLD.
- To get knowledge of different FPGA series.
- To study different CPLD series.

UNIT - I FINITE STATE MACHINE (FSM) 9

Introduction, Design Strategies, Mealy & Moore model, Realization of State Diagram & state table from verbal description, Minimization of State Table from completely & Incompletely specified State Machine, Introduction to Algorithmic State Machine.

UNIT - II ASYNCHRONOUS SEQUENTIAL CIRCUIT 9

Introduction to Asynchronous Sequential Machine (ASM), fundamental & pulse mode Asynchronous Sequential machine, Secondary State Assignments in Asynchronous Sequential machine, Races & Hazards.

UNIT - III PROGRAMMABLE LOGIC DEVICES (PLD) 9

Introduction, Architecture, Features & Digital Design of ROM, EPROM, EEPROM, Flash Memory, PLA, PAL & PGA.
Design of Combinational and Sequential Circuits, keypad scanner using PLD.

UNIT - IV FIELD PROGRAMMABLE GATE ARRAY (FPGA) 9

FPGA-Configurable Logic Block, IO block programmable interconnect, LUT based, Multiplexer based Technology mapping, Routing architecture, FPGA Design flow.
Block Diagram and CLB of Xilinx FPGA XC3000 and Xilinx FPGA XC4000, use of One-hot Assignment Technique in FPGA.

UNIT - V COMPLEX PROGRAMMABLE LOGIC DEVICES (CPLD) 9

Difference between FPGA and CPLDs, Altera series – Max 5000/7000 series and Altera FLEX logic- 10000 series CPLDs, AMD's- CPLD (Mach 1 to 5), Cypress FLASH 370 Device technology, Lattice plsi architectures – 3000 series – Speed performance and system programmability.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. P. K. Chan& S. Mourad, Digital Design using Field Programmable Gate Array, Prentice Hall.
2. S. Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Pub.

REFERENCES:

1. J. Old Field, R. Dorf, Field Programmable Gate Arrays, John Wiley& Sons, New York.
2. S.Brown, R.Francis, J.Rose, Z.Vransic, Field Programmable Gate Array, Kluwer Pub
3. Richard FJinder, “Engineering Digital Design,” Academic press

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : ADVANCED DIGITAL DESIGN USING VERILOG		**Course code: 24ECM04**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply state machine concepts to design and minimize synchronous sequential circuits using Mealy, Moore, and ASM models.	I	K3
CO2	Implement asynchronous sequential circuit design techniques to analyze races and hazards in pulse and fundamental mode circuits.	II	K3
CO3	Construct digital systems using Programmable Logic Devices (PLDs) such as ROM, PLA, PAL, and FPGA-based memory devices.	III	K3
CO4	Employ FPGA design methodologies to implement digital circuits using configurable logic blocks, routing architectures, and technology mapping.	IV	K3
CO5	Execute CPLD-based design techniques to realize programmable digital systems using industry-standard CPLD architectures.	V	K3

24ECM05	DIGITAL INTEGRATED CIRCUIT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of MOS and CMOS logic gate design.
- To analyze the CMOS combinational and sequential logic circuit design.
- To acquire the knowledge about dynamic logic circuit design.
- To study the VLSI design methodology.
- To study thedifferent ASIC Design Flow.
-

UNIT - I MOSFET and CMOS Theory **9**

Evolution of VLSI, MOS threshold voltage, MOS device design equations, MOSFET scaling and small geometry effects, MOSFET capacitances.

CMOS logic gate design: CMOS inverter, DC characteristics, rise time, fall time delays, noise margin, static & dynamic power dissipation, CMOS NAND, NOR, XOR and XNOR gates, Transistor sizing.

UNIT - II CMOS COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUIT DESIGN **9**

CMOS Combinational Circuit: Design Half Adder, Full Adder, Multiplexer, Demultiplexers using CMOS.

CMOS Sequential logic circuits: Design SR latch, SR flip flop, JK flip flop, D flip flop using CMOS.

UNIT - III DYNAMIC LOGIC CIRCUIT DESIGN **9**

Logic Gate design using pass transistor, different Combinational Circuit design using transmission gate and Pseudo NMOS logic.

Dynamic logic circuits: Basic principle, non-ideal effects, domino CMOS logic, high performance dynamic CMOS circuits, clocking issues, clock distribution.

UNIT - IV VLSI DESIGN METHODOLOGY **9**

VLSI design methodology, design Hierarchy, concept of regularity, modularity & locality, VLSI design style like Full Custom, Semi-Custom, Gate Array, Standard Cell and FPGA, design flow, Design quality Parameters, computer aided design technology, stick diagram and design rules, lambda-based design rules.

UNIT - V ASIC DESIGN FLOW **9**

Introduction of Application Specific Integrated Circuit (ASIC) Design Flow: An overview of Backend VLSI Design Flow – Libraries, Floor-planning, Placement, Routing, Verification, Testing. Specifications and Schematic cell Design, Spice simulation Analysis of analog and digital circuits, Circuit Extraction, Electrical rule check, Layout Vs. Schematic (LVS), Post-layout Simulation and Parasitic extraction, Design format, Timing analysis, Back

notation and Post layout simulation, ASIC design implementation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sung-Mo Kang & Yosuf Leblebici, “CMOS Digital Integrated Circuits: Analysis & Design”,Mcgraw Hill, 4th Edition.
2. A.S. Sedra and K.C. Smith, “Microelectronic Circuits,” Saunder's College11 Publishing, 4th edition.

REFERENCES:

1. Introduction to VLSI, Eshraghian & Pucknell, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007
2. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL INTEGRATED CIRCUIT		**Course code: 24ECM05**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Apply MOSFET characteristics and CMOS logic design principles to design basic CMOS logic gates.	I	K3
CO2	Construct CMOS-based combinational and sequential logic circuits for digital applications.	II	K3
CO3	Develop dynamic CMOS logic circuits using pass transistor, transmission gate, pseudo-NMOS, and domino logic techniques.	III	K3
CO4	Illustrate VLSI design methodology, layout design rules, and CAD tools in CMOS circuit design.	IV	K3
CO5	Perform ASIC design implementation using floor planning, routing, verification, timing analysis, and post-layout simulation.	V	K3

24ECM06	VLSI TESTING AND TESTABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basics of testing and fault modeling.
- To get knowledge of testing and testability of combinational circuits.
- To get knowledge of testing and testability of sequential circuits.
- To study the Built-in Self-Test (BIST), memory and delay faults including IDDQ testing.
- To study the verification using UVM.

UNIT - I BASICS OF TESTING AND FAULT MODELLING 9

Introduction, Principle of testing, Types of testing, DC and AC parametric tests, Fault modelling, Stuck-at fault, Fault equivalence, Fault collapsing, Fault dominance, Fault simulation, Temporary Faults, Testing of Chips, Automatic test equipment.

UNIT - II TESTING AND TESTABILITY OF COMBINATIONAL CIRCUITS 9

Test generation basics, Test generation algorithms, Path sensitization, Boolean difference, D-algorithm, Testable combinational logic circuit design, The Reed Mullar Expansion Technique, Three-Level OR-AND-OR Design, Automatic Synthesis of Testing Logic, Testable Design of Multilevel Combinational Circuits, Synthesis of Random Pattern Testable Combinational Circuits, Path Delay Fault Testable Combinational Logic Design, Testable PLA Design.

UNIT - III TESTING AND TESTABILITY OF SEQUENTIAL CIRCUITS 9

Testing of sequential circuits as iterative combinational circuits, state table verification, test generation based on circuit structure, Design of testable sequential circuits, Ad Hoc design rules, scan path technique (scan design), Partial scan, Level Sensitive Scan Design, Random Access Scan Technique, Partial Scan, Testable Sequential Circuit Design Using Non scan Techniques, Cross Check, Boundary Scan.

UNIT - IV BUILT-IN SELF-TEST, DELAY FAULT AND IDDQ TESTING 9

Test pattern generation of Built-in Self-Test (BIST), Output Response Analysis, Circular BIST, BIST Architectures.

Testable memory design, RAM fault models, test algorithms for RAMs, Delay faults, Delay test, IDDQ testing, testing methods, limitations of IDDQ Testing, BIST Techniques for Ram Chips, Test Generation and BIST for Embedded RAMs.

UNIT - V VERIFICATION USING UVM 9

Introduction to Universal Verification Methodology (UVM), Transaction, Test bench & its component, UVM class factory overview, UVM reporting, Device Under Test (DUT) and its connection with environment, Scoreboards, coverage, predictors, monitors, Hierarchy in UVM, Factory Overrides, Interfaces in UVM, Configuration, Introduction of sequences,

Multiple Sequences configuration, UVM register Model, RM & its use in verification, RM integration, TLM (Transaction Level Modelling).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. N. K. Jha and S. G. Gupta, “Testing of Digital Systems”, Cambridge University Press.
2. M. L. Bushnell and V. D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, Kluwar Academic Publishers.
3. P. K. Lala, “Digital Circuit Testing and Testability”, Academic Press.

REFERENCES:

1. Zainalabe Navabi, “Digital System Test and Testable Design: Using HDL Models and Architectures”, Springer.
2. M.Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VLSI TESTING AND TESTABILITY		**Course code: 24ECM06**	
CO	**COURSE OUTCOMES**	**UNIT**	**K- CO**
CO1	Utilize testing principles and fault modelling techniques to identify faults in digital integrated circuits.	I	K3
CO2	Implement test generation algorithms and design-for-testability techniques for combinational logic circuits.	II	K3
CO3	Employ scan-based and non-scan design-for-testability techniques to test sequential circuits.	III	K3
CO4	Demonstrate Built-In Self-Test (BIST), memory testing, delay fault, and IDDQ testing techniques for testing VLSI circuits.	IV	K3
CO5	Execute Universal Verification Methodology (UVM) concepts and transaction-level modelling techniques to verify digital hardware designs.	V	K3