Dr. Babasaheb Ambedkar Technological University

Course Structure and Syllabus

For

M. Tech. (Electronics & Communication Engineering)

Two Year (Four Semester) Course

(w.e.f. July 2017)

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,

Lonere-402103, Raigad (MS)

M.Tech. (Electronics & Communication Engineering)

Objectives

I. To serve the society and nation, by providing high quality engineering educational programs to the students, engaging in research and innovations that will enhance the skill and knowledge and assisting the economic development of the region, state, and nation through technology transfer.

II. To equip the postgraduate students with the state of the art education through research and collaborative work experience/culture to enable successful, innovative, and life-long careers in Electronics and Telecommunication.

III. To encourage the post-graduates students, to acquire the academic excellence and skills necessary to work as Electronics and Telecommunication professional in a modern, ever-evolving world.

IV. To provide the broad understanding of social, ethical and professional issues of contemporary engineering practice and related technologies, as well as professional, ethical, and societal responsibilities.

V. To inculcate the skills for perusing inventive concept to provide solutions to industrial, social or nation problem.

Outcomes

I. Students of this program will have ability to apply knowledge of mathematics, sciences and engineering to Electronics and Telecommunication problems.

II. Postgraduate students will gain an ability to design and conduct experiments, as well as to analyze and interpret data/results.

III. Learners of this program will built an ability to design and develop a system, components, devices, or process to meet desired needs.

IV. Masters students of this program will have an ability to work on multi-disciplinary teams and also as an individual for solving issues related to Electronics and Telecommunication.

V. Learners of this program will have an ability to identify, formulate, and solve Engineering problems by applying mathematical foundations, algorithmic principles, and Electronics and Telecommunication theory in the modeling and design of electronics systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.

VI. Postgraduate students will have an ability to communicate effectively orally and in writing and also understanding of professional and ethical responsibility.

VII. Postgraduate students will have an ability to use the techniques, skills, and modern engineering EDA tools necessary for Electronics and Telecommunication practices.

VIII. Learners of this program will have an ability to evaluate Electronics and Telecommunication Engineering problems with cost effectiveness, features, and user friendliness to cater needs for innovative product development.

IX. Postgraduate students will have an ability to solve contemporary social and industrial problems by engaging in life-long learning.

Dr. Babasaheb Ambedkar Technological University

Teaching and Examination Scheme for

M.Tech. (Electronics & Communication) w.e.f. July 2017

Sr. No.	Course Code	Name of the course	Hours/Week			Credit	Examination scheme				
							Theory		IA	PR/OR	TOTAL
			L	P	T		TH	Test			
First Semester											
01	MTECC101	Advanced Communication Engineering	03	--	1	04	60	20	20	--	**100**
02	MTECC102	Wireless Communication	03	--	1	04	60	20	20	--	**100**
03	MTECC103	Signal Processing Algorithms & Applications	03	--	1	04	60	20	20	--	**100**
04	MTECE114	Elective-I	03	--	--	03	60	20	20	--	**100**
05	MTECE125	Elective-II	03	--	--	03	60	20	20	--	**100**
06	MTECC106	Communication Skills	02	--	--	02	--	--	25	25	**50**
07	MTECL107	PG Lab-I*	--	03	--	02	--	--	25	25	**50**
		Total for Semester I	**17**	**03**	**03**	**22**	**300**	**100**	**150**	**50**	**600**
Second Semester											
01	MTECC201	Image and Video Processing	03	--	1	04	60	20	20	--	**100**
02	MTECC202	Information Theory and Coding	03	--	1	04	60	20	20	--	**100**
03	MTECE233	Elective-III	03	--	--	03	60	20	20	--	**100**
04	MTECE244	Elective- IV	03	--	--	03	60	20	20	--	**100**
05	MTECE255	Elective-V- (Open to all)	03	--	--	03	60	20	20	--	**100**
06	MTECS206	Seminar-I	--	04	--	02	--	--	50	50	**100**
07	MTECP207	Mini-Project	--	04	--	02	--	--	50	50	**100**
		Total for Semester II	**15**	**8**	**02**	**21**	**300**	**100**	**200**	**100**	**700**
Third Semester											
1	MTECC301	Project Management & Intellectual Property Rights (Self Study)#	--	--	--	02	--	--	50	50	**100**
2	MTECP302	Project-I	--	--	--	10	--	--	50	50	**100**
		Total for Semester III	**--**	**--**	**-**	**12**	**--**	**--**	**100**	**100**	**200**
Fourth Semester											
1	MTECP401	Project-II	--	--	--	20	--	--	100	100	**200**
		Total for Semester IV	**--**	**--**	**--**	**20**	**--**	**--**	**100**	**100**	**200**
GRAND TOTAL											**1700**

* PG Lab-I –Practical shall be based on courses of first semester.

Student has to choose this course either from NPTEL/MOOC pool and submission of course completion certificate is mandatory.

Elective-I

A. Artificial Neural Networks and Applications
B. Electronics Interference and Compatibility
C. Analog and Mixed Signal Processing
D. Low Power VLSI Circuit & System
E. Smart Antenna

Elective-II

A. Remote Sensing Systems
B. Advanced Radar System
C. Optical Fiber Communication
D. Statistical Signal Processing
E. Microelectronics

Elective-III

A. Multirate Digital Signal Processing
B. Embedded System Design
C. Wireless Sensor Network Design
D. Microwave Design and Measurement
E. Estimation and Detection Theory

Elective-IV

A. Advanced Biomedical Signal Processing
B. Reconfigurable Computing
C. Digital VLSI Design
D. Networks and Systems Security
E. Multicarrier Communication

Elective-V (Open)

A. Internet of Things
B. Linear Algebra
C. Multimedia Communication
D. Research Methodology
E. Wavelet Transforms and its Applications

ADVANCED COMMUNICATION ENGINEERING

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide basic knowledge in the field of Advanced Communication Engineering
B	To develop greater awareness and sensitivity to some important considerations of advanced communication

Course Outcomes:

CO1	Learner will learn how to design and represent band pass signal
CO2	Learner will be able to analyze digital modulation techniques and their reception
CO3	Learner will be able to demonstrate basic principles of data communication and different digital data transmission formats
CO4	Learner will learn how to derive BER and PEP expression
CO5	Learner will be know the different transmission principles
CO6	Learner will know different types of broadband networks and different networking aspects.

Unit I

Spread Spectrum Communication: Direct sequence and frequency hopped spread spectrum, spreading sequences and their correlation functions, Acquisition and tracking of spread spectrum signals Code, Division Multiple Access (CDMA): DS-CDMA on AWGN channels, DS-CDMA on frequency selective fading channels, Performance analysis of cellular DS-CDMA, Capacity estimation, Power control effect of imperfect power control on DS-CDMA performance, Soft Hand offs, Spreading/coding tradeoffs, multi carrier CDMA, IS95A CDMA systems, 3rd Generation CDMA systems,

UNIT II

Multi user detection, Optimum receivers, SIC, PIC receivers and performance, Networks & Services: Network Transmission System Design Services, Characterization of networks & tele services, The Telephone Network – Past, Present & Future, and Network issues.

UNIT III

Data Communication Networks: Basic principles of data communication – synchronous and asynchronous transmission – digital data transmission formats NRZ, RZ, AMI, ASI & Manchester coding, Error correcting codes, Hamming codes, Orthogonal codes, Switching – Circuit switching, Message switching, Packet switching, Standard communication interface multipliers and concentrators,

Protocols (BOP-COP – standard networks and standards, OSI, (D) ARPANET, NICNET, SNA, SELS etc. LAN types of LAN – WAN, Digital telephony, Basic principle of ISDN – E Mail – Voice mail.

UNIT IV

Transmission Principles: Transmission aspects, Signals and Impairments, Digital Speech Transmission, Digitisation of Speech & Audio.

UNIT V

Teletraffic: Digital Networks, Network Synchronization, Multiplexing – Digital Hierarchies, Synchronous Digital Hierarchy, Digital Switching, Signaling,

UNIT VI

Introduction to Teletraffic. ISDN & ATM: Integrated Services Digital Network – ISDN, Broadband ISDN & ATM, Broadband Access Networks, Optical Networks, Network Aspects: Intelligent Network, Network Management, and Introduction to Network management softwares.

Text Books/Reference:

1. Andrew J Viterbi, CDMA Principles of spread spectrum communications, Addition Wesley, (1995).
2. J S Lee and L E Miller, CDMA systems engineering handbook, Artech House, (1998).
3. Marvin K Simon, Jim K Omura, Robert A Scholtz, Bary Klevit, Spread Spectrum Communications, (1995).
4. Sergio Verdu, Multiuser Detection, Cambridge University Press, (1998).
5. Andrew S Tanenbaum, Computer Networks, Prentice Hall of India.

WIRELESS COMMUNICATION

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in depth understanding for fundamental concepts of modern mobile and wireless communication system
B	To develop understanding on the challenges and opportunities in the wireless medium in designing current and future wireless communication systems and networks.

Course Outcomes:

CO1	Learner will be able to analyze different services and their requirements.
CO2	Learner will be able to analyze and design receiver and transmitter diversity techniques
CO3	Learner will be able to determine the appropriate transceiver design of multi-antenna systems and evaluate the data rate performance.
CO4	Learner will be able to Design wireless communication systems with key 3G (e.g.,CDMA) and 4G (OFDM) technologies
CO5	Learner will be able to Describe and differentiate four generations of wireless standard for cellular networks.

UNIT I

Services And Technical Challenges:

Types of Services, Requirements for the services, Multipath propagation, Spectrum Limitations, Noise and Interference limited systems, Principles of Cellular networks, Multiple Access Schemes.

UNIT II

Wireless Propagation Channels

Propagation Mechanisms (Qualitative treatment), Propagation effects with mobile radio, Channel Classification, Link calculations, Narrowband and Wideband models.

UNIT III

Wireless Transceivers

Structure of a wireless communication link, Modulation and demodulation – Quadrature Phase Shift Keying, p/4-Differential Quadrature Phase Shift Keying, Offset-Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Minimum Shift Keying, Gaussian Minimum Shift Keying, Power spectrum and Error performance in fading channels.

UNIT IV

Signal Processing In Wireless Systems

Principle of Diversity, Macrodiversity, Microdiversity, Signal Combining Techniques, Transmit diversity, Equalisers- Linear and Decision Feedback equalisers, Review of Channel coding and Speech coding techniques.

UNIT V

Advanced Transceiver Schemes

Spread Spectrum Systems- Cellular Code Division Multiple Access Systems- Principle, Power control, Effects of multipath propagation on Code Division Multiple Access, Orthogonal Frequency Division Multiplexing – Principle, Cyclic Prefix, Transceiver implementation, Second Generation(GSM, IS–95) and Third Generation Wireless Networks and Standards.

UNIT VI

3G and 4G Wireless Standards

GSM, GPRS, WCDMA, LTE, WiMAX.

Text Books/Reference:

1. Rappaport. T.S., Wireless communications, Pearson Education, 2003.
2. Gordon L. Stuber, Principles of Mobile Communication, Springer International Ltd., 2001.
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

SIGNAL PROCESSING ALGORITHMS AND APPLICATIONS

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To instill research skills and bring in optimal solutions and novel products to signal processing and allied application areas using modern technology and tools that are technically sound, economically feasible and socially acceptable.
B	To enable the graduates to engage in signal processing and its broad range of applications to understand the challenges of the rapidly changing environment and adapt their skills through reflective and continuous learning.
C	To provide graduates strong mathematical skills and in depth knowledge in signal theory to analyze and solve complex problems in the domain of signal processing

Course Outcomes:

CO1	Learner will be able to analyze the time and frequency response of discrete time system.
CO2	Learner will be able to design digital filters for various applications.
CO3	Learner will be able to design FIR and IIR filters for various applications
CO4	Learner will be able to understand the fundamentals of multi rate signal processing and its application
CO5	Learner will be able to understand signal representation in terms of dimension, orthogonality etc.
CO6	Learner will be able to analyze least square method for power spectrum estimation

UNIT I

Introduction

Review of discrete time signals and systems, Different transforms, Filtering, Use of DFT in linear filtering, Filtering of long data sequences, Spectrum, Algorithm for convolution and DFT.

UNIT II

LTI DT System in Transform Domain and Digital Filter Structures

Simple Digital Filters**,** All Pass, Linear Phase and Minimum & Maximum phase and Complementary transfer Functions. Basic FIR and IIR Digital Filter Structures, Linear Phase Structure IIR, FIR and All pass Lattice Structure.

UNIT III

Design of Digital Filters

General consideration, Design of FIR filters, Design of IIR filters from Analog filters, Frequency transformations, Design of Digital Filters Based on Least-square Method. Spectral Transformation of IIR Filters.

UNIT IV

Multirate Signal Processing

Filter banks, Interpolators, Decimators, Polyphase decomposition, Analysis and synthesis, Orthogonal and orthonormal filter banks.

UNIT V

Signal Representation

Representation of deterministic signals, orthogonal representation of signals, Dimensionality of signal spaces, Construction of orthogonal basis functions, Time-bandwidth relationship, RMS duration and bandwidth, Uncertainty relations, Multiresolution Analysis and Wavelet Transform.

UNIT VI

Linear Prediction and Optimum Filter Design

Least square methods for system modeling, Adaptive filters, Power spectrum estimation.

Text Books/Reference:

1. Sanjit Mitra, Digital Signal Processing A Computer-Based Approach, , MCG
2. A V Oppenheim, Schafer, Discrete Time Signal Processing; PHI.
3. Proakis; McMillan, Advanced Digital Signal Processing.
4. P P Vaidyanathan, Multirate systems and Filter Banks; Prentice Hall Eaglewood.
5. John D Proakis, Digital Signal Processing : Principles, Algorithms and Applications; PHI.
6. S Hykin, Adaptive Filter Theory; PHI.

ELECTIVE-I

ARTIFICIAL NEURAL NETWORKS AND APPLICATIONS

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of fundamental theory and concepts of computational intelligence methods
B	To understand the fundamental theory and concepts of neural networks, neuro-modeling, several neural network paradigms and its applications.

Course Outcomes:

CO1	Learner will be able to articulate analogy of human neural network for understanding of artificial learning algorithms.
CO2	Learner will be able to analyze radial basis function network.
CO3	Learner will be able to analyze neural network architecture & basic learning algorithms.
CO4	Learner will be able to understand mathematical modeling of neurons, neural networks.
CO5	Learner will be able to analyze training, verification and validation of neural network models
CO6	Learner will be able to design Engineering applications that can learn using neural networks

UNIT I

Brain Style Computing: Origins and Issues**,** Biological neural networks, Neuron Abstraction, Neuron Signal.

UNIT II

Functions, Mathematical Preliminaries, Artificial Neurons, Neural Networks and Architectures Pattern analysis tasks: Classification, Clustering, mathematical models of neurons, Structures of neural networks, learning principles.

UNIT III

Feed forward neural networks: Pattern classification using perceptron, Multilayer feed forward neural networks (MLFFNNs), Pattern classification and regression using MLFFNNs, Error back-propagation learning, Fast learning methods: Conjugate gradient method.

UNIT IV

Auto-associative neural networks, Pattern storage and retrieval, Hopfield model, recurrent neural networks, Bayesian neural networks,

UNIT V

Radial basis function networks: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification

UNIT VI

Self-organizing maps: Pattern clustering, Topological mapping, Kohonen's self-organizing map Introduction to cellular neural network, Fuzzy neural networks, and Pulsed neuron models recent trends in Neural Networks

Text Books/Reference:

1. Satish Kumar, Neural Networks, A Classroom Approach, Tata McGraw-Hill, 2003

2. JacekZurada, Introduction to Artificial Neural Networks, Jaico Publishing House, 1997.

3. S.Haykin, Neural Networks, A Comprehensive Foundation, Prentice Hall, 1998.

4. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

5. B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 1999.

6. L.O. Chua and T. Roska, Cellular Neural Networks and Visual Computing Foundation and Applications, Cambridge Press, 2002.

ELECTIVE-I

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH : 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To familiarize with the fundamentals that are essential for electronics industry in the field of EMI / EMC
B	To understand EMI sources and its measurements.
C	To understand the various techniques for electromagnetic compatibility.

Course Outcomes:

CO1	Learner will acquire knowledge of EMI / EMC sources and their standards
CO2	Lerner will be able to measure different parameters of interference in EM
CO3	Learner will be able to reduce the interference within EM devices
CO4	Lerner will be able to illustrate the physical and statistical model of EM devices
CO5	Lerner will be able to analyze the EM devices in terms of Computer Based Modeling and Simulation
CO6	Learner will be able to design electronic systems that function without errors or problems related to electromagnetic compatibility.

UNIT I

Introduction to EMI / EMC:

EMI / EMC Standards, Introduction to E, H, Near and far field radiators, Receptors and antennas, Different types of EMI sources and possible remedies.

UNIT II

Measurement techniques in EMI:

Open area test sites, Radiated interference measurements, Conducted interference measurements, Interference immunity.

UNIT III

EMI reduction techniques:

Grounding, Shielding, Bonding, and EMI filters.

UNIT IV

Probabilistic and Statistical Physical Model:

Introduction, Probability considerations, Statistical Physical Models of EMI / EMC, EMC of terrestrial radio communication systems.

UNIT V

Computer Based Modeling and Simulation:

Computer Based Modeling and Simulation of EMI Models and Signal Integrity.

Text Books /Reference:

1. V. Prasad Kodali, Engineering Electromagnetic Compatibility, Principles and Measurement Technologies; IEEE Press
2. Devid A. Weston, Marcol Dekker, Electromagnetic Compatibility, Principles and Applications;, Inc New York.

ELECTIVE-I

ANALOG AND MIXED SIGNAL PROCESSING

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of the fundamental concepts of analog signal processing.
B	To provide in-depth understanding of data conversion, PLL design, filter design.

Course Outcomes:

CO1	Learner will be able to distinguish between fundamental concepts of analog an discrete time signal processing.
CO2	Learner will be able to design switched capacitor filters.
CO3	Learner will be able to demonstrate basics of analog to digital data conversion.
CO4	Learner will be able to design analog and digital PLLs
CO5	Learner will be able to understand fundamentals of green data converters.

UNIT I

Switched Capacitor filters: Introduction to Analog and Discrete Time signal processing, sampling theory, Nyqist and over sampling rates, Analog filters, analog amplifiers, lock in amplifiers,

UNIT II

Analog integrated and discrete time switched capacitor filters, non-idealities in switched capacitor filters, architectures for switched capacitor filters and their applications and design. Switched capacitor amplifiers.

UNIT III

Data converters: Basics of data converters, Types of data converters, types of ADCs, Successive approximation, dual slope, Flash type, pipelined ADCs, hybrid ADCs, high resolution ADCs, parallel path ADCs like time-interleaved and multi-channel converters.

UNIT IV

Types of DACs and their architectures, binary weighted DACs. Performance metrics of data converters, SNR, SFDR, SNDR.

UNIT V

Background and foreground techniques to improve performance of data converters, Green data converters (low power design).

UNIT VI

Frequency synthesizers and synchronization: Analog PLLs, Digital PLLs design and architectures, Delay locked loops design and architectures. Direct Digital Synthesis.

Text/Reference Books

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008

2. R. Jacob Baker, Switched-Current Signal Processing and A/D Conversion Circuits: Design and Implementation, , Wiley India IEEE press 2008.

3. Andrzej Handkiewicz, Mixed Signal Systems: a guide to CMOS circuit design, , IEEE computer Society Press.

4. Walt Kester, Mixed Signal and DSP Design techniques, Engineering Analog Devices Inc, Engineering Analog Devices Inc, , Publisher Newnes.

5. Bar-Giora Goldberg, Digital Frequency Synthesis Demystified, Published by Elsevier.

ELECTIVE-I

LOW POWER VLSI CIRCUIT & SYSTEM

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of the fundamental concepts of VLSI circuit and system.
B	To provide various strategies and methodologies for designing low power circuit and Systems.

Course Outcomes:

CO1	Learner will be able to distinguish between different logic families.
CO2	Learner will be able to understand different sources of power dissipation
CO3	Learner will be able to understand the supply voltage scaling approaches
CO4	Learner will be able to understand capacitance minimization approaches
CO5	Learner will be able to differentiate between leakage power minimization approaches.

UNIT I

BASICS OF MOS CIRCUITS:

MOS Transistor structure and device modelling, MOS Inverters , MOS Combinational Circuits - Different Logic Families

UNIT II

SOURCES OF POWER DISSIPATION:

Dynamic Power Dissipation: Short Circuit Power, Switching Power, Gliching Power, Static Power Dissipation, Degrees of Freedom

UNIT III

SUPPLY VOLTAGE SCALING APPROACHES:

Device feature size scaling, Multi-Vdd Circuits , Architectural level approaches: Parallelism, Pipelining , Voltage scaling using high-level transformations , Dynamic voltage scaling ,Power Management

UNIT IV

CAPACITANCE MINIMIZATION APPROACHES:

Hardware Software Tradeoff , Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization , Clock Gating , Logic styles

UNIT V

LEAKAGE POWER MINIMIZATION APPROACHES:

Variable-threshold-voltage CMOS (VTCMOS) approach , Multi-threshold-voltage CMOS (MTCMOS) approach , Power gating ,Transistor stacking , Dual-Vt assignment approach (DTCMOS)

UNIT VI

SPECIAL TOPICS:

Adiabatic Switching Circuits , Battery-aware Synthesis , Variation tolerant design CAD tools for low power synthesis

Text Books /Reference:

1. Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata Mcgrag Hill.
2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).
3. A. Bellamour, and M. I. Elmasri, Low Power VLSI CMOS Circuit Design, Kluwer Academic Press, 1995.
4. Anantha P. Chandrakasan and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publishers, 1995.
5. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley-Interscience, 2000

ELECTIVE-I

SMART ANTENNA

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of modern antenna concepts, and practical antenna design for various applications
B	To provide in-depth understanding of of smart antenna concept with a view that the student can further explore the topic for research purpose.

Course Outcomes:

CO1	Learner will be able to compare the performances of digital radio receivers and software radios.
CO2	Learner will be able to understand the CDMA spatial processors to analyze the multi-cell systems.
CO3	Learner will be able to analyze the channel models for smart antenna systems.
CO4	Learner will be able to understand the environmental parameters for signal processing of smart antenna systems.
CO5	Learner will be able to evaluate the requirements for the design and implementation of smart antenna systems

UNIT I:

Introduction to Smart Antennas, Need for Smart Antennas, Smart Antenna Configurations.

UNIT II:

Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Mutual Coupling Effects, DOA Estimation Fundamentals, Introduction to Array Response Vector, Received Signal Model, The Subspace Based Data Model, Signal Auto-covariance Matrices.

UNIT III:

Conventional DOA Estimation Methods: Conventional Beam forming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, The MUSIC Algorithm, The ESPRIT, Algorithm, Uniqueness of DOA Estimates,

UNIT IV:

Beam forming Fundamentals, The Classical Beam former-Statistically Optimum Beam forming Weight Vectors, The Maximum SNR Beam former, The Multiple Side lobe Canceller and the Maximum, SINR Beam former- Minimum Mean Square Error (MMSE),.

UNIT V:

Direct Matrix Inversion, (DMI), Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beam forming, The Least Mean Square (LMS) Algorithm, The Recursive Least Squares (RLS) Algorithm, Space–Time Processing: Introduction, Discrete Space–Time Channel and Signal Models, Space–Time, Beam forming, Inter symbol and Co-Channel Suppression, ISI Suppression, CCI, Suppression,

UNIT VI:

Data Rates in MIMO Systems, Single-User Data Rate Limits, Multiple Users Data Rate Limits, Data Rate Limits Within a Cellular System, MIMO in Wireless Local Area Networks, Mobile Stations' Smart Antennas, Combining Techniques, Selection (Switched) Diversity, Maximal Ratio Combining, Adaptive Beam forming or Optimum Combining, RAKE Receiver Size, Mutual Coupling Effects, Dual-Antenna Performance Improvements, Downlink Capacity Gains

Text Books /Reference:

1. C. A. Balanis, Antenna Theory and design, John Wiley and sons, 1997.
2. J. D. Kraus, antennas, Mc-Graw-Hill, 1988.
3. R. A. Sainathi, CAD of microstrip antennas for wireless applications, Artech House, 1996.
4. R. Garg, P. Bharhia, I. Bahl, and A. Ittipiboo, Microstrip antenna design handbook, Artech House.

ELECTIVE-II

REMOTE SENSING SYSTEM

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH : 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To expose the students to the basics of remote sensing system
B	To provide an in-depth understanding needed to perform image processing using different remote sensing techniques.

Course Outcomes:

CO1	The course gives you an insight into remote sensing, both in theory (mathematical and physical background) and in practice (applications and training)
CO2	Learner will be able to understand the information content of remotely sensed data and how to retrieve the information.
CO3	Learner will be able to understand the basics of digital image pprocessing
CO4	Learner will be able to decide which remote sensing techniques suite your specific needs
CO5	Learner will be able to know the current trending topics in the field of remote sensing.

UNIT I

Introduction, Basic concepts of remote sensing, Energy sources and radiation principles, Energy interactions with atmosphere and earth surface features, Spectral reflectance curves,

UNIT II

Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Multispectral, thermal and hyperspectral sensing.

UNIT III

Digital Image Processing - Image restoration, Image enhancement and Information extraction, Image processing software, Digital Elevation Modeling,

UNIT IV

Sources of digital elevation data, Shuttle Radar Topographic Mission (SRTM) data, DEM for Slope, Aspect, Flow direction, Flow pathways, Flow accumulation, Streams, Catchment area delineation,

UNIT V

Remote sensing applications for watershed management, Rainfallrunoff modeling, Irrigation management, Flood mapping, Drought assessment, Environment and ecology,

UNIT VI

Advanced Topics - Microwave remote sensing, sources of microwave data, Global positioning System (GPS).

Text Books /Reference:

1. T.M. Lillesand and R.W. Kiefer, Remote Sensing and Image Interpretation', , John Wiley & Sons, Singapore, 2002.
2. J.B. Cambell, Introduction to Remote Sensing', Taylor & Francis, UK, 2002.
3. F.F. Sabins Jr, W.H. Freeman & Co, Remote Sensing - Principles and Interpretation',., New York, 1986.
4. R.A. Schowengerdt, Remote Sensing - Models and Methods for Image Processing', , Elsevier India Pvt. Ltd., New Delhi, 2006.
5. Paul J Gibson, Introduction to Remote Sensing - Principles and Concepts' by, Routledge - Taylor & Francis, 2000.
6. Paul J Gibson and Clare H Power, Introduction to Remote Sensing - Digital Image Processing and ApplicationsRoutledge - Taylor & Francis, 2000.

ELECTIVE-II
ADVANCED RADAR SYSTEM

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in depth learning of conventional RADAR System.
B	To overcome the problem faced by conventional RADAR System and implement the modern RADAR system for the welfare of society.

Course Outcomes:

CO1	Learner will be able to study historical background of RADAR system.
CO2	Learner will be able to analyze Doppler radar and MTI: Doppler effect.
CO3	Learner will be able to learn importance of the ambiguity function and the matched filter.
CO4	Learner will be able to explore the concepts of Aperture Radar: principles, SAR.
CO5	Learner will be able to sunthesize Kalman filters.
CO6	Learner will be able to application of Bistatic radar:

UNIT I

Introduction: historical background, radar terminology, radar band designations The radar equation: point targets, radar cross section, distributed targets, propagation, coverage diagrams.

UNIT II

Noise, clutter and detection: theory of detection, sea and land clutter models, CFAR Processing Displays: A,scope, B,scope, PPI, modern displays, Doppler radar and MTI: Doppler effect, delay line cancellers, blind speeds, staggered PRFs, Adaptive Doppler filtering

UNIT III

Pulse Doppler processing and STAP: airborne radar, high, low and medium PRF operation, Space Time Adaptive Processing, Pulse compression: principles, the ambiguity function, the matched filter, chirp waveforms, SAW technology

.**UNIT IV**

Waveform design: nonlinear FM, phase codes, waveform generation and compression FM radar: principles, radar equation, effect of phase and amplitude errors.,Synthetic Aperture Radar: principles, SAR processing, autofocus, spotlight mode, airborne and spaceborne systems and applications, interferometry, ISAR.

UNIT V

Tracking radar: conical scan, monopulse, tracker, track while scan, Kalman filters,Avionics and radionavigation: Air Traffic Control, primary and secondary radar, GPS Phased array, radar: phased array principles, array signal processing, multifunction radar, scheduling, Electronic Warfare: ESM, ECM, ECCM; super resolution, IFM, types of jammers, calculation of performance, adaptive arrays, LPI radar.

UNIT VI

Stealth and counter, stealth: stealth techniques for aircraft and other target types, low frequency and UWB radar,Bistatic radar: bistatic geometry, bistatic radar equation, synchronisation, illuminators of opportunity System design examples.

Text Books/Reference:

1. Mark Richards, James Scheer, William Holm, Principles of Modern Radar SciTech Publishing, 2010, ISBN number: 978-1891121524
2. Introduction to Radar Systems – Merrill I. Skolnik, SECOND EDITION, McGraw-Hill, 1981.

ELECTIVE-II

OPTICAL FIBER COMMUNICATION

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH : 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To expose the students to the basics of signal propagation through optical fibers, fiber impairments, components and devices and system design.
B	To provide an in-depth understanding needed to perform fiber-optic communication system engineering calculations, identify system tradeoffs, and apply this knowledge to modern fiber optic systems.

Course Outcomes:

CO1	Learner will be able to recognize and classify the structures of Optical fiber and types.
CO2	Learner will be able to demonstrate electromagnetic and mathematical analysis of light wave propagation.
CO3	Learner will be able to analyze fabrication techniques of different optical fibers.
CO4	Learner will be able to interpret behavior of pulse signal and various loss mechanism.
CO5	Learner will be able to interpret Dispersion compensation mechanism, Scattering effects and modulation techniques.
CO6	Learner will be able to interpret working of Fiber based devices.

UNIT I

Introduction and importance of Fiber Optics Technology, Ray analysis of optical fiber: Propagation mechanism of rays in an opticalfiber, Meridional rays, Skew rays, Fiber numerical aperture, dispersion.

UNIT II

Electromagnetic (modal) analysis of Step index multimode fibers: Wave equation and boundary conditions, Characteristics equation, TE, TH and Hybrid modes, Weakly guiding approximation,

linearly polarized modes, Single mode fiber, V parameter, Power confinement and mode cutoff, Mode field diameter.

UNIT III

Graded-index fiber: Modal analysis of graded index fiber, WKB analysis, Optimum profile.

Experimental techniques in fiber optics: Fiber fabrication (OVD, VAD, CVD, MCVD,PMCVD etc) and characterization, Splices, Connectors and fiber cable.

UNIT IV

Loss mechanism in optical fiber: Absorption loss, scattering loss, bending loss, splice loss.

Pulse propagation, Dispersion and chirping in single mode fibers: Pulse propagation in non-dispersive and dispersive medium, Pulse broadening and chirping, Group and phase velocity, Intermodal and intramodal dispersion, Group velocity (material and waveguide) dispersion, Higher order dispersion, Fiber bandwidth.

UNIT V

Dispersion compensation mechanism: Dispersion tailored and dispersion compensating fibers, Fiber Birefringence and polarization mode dispersion, Fiber bandwidth, Nonlinear effects in optical fiber: Stimulated Raman Scattering, Stimulated Brillouin Scattering, Self-Phase, Modulation, Cross Phase Modulation, Optical Solitons.

UNIT VI

Fiber based devices: Erbium-doped fiber amplifiers and lasers, Fiber Bragg gratings, Optical Fiber Sensors.Photonic Crystal fibers.

Text Books/Reference:

1. A. K. Ghatak , K. Thyagarajan, Introduction to Fiber Optics, Cambridge University Press (1998).
2. G. P. Agarwal, Fiber Optic Communication Systems, John Wiley Sons(1997).
3. John A. Buck, Fundamentals of Optical Fibers, Wiley Interscience, (2004).
4. J. M. Senior, Optical Fiber Communication, Prentice Hall (1999).
5. G. Keiser, Optical Fiber Communications, McGraw Hill (2000).
6. K. Okamoto, Fundamentals of Optical Waveguides, Academic Press,(2000).
7. K. Iizuka, Elements of Photonics Vol I &II, Wiley-Interscience (2002).
8. D. W. Prather et.al, Photonic Crystal, Wiley (2009).

ELECTIVE-II

STATISTICAL SIGNAL PROCESSING

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH : 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of more advanced probability theory, leading into random process theory and focus on discrete time methods.
B	To provide in-depth understanding of fundamental concepts of statistical signal processing.

Course Outcomes:

CO1	Learner will be able to generalize the properties of statistical models in the analysis of Signals using Stochastic processes.
CO2	Learner will be able to compare different Stochastic Processes and Models.
CO3	Learner will be able to demonstrate optimum linear filter algorithms and structures.
CO4	Learner will be able to Differentiate the prominence of various spectral estimation techniques for Achieving higher resolution in the estimation of power spectral density.
CO5	Learner will be able to visualize Least Square Filtering and Computation techniques.
CO6	Learner will be able to interpret adaptive filtering and its applications.

UNIT I

Introduction

Random Signals, Spectral Estimation, Adaptive Filtering, Random Variables, Distribution and Density Functions, Random Vectors: Definition, Transformation and Linear Combination of Random Vectors Linear System with Stationary Input, Innovations and Representation of Real Vectors, DT Stochastic Process: Stationarity, Ergodicity and Frequency Domain Representation of SP, Principles of Estimation.

UNIT II

Stochastic Processes and Models: Characterization of DT Stochastic Process, Correlation Matrix, Properties of Correlation Matrix, Stochastic Models: MA and AR Models, ARMA Models Hold Decomposition, Asymptotic Stationarity of AR Process, Yule Walker Equations, Power Spectral Density, Properties of Power Spectral Density Transmission of Stationary

Process Through a Linear Filter, Other Statistical Characteristics of Stochastic Process Power Spectral Estimation, Spectral Correlation Density, Polyspectra

UNIT III

Optimum Linear Filters: Optimum Signal Estimation, Linear Mean Square Estimation, Solution of Normal Equations, Optimum FIR Filters, Linear Prediction: Linear Signal Estimation, Forward Linear Estimation, Backward Linear Estimation, Stationary Processes and Properties, Optimum IIR Filters, Inverse Filtering and Deconvolution.

UNIT IV

Algorithms and Structures For Optimum Filters: Fundamentals of Order-Recursive Algorithms, Interpretation of Algorithmic Quantities, Order-Recursive Algorithms for Optimum FIR Filters, Algorithms of Levinson and Levinson-Durbin, Lattice Structure for Optimum Filters, Schur Algorithm, Triangularization and Inverse of Toeplitz Matrices, Kalman Filter Algorithm.

UNIT V

Least Square Filtering: Principle of LS, Linear Least Square Error Estimation, Least Square Filter, Linear Least Square Signal Estimation, LS Computation using Normal Equations, LS Computation using Orthogonalization Techniques, LS Computation using Singular Value Decomposition Techniques, Problems.

UNIT VI

Adaptive Filtering: Introduction, Typical Applications, Principles of Adaptive Filters, Method of Steepest Decent, LMS Algorithm, RLS Adaptive Filter, Fast RLS Algorithms for FIR Filtering, Frequency Domain and Subband Adaptive Filters.

Text Books/Reference:

1. S. Haykin, Adaptive Filter Theory, PHI.
2. D. G. Manolakis, V. K. Ingle, S. M. Kogon, Statistical and Adaptive Signal Processing;; McGraw Hill.

ELECTIVE-II

MICROELCTRONICS

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH : 60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding and to be able to apply basic concepts of semiconductor physics relevant to devices
B	To be able to analyze and design microelectronic circuits for linear amplifier and digital applications

Course Outcomes:

CO1	Learner will be able to discuss MOS structure in terms of different parameters
CO2	Learner will be able to express different CMOS technologies
CO3	Learner will get knowledge of design rules for the CMOS design
CO4	Learner will be able to understand how devices and integrated circuits are fabricated and describe discuss modern trends in the microelectronics industry
CO5	Learner will be able to determine the frequency range of simple electronic circuits and understand the high frequency limitations of BJTs and MOSFETs
CO6	Learner will be able to design simple devices and circuits to meet stated operating specifications

UNIT I

Ideal I-V Characteristics, C-V Characteristics: MOS Capacitance models, MOS Gate Capacitance Model, MOS Diffusion Capacitance Model. Non ideal I-V Effects: Velocity Saturation and Mobility Degradation, Channel Length Modulation, Body Effect, Sub threshold Conduction, Junction Leakage, Tunneling, Temperature and Geometry Dependence. DC Transfer characteristics: Complementary CMOS Inverter DC Characteristics, Beta Ratio Effects, Noise Margin, Ratio Inverter Transfer Function, Pass Transistor DC Characteristics, Tristate Inverter, Switch- Level RC Delay Models

UNIT II

CMOS Technologies: Background, Wafer Formation, Photolithography, Well and Channel Formation, Silicon Dioxide (SiO2), Isolation, Gate Oxide, Gate and Source/Drain Formation, Contacts and Metallization, Passivation, Metrology.

UNIT III

Layout Design Rules: Design Rules Background, Scribe Line and Other Structures, MOSIS Scalable CMOS Design Rules, Micron Design Rules. CMOS Process Enhancements: Transistors, Interconnect, Circuit Elements, Beyond Conventional CMOS. CMOS Fabrication

and Layout: Inverter Cross-section, Fabrication Process, Layout Design rules, Gate Layout, Stick Diagrams.

UNIT IV

Delay Estimation: RC Delay Models, Linear Delay Model, Logical Effort, Parasitic Delay. Logical Effort and Transistor Sizing: Delay in a Logic Gate, Delay in Multistage Logic Networks, choosing the Best Number of Stages. Power Dissipation: Static Dissipation, Dynamic Dissipation, Low-Power Design. Interconnect: Resistance, Capacitance, Delay, Cross talk. Design Margin: Supply Voltage, Temperature, Process Variation, Design Corners. Reliability, Scaling.

UNIT V

Static CMOS Logic : Inverter, NAND Gate, Combinational Logic, NOR Gate, Compound Gates, Pass Transistors and Transmission Gates, Tristates, Multiplexers, Latches and Flip-Flops, Circuit Families: Static CMOS, Ratioed Circuits,

UNIT VI

Cascode Voltage Switch Logic, Dynamic Circuits, Differential Circuits, Sense Amplifier Circuits, BiCMOS Circuits, Low Power Logic Design, Comparison of Circuit Families, Analog Circuit Designs, MOS Small-signal Models, Common Source Amplifier, The CMOS Inverter as an Amplifier, Current Mirrors, Differential Pairs, CMOS Operational Amplifier topologies, Digital to Analog Converters, switched capacitors, Analog to Digital Converters, RF Circuits

Text Books/Reference:

1. J. M. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits : A Design Perspective, Pearson/PHI (Low Price Edition)
2. S-M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, McGraw-Hill
3. B. Razavi, Design of Analog CMOS Integrated Circuits, McGraw-Hill
4. P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, Second Edition, Oxford University Press
5. P. Gray, P. J. Hurst, S. H. Lewis and R. Meyer, Analysis and Design of Analog Integrated Circuits, Fourth Edition,Wiley, 2001. (Low Price Edition)

COMMUNICATION SKILLS

Weekly Teaching Hours	TH: 02		Practical: -	
Scheme of Marking	TH: --	IA: 25	PR/OR: 25	Total: 50

Course Objectives:

A	To become more effective confident speakers and deliver persuasive presentations
B	To develop greater awareness and sensitivity to some important considerations in interpersonal communication and learn techniques to ensure smoother interpersonal relations

Course Outcomes:

CO1	Learner will be able to understand the fundamental principles of effective business communication
CO2	Learner will be able to apply the critical and creative thinking abilities necessary for effective communication in today's business world
CO3	Learner will be able to organize and express ideas in writing and speaking to produce messages suitably tailored for the topic, objective, audience, communication medium and context
CO4	Learner will be able to demonstrate clarity, precision, conciseness and coherence in your use of language
CO5	Learner will be able to become more effective confident speakers and deliver persuasive presentations

UNIT I

Introduction to communication, Necessity of communication skills, Features of good communication, Speaking skills, Feedback & questioning technique, Objectivity in argument

UNIT II

Verbal and Non-verbal Communication, Use and importance of non-verbal communication while using a language, Study of different pictorial expressions of non-verbal communication and their analysis

UNIT III

Academic writing, Different types of academic writing, Writing Assignments and Research Papers, Writing dissertations and project reports

UNIT IV

Presentation Skills: Designing an effective Presentation, Contents, appearance, themes in a presentation; Tone and Language in a presentation, Role and Importance of different tools for effective presentation

UNIT V

Motivation/ Inspiration: Ability to shape and direct working methods according to self-defined criteria;Ability to think for oneself, Apply oneself to a task independently with self-motivation, Motivation techniques: Motivation techniques based on needs and field situations

UNIT VI

Self-management, Self-evaluation, Self-discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency etc. Self-awareness, Identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride leadership & Team dynamics

Text Books/Reference:

1. Mitra, Barun, Personality Development and Soft Skills, Oxford University Press, 2016.
2. Ramesh, Gopalswamy, The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education, 2013.
3. Covey, Stephen R., Seven Habits of Highly Effective People: Powerful Lessons in Personal Change, Simon and Schuster, 09-Nov-2004
4. Rosenberg Marshall B., Nonviolent Communication: A Language of Life, PuddleDancer Press, 01-Sep-2003

PG Lab-I

Weekly Teaching Hours	TH: --		Practical: 03	
Scheme of Marking	TH: --	IA: 25	PR/OR: 25	Total: 50

Practical's of the Lab - I shall be based on the courses of first semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.

IMAGE & VIDEO PROCESSING

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in depth understanding of image and video processing.
B	To perform mathematical analysis of image and video processing and implement it.
C	To provide solutions to real time problems using knowledge of subject.

Course Outcomes:

CO1	Learner will be able to basics of correlation and convolution in image processing.
CO2	Learner will be able to understand concept Noise characterization, and Noise restoration filters.
CO3	Learner will be able to estimate different aspects of LZW coding, Transform Coding.
CO4	Learner will be able to start to learn Analog video and Digital Video.
CO5	Learner will be able to estimate 2-D Motion.
CO6	Learner will be able to lean various types of coding.

UNIT I

Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, sampling and quantization, Intensity transformations, contrast stretching, histogram equalization, Correlation and convolution, Smoothing filters, sharpening filters, gradient and Laplacian

UNIT II

Basic Framework, Interactive Restoration, Image deformation and geometric transformations, image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Estimation of Degradation functions, Restoration from projections.

UNIT III

Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Huffman Coding, Arithmetic Coding, Golomb Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, FAX compression (CCITT Group-3 and Group-4), Symbol-based coding, JBIG-2, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation

UNIT IV

Basic Steps of Video Processing: Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations

UNIT V

2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global

UNIT VI

Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

Text Books/Reference:

1. Gonzaleze and Woods ,Digital Image Processing , 3rd edition , Pearson
2. Yao wang, Joem Ostarmann and Ya quin Zhang, Video processing and communication ,1stedition , PHI
3. M. Tekalp ,Digital video Processing, Prentice Hall International

INFORMATION THEORY AND CODING

Weekly Teaching Hours	TH : 03	Tut: 01		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of principles and applications of information theory.
B	To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
C	To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

CO1	Learner will be able to formulate equations for entropy mutual information and channel capacity for all types of channels.
CO2	Learner will be able to distinguish between different types error correcting codes based on probability of error
CO3	Learner will be able to design a digital communication system by selecting an appropriate error correcting codes for a particular application.
CO4	Learner will be able to explain various methods of generating and detecting different types of error correcting codes
CO5	Learner will be able to formulate the basic equations of linear block codes.
CO6	Learner will be able to compare the performance of digital communication system by evaluating the probability of error for different error correcting codes

UNIT I

Theory of Probability and Random Processes

Concept of probability, Random variables, Probability models, Statistical averages, Central limit theorem, Correlation, Linear mean square estimation.

UNIT II

Random Processes

Random variable and random process, Power spectral density of a random process, Multiple random processes, Transmission of random processes through linear systems, Band-pass random processes, Optimum filtering.

UNIT III

Noise in Communication Systems

Behavior of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT IV

Information Theory

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT V

Error Correcting Codes

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ, Performance of codes, Comparison of coded and un-coded systems.

UNIT VI

Speech Coding

Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders.

Text Books/Reference:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Das, Mullick, Chaterjee, Principles of Digital Communication; New Age International.
3. Taub, Schilling; Principles of Communication Engineering (2^{nd}Edition);; TMH.
4. Thomas M. Cover, Joy A. Thomas Elements of Information Theory; Wiley Inter-science.
5. R.P.Singh, S.D. Sapre, Communication systems : Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication : Principles and Practice (2^{nd} Edition); Pearson India.

ELECTIVE-III

MULTIRATE DIGITAL SIGNAL PROCESSING

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To master the fundamentals of multirate signal processing and demonstrate the ability to solve problems in sample rate conversion, filter banks, and transmultiplexers.

Course Outcomes:

CO1	Learner will be able to develop efficient realizations for upsampling and downsampling of signals using the polyphase decomposition
CO2	Learner will be able to design and implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters to meet specifications
CO3	Learner will be able to design digital filter banks based on the techniques presented
CO4	Learner will be able to analyze fundamental concepts of wavelets.
CO5	Learner will be able to distinguish between wavelets and multirate filter banks, from the point of view of implementation.

UNIT I

Fundamentals of Multirate Systems

Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Mulstage implementation, Some application of multirate systems, Special filter and filter banks.

UNIT II

Maximally Decimaled Filter Banks

Introduction, Errors created in the QMF bank, A simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Transmultiplexer.

UNIT III

Paranitary Perfect Reconstruction Filter Banks

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Tranform coding and LOT.

UNIT IV

Linear Phase and Cosine Modulated Filter Banks

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT V

The Wavelet Transform and its Relation to Multirate Filter Banks

Introduction, Background and outline, Short time fourier transform, The Wavelet transform, DT orthonomal Wavelets, Continuous time orthonormal Wavelet basis.

UNIT VI

Multidimensional, Multivariable and Lossless Systems

Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals. Review of discrete time multi-input multi-output LTI System, ParaUNITary and lossless system.

Text Books/Reference:

1. P.P.Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey, Multirate System and Filter Banks
2. N.J.Fliege , John Wiley & Sons, Multirate Digital Signal Processing
3. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application
4. C. Sidney Burrus , R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform

ELECTIVE-III

EMDEDDED SYSTEM DESIGN

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around a modern embedded processor.

Course Outcomes:

CO1	Learner will have understanding of fundamental embedded systems design paradigms, architectures, possibilities and challenges, both with respect to software and hardware
CO2	Learner will be able to analyze a wide competence from different areas of technology, especially from computer engineering, study of processor for deep understanding analyze case study of Pentium processor
CO3	Learner will be able to demonstrate architecture of 8051, Instruction set, Addressing modes. Programming8051 for various applications. Interfacing of LED/LCD, keyboard, stepper motor, ADC/DAC and sensors, RTC, serial communication with micro-controller.
CO4	Learner will be able to analyze deep state-of-the-art theoretical knowledge in the areas of real-time systems, artificial intelligence, learning systems, sensor and measuring systems, and their interdisciplinary nature needed for integrated hardware/software development of embedded systems.
CO5	Learner will have ability to analyze a system both as whole and in the included parts, to understand how these parts interact in the functionality and properties of the system, and understanding and experience of state-of-the-practice industrial embedded systems and intelligent embedded system development.

UNIT I

Fundamentals of Embedded System

Embedded System overview, Design challenges, Processor Technology, IC Technology, Design Technology.

UNIT II

Embedded System Hardware

Evaluation of Processors, Microprocessor architecture overview- CISC and RISC, Case study of Pentium processor architecture.

UNIT III

Microcontroller Architecture and **Interfacing**

Architecture of 8051, Instruction set, Addressing modes, Programming Examples. Interfacing of LED/LCD, keyboard, stepper motor, ADC/DAC and sensors, RTC, serial communication with micro-controller.

UNIT IV

Study of semiconductor memory

Memory device characteristics, SRAM, DRAM, SSRAM, SDRAM, RDRAM, FLASH, Smart card memory and interfacing of memory with micro-controller.

UNIT V

Introduction to DSP Processors

Architecture, features, instruction set, typical applications (TMS320XX or ADSP 21010).

UNIT VI

Embedded software and Applications

Introduction to software Engg, C cross compiler, Computational models, FSM, Concurrent state model, Concurrent Processes, Communication among processes, synchronization among processes. Introduction to RTOS**:** Windows CE, VX works.

Applications: Network protocols- TCP/IP, Embedded Ethernet, CANBUS, I2C bus, Mod Bus, Digital Camera.

Text Books/Reference:

1. Frank Vahid and Tony Givargis, "EMBEDDED SYSTEM DESIGN A Unified Hardware/Software Introduction", John Wiley and sons ltd., 2002
2. M.A. Mazidi and J.G. Mazidi, "The 8051 Micro-controller and Embedded System" Pearson Education Asia, 2000
3. K.J. Ayala, "The 8051 Micro-controller", Penram International Pub., 1996
4. INTEL Microcontroller Manual
5. J. Zimmermann: "Fuzzy set theory and its applications, second edition, Allied Publishers limited, New Delhi, 1996.

ELECTIVE-III

WIRELESS SENSOR NETWORK DESIGN

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of design and implementation of WSN
B	To provide ability to formulate and solve problems creatively in the area of WSN
C	To provide in-depth understanding of various applications of WSN.

Course Outcomes:

CO1	Learner will be able to understand the need of WSN and also will analyze the challenges in creating WSN
CO2	Learner will be able to design the architecture of WSN
CO3	Learner will be able analyze the power and security constraints in WSN
CO4	Learner will study different operating system to operate WSN
CO5	Learner will be able to understand the basic functioning of WSN at physical layer
CO6	Learner will be able to understand different protocols at network layer to for multiple channel accessing

UNIT I

Introduction: Motivation for a Network of Wireless Sensor Nodes, Sensing and Sensors, Wireless Networks, Challenges and Constraints. Applications: Health care, Agriculture, Traffic and others.

UNIT II

Architectures: Node Architecture, the sensing subsystem, processor subsystem, communication, interface, LMote, XYZ, Hogthrob node architectures

UNIT III

Power Management-Through local power, processor, communication subsystems and other means, time Synchronization need, challenges and solutions overview for ranging techniques Security Fundamentals, challenges and attacks of Network Security, protocol mechanisms for security.

UNIT IV

Operating Systems-Functional and non functional Aspects, short overview of prototypes – TinyOS, SOS, Contiki, Lite OS, sensor grid.

UNIT V

Physical Layer –Basic Components, Source Encoding, Channel Encoding, Modulation, Signal Propagation

UNIT VI

Medium Access Control–types, protocols, standards and characteristics, challenges, Network Layer-Routing Metrics, different routing techniques.

Text Books/Reference:

1. Dargie, W. and Poellabauer, C., Fundamentals of wireless sensor networks: theory and practice, John Wiley and Sons, 2010
2. Sohraby, K., Minoli, D., Znati, T. Wireless sensor networks: technology, protocols, and applications, John Wiley and Sons, 2007
3. Hart, J. K. and Martinez, K. (2006) Environmental Sensor Networks: A revolution in the earth system science? Earth-Science Reviews, 78.
4. Protocols and Architectures for Wireless Sensor Networks-Holger Karl, Andreas Willig-08-Oct 2007

ELECTIVE-III

MICROWAVE DESIGN & MEASUREMENT

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in depth understanding of image and video processing.
B	To perform mathematical analysis of image and video processing and implement it.
C	To provide solutions to real time problems using knowledge of subject.

Course Outcomes:

CO1	Learner will be able to start learning of Introduction to Microwaves.
CO2	Learner will be able to Microwave Semiconductor Devices.
CO3	Learner will be able to differentiate Passive and Active microwave Devices.
CO4	Learner will be able to study importance of Impedance transformation, and matching
CO5	Learner will be able to design the antennas for Micro wave.
CO6	Learner will be able to lean Modern Trends in Microwaves Engineering.

UNIT I

INTRODUCTION TO MICROWAVES.

History of Microwaves, Microwave Frequency bands.Applications of Microwaves: Civil and Military, Medical, EMI/ EMC, **Mathematical model of Microwave Transmission**:Concept of Mode, Characteristics of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission

UNIT II

ANALYSIS OF RF AND MICROWAVE TRANSMISSION LINES

Coaxial Line.Rectangular Waveguide, Circular waveguide. Stripline. Microstrip Line. **Microwave Network Analysis:** Equivalent Voltages and currents for non-TEM lines, Network parameters for microwave Circuits.Scattering Parameter.

UNIT III

PASSIVE AND ACTIVE MICROWAVE DEVICES:

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonaton, Transistors, oscillators, mixers.Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes.Microwave tubes: Klystron, TWT, Magnetron

UNIT IV

MICROWAVE DESIGN PRINCIPLES

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design. Microwave Power amplifier Design. Low Noise Amplifier Design. Microwave Mixer Design.Microwave Oscillator Design. **Microwave Antenna:**Microwave Antenna Parameters,Microwave antenna for ground based systems,airborne based systems,Microwave antenna for satellite borne systems Microwave Planar Antenna

UNIT V

MICROWAVE MEASUREMENTS.

Power, Frequency and impedance measurement at microwave frequenc,Network Analyser and measurement of scattering parameters.Spectrum Analyser and measurement of spectrum of a microwave signal. Noise at microwave frequency and measurement of noise figure.Measurement of Microwave antenna parameters, **Microwave Systems:** Radar Systems.Cellular Phone Satellite Communication. RFID. GPS

UNIT VI

MODERN TRENDS IN MICROWAVES ENGINEERING

Effect of Microwaves on human body, Medical and Civil applications of microwaves,Electromagnetic interference / Electromagnetic Compatibility (EMI / EMC),Monolithic Microwave IC fabrication. RFMEMS for microwave components. Microwave Imaging.

Text Books/Reference:

1. David M. Pozar, "Microwave Engineering", Third Edition, Wiley India.
2. S. Ramo, J.R.Whinnery and T.V.Duzer, "Fields and Waves in Communication Electronics", Third Edition, Wiley India.
3. R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press.

ELECTIVE-III

ESTIMATION AND DETECTION THEORY

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding basics of detection and estimation theory.
B	To be able to design and analyze optimum detection schemes

Course Outcomes:

CO1	Learner will have basic knowledge of linear algebra
CO2	Learner will be able to Acquire basics of statistical decision theory used for signal detection and estimation.
CO3	Learner able to understood the detection of deterministic and random signals using statistical models.
CO4	Learner will be able to the performance of signal parameters using optimal Estimators
CO5	Learner will be able to understand different estimation schemes such as ML and MMSE estimators

UNIT I

Linear Algebra

Vector space : linear dependence, Basis and dimension, vector subspace, inner product spaces, orthonormal basis and Gram- Schmidt Process of orthogonalisation, computation of linear dependence, linear transformation and matrices, change of basis, orthogonal and unitary transformation, Eigenvalue, Eigen vectors and characteristics equation. Systems theory, stochastic processes, Gauss Markov models, representation of stochastic processes, likelihood and sufficiency.

UNIT II

Binary Decision: Single Observation

Introduction to structure ofdecision and estimation problems.MaximumLikelihood decision criterian, Neyman-person criterian, Probability of error criterian, Bays risk criterian, Min-Max criterian, problems

UINT III

Binary Decision: Multiple Observations

Vector observation, The general Gaussion problem, Waveform observations and additive Gaussion noise, problems

UNIT IV

Multiple Decision: Multiple Decision

Bays risk, Probability of error: General case, Probability of error: Gaussion case, Ensure decision problems.

UNIT V

Composite And Nonparametric Decision Theory

Composite decisions Sign test, Wilason test, problems

UNIT VI

Fumdamentals of Estimation

Maximum likelihood method, Bays cost method, Relationship of Estimation, Linear minimum, Variance and Least-square methods. Properties of Estimations: Unbiased estimators, Efficient estimators, Asymphotic properties.

Text Books/Reference:

1. James Melsa and David Cohn, Mc-Graw Hill, Decision and Estimation Theory
2. Harry L, Van Trees, John Wiley and Sons Inc, Detection, Estimation, and Modulation Theory

ELECTIVE-IV

ADVANCED BIOMEDICAL SIGNAL PROCESSING

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To introduce students to the principles of signal processing techniques when applied specifically to biomedical signals
B	To provide in depth understanding of methods and tools for extracting information from digitally acquired biomedical signals.

Course Outcomes:

CO1	Learner will be able to demonstrate a systematic knowledge of the complex physical and physiological principles that underpin the measurement of biomedical signals.
CO2	Learner will be able to demonstrate an advanced understanding of the principles of digital signal processing.
CO3	Learner will be able to systematically apply advanced methods to extract relevant information from biomedical signal measurements.
CO4	Learner will be able to critically assess the appropriateness of cutting-edge biomedical signal processing techniques for various problems in the field.
CO5	Learner will be able to evaluate the effectiveness of techniques applied to biomedical signals against specific benchmarks.

UNIT I

Introduction To Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis (Wavelet) of biomedical signals- Processing of Random & Stochastic signals – spectral estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments

UNIT II

Concurrent, Coupled And Correlated Processes - illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG - Muscle-contraction interference. Event detection - case studies with ECG & EEG - Independent component Analysis - Cocktail party problem applied to EEG signals - Classification of biomedical signals.

UNIT III

Cardio Vascular Applications : Basic ECG - Electrical Activity of the heart- ECG data acquisition – ECG parameters & their estimation - Use of multiscale analysis for ECG parameters estimation - Noise & Artifacts- ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection - Arrhythmia analysis

UNIT IV

Data Compression: Lossless &Lossy- Heart Rate Variability – Time Domain measures - Heart Rhythm representation - Spectral analysis of heart rate variability - interaction with other physiological signals.

UNIT V

Introduction to EEG: The electroencephalogram - EEG rhythms & waveform - categorization of EEG activity - recording techniques - EEG applications- Epilepsy, sleep disorders, brain computer interface.

UNIT VI

EEG Modeling - linear, stochastic models – Non linear modeling of EEG - artifacts in EEG & their characteristics and processing – Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis – correlation analysis of EEG channels - coherence analysis of EEG channels.

Text Books/Reference:

1. D.C.Reddy ,"Biomedical Signal Processing: Principles and techniques" ,Tata McGraw Hill, New Delhi, 2005
2. Willis J Tompkins , Biomedical Signal Processing -, ED, Prentice – Hall, 1993
3. R. Rangayan, "Biomedical Signal Analysis", Wiley 2002.
4. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001
5. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier
6. Semmlow, "Bio-signal and Biomedical Image Processing", Marcel Dekker
7. Enderle, "Introduction to Biomedical Engineering," 2/e, Elsevier, 2005

ELECTIVE-IV

RECONFIGURABLE COMPUTING

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To learn the basics of field of reconfigurable computing
B	To learn Advance digital design skills by developing a reconfigurable computing application Learn a hardware design language Chisel - An introduction to research methodology

Course Outcomes:

CO1	Learner will be able to understand concept of static and dynamic reconfiguration.
CO2	Learner will able to use the basics of the PLDs for designing reconfigurable circuits.
CO3	Learner will be able to understand the reconfigurable system design using HDL
CO4	Learner will able to demonstrate different architectures of reconfigurable computing.
CO5	Learner will able to understand different applications of reconfigurable computing

UNIT I

Types of computing and introduction to RC: General Purpose Computing, Domain-Specific Processors, Application Specific Processors; Reconfigurable Computing, Fields of Application; Reconfigurable Device Characteristics, Configurable, Programmable, and Fixed-Function Devices; General-Purpose Computing, General-Purpose Computing Issues;

UNIT II

Metrics: Density, Diversity, and Capacity; Interconnects, Requirements, Delays in VLSI Structures; Partitioning and Placement

UNIT III

Routing; Computing Elements, LUTs, LUT Mapping, ALU and CLBs; Retiming, Fine-grained & Coarse-grained structures; Multi-context;

UNIT IV

Different architectures for fast computing viz. PDSPs, RALU, VLIW, Vector Processors, Memories, CPLDs, FPGAs, Multi-context FPGA, Partial Reconfigurable Devices; Structure and Composition of Reconfigurable Computing Devices: Interconnect, Instructions, Contexts, Context switching, RP space model;

UNIT V

Reconfigurable devices for Rapid prototyping, Non-frequently reconfigurable systems, Frequently reconfigurable systems; Compile-time reconfiguration, Run-time reconfiguration

UNIT VI

Architectures for Reconfigurable computing: TSFPGA, DPGA, Matrix; Applications of reconfigurable computing: Various hardware implementations of Pattern Matching such as the Sliding Windows Approach, Automaton-Based Text Searching. Video Streaming

Text Books/Reference:

1. Andre Dehon, “Reconfigurable Architectures for General Purpose Computing”.
2. IEEE Journal papers on Reconfigurable Architectures.
3. “High Performance Computing Architectures” (HPCA) Society papers.
4. Christophe Bobda, “Introduction to Reconfigurable Computing”, Springer Publication.
5. Maya Gokhale, Paul Ghaham, “Reconfigurable Computing”, Springer Publication

ELECTIVE-IV

DIGITAL VLSI DESIGN

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To understand different abstract levels in Verilog for modeling digital circuits.
B	To know the design of MOS memories and the various precautionary methods to be used in their design.

Course Outcomes:

CO1	Learner will be able to understand MOSFET device structures their physical operations, Current voltage characteristics. Fabrication process of MOS device, Making circuit with MOS devices their design equation . designing layout of such circuits, studying pass transistors
CO2	Learner will be able to understand VHDL language for synthesizing Digital Circuits. Digital circuits include asynchronous and synchronous design issues and state machine synthesizing this circuits. Building state machines with Moore and mealy machines. Understanding how to write package,sub program and test benches.
CO3	Learner will be able to understand Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs.
CO4	Learner will be able to understand designing of SRAM and DRAM.
CO5	Learner will be able to implement Floor planning concepts, shape functions and floor plan sizing, understanding types of local routing problems Area routing, channel routing, global routing, algorithms for global routing.
CO6	Learner will be able to analyze Need of Design for Testability (DFT), Controllability, predictability, testability, built in Self Test (BIST), Partial and full scan check. Understanding the system which connects host to target and need of boundary scan check, JTAG, Test Access Port (TAP) controller.

UNIT I

Introduction to VLSI Circuits

Introduction to MOSFETs**:** MOS Transistor Theory –Device Structure and Physical Operation, Current Voltage Characteristics, Fabrication, MOS Capacitor, Body Effect, Temperature Effects,Channel Length Modulation, Latch-up. MOS Inverter: MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations, Transistor Sizing, Voltage Transfer Characteristics, Power Dissipation, Noise Margin, Power

Delay Product, Energy dissipation. MOS Layers Stick/Layout Diagrams; Layout Design Rules, Issues of Scaling, Scaling factor for device parameters. Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates: Primitive Logic Gates.

UNIT II

Digital Circuit Design using VHDL

Design of sequential circuits, asynchronous and synchronous design issues, state machine modeling (Moore and mealy machines), packages, sub programs, attributes, test benches.

UNIT III

Programmable Logic Devices

Complex Programmable Logic Devices – Architecture of CPLD, Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs.

UNIT IV

CMOS Subsystem Design

Semiconductor memories, memory chip organization, Random Access Memories (RAM), Static RAM (SRAM), standard architecture, 6T cell, sense amplifier, address decoders, timings.Dynamic RAM (DRAM), different DRAM cells, refresh circuits, timings.

UNIT V

Floor Planning and Placement

Floor planning concepts, shape functions and floor plan sizing, Types of local routing problems Area routing, channel routing, global routing, algorithms for global routing.

UNIT VI

Fault Tolerance and Testability

Types of fault, stuck open, short, stuck at 1, 0 faults, Fault coverage, Need of Design for Testability (DFT), Controllability, predictability, testability, built in Self Test (BIST), Partial and full scan check, Need of boundary scan check, JTAG, Test Access Port (TAP) controller.

Text Books/Reference:

1. Neil H. Weste and Kamran, Principles of CMOS VLSI Design, Pearson Publication
2. John F. Wakerly, Digital Design, Principles and Practices, Prentice Hall Publication
3. Douglas Perry, VHDL, McGraw Hill Publication.
4. Charles Roth, Digital System Design using VHDL, McGraw Hill Publication.
5. Data Sheets of PLDs.
6. Sung-Mo (Steve) Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata
7. McGraw Hill Publication.

ELECTIVE-IV
NETWORKS AND SYSTEMS SECURITY

Weekly Teaching Hours TH : 03 Tut: --

Scheme of Marking TH :60 Tests : 20 IA: 20 Total : 100

Course Objectives:

A	To provide in depth understanding of networks and systems security
B	To correlate the concept of networks and systems security to the concerned field and provide the better security.

Course Outcomes:

CO1	Learner will be able to start learning of networks and systems security
CO2	Learner will be able to gain the knowledge of Access Control.
CO3	Learner will be able to concern about Reference Monitors.
CO4	Learner will be able to study ccryptography.
CO5	Learner will be able to design Network & Software Security.
CO6	Learner will be able to lean about New Access Control.

UNIT I

Introduction, History of Computer Security, Managing Computer Security, Foundations of Computer Security / Identification and Authentication

UNIT II

Access Control (Spoofing, Password Protection, Single Sign On , Hacking Discussion / BackTrack Demo, Unix Security

UNIT III

Reference Monitors and Security Models (Memory Protection, Access Control, BLP)

UNIT IV

More Security Models & Security Evaluation (BIBA, Chinese Wall, Orange Book, Security Evaluation and Accreditation, Disaster Planning),Cryptography (Digital Signatures and Encryption)

UNIT V

Authentication in Distributed Systems and Key Establishment & Communications, Network & Software Security (Firewalls, Intrusion Detection, Authentication Protocols)

UNIT VI

Mobile Security (GSM, IPv6, WLAN, Bluetooth) & Web Security / New

Access Control (Java Security, Cookies, SPKI, Trust, DRM)

Text Books/Reference:

1. Stallings, Cryptography and Network Security: Principles and Practice, 5/e (Prentice Hall, 2010). Relative to this book's 4th edition, the network security components and an extra chapter on SNMP are also packaged as Stallings' Network Security Essentials: Applications and Standards, 3/e (Prentice Hall, 2007).
2. Kaufman, Perlman and Speciner, Network Security: Private Communications in a Public World, second edition (Prentice Hall, 2003).
3. Menezes, van Oorschot and Vanstone, Handbook of Applied Cryptography (CRC Press, 1996; 2001 with corrections), free online for personal use.

ELECTIVE-IV
MULTICARRIER COMMUNICATION

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of basic concepts of Multicarrier techniques
B	To make students familier with modern communication system

Course Outcomes:

CO1	Learner will be able to understand practical limits on CDMA & OFDM systems
CO2	Learner will be able to understand basic principles of CDMA & OFDM systems
CO3	Learner will be able to perform analysis of CDMA & OFDM systems
CO4	Learner will be familiar with other modern communication systems
CO5	Learner will be able to design CDMA & OFDM systems

UNIT I

Introduction to digital communication: Introduction to digital communication, high rate wireless application, wireless channel fundamentals, digital communication system fundamentals, Multi-Carrier system fundamentals, comparison with single carrier communication system.

UNIT II

System Architecture: Basics of OFDM, FFT implementation, power spectrum, efficiency Impairments of wireless channels to OFDM, signals Performance optimization, clipping in multi-carrier system, channel partitioning, optimization through coding.

UNIT III

Performance, Channel Estimation and Equalization Synchronization, channel estimation & equalization: Timing & frequency offset, synchronization and system architecture, timing and frame synchronization frequency offset estimation. Channel Estimation and equalization Coherent detection, noncoherent detection, performance, channel estimation for MIMO-OFDM

UNIT IV

Channel coding: Need for coding block, coding in OFDM convolution encoding, concatenated coding, coding in OFDM

UNIT V

PAPR Reduction Techniques: Peak power reduction techniques PAPR properties of OFDM signals, PAPR reduction with and without signal distortion PAPR reduction for multi-carrier CDMA

UNIT VI

Applications of multi-carrier communication Coding in OFDM, wireless LAN, digital audio & video broadcasting OFDM based multiple access techniques, mitigation of clipping effects)

Text Books/Reference:

1.Bahai, Saltzberg, Ergen : Multi-carriers Digital communications, Springer

2.Rappaport, T.S, Wireless communication, Prentice Hall

3.Heiskala, J., Terry J., OFDM wireless LANs: A Theoretical and practical guide. Samps Publishing 2002

4.Haykinls, Communication system, John Wiley & Sons.

5. Oppenheim, A.V., Schafer R.W., Discrete – Time signal processing New Jerssey : Prentice Hall Inc.

6.Bingham, J.A.C., ADSL, VDSL and multi-carrier modulation New York Wiley.

7.OFDM orthogonal frequency Division Multiplexing. Nova Engineering.

ELECTIVE V

INTERNET OF THINGS

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	Students will be explored to the interconnection and integration of the physical world and the cyber space.
B	To provide ability to design and develop IOT devices.

Course Outcomes:

CO1	Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
CO2	Learner will be able to interpret IOT working at transport layer with the help of various protocols
CO3	Learner will be able to understand IOT concept at data link layer
CO4	Learner will be able to apply the concept of mobile networking to the internet connected devices
CO5	Learner will be able to measure and schedule the performance of networked devices in IOT
CO6	Learner will be able to analyze the challenges involve in developing IOT architecture

UNIT I

Introduction: What is the Internet of Things: History of IoT, about objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, and basic nodal capabilities.

UNIT II

Fundamental IoT Mechanisms & Key Technologies : Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT III

Radio Frequency Identification Technology: Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication.

UNIT IV

Wireless Technologies For IoT : Layer ½ Connectivity : WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and its low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication(DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT V

Governance of The Internet of Things: Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles, private organizations, International regulation and supervisor, substantive principles for IoT governance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoT infrastructure governance, robustness, availability, reliability, interoperability, access. Future governance issues, practical implications, legal implications.

UNIT VI

Internet of Things Application Examples: Smart Metering, advanced metering infrastructure, e-Health/Body area network, City automation, automotive applications. Home automation, smart cards, Tracking, Over-The-Air passive surveillance/Ring of steel, Control application examples.

Text Books/Reference:

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
3. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978- 3842-19156-5, Springer.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

ELECTIVE V

LINEAR ALGEBRA

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of fundamental concepts of linear algebra
B	To understand the importance of linear algebra and learn its applicability to practical problems

Course Outcomes:

CO1	Learner will be able to solve and analyze linear system of equation
CO2	Learner will be able to analyze the direct notations, duality, adjointness, bases, dual bases in linear algebra
CO3	Learner will be able to understand the concept of Linear transformations and matrices, equivalence, similarity.
CO4	Learner will be able to understand eigen values and eigen vectors using characteristics polynomials
CO5	Learner will be able to understand the singular value decomposition of the matrix
CO6	Learner will be able to understand the inverse of matrix

UNIT I

Fields Fq, R, C. Vector Spaces over a field, Fn, F[ɵ]=Polynomials in one Variable.

UNIT II

Direct Notations, Ket, bra vector, duality, adjointness, linear transformations, bases, dual bases.

UNIT III

Linear transformations and matrices, equivalence, similarity.

UNIT IV

Eigenvalues, eigenvectors, diagonalization, Jordoncanonical form

UNIT V

Bilinear and sesquilinear forms, inner product, orthonormal, bases, orthogonal decomposition, projections

UNIT VI

System of equations, generalized inverses.

Text Books/Reference:

1. Linear Algebra and Group Representations, Ronald Shaw, AcademicPress, Volume I-1982.

2. Linear Algebra and Group Representations, Ronald Shaw, AcademicPress, Volume II-1983.

3. Linear Algebra, A. R. Rao, Bhima Sankaran, TRIM, 2nd Edition, Hindustan

ELECTIVE V

MULTIMEDIA COMMUNICATION

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding for multimedia communication standards and compression techniques
B	To provide in-depth understanding for representation of image, video

Course Outcomes:

CO1	Learner will be able to understand different multimedia communication devices.
CO2	Learner will be able to analyze different multimedia compression techniques.
CO3	Learner will be able to analyze fundamental concepts of multimedia building blocks.
CO4	Learner will be able to demonstrate a diverse portfolio that reflects multimedia aesthetic proficiency.
CO5	Learner will be able to demonstrate a set of professional skills and competencies in their practice of multimedia communication.

UNIT I

Introduction to Multimedia, Multimedia Information, Multimedia Objects, Multimedia in business and work. Convergence of Computer, Communication and Entertainment products Stages of Multimedia Projects Multimedia hardware, Memory & storage devices, Communication devices, Multimedia software's, presentation tools, tools for object generations, video, sound, image capturing, authoring tools, card and page based authoring tools.

UNIT II

Multimedia Building Blocks: Text, Sound MIDI, Digital Audio, audio file formats, MIDI under windows environment Audio & Video Capture.

UNIT III

Data Compression Huffman Coding, Shannon Fano Algorithm, Huffman Algorithms, Adaptive Coding, Arithmetic Coding Higher Order Modelling. Finite Context Modelling, Dictionary based Compression, Sliding Window Compression, LZ77, LZW compression, Compression, Compression ratio loss less & lossy compression.

UNIT IV

Speech Compression & Synthesis Digital Audio concepts, Sampling Variables, Loss less compression of sound, loss compression & silence compression.

UNIT V

Images Multiple monitors, bitmaps, Vector drawing, lossy graphic compression, image file formatic animations Images standards, JPEG Compression, Zig Zag Coding, Multimedia Database.Content based retrieval for text and images,Video:

UNIT VI

Video representation, Colors, Video Compression, MPEG standards, MHEG Standard Video Streaming on net, Video Conferencing, Multimedia Broadcast Services, Indexing and retrieval of Video Database, recent development in Multimedia.

Text Books/Reference:

1. Tay Vaughan, Multimedia, Making IT Work, McGraw Hill.
2. Buford, Multimedia Systems, Addison Wesley.
3. Mark Nelson, Data Compression Hand Book, BPB.
4. Sleinreitz, Multimedia System, Addison Wesley

ELECTIVE V

RESEARCH METHODOLOGY

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To develop a research orientation among the scholars and to acquaint them with fundamentals of research methods.
B	To develop understanding of the basic framework of research process.
C	To identify various sources of information for literature review and data collection.
D	To understand the components of scholarly writing and evaluate its quality.

Course Outcomes:

CO1	Learner will be able to understand the meaning, objective , motivation and type of research
CO2	Learner will be able to formulate their research work with the help of literature review
CO3	Learner will be able to develop an understanding of various research design and techniques
CO4	Learner will be able to have an overview knowledge of modeling and simulation of research work
CO5	Learner will be able to collect the statistical data with different methods related to research work
CO6	Learner will be able to write their own research work with ethics and non-plagiarized way

UNIT I

Introduction: Defining research, Motivation and Objectives, Types of research

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research

UNIT II

Research Formulation: Formulating The research Problem, Literature Review, Development of Working Hypothesis

UNIT III

Research Design: Important Concept in Research Design, Research Life Cycle, Developing Research Plan

UNIT IV

Overview of Modeling and Simulation: Classification of models, Development of Models, Experimentation, Simulation.

UNIT V

Statistical Aspects: Methods of Data Collection, Sampling Methods, Statistical analysis, Hypothesis testing.

UNIT VI

Research Report: Research Ethics, Plagiarism, Research Proposal, Report Writing and Writing Research Papers.

Text Books/Reference:

1. J.P. Holman, Experimental Methods for Engineers.
2. C.R. Kothari, Research Methodology, Methods & Techniques.

ELECTIVE-V

WAVELET TRANSFORMS AND ITS APPLICATIONS

Weekly Teaching Hours	TH : 03	Tut: --		
Scheme of Marking	TH :60	Tests : 20	IA: 20	Total : 100

Course Objectives:

A	To provide in-depth understanding of fundamental concepts of Wavelets.
B	To study wavelet related constructions, its applications in signal processing, communication and sensing.

Course Outcomes:

CO1	Learner will be able to understand the meaning of wavelet transform
CO2	Learner will be able to understand the terminologies used in Wavelet transform with its properties
CO3	Learner will be able to demonstrate various filter bank using wavelet transformation
CO4	Learner will be able to understand bases , orthogonal bases in wavelet transform
CO5	Learner will be able to understand different types of wavelet transform
CO6	Learner will be able to design practical system using wavelet transform

UNIT I

Continuous Wavelet Transform Introduction, Continuous-time wavelets, Definition of the CWT, the VWT as a Correlation, Constant-Factor Filtering Interpretation and Time-Frequency Resolution, the VWT as an Operator, Inverse CWT, Problems.

UNIT II

Introduction to Discrete Wavelet Transform and Orthogonal Wavelet Decomposition: Introduction, Approximation of Vectors in Nested Linear Vector Subspaces, Examples of an MRA, Problems.

UNIT III

MRA, Orthonormal Wavelets, And Their Relationship To Filter Banks: Introduction, Formal Definition of an MRA, Construction of General Orthonormal MRA, a wavelet Basic for the MRA,

UNIT IV

Digital Filtering Interpretation, Examples of Orthogonal Basic Generating Wavelets, Interpreting Orthonormal MRAs for Discrete-Time signals, Miscellaneous Issues Related to PRQME Filter Banks, generating Scaling Functions and wavelets from Filter Coefficient, Problems.

UNIT V

Wavelet Transform And Data Compression: Introduction, Transform Coding, DTWT for ImageCompression, Audio Compression, And Video Coding Using Multiresolution Techniques: a Brief Introduction.

UNIT VI

Other Application 0f Wavelet Transforms: Introduction, Wavelet denoising speckles Removal, Edge Detection and Object Isolation, Image Fusion, Object Detection by Wavelet Transform of Projections, Communication application.

Text Books/Reference:

1. C. Sidney Burrus, R. A. Gopianath, Pretice Hall, Introduction to Wavelet and Wavelet Transform
2. P.P.Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey, Multirate System and Filter Banks
3. N.J.Fliege , John Wiley & Sons, Multirate Digital Signal Processing
4. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application
5. James S. Walker, “A Primer on Wavelets and their Scientific Applications”, CRC Press, (1999).
6. Rao, “Wavelet Transforms”, Pearson Education, Asia.

SEMINAR I

Weekly Teaching Hours	TH: -	Practical: 04	
Scheme of Marking	IA: 50	PR/OR: 50	Total: 100

The seminar shall be on the state of the art in the area of the wireless communication and computing and of student's choice approved by an authority. The student shall submit the duly certified seminar report in standard format, for satisfactory completion of the work duly signed by the concerned guide and head of the Department/Institute.

MINI PROJECT

Weekly Teaching Hours	TH: -	Practical: 04	
Scheme of Marking	IA: 50	PR/OR: 50	Total: 100

The mini project shall be based on the recent trends in the industry, research and open problems from the industry and society. This may include mathematical analysis, modelling, simulation, and hardware implementation of the problem identified. The mini project shall be of the student's choice and approved by the guide. The student has to submit the report of the work carried out in the prescribed format signed by the guide and head of the department/institute.

PROJECT MANAGEMENT AND INTELLECTUAL PROPERTY RIGHTS

Weekly Teaching Hours	TH: -	Practical: -	
Scheme of Marking	IA: 50	PR/OR: 50	Total: 100

The Student has to choose this course either from NPTEL/MOOCs/SWAYAM pool. It is mandatory to get the certification of the prescribed course.

PROJECT-I

Weekly Teaching Hours	TH: -	Practical: -	
Scheme of Marking	IA: 50	PR/OR: 50	Total: 100

Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work, the candidate shall deliver a presentation on progress of the work on the selected dissertation topic.

It is desired to publish the paper on the state of the art on the chosen topic in international conference/ journal.

The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

PROJECT-II

Weekly Teaching Hours	TH: -	Practical: -	
Scheme of Marking	IA: 100	PR/OR: 100	Total: 200

In Project - II, the student shall complete the remaining part of the project which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions.

It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal.

The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.