SRI VENKATESWARA COLLEGE OF ENGINEERING
(An Autonomous Institution, Affiliated to Anna University, Chennai)
SRIPERUMBUDUR TK.- 602 117
REGULATION – 2016
M.E. COMMUNICATION SYSTEMS
CURRICULUM AND SYLLABUS

SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	MA16182	Applied Mathematics for Communication Engineers	3	1	0	4
2	CU16101	Advanced Radiation Systems	3	0	0	3
3	CU16102	Advanced Digital Communication Techniques	3	0	0	3
4	CU16103	Advanced Digital Signal Processing	3	1	0	4
5	CU16104	Optical Networks	3	0	0	3
6		Elective I	3	0	0	3
PRACTICALS						
7	CU16111	Communication Systems Laboratory	0	0	3	2
		TOTAL	**18**	**2**	**3**	**22**

SEMESTER II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CU16201	Wireless Communication Networks	3	0	0	3
2	CU16202	MIC and RF System Design	3	0	0	3
3	CU16203	Electromagnetic Interference and Compatibility	3	0	0	3
4		Elective II	3	0	0	3
5		Elective III	3	0	0	3
6		Elective IV	3	0	0	3
PRACTICALS						
7	CU16211	Innovative System Design Laboratory	0	0	3	2
		TOTAL	**18**	**0**	**3**	**20**

SEMESTER III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1		Elective V	3	0	0	3
2		Elective VI	3	0	0	3
3		Elective VII	3	0	0	3
PRACTICALS						
4	CU16311	Project Work (Phase I)	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICALS						
1	CU16411	Project Work (Phase II)	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

ELECTIVE I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	AL16102	Advanced Microprocessor and Microcontroller	3	0	0	3
2	AL16012	Analog and Mixed Mode VLSI Design	3	0	0	3
3	AL16025	Real Time Embedded systems	3	0	0	3
4	AL16023	MEMS and NEMS	3	0	0	3
5	AL16202	ASIC and FPGA Design	3	0	0	3

ELECTIVE II

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16017	Communication Networks Modeling and Simulation	3	0	0	3
2	CU16001	Digital Communication Receivers	3	0	0	3
3	CU16002	Detection and Estimation Theory	3	0	0	3
4	AL16019	VLSI for Wireless Communication	3	0	0	3
5	CU16003	Cognitive Radio	3	0	0	3

ELECTIVE III

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CU16004	Speech and Audio Signal processing	3	0	0	3
2	CU16005	Advanced Digital Image Processing	3	0	0	3
3	CU16006	Radar Signal Processing	3	0	0	3
4	CP16009	Speech Processing and Synthesis	3	0	0	3

ELECTIVE IV

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CU16007	Wavelet Transforms and Applications	3	0	0	3
2	AL16030	DSP Processor Architecture and Programming	3	0	0	3
3	NW16015	High Performance Networks	3	0	0	3
4	CP16025	Reconfigurable Computing	3	0	0	3

ELECTIVE V

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	NW16018	Network Routing Algorithms	3	0	0	3
2	NW16016	Wireless Ad hoc and Sensor Networks	3	0	0	3
3	CU16008	Internetworking Multimedia	3	0	0	3
4	NW16019	Multimedia Compression Techniques	3	0	0	3
5	CU16009	Ultra Wide Band Communication	3	0	0	3

ELECTIVE VI

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CP16036	Soft Computing	3	0	0	3
2	NW16020	Network Processor	3	0	0	3
3	NW16008	Network Management	3	0	0	3
4	NW16021	Communication Network Security	3	0	0	3
5	CU16010	Neural Networks and Applications	3	0	0	3

ELECTIVE VII

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	CU16011	Advanced Satellite Based Systems	3	0	0	3
2	CU16012	Electromagnetic and Photonic Band Gap Structures for Antenna Engineering	3	0	0	3
3	CU16013	OFDM Systems	3	0	0	3
4	CU16014	RF Filter Design	3	0	0	3
5	CU16015	Underwater Acoustic Signal Processing	3	0	0	3

MA16182 APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS

L	T	P	C
3	1	0	4

OBJECTIVES:

- To develop the ability to use the concepts of Linear algebra and Special functions for solving problems related to Networks.
- To formulate and construct a mathematical model for a linear programming problem in real life situation.
- To expose the students to solve ordinary differential equations by various techniques.

UNIT I LINEARALGEBRA 9+3

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --Toeplitz matrices and some applications.

UNIT II LINEAR PROGRAMMING 9+3

Formulation – Graphical solution – Simplex method – Two phase method -Transportation and Assignment Models.

UNIT III ORDINARYDIFFERENTIALEQUATIONS 9+3

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT IV TWO DIMENSIONALRANDOM VARIABLES 9+3

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT V QUEUEING MODELS 9+3

Poisson Process – Markovian queues – Single and Multi-server Models – Little's formula Machine Interference Model – Steady State analysis – Self Service queue.

TOTAL: 45+15:60 PERIODS

OUTCOMES:

- To achieve an understanding of the basic concepts of algebraic equations and method of solving them.
- To familiarize the students with special functions and solve problems associated with Engineering applications.

REFERENCES:

1. Richard Bronson, Gabriel B.Costa, "Linear Algebra", Academic Press, Second Edition, 2007.
2. Richard Johnson, Miller & Freund, "Probability and Statistics for Engineers", 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).
3. Taha H.A., "Operations Research: An introduction", Pearson Education Asia, New Delhi, Nint Edition, 2012.
4. Donald Gross and Carl M. Harris, "Fundamentals of Queueing Theory", 2nd edition, John Wiley and Sons, New York (1985).
5. Moon, T.K., Sterling, W.C., Mathematical methods and algorithms for signal processing, Pearson Education, 2000.

CU16101 ADVANCED RADIATION SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enhance the students knowledge in the area of various antenna design and to make them understand their radiation mechanism.
- To impart knowledge about the state of art in antenna technology.

UNIT I ANTENNA FUNDAMENTALS **9**

Antenna fundamental parameters, Radiation integrals, Radiation from surface and line current distributions – dipole, monopole, loop antenna; Mobile phone antenna- base station, hand set antenna; Image; Induction, reciprocity theorem, Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques.

UNIT II RADIATION FROM APERTURES **9**

Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.

UNIT III ARRAYS **9**

Introduction-General structure of phased array, linear array theory, variation of gain as a function of pointing direction, effects of phase quantization, frequency scanned arrays, analog beam forming matrices-Active modules, digital beam forming, MEMS technology in phased arrays-Retro directive and self phased arrays.

UNIT IV MICRO STRIP ANTENNA **9**

Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of microstrip array antenna.

UNIT V EMC ANTENNA AND ANTENNA MEASUREMENTS **9**

Concept of EMC measuring antenna; Receiver and Transmitter antenna factors; Log periodic dipole, Biconical, Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, the student should be able to:

- Describe the fundamentals to recent techniques in antenna technology.
- Design and assess the performance of various antennas.

REFERENCES:

1. Hubregt.J.Visser “Antenna Theory and Applications” 1st Edition, John Wiley & Sons Ltd,Newyork,2012.
2. Zhijun Zhang” Antenna Design for Mobile Devices” 1st Edition, John Wiley & Sons (Asia) Ltd,Newyork,2011.
3. Xavier Begaud, “Ultra Wide Band Antennas” , 1st Edition, ISTE Ltd and John Wiley & Sons Ltd,Newyork,2013
4. Balanis.A, “Antenna TheoryAnalysis and Design”, John Wiley and Sons, New York, 1982.
5. Krauss.J.D, “Antennas”, II edition, John Wiley and sons, New York, 1997.
6. I.J. Bahl and P. Bhartia,” Microstrip Antennas”,Artech House,Inc.,1980

7. W.L.Stutzman and G.A.Thiele, ”Antenna Theory and Design”, 2nd Edition, John Wiley& Sons Inc.,1998.
8. S.Drabowitch et.al.:, ”Modern Antennas”, 2nd Edition Springer science business Media, Inc.2005.

CU16102 ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the basics of signal-space analysis and digital transmission.
- To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
- To understand Orthogonal Frequency Division Multiplexing.
- To understand the different block coded and convolutional coded digital communication systems.
- To understand the different Equalizers.

UNIT I COHERENTAND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK--BER Performance Analysis. Carrier Synchronization- Bit synchronization.

UNIT II EQUALIZATION TECHNIQUES 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signalsEqualization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITALCOMMUNICATION 9

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed – Solomon codes - Space time block codes.

UNIT IV CONVOLUTIONALCODED DIGITALCOMMUNICATION 9

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

UNIT V OFDM 9

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes- Clipping, Filtering, Coding and Scrambling.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Develop the ability to understand the concepts of signal space analysis coherent and noncoherent receivers.
- Comprehend the generation of OFDM signals and the processing of the signals.
- Possess knowledge on different block codes and convolutional codes.
- Conceptually appreciate different Equalization techniques.

REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.
2. Simon Haykin, Digital communications, John Wiley and sons, 1998.
3. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.
4. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001.
5. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.
6. Stephen G. Wilson., 'Digital Modulation and Coding', First Indian Reprint ,Pearson Education, 2003.
7. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.

CU16103 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 1 0 4

OBJECTIVES:

- The purpose of this course is to provide in-depth treatment on methods and techniques in discrete-time signal transforms, digital filter design, optimal filtering power spectrum estimation, multi-rate digital signal processing.
- DSP architectures which are of importance in the areas of signal processing, control and communications.

UNIT I DISCRETE RANDOM SIGNALPROCESSING 9+3

Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling-Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records, Stochastic Models.

UNIT II SPECTRUM ESTIMATION 9+3

Non-Parametric methods - Correlation method - Co-variance estimator - Performance analysis of estimators – Unbiased consistent estimators - Periodogram estimator - Barlett spectrum estimation- Welch estimation - Model based approach - AR, MA, ARMA Signal modeling - Parameter estimation using Yule-Walker method.

UNIT III LINEAR ESTIMATIONAND PREDICTION 9+3

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion Wiener filter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter - Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization, Levinson recursion algorithm for solving Toeplitz system of equations.

UNIT IV ADAPTIVE FILTERS 9+3

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

UNIT V MULTIRATE DIGITALSIGNALPROCESSING 9+3

Mathematical description of change of sampling rate - Interpolation and Decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor -Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

L+T= 45+15, TOTAL: 60 PERIODS

COURSE OUTCOMES:

Students should be able to:

- To design adaptive filters for a given application.
- To design multirate DSP systems.

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006
2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000.
3. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, New Delhi, 2005.
4. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.
5. S. Kay, "Modern spectrum Estimation theory and application", Prentice Hall, Englehood Cliffs, NJ1988.
6. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

CU16104 **OPTICAL NETWORKS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study and understand various optical system components
- To get acquainted with different types of optical network architectures and their applications
- Study about different wavelength routing network
- To study about packet switching and access networks
- To learn about designing of optical communication networks and managing them

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; SONET / SDH standards, Metropoliton Area Networks, Layered Architecture; Broadcast and Select Networks–Topologies for Broadcast Networks, Media Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength Assignment [RWA], Virtual topology design, Wavelength Routing Testbeds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, OTDM networks; Optical Access Network Architectures; Future Access Networks.

UNIT V NETWORK DESIGNAND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, the student should be able to:

- The students will be able to use the different optical components such as multiplexers, switches, filters etc., to build a optical network.
- The students will be able to design broadcast and select WDM and Wavelength routing networks that are suitable for MANs.
- The students will be able to analyze the various issues associated with deploying the optical technology in different types of network with suitable control and management aspects of optical network.

REFERENCES:

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks : A Practical Perspective”, Harcourt Asia Pte Ltd., Second Edition 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks : Concept, Design and Algorithms”, Prentice Hall of India, Ist Edition, 2002.
3. Biswanath Mukherjee, “Optical Communication Networks”, Mc-GrawHill ©1997, First Edition ISBN 0-07-044435-8.
4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
5. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks : A Practical Perspective”, Harcourt Asia Pte Ltd., First Edition 2004.

CU16111 COMMUNICATION SYSTEM LABORATORY

L	T	P	C
0	0	3	2

COURSE OBJECTIVES

- To enable the student to verify the basic principles communication system design, coding and modulation, synchronization aspects and the overall baseband system design.
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.
- To enable the student to appreciate the practical aspects of baseband system design and understand the associated challenges.

List of Experiments

1. Measurement of transmission line parameters.
2. S-parameter estimation of Microwave devices.
3. Design and testing of a Microstrip coupler.
4. Characteristics of λ/4 and λ/2 transmission lines.

Use appropriate simulation tools for the following experiments.

1. Channel equalizer design (LMS, RLS).
2. Antenna Radiation Pattern measurement.
3. Performance Evaluation of digital modulation schemes.
4. OFDM transceiver design.
5. Simulation of Microstrip Antennas.
6. Performance evaluation of simulated CDMA System.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course, the student should be able to:

- Design and Development of RF component and systems.
- Compare and analyze the various Signal Processing and Wireless Communication standards.

CU16201 WIRELESS COMMUNICATION NETWORKS L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of wireless communication.
- To make the students to know about the various propagation methods, Channel models, capacity calculations multiple antennas and multiple user techniques used in the mobile communication.
- To enhance the understanding of Wi-fi, 3G systems and 4G networks.

UNIT I WIRELESS CHANNELPROPAGATIONAND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification-channel models– COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading –shadowing Distributions, Link power budget Analysis.

UNIT II DIVERSITY 9

Capacity of flat and frequency selective fading channels-Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.

UNIT III MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spacial Multiplexing and BLAST Architectures.

UNIT IV MULTI USER SYSTEMS 9

Multiple Access: FDMA,TDMA, CDMA,SDMA, Hybrid techniques, Random Access: ALOHA,SALOHA,CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.

UNIT V WIRELESS NETWORKS 9

3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture-Introduction to wireless LANs-IEEE 802.11 WLANs - Physical Layer- MAC sublayer.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- The students understand the state of art techniques in wireless communication.
- Students are enriched with the knowledge of present day technologies to enable them to face the world and contribute back as researchers.

REFERENCES:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. HARRY R. ANDERSON, “Fixed Broadband Wireless System Design” John Wiley –India, 2003.
3. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.
4. Simon Haykin & Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
5. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003.
6. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.
7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, http://books.elsevier.com/9780123735805:, 2007.
8. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.
9. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.
10. Sumit Kasera and Nishit Narang,“3G Networks – Architecture, Protocols and Procedures”, Tata McGraw Hill, 2007.

CU16202 MICAND RF SYSTEM DESIGN L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of RF radio system design.
- To understand the various components that constitute an RF radio system for wireless Communications.
- To know the basic analysis techniques needed for evaluating the performance of an RF radio system for Wireless applications.

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

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

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS 9

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

UNIT III FEEDBACK SYSTEMSAND POWERAMPLIFIERS 9

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

UNIT IV RF FILTER DESIGN, OSILLATOR, MIXER 9

Overview-basic resonator and filter configuration-special filter realizations-filter implementation. Basic oscillator model-high frequency oscillator configuration-basic characteristics of mixers-phase locked loops-RF directional couplers hybrid couplers-detector and demodulator circuits.

UNIT V MIC COMPONENTS,ANTENNASAND MEASUREMENT TECHNIQUES 9

Introduction to MICs-Fabrication Technology, Advantage and applications, MIC components Micro strip components, Coplanar circuits, Integrated antennas, photonic band gap antennas, Measurement techniques-test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to design RF circuits.
- To be able to analyse the performance of RF circuits.

REFERENCES:

1. T. Lee, ”Design of CMOS RF Integrated Circuits”, Cambridge, 2004.
2. B.Razavi, “RF Microelectronics”, Pearson Education, 1997.
3. Jan Crols, MichielSteyaert, ”CMOS Wireless Transceiver Design”, Kluwer Academic Publications, 1997.
4. B. Razavi, Design of analog CMOS Integrated Circuits”, McGraw Hill,2001.

5. I.D. Robertson &S. Lucyszyn, “RFIC and MMIC Design and Technology”, IEE Circuits, Devices and Systems series 13, London, UK, 2001.

CU16203	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of EMI.
- To study EMI Sources.
- To understand EMI problems.
- To understand Solution methods in PCB.
- To understand Measurement technique for emission.
- To understand Measurement technique for immunity.

UNIT I EMI/EMC CONCEPTS **9**

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES **9**

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

UNIT III EMI CONTROLTECHNIQUES **9**

Shielding Material-Shielding integrity at discontinuties, Filtering-Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets.

UNIT IV EMC DESIGN OF PCBS **9**

EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits, Component selection and mounting; PCB trace impedance; Routing; Cross talk control Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V EMI MEASUREMENTSAND STANDARDS **9**

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; TX/Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462. Frequency assignment-spectrum conversation. British VDE standards, Euro norms standards in japan – comparisons. EN Emission and Susceptibility standards and Specifications.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- To design a EMI free system
- To reduce system level crosstalk
- To design high speed Printed Circuit board with minimum interference
- To make our world free from unwanted electromagnetic environment.

REFERENCES:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, Newyork, 1996.
2. Clayton R.Paul," Introduction to Electromagnetic Compatibility", John Wiley Publications, 2008.
3. Henry W.Ott.,"Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.
4. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech house, Norwood, 1986.
5. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC" , Vol I-V, 1988.

CU16211 INNOVATIVE SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	3	2

OBJECTIVES:

- To encourage the students to identify socially relevant problems,
- To enable him to think of creative solutions for the same,
- To design and conduct suitable experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts,
- To enable the student to appreciate the practical aspects of system design and understand the associated challenges.
- To help him develop low cost proof of concept system prototype.

METHODOLOGY:

- Students could form teams not exceeding 2 members,
- Students should submit / present their ideas to the Lab-in-Charge and get it approved,
- Student should submit proposal with system/ technical details and cost implications.
- Students should periodically demonstrate the progress they have made.

EVALUATION:

Students should be evaluated on the basis of the following:

- Social relevance of their work.
- Utility of the system developed.
- Level of proof of concept.
- Industry support if obtained, etc.

OUTCOMES:

- The student would be able to identify socially relevant issues and apply his knowledge to evolve feasible solutions.
- The student would be able to comprehensively record and report the measured data,write reports, communicate research ideas and do oral presentations effectively.

TOTAL: 60 PERIODS

ELECTIVE I

AL16102	ADVANCED MICROPROCESSOR AND MICROCONTROLLER	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the fundamental concepts of microprocessor architecture.
- To gain knowledge about high performance CISC and RISC architectures.
- To study about 8 bit Microcontrollers viz. 68HC11 and PIC.

UNIT I OVERVIEW **9**

Generic Architecture--Instruction Set – Data formats –Addressing modes – Memory hierarchy – register file –Cache – Virtual memory and paging – Segmentation- pipelining –the instruction pipeline – pipeline hazards – instruction level parallelism – reduced instruction set –Computer principles – RISC versus CISC.

UNIT II HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM **9**

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set –addressing modes – Programming the Pentium processor.

UNIT III HIGH PERFORMANCE RISCARCHITECTURE –ARM **9**

Organization of CPU – Bus architecture –Memory management unit - ARM instruction set- Thumb Instruction set- addressing modes – Programming the ARM processor.6

UNIT IV MOTOROLA68HC11 MICROCONTROLLERS **9**

Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface –A/D Converter PWM and UART.

UNIT V PIC MICROCONTROLLER **9**

CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing –UART-A/D Converter – PWM and introduction to C-Compilers.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Students will be able:

- To understand the internal organization of advanced microprocessors and microcontrollers.
- To discriminate the performance of pipe-lining and non-pipe-lining architecture of microprocessors.
- To design an automated system with programming module from the knowledge gained from CISC and RISC architecture.

REFERENCES:

1. Daniel Tabak, ‘’Advanced Microprocessors” McGraw Hill.Inc., 1995 (recent edition).
2. James L. Antonakos , “ The Pentium Microprocessor ‘’Pearson Education , 1997.
3. Steve Furber , ‘’ARM System –On –Chip architecture“ Addision Wesley, 2000.
4. Gene .H.Miller.” Micro Computer Engineering,” Pearson Education, 2003.
5. John .B.Peatman , “ Design with PIC Microcontroller , Prentice hall, 1997.

6. James L.Antonakos ,” An Introduction to the Intel family of Microprocessors ‘’ Pearson Education 1999.
7. Barry.B.Breg,” The Intel Microprocessors Architecture, Programming and Interfacing “ , PHI,2002.
8. Valvano "Embedded Microcomputer Systems" Thomson Asia PVT LTD first reprint 2001.

AL16012 ANALOGAND MIXED MODE VLSI DESIGN

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the concepts of MOS large signal model and small signal model.
- To understand the concepts of D/A conversion methods and their architectures.
- To design filters for ADC.
- To study about the switched capacitor circuits.

UNIT I INTRODUCTIONAND BASIC MOS DEVICES 9

Challenges in analog design-Mixed signal layout issues- MOS FET structures and characteristics large signal model – small signal model- single stage Amplifier-Source follower- Common gate stage – Cascode Stage.

UNIT II SIBMICRON CIRCUIT DESIGN 9

Submicron CMOS process flow, Capacitors and resistors, Current mirrors, Digital Circuit Design, Delay Elements – Adders- OPAmp parameters and Design.

UNIT III DATACONVERTERS 9

Characteristicsof Sample and Hold- Digital to Analog Converters- architecture-Differential Non linearity-Integral Non linearity- Voltage Scaling-Cyclic DAC-Pipeline DAC-Analog to Digital Converters- architecture – Flash ADC-Pipeline ADC-Differential Non linearity-Integral Non linearity.

UNIT IV SNR IN DATACONVERTERS 9

Overview of SNR of Data Converters- Clock Jitters- Improving Using Averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating Filters for DAC.

UNIT V SWITCHED CAPACITOR CIRCUITS 9

Resistors, First order low pass Circuit, Switched capacitor Amplifier, Switched Capacitor Integrator.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Student will be able to analyze MOS analog circuits using small signal model and large signal model
- Students will be able to design and implement submicron digital circuits
- Students will be able to design,implement and analyze the characteristics of data converters, digital filters and switched capacitor circuits

REFERENCES:

1. Vineetha P.Gejji Analog and Mixed Mode Design - Prentice Hall, 1st Edition , 2011 .
2. Jeya Gowri Analog and Mixed Mode Design- Sapna publishing House 2011.

AL16025	REALTIME EMBEDDED SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students,the concept of embedded systems,and its hardware and software.
- To analyse devices and buses used for embedded networking.
- To have an insight into the programming concepts used in embedded systems.
- To explain real time operating systems and inter-task communication.

UNIT I INTRODUCTION TO EMBEDDED COMPUTING 9

Complex systems and microprocessors – Design example: Model train controller – Embedded system design process – Formalism for system design – Instruction sets Preliminaries – ARM Processor – CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption.

UNIT II COMPUTING PLATFORM AND DESIGNANALYSIS 9

CPU buses – Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

UNIT III PROCESSAND OPERATING SYSTEMS 9

Multiple tasks and multi processes – Processes – Context Switching – Operating Systems – Scheduling policies - Multiprocessor – Inter Process Communication mechanisms – Evaluating operating system performance – Power optimization strategies for processes.

UNIT IV HARDWAREACCELERATES & NETWORKS 9

Accelerators – Accelerated system design – Distributed Embedded Architecture – Networks for Embedded Systems – Network based design – Internet enabled systems.

UNIT V CASE STUDY 9

Hardware and software co-design - Data Compressor - Software Modem – Personal Digital Assistants – Set–Top–Box. – System-on-Silicon – FOSS Tools for embedded system development.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course,the students would be able to

- Understand and appreciate the significance of Embedded system
- Analyse and Identify suitable hardware,software and buses required for the problem of interest
- To carry on realtime scheduling and communication.
- To develop varied embedded applications

REFERENCES:

1. Wayne Wolf, “Computers as Components - Principles of Embedded Computer System Design”, Morgan Kaufmann Publisher, 2006.
2. David E-Simon, “An Embedded Software Primer”, Pearson Education, 2007.

3. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, dreamtech press, 2005.
4. Tim Wilmshurst, “An Introduction to the Design of Small Scale Embedded Systems”, Pal grave Publisher, 2004.
5. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc-Graw Hill, 2004.
6. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.

AL16023	MEMS AND NEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introducing the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To introducing concepts of quantum mechanics and nano systems.

UNIT I OVERVIEWAND INTRODUCTION 9

New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials.

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.

UNIT IV MICROACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

UNIT V NANOSYSTEMSAND QUANTUM MECHANICS 9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

TOTAL: 45 PERIODS

OUTCOMES: Upon Completion of the course, the students will be able to

- Identify the scope and applications of Micro and Nanoelectromechanical systems
- Design of fabrication techniques used in MEMS
- Identify various micro sensors used in MEMS
- Identify the Micro actuators which can be used in MEMS and to apply them suitably.
- Design different types of MEMS/NEMS devices depending on the required application

REFERENCES:

1. Marc Madou, “Fundamentals of Microfabrication”, CRC press 1997.
2. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers,2001.
3. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2002.
4. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006,
5. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.

AL16202 **ASIC AND FPGA DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC.
- To analyse the synthesis, Simulation and testing of systems.
- To understand the design issues of SOC.
- To know about different high performance algorithms and its applications in ASICs.

UNIT I OVERVIEW OFASIC AND PLD **9**

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices : ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs.

UNIT II ASIC PHYSICAL DESIGN **9**

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing : global routing - detailed routing - special routing circuit extraction – DRC.

UNIT III LOGIC SYNTHESIS, SIMULATIONAND TESTING **9**

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation -automatic test pattern generation.

UNIT IV FPGA **9**

Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology mapping for FPGAs, Xilinx XC4000 - ALTERA’s FLEX 8000/10000, ACTEL’s ACT-1,2,3 and their speed performance Case studies: Altera MAX 5000 and 7000 -Altera MAX 9000 – Spartan II and Virtex II FPGAs -Apex and Cyclone FPGAs.

UNIT V SOC DESIGN **9**

Design Methodologies – Processes and Flows - Embedded software development for SOC – Techniques for SOC Testing – Configurable SOC – Hardware / Software codesign Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB.

TOTAL: 45 PERIODS

OUTCOMES:

- Demonstrate VLSI design-flow and appreciate FPGA architecture and to familiarize the different types of programming technologies and logic devices.
- Understand the architecture of different types of FPGA and introduce the principles of design logic cells, I/O cells and interconnect architecture, with equal importance given to FPGA and ASIC styles and also to understand the algorithms used for partitioning, floor planning, and placement and routing during ASIC construction.
- Understand and analyze the synthesis, Simulation and testing of systems.
- Understand the basics of System on Chip and platform based design.

REFERENCES:

1. M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc., 1997.
2. S. Trimberger, Field Programmable GateArray Technology, Edr, Kluwer Academic Publications, 1994.
3. John V.Oldfield, Richard C Dore, Field Programmable GateArrays, Wiley Publications 1995.
4. P.K.Chan & S. Mourad, Digital Design Using Field Programmable Gate Array, Prentice Hall, 1994.
5. Parag.K.Lala, Digital System Design using Programmable Logic Devices , BSP, 2003.
6. S. Brown, R. Francis, J. Rose, Z. Vransic, Field Programmable Gate Array, Kluwer Pubin,1992.
7. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork, 1995.
8. Farzad Nekoogar and Faranak Nekoogar, FromASICs to SOCs:APractical Approach, Prentice Hall PTR, 2003.
9. Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
10. R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers,2000.
11. F. Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR, 1999.

ELECTIVE II

NW16017	COMMUNICATION NETWORK MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the modeling of layers.
- To understand the concept of Monte Carlo simulation

UNIT I INTRODUCTION TO MODELING AND SIMULATION 9

Introduction, Discrete-event Simulation, Modeling for Computer Simulation, Tools and Methods for Network Simulation, The Simulation Platform, Simulation Framework, Tools and Modeling Approaches for Simulating Hardware.

UNIT II MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system.

UNIT III LOWER LAYER & LINK LAYER WIRELESS MODELING 9

Physical Layer Modeling, Description of the Main Components of the PHY Layer, Accurate Simulation of Physical Layers, Physical Layer Modeling for Network Simulations, Link Layer Modeling, Medium Access Control (MAC) Protocols, Logical Link Control, Forward Error Detection and Correction, Backward Error Detection and Correction, Queueing and Processing Delay.

UNIT IV CHANNEL MODELING & MOBILITY MODELING 9

Channel Modeling: The Physics of Radiation, The Nature of Electromagnetic Radiation, Classification of Propagation Models, Deterministic Approaches by Classical Field Theory, Deterministic Geometric Optical Approaches, Empirical Path Loss Approaches, Stochastic Shadowing Models, Stochastic Fading Models, MIMO Channel Models. Mobility modeling: Categorization of Mobility Models, Mobility Models, Random Walk Model, Random Waypoint Model Random Direction Model, Gauss-Markov Model, Manhattan Model, Column Model, Pursue Model, Nomadic Community Model, Selection of Appropriate Mobility Models.

UNIT V HIGHER LAYER MODELING & MODELING THE NETWORK TOPOLOGY 9

Higher Layer Modeling: Modeling the Network Layer and Routing Protocols, Components of a Routing Protocol, Metrics, Virtual Routing on Overlays, Modeling Transport Layer Protocols, Modeling Application Traffic. Modeling the Network Topology: Abstraction of Network Topologies by Graphs, Characterizing Graphs, Common Topology Models, Geometric Random Graph –he Waxman Model, Hierarchical Topologies, Preferential Linking – The Barabási-Albert Model , Modeling the Internet.

TOTAL: 45 PERIODS

OUTCOMES: Student will be able to

- Present the basic concepts and properties of random variables, random processes and mode ls and compute the response of the system that are used for simulating communication syst ems.
- Model fading and multipath channels that are used in the performance analysis of GSM, U

WB, Wi-Fi, Wi-
Max and LTE communication systems and generate sampled values of random process that are used to model signals, noise, interference and time varying channels in communication systems.

- Estimate the parameters such as average level, probability density function, power spectral density, delay and phase of the waveform.
- Estimate the bit error rate using montocarle simulation and simplify and validate the simula tion procedures using bounds and approximations.
- Evaluate the performance of the communication system in terms of performance parameter such as outage probability, bit error rate for a given scenario using modeling and simulation .

REFERENCES:

1. K.Wehrie. Gunes, J.Gross, "Modeling and Tools for Network simulation", Springer, 2010.
2. Irene Karzela, "Modeling and Simulating Communications Networks", Prentice Hall India, 1998,
3. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, "Principles of Communication Systems Simulation", Pearson Education (Singapore) Pvt. Ltd, 2004.
4. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, "Simulation of Communication Systems: Modeling, Methodology and Techniques", Plenum Press, New York, 2001.
5. Nejat; Bragg, Arnold, "Recent Advances in Modeling and Simulation Tools for Communication Networks and Services", Springer, 2007.

CU16001 DIGITAL COMMUNICATION RECEIVERS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To recall Digital baseband and Passband Schemes.
- To understand and analyze receivers for AWGN and Fadding channel.
- To understand about Synchronization and equalization techniques.

UNIT I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES 9

Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

UNIT II OPTIMUM RECEIVERS FORAWGN CHANNEL 9

Correlation demodulator, matched filter, maximum likelihood sequence detector, optimum receiver for CPM signals, M –ary orthogonal signals, envelope detectors for Maryand correlated binary signals.

UNIT III RECEIVERS FOR FADING CHANNELS 9

Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.

UNIT IV SYNCHRONIZATION TECHNIQUES 9

Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

UNIT V ADAPTIVE EQUALIZATION 9

Zero forcing algorithm, LMS algorithm, adaptive decision-feedback equalizer and Equalization of Trellis-coded signals. Kalman algorithm, blind equalizers and stochastic gradient algorithm.

TOTAL: 45 PERIODS

OUTCOMES: Student will be able to

- Demonstrate an understanding of the basic principles of random signal processing, spectral estimation methods and their applications.
- Demonstrate an understanding of the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.
- Apply his knowledge for designing a baseband system addressing the channel impairments.

REFERENCES:

1. Heinrich Meyer, Mare Moeneclacy, Stefan. A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
2. U.Mengali & A.N.D' Andrea, Synchronization Techniques for Digital Receivers, Kluwer,

1997.
3. John.G.Proakis, “Digital communication “4th Edition, McGraw-Hill, New York, 2001.
4. E.A.Lee and D.G. Messerschmitt, “Digital communication ", 2nd Edition, Allied Publishers, New Delhi, 1994.
5. Simon Marvin, “Digital communication over fading channel; An unified approach to performance Analysis ", John Wiley, New York, 2000.
6. H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990.
7. R. G. Gallager, Principles of Digital Communication, Cambridge University Press, 2008.

CU16002 DETECTION AND ESTIMATION THEORY L T P C
3 0 0 3

OBJECTIVES:

- To enable the student to understand the basic principles of random signal processing, spectral estimation methods and their applications.
- To enable the student to understand the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes-Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION 9

Estimation of spectra from finite duration signals, Nonparametric methods–Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods –ARMA,AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.

UNIT III DETECTIONAND ESTIMATION CRITERIA 9

Detection criteria: Bayes detection techniques, MAP, ML,–detection of M-ary signals, Neyman Peason, minimax decision criteria. Estimation: linear estimators, non-linear estimators, Bayes, MAP,ML, properties of estimators, phase and amplitude estimation.

UNIT IV SYNCHRONIZATION 9

Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.

UNIT V RECEIVERS FORAWGNAND FADING CHANNELS 9

Optimum receivers for AWGN channel -Correlationdemodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to demonstrate an understanding of the basic principles of random signal processing, spectral estimation methods and their applications.
- The student would be able to demonstrate an understanding of the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.
- The student would be in a position to apply his knowledge for designing a baseband system addressing the channel impairments.
- Heinrich Meyer, Mare Moeneclacy, Stefan. A. Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
- Sergio Verdu, "Multiuser Detection", Cambridge University Press, 1998.

REFERENCES:

1. Monson H.Hayes, 'Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002.
2. John J. Proakis, Dimitris G.Manolakis, :Digital Signal Processing', Pearson Education, 2002.
3. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001.
4. Bernard Sklar and Pabitra Kumar Roy, Digital Communications: Fundamentals & Applications, 2/E, Pearson Education India, 2009.
5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.

AL16019 VLSI FOR WIRELESS COMMUNICATION

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the design concepts of low noise amplifiers.
- To study the various types of mixers designed for wireless communication.
- To study and design PLL and VCO.
- To understand the concepts of CDMA in wireless communication.

UNIT I COMPONENTS AND DEVICES **9**

Integrated inductors, resistors, MOSFET and BJT AMPLIFIER DESIGN: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers.

UNIT II MIXERS **9**

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion -High-Frequency Case – Noise - A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer - Conversion Gain in Unbalanced Switching Mixer – Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain in Single Ended Sampling Mixer -Distortion in Single Ended Sampling Mixer -Intrinsic Noise in Single Ended Sampling Mixer-Extrinsic Noise in Single Ended Sampling Mixer.

UNIT III FREQUENCY SYNTHESIZERS **9**

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers -LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example (DECT Application).

UNIT IV SUB SYSTEMS **9**

Data converters in communications, adaptive Filters, equalizers and transceivers.

UNIT V IMPLEMENTATIONS **9**

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System.

TOTAL: 45 PERIODS

OUTCOMES: Student will be able to

- Understand the concept of PLL and VCO.
- Understand the comments of CDMA in wireless communication.

REFERENCES:

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002.
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press ,2003.
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI Wireless Design - Circuits and Systems", Kluwer Academic Publishers, 2000.
5. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999.

6. J. Crols and M.Steyaert,“CMOS Wireless Transceiver Design,” Boston, Kluwer Academic Pub., 1997.

CU16003 **COGNITIVE RADIO** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
- To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.
- To expose the student to the evolving next generation wireless networks and their associated challenges.

UNIT I INTRODUCTION TO SDR **9**

Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications, Antenna for Cognitive Radio.

UNIT II SDR ARCHITECTURE **9**

Essential functions of the software radio, architecture goals, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules, architecture partitions.

UNIT III INTRODUCTION TO COGNITIVE RADIOS **9**

Marking radio self-aware, the cognition cycle, organization of congnition tasks, structuring knowledge for cognition tasks, Enabling location and environment awareness in cognitive radios –concepts, architecture, design considerations.

UNIT IV COGNITIVE RADIOARCHITECTURE **9**

Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, design rules.

UNIT V NEXT GENERATION WIRELESS NETWORKS **9**

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

OUTCOMES:

1. The student would be able to appreciate the motivation and the necessity for cognitive radio communication strategies.
2. The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
3. The student would be able to demonstrate the impact of the evolved solutions in future wireless network design.

REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, "Cognitive Radio Communications And Networks - Principles And Practice", Elsevier Inc. , 2010.
2. E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, "Principles of Cognitive Radio", Cambridge University Press, 2013.
3. Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks" , John Wiley & Sons, Ltd, 2009.
4. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks-From Theory to Practice", Springer Series: Analog Circuits and Signal Processing, 2009.
5. J.Mitola,"Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
6. Simon Haykin, "Cognitive Radio: Brain–empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.
7. Ian F.Akyildiz, Won –Yeol Lee, Mehmet C.Vuran, Shantidev Mohanty, "NeXt generation /dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks, May 2006.

ELECTIVE III

CU16004	SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the basic concepts of speech and audio.
- To study the analysis of various M-band filter banks for audio coding.
- To learn various transform coders for audio coding.
- To study the speech processing methods in time and frequency domain.

UNIT I MECHANICS OF SPEECH ANDAUDIO 9

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes– Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking-Non simultaneous Masking - Perceptual Entropy - Basic measuring philosophy-Subjective versus objective perceptual testing -The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT II TIME-FREQUENCY ANALYSIS:FILTER BANKS AND TRANSFORMS 9

Introduction-Analysis-Synthesis Framework for M-band Filter Banks-Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree Structured QMF and CQF M-band Banks – Cosine Modulated "Pseudo QMF" M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT)-Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion-Preecho Control Strategies.

UNIT III AUDIO CODINGAND TRANSFORM CODERS 9

Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4AudioCoding-Optimum Coding in the Frequency Domain -Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.

UNIT IV TIMEAND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING 9

Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude–Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods HOMOMORPHIC SPEECHANALYSIS: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders.

UNIT V LINEAR PREDICTIVEANALYSIS OF SPEECH 9

Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method– Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of

LPC parameters – Pitch detection using LPC parameters–Formant analysis –VELP – CELP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to

- Understand the fundamentals of audio and speech signal processing and associated techniques.
- Understand how to solve practical problems with some basic audio & speech signal processing techniques.
- Analyze and design algorithms to extract parameters from the speech signal.
- Analyze and design algorithms for coding speech and audio signal.

REFERENCES:

1. Digital Audio Signal Processing, Second Edition, Udo Zölzer,A John Wiley&sons Ltd Publications
2. Applications of Digital Signal Processing to audio and acoustics Mark Kahrs, Karlheinz Brandenburg, Kluwer Academic Publishers New york, Boston, Dordrecht, London, Moscow
3. Digital Processing of Speech signals – L.R.Rabiner and R.W.Schaffer - Prentice Hall –1978.

CU16005 ADVANCED DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets.

UNIT I FUNDAMENTALS OF DIGITALIMAGE PROCESSING 9

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing.

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT III FEATURE EXTRACTION 9

First and second order edge detection operators, Phase congruency, Localized feature extraction detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors-Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV REGISTRATIONAND IMAGE FUSION 9

Registration- Preprocessing, Featureselection-points, lines, regions and templates Feature correspondence-Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling-Nearest Neighbour and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION 9

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- To understand image formation and the role human visual system plays in perception of gray and color image data.
- To apply image processing techniques in both the spatial and frequency (Fourier) domains.
- To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
- To conduct independent study and analysis of feature extraction techniques.
- To understand the concepts of image registration and image fusion.
- To analyze the constraints in image processing whendealing with 3D data sets and to apply image processing algorithms in practical applications.

TEXT BOOKS:

1. John C.Russ, "The Image Processing Handbook", CRC Press,2007.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 2008.
3. Ardeshir Goshtasby, "2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications", John Wiley and Sons,2005.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing', Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, , Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.
3. Rick S.Blum, Zheng Liu," Multi sensor image fusion and its Applications ",Taylor& Francis,2006.

CU16006 RADAR SIGNAL PROCESSING L T P C
3 0 0 3

OBJECTIVES:

- To understand the Radar Signal acquisition and sampling in multiple domains.
- To provide clear instruction in radar DSP basics.
- To equip the skills needed in both design and analysis of common radar algorithms.
- To understand the basics of synthetic aperture imaging and adaptive array processing.
- To illustrate how theoretical results are derived and applied in practice.

UNIT I INTRODUCTION TO RADAR SYSTEMS 9

History and application of radar, basic radar function, elements of pulsed radar, review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing.

UNIT II SIGNAL MODELS 9

Components of a radar signal, amplitude models, types of clutters, noise model and signal-to noise ratio, jamming, frequency models: the doppler shift, spatial models, spectral model.

UNIT III SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS 9

Domains and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting the pulse repetition interval, Sampling the doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.

UNIT IV RADAR WAVEFORMS 9

Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range side lobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency Codes.

UNIT V DOPPLER PROCESSING 9

Alternate forms of the Doppler spectrum, Moving target indication (MTI),Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing.

TOTAL: 45 PERIODS

OUTCOMES: Student will be able to

- Understand the concept of Radar system
- Understand the effect of Quantization

REFERENCES:

1. Fundamentals of Radar Signal Processing, Mark A. Richards McGraw-Hill, New York, 2005.
2. Principles of Radar and Sonar Signal Processing, Francois Le Chevalier, Artech House.
3. Radar systems, Peak Detection and Tracking, Michael O Kolawole ,2010,Elseveir.
4. Introduction To Radar Systems 3/E, Skolnik, McGraw Hill.

5. Radar Principles, Peyton Z. Peebles, 2009 Wiley India.
6. Radar Design Principles-Signal Processing and the environment, Fred E. Nathanson, PHI.

CP16009 SPEECH PROCESSINGAND SYNTHESIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the mathematical foundations needed for speech processing.
- To understand the basic concepts and algorithms of speech processing and synthesis.
- To familiarize the students with the various speech signal representation, coding and recognition techniques.
- To appreciate the use of speech processing in current technologies and to expose the students to real– world applications of speech processing.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONSAND CODING **9**

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXTANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word.
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals.
- Justify the use of formant and concatenative approaches to speech synthesis.
- Identify the apt approach of speech synthesis depending on the language to be processed.
- Determine the various encoding techniques for representing speech.

REFERENCES:

1. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, "Spoken Language Processing – A guide to Theory,Algorithm and System Development", Prentice Hall PTR, 2001.
2. Thomas F.Quatieri, "Discrete-Time Speech Signal Processing", Pearson Education, 2002.
3. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", Prentice Hall Signal Processing Series, 1993.
4. Sadaoki Furui, "Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)", Marcel Dekker, 2000.
5. Joseph Mariani, "Language and Speech Processing", Wiley, 2009.

ELECTIVE IV

CU16007 WAVELET TRANSFORMS AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the basics of signal representation and Fourier theory.
- To understand Multi Resolution Analysis and Wavelet concepts.
- To study the wavelet transform in both continuous and discrete domain.
- To understand the design of wavelets using Lifting scheme.
- To understand the applications of Wavelet transform.

UNIT I FUNDAMENTALS **9**

Vector Spaces – Properties–Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis.

UNIT II MULTI RESOLUTIONANALYSIS **9**

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.

UNIT III CONTINUOUS WAVELET TRANSFORMS **9**

Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal)– Tiling of Time – Scale Plane for CWT.

UNIT IV DISCRETE WAVELET TRANSFORM **9**

Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT– Multi Band Wavelet Transforms Lifting Scheme-Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z –Domain.

UNIT V APPLICATIONS **9**

Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding– Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions–Edge Detection and Object Isolation, Image Fusion, and Object Detection.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Use Fourier tools to analyse signals.
- Gain knowledge about MRA and representation using wavelet bases.
- Acquire knowledge about various wavelet transforms and design wavelet transform.
- Apply wavelet transform for various signal & image processing applications.

TEXT BOOKS:

1. Rao R M and A S Bopardikar,―Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000.
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

REFERENCES:

1. J.C. Goswami and A.K.Chan,"Fundamentals of wavelets: Theory, Algorithms and Applications" Wiley Interscience Publication, John Wiley & Sons Inc., 1999.
2. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995.
3. Stephen G. Mallat, "A wavelet tour of signal processing" 2nd Edition Academic Press, 2000.
4. Soman K P and Ramachandran K I, ―Insight into Wavelets From Theory to practice, Prentice Hall, 2004.

AL16030 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING

L	T	P	C
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OBJECTIVES:

The objective of this course is to provide in-depth knowledge on

- Digital Signal Processor basics.
- Third generation DSP Architecture and programming skills.
- Advanced DSP architectures and some applications.

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Multiplier and Multiplier accumulator –Modified Bus Structures and Memory access in PDSPs –Multiple access memory – Multi-port memory – VLIW architecture-Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT II TMS320C5X PROCESSOR 9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions – Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III TMS320C6X PROCESSOR 9

Architecture of the C6x Processor – Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT IV ADSPPROCESSORS 9

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

UNIT V ADVANCED PROCESSORS 9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL: 45 PERIODS

OUTCOMES:

Students should be able to:

- Become Digital Signal Processor specialized engineer.
- DSP based System Developer.

REFERENCES:

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications" – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S.Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
3. User guides Texas Instrumentation, Analog Devices, Motorola.
4. Rulph Chassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, Ajohn Wiley & Sons, Inc., Publication, 2005.

NW16015 HIGH PERFORMANCE NETWORKS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To develop a comprehensive understanding of multimedia networking.
- To study the types of VPN and tunneling protocols for security.
- To learn about network security in many layers and network management.

UNIT I INTRODUCTION **9**

Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN,ATM.

UNIT II MULTIMEDIANETWORKING APPLICATIONS **9**

Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services.

UNIT III ADVANCED NETWORKS CONCEPTS **9**

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN.MPLS-operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

UNIT IV TRAFFIC MODELLING **9**

Little's theorem, Need for modeling, Poisson modeling and its failure, Non- poisson models, Network performance evaluation.

UNIT V NETWORK SECURITYAND MANAGEMENT **9**

Principles of cryptography – Authentication – integrity – key distribution and certification – Access control and: fire walls – attacks and counter measures – security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1.

TOTAL: 45 PERIODS

OUTCOMES: Student will be able to

- Able to identify the multimedia networks around and Virtual Private Network.
- Will be able to analyze the various parameters of networking and traffic modeling of networks.
- Will be able to understand various algorithms in network security and network management involved in internet.

REFERENCES:

1. J.F. Kurose & K.W. Ross, "Computer Networking- Atop down approach featuring the internet", Pearson, 2nd edition, 2003.
2. Walrand .J. Varatya, High performance communication network, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2nd Edition, 2000.
3. LEOM-GarCIA, WIDJAJA, "Communication networks", TMH seventh reprint 2002.
4. Aunurag kumar, D. Manjunath, Joy kuri, "Communication Networking", Morgan Kaufmann Publishers, 1ed 2004.

5. Hersent Gurle & petit, “IP Telephony, packet Pored Multimedia communication Systems”, Pearson education 2003.
6. Fred Halsall and Lingana Gouda Kulkarni, “Computer Networking and the Internet” fifth edition, Pearson education.
7. Nader F.Mir ,Computer and Communication Networks, first edition.
8. Larry l.Peterson & Bruce S.David, “Computer Networks: A System Approach”-1996

CP16035 RECONFIGURABLE COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the need for reconfigurable computing.
- To expose the students to various device architectures.
- To examine the various reconfigurable computing systems.
- To understand the different types of compute models for programming reconfigurable architectures.
- To expose the students to HDL programming and familiarize with the development environment.
- To expose the students to the various placement and routing protocols.
- To develop applications with FPGAs.

UNIT I DEVICE ARCHITECTURE **9**

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

UNIT II RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS **9**

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

UNIT III PROGRAMMING RECONFIGURABLE SYSTEMS **9**

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

UNIT IV MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS **9**

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

UNIT V APPLICATION DEVELOPMENT WITH FPGAS **9**

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Identify the need for reconfigurable architectures.
- Discuss the architecture of FPGAs.
- Point out the salient features of different reconfigurable architectures.
- Build basic modules using any HDL.
- Develop applications using any HDL and appropriate tools.
- Design and build an SoPC for a particular application.

REFERENCES:

1. Maya B. Gokhale and Paul S. Graham, "Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays", Springer, 2005.
2. Scott Hauck and Andre Dehon (Eds.), "Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation", Elsevier / Morgan Kaufmann, 2008.
3. Christophe Bobda, "Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications", Springer, 2010.

ELECTIVE V

NW16018	NETWORK ROUTING ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expose the students to the layered architecture for communication networks and the specific functionality of the network layer.
- To enable the student to understand the basic principles of routing and the manner this is implemented in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
- To enable the student to understand the different routing algorithms existing and their performance characteristics.

UNIT I INTRODUCTION **7**

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

UNIT II INTERNET ROUTING **10**

Interior protocol: Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III ROUTING IN OPTICALWDM NETWORKS **10**

Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms-AG, MWPG.

UNIT IV MOBILE – IPNETWORKS **9**

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based: Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).

UNIT V MOBILEAD –HOC NETWORKS **9**

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms– Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

TOTAL: 45 PERIODS

OUTCOMES:

- Given the network and user requirements and the type of channel over which the network has to operate, the student would be in a position to apply his knowledge for identifying a suitable routing algorithm, implementing it and analyzing its performance.
- The student would also be able to design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.

REFERENCES:

1. William Stallings, 'High speed networks and Internets Performance and Quality of Service', IInd Edition, Pearson Education Asia. Reprint India 2002
2. M. Steen Strub, 'Routing in Communication network, Prentice –Hall International, Newyork,1995.
3. S. Keshav, 'An engineering approach to computer networking' Addison Wesley 1999.
4. William Stallings, 'High speed Networks TCP/IP and ATM Design Principles, Prentice-Hall, New York, 1995.
5. C.E Perkins, 'Ad Hoc Networking', Addison – Wesley, 2001.
6. Ian F. Akyildiz, Jiang Xie and Shantidev Mohanty, "A Survey of mobility Management in Next generation All IP- Based Wireless Systems", IEEE Wireless CommunicationsAug.2004, pp 16-27.
7. A.T Campbell et al., "Comparison of IP Micro mobility Protocols," IEEE Wireless Communications Feb.2002, pp 72-82.
8. C.Siva Rama Murthy and Mohan Gurusamy, " WDM Optical Networks – Concepts, Design and Algorithms", Prentice Hall of India Pvt. Ltd, New Delhi –2002.

NW16016 WIRELESS ADHOC AND SENSOR NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the constraints of the wireless physical layer that affect the design and performance of ad hoc and sensor networks, protocols, and applications.
- To understand MAC, Routing protocols that have been proposed for ad hoc and sensor networks
- To understand the energy issues in sensor networks and how they can be addressed using scheduling, media access control, and special hardware
- To explain various security threats to ad hoc networks and describe proposed solutions

UNIT I ADHOC NETWORKS AND ROUTING PROTOCOLS 9

Ad hoc Wireless Networks – What is an Ad Hoc Network? Heterogeneity in Mobile Devices – Wireless Sensor Networks – Traffic Profiles – Types of Ad hoc Mobile Communications – Types of Mobile Host Movements – Challenges Facing Ad hoc Mobile Networks – Ad hoc wireless Internet. Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks – Classifications of Routing Protocols – Table–Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV) – Wireless Routing Protocol (WRP) – Cluster Switch Gateway Routing (CSGR) – Source–Initiated On–Demand Approaches – Ad hoc On– Demand Distance Vector Routing(AODV) – Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) –Signal Stability Routing (SSR) –Location–Aided Routing (LAR) – Power–Aware Routing (PAR) –Zone Routing Protocol (ZRP).

UNIT II MULTICAST ROUTING AND SECURITY 9

Issues in Designing a Multicast Routing Protocol – Operation of Multicast Routing Protocols –An Architecture Reference Model for Multicast Routing Protocols –Classifications of Multicast Routing Protocols – Tree–Based Multicast Routing Protocols– Mesh–Based Multicast Routing Protocols – Summary of Tree and Mesh based Protocols – Energy– Efficient Multicasting – Multicasting with Quality of Service Guarantees – Application – Dependent Multicast Routing – Comparisons of Multicast Routing Protocols - Design Goals of a Transport Layer Protocol for Ad hoc Wireless Networks –Classification of Transport Layer Solutions – TCP over Ad hoc Wireless Networks- Security in Ad Hoc Wireless Networks – Network Security Requirements – Issues and Challenges in Security Provisioning – Network Security Attacks – Key Management – Secure Routing in Ad hoc Wireless Networks.

UNIT III QoS AND ENERGY MANAGEMENT 9

Issues and Challenges in Providing QoS in Ad hoc Wireless Networks – Classifications of QoS Solutions – MAC Layer Solutions – Network Layer Solutions – QoS Frameworks for Ad hoc Wireless Networks Energy Management in Ad hoc Wireless Networks – Introduction – Need for Energy Management in Ad hoc Wireless Networks – Classification of Energy Management Schemes – Battery Management Schemes – Transmission Power Management Schemes –System Power Management Schemes.

UNIT IV SENSOR NETWORKS – ARCHITECTURE AND MACPROTOCOLS 9

Single node architecture – Hardware components, energy consumption of sensor nodes, Network

architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks, physical layer and transceiver design consideration in wireless sensor networks, Energy usage profile, choice of modulation, Power Management - MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols - SMAC, BMAC, Traffic-adaptive medium access protocol (TRAMA), Link Layer protocols – fundamentals task and requirements ,error control, framing, link management.

UNIT V SENSOR NETWORKS – ROUTING PROTOCOLS AND OPERATING SYSTEMS **9**

Gossiping and agent-based uni-cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing –LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques. Introduction to TinyOS – NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, Emulator TOSSIM.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Identify the unique issues and challenges in ad-hoc/sensor networks.
- Describe the current technology trends for the implementation and deployment of wireless ad-hoc/sensor networks.
- Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks.
- Comprehend the various sensor network Platforms, tools and applications

REFERENCES:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. C. K. Toh, “Ad Hoc Mobile Wireless Networks Protocols and Systems”, Prentice Hall, PTR,2001.
3. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2000.
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, “ Wireless Sensor Networks Technology-Protocols and Applications”, John Wiley & Sons, 2007.
5. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks: an information processing approach”, Else vier publication, 2004.
6. C.S.Raghavendra Krishna, M.Sivalingam and Tarib znati, “Wireless Sensor Networks”, Springer publication, 2004.
7. Holger Karl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John wiley publication, Jan 2006.
8. K.Akkaya and M.Younis, “ A Survey of routing protocols in wireless sensor networks”, Elsevier Adhoc Network Journal, Vol.3, no.3,pp. 325-349, 2005.
9. Philip Levis, “ TinyOS Programming”, 2006 – www.tinyos.net.
10. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey”,computer networks, Elsevier, 2002, 394 - 422.
11. Jamal N. Al-karaki, Ahmed E. Kamal, “Routing Techniques in Wireless sensor networks: A survey”, IEEE wireless communication, December 2004, 6 – 28.

CU16008 INTERNETWORKING MULTIMEDIA

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To identify and analyze the requirements that a distributed multimedia application may enforce on the communication network.
- To teach techniques for an efficient transmission of multimedia signals over networks.
- To include all the important aspects that has significant impact on the enhancements to the basic Internet architecture and its associated protocols.

UNIT I MULTIMEDIANETWORKING 9

Digital Sound, Video and Graphics – Basic Multimedia Networking – Multimedia Characteristics – Evolution of Internet Services Model – Network Requirements for Audio / Video Transform –Multimedia Coding and Compression for Text, Image Audio And Video.

UNIT II BROADBAND NETWORK TECHNOLOGY 9

Broadband Services – ATM and IP, IPV6, High Speed Switching – Resource Reservation, Buffer Management – Traffic Shaping –Caching – Scheduling and Policing, Throughput, Delay and Jitter Performance – Storage and Media Services – Voice and Video Over IP – MPEG–2 over ATM/IP – Indexing Synchronization of Requests – Recording and Remote Control.

UNIT III RELIABLE TRANSPORT PROTOCOL AND APPLICATIONS 9

Multicast over Shared Media Network – Multicast Routing and Addressing – Scaling Multicast and NBMA Networks – Reliable Transport Protocols – TCP Adaptation Algorithm – RTP, RTCP – MIME – Peer–to–Peer Computing – Shared Application – Video Conferencing,
Centralized and Distributed Conference Control – Distributed Virtual Reality – Light Weight Session Philosophy .

UNIT IV MULTIMEDIA COMMUNICATION STANDARDS 9

Objective of MPEG – 7 Standard – Functionalities and Systems of MPEG–7 MPEG–21 Multimedia Framework Architecture – Content Representation – Content Management and Usage –Intellectual Property Management – Audio Visual System – H322: Guaranteed QOS LAN Systems – MPEG_4 Video Transport Across Internet.

UNIT V MULTIMEDIACOMMUNICATIONACROSS NETWORKS 9

Packet Audio/Video in The Network Environment –Video Transport across Generic Networks – Layered Video Coding – Error Resilient Video Coding Techniques – Scalable Rate Control – Streaming Video Across Internet – Multimedia Transport Across ATM Networks and IP Network –Multimedia Across Wireless Networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to.

- Design efficient protocols for transmission of multimedia signals over networks
- Describe mechanisms for providing QoS guarantees in the network and to propose experiments to analyse their performance.
- Analyze the MPEG standard and its QoS requirement.
- Analyze the network performance with wireless Multi media across ATM/IP networks

REFERENCES:

1. B O Szuprowicz, “Multimedia Networking”, McGraw Hill, Newyork, 1995.
2. KR Rao, Zoran S, Bojkovic and Dragorad A, Milovanovic “Multimedia communication systems”, PHI, 2003.
3. Jon Crowcroft, Mark Handley, Ian Wakeman “Internetworking Multimedia” Harcourt, Singapore, 1998.
4. Tay Vaughan,“Multimedia Making it to work”, 4th edition Tata McGraw Hill, New Delhi, 2000.

NW16019 MULTIMEDIA COMPRESSION TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide in-depth knowledge about.
- Data Compression.
- Text Compression and Audio Compression.
- Image and Video Compression.

UNIT I INTRODUCTION **9**

Special features of Multimedia – Graphics and Image Data Representations - Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications -Need for Compression - Taxonomy of compression techniques – Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies.

UNIT II TEXT COMPRESSION **9**

Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmatic coding – Shannon - Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III AUDIO COMPRESSION **9**

Audio compression techniques - μ- Law and A- Law companding. Speech compression-waveform codecs- source codecs – hybrid codecs- Shorten compressor, Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders.

UNIT IV IMAGE COMPRESSION **9**

Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization– Contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders –JPEG 2000 standards – JBIG, JBIG2 Standards.

UNIT V VIDEO COMPRESSION **9**

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 MPEG Video CodingII: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.

TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

- Explain Scalar quantization theory and Rate Distribution Theory.
- Understand different coding techniques.
- Describe Contour based compression and Motion estimation techniques.

REFERENCES:

1. Khalid Sayood : Introduction to Data Compression, Morgan Kauffman Harcourt India,2nd Edition, 2000.
2. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q.Shi, Huifang Sun : Image and Video Compression for Multimedia Engineering-Fundamentals, Algorithms & Standards, CRC press, 2003.
4. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004.
5. Mark Nelson : Data compression, BPB Publishers, New Delhi,1998.
6. Mark S.Drew, Ze-Nian Li : Fundamentals of Multimedia, PHI, 1st Edition, 2003.
7. Watkinson,J : Compression in Video and Audio, Focal press,London.1995.
8. Jan Vozer : Video Compression for Multimedia, AP Profes, New York, 1995.

CU16009 ULTRAWIDE BAND COMMUNICATION

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts, features and interferences of UWB.
- To enable the students to understand the UWB technologies, channel models and signal processing.
- To impart knowledge about the UWB antennas, applications and regulations

UNIT I INTRODUCTION TO UWB 9

History, Definition, FCC Mask, UWB features, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wireless services.

UNIT II UWB TECHNOLOGIESAND CHANNEL MODELS 9

Impulse Radio, Pulsed Multiband, Multiband OFDM, features: Complexity, Power Consumption, Security and achievable data rate. MIMO Multiband OFDM, Differential multiband OFDM, Performance characterization Ultra Wide Band Wireless Channels Channel model: Impulse Response Modeling of UWB Wireless Channels, IEEE UWB channel model, Path loss, Delay profiles, Time and frequency modeling.

UNIT III UWB SIGNAL PROCESSING 9

Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit Reference (T-R) Technique, UWB Range- Data Rate Performance, UWB Channel Capacity UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS Location Error, Locationing with OFDM.

UNIT IV UWB ANTENNAS 9

Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad band antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broad band UWB antennas.

UNIT V UWB APPLICATIONS AND REGULATIONS 9

Wireless Ad hoc Networking, UWB Wireless Sensor, RFID, Consumer Electronics and Personal, Asset Location, Medical applications UWB Regulation and standards in various countries, UWB Regulation in ITU, IEEE Standardization.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Demonstrate an understanding of UWB concepts, technologies and channel models.
- Conversant with UWB modulation schemes, BER performance, location and positioning methods and also will be able to design UWB antennas.
- Have a deep understanding of the various UWB applications, regulations and standards and would be able to apply them to various networks.

REFERENCES:

1. Homayoun Nikookar and Ramjee Prasad, "Introduction to Ultra Wideband for Wireless Communications"1st Edition, Springer Science & Business Media B.V. 2009.

2. Thomas Kaiser, Feng Zheng “Ultra Wideband Systems with MIMO”, 1st Edition, John Wiley & Sons Ltd, New York, 2010.
3. W. Pam Siriwongpairat and K.J.Ray Liu, “Ultra-Wideband Communications Systems: Multiband OFDM approach” John Wiley and IEEE press, New York 2008.

ELECTIVE VI

CP16036	SOFT COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the key aspects of Soft computing and Neural networks.
- To know about the components and building block hypothesis of Genetic algorithm.
- To understand the features of neural network and its applications
- To study the fuzzy logic components
- To gain insight onto Neuro Fuzzy modeling and control
- To gain knowledge in machine learning through Support vector machines.

UNIT I INTRODUCTION TO SOFT COMPUTING 9

Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics.

UNIT II GENETIC ALGORITHMS 9

Introduction, Building block hypothesis, working principle, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem),Differences & similarities between GA & other traditional methods, Applications of GA.

UNIT III NEURAL NETWORKS 9

Machine Learning using Neural Network, Adaptive Networks – Feed Forward Networks– Supervised Learning Neural Networks – Radial Basis Function Networks - Reinforcement Learning – Unsupervised Learning Neural Networks – Adaptive Resonance Architectures – Advances in Neural Networks.

UNIT IV FUZZY LOGIC 9

Fuzzy Sets – Operations on Fuzzy Sets – Fuzzy Relations – Membership Functions-Fuzzy Rules and Fuzzy Reasoning – Fuzzy Inference Systems – Fuzzy Expert Systems – Fuzzy Decision Making.

UNIT V NEURO-FUZZY MODELING 9

Adaptive Neuro-Fuzzy Inference Systems – Coactive Neuro-Fuzzy Modeling – Classification and Regression Trees – Data Clustering Algorithms – Rule base Structure Identification – Neuro-Fuzzy Control – Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Implement machine learning through Neural networks.
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Write Genetic Algorithm to solve the optimization problem
- Use Support Vector Machine for enabling the machine learning.

REFERENCES:

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003.
2. Kwang H.Lee, “First course on Fuzzy Theory and Applications”, Springer–Verlag Berlin Heidelberg, 2005.
3. George j. klir and bo yuan, “fuzzy sets and fuzzy logic-theory and applications”, prentice hall, 1995.
4. James a. freeman and david m. skapura, “neural networks algorithms, applications, and programming techniques”, pearson edn., 2003.
5. David e. goldberg, “genetic algorithms in search, optimization and machine learning”, addison wesley, 2007.
6. Mitsuo gen and runwei cheng,”genetic algorithms and engineering optimization”, wiley publishers 2000.
7. Mitchell melanie, “an introduction to genetic algorithm”, prentice hall, 1998.
8. S.N.Sivanandam, s.n.deepa, “introduction to genetic algorithms”, springer, 2007.
9. Eiben and smith “introduction to evolutionary computing” springer.
10. E. Sanchez, t. shibata, and l. a. zadeh, eds., "genetic algorithms and fuzzy logic systems: soft computing perspectives, advances in fuzzy systems - applications and theory", vol. 7 river edge, world scientific, 1997.

NW16020	NETWORK PROCESSOR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic architectures used for packet processing and the role of network processors.
- To know the fundamentals and implementation of a network processor as an example of an embedded system.
- To choose a network systems project and implement the project on one or more platforms.

UNIT I INTRODUCTION 9

Traditional protocol processing Systems – Network processing Hardware – Basic Packet Processing Algorithms and data Structures - Packet processing functions – Protocol Software – Hardware Architectures for Protocol processing – Classification and Forwarding – Switching Fabrics.

UNIT II NETWORK PROCESSOR TECHNOLOGY 9

Network Processors: Motivation and purpose – Complexity of Network Processor Design – Network Processor Architectures architectural variety, architectural characteristics Peripheral Chips supporting Network Processors: Storage processors, Classification Processors, Search Engines, Switch Fabrics, Traffic Managers.

UNIT III COMMERCIALNETWORK PROCESSORS 9

Multi-Chip Pipeline, Augmented RISC processor, Embedded Processor plus Coprocessors, Pipelilne of Flomogeneous processors. Configurable Instruction setprocessors – Pipeline of Electrogeneous processors – Extensive and Diverse processors – Flexible RISC plus Coprocessors – Scalability issues – Design Tradeuffs and consequences.

UNIT IV NETWORK PROCESSOR: ARCHITECTURE AND PROGRAMMING 9

Architecture: Intel Network Processor: Multiheaded Architecture Overview – Features - Embedded EISC processor – Packet Processor Hardware – Memory interfaces – System and Control Interface Components – Bus Interface. Programming Software Development Kit-IXP Instruction set – register formats – Micro Engine Programming – Intra thread and Inter-thread communication – thread synchronization – developing sample applications – control plane – ARM programming.

UNIT V IOS TECHNOLOGIES

CISCO COS – Connectivity and scalability – high availability – IP routing – IP services – IPV6 Mobile IP – MPLS – IP Multicast 0 Manageability – QoS – Security – Switching – Layer VPN2.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Design a network processors with protocol Software and different Hardware architectures.
- Design a commercial network processors using RISC , Embedded processor and Co-processors.
- Analyze thread level synchronization and communication of a network processor.
- Analyze the IP, Mobile IP & MPLS requirements of a network processor.and its QoS requirements.

REFERENCES:

1. Douglas E.Comer "Networks Systems Design using Network Processors" Prentice Hall JaN. 2003.
2. Panas C. Lekkas, "Network Processors: Architectures, Protocols and Paradigms Telecom Engineering", McGraw Hill, Professional, 2003.
3. Patrick Crowley, M a Eranklin, H. Hadminglu, PZ Onfryk, "Network Processor Design, Issues and Practices Vol-1" Morgan Kaufman, 2002.
4. Patrick Crowley, M a Frankliln, H. Hadimioglyum PZ Onufryk, Network Processor Design, Issues and Prentices vol.II, Morgan Kaufman, 2003.
5. Erik, J.Johnson and Aaron R.Kunze, "IXP2400/2806 Programming: The Microengine Coding Grade" Intel Press.
6. Hill Carlson, "Intel Internet Exchange Architecture & Applications a Practical Guide to Intel's network Processors" Intel press. www.cisco.com

NW16008 **NETWORK MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

The objective of this course is to

- To understand the need for interoperable network management.
- To learn to the concepts and architecture behind standards based network management.
- To understand the concepts and terminology associated with SNMP and TMN.
- To understand network management as a typical distributed application.
- To study the current trends in network management technologies.

UNIT I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY 9

Network Topology, LAN, Network node components- Hubs, Bridges, Routers, Gateways, Switches, WAN, ISDN TransmissionTechnology, Communications protocols and standards. Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network.

UNIT II OSI NETWORK MANAGEMENT 9

OSI Network Management Model - Organizational Model - Information Model, Communication Model. Abstract Syntax Notation – Encoding structure, Macros Functional model CMIP/CMIS.

UNIT III INTERNET MANAGEMENT(SNMP) 9

SNMP(V1 andV2) - Organizational model - System Overview, The information model, communication model-Functional model, SNMP proxy server, Management information, protocol remote monitoring- RMON SMI and MIB, RMON1, RMON2 - A Case Study of Internet Traffic Using RMON.

UNIT IV BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology-VP, VC, ATM Packet, Integrated service, ATMLAN emulation, Virtual Lan. ATM Network Management – ATM Network reference model, integrated local management Interface. ATM Management Information base, Role of SNMD and ILMI in ATM Management, M1, M2, M3, M4 Interface. ATM Digital Exchange Interface Management, TMN conceptual Model - TMN Architecture, TMN Management Service Architecture.

UNIT V NETWORK MANAGEMENT APPLICATIONS 9

Configuration management, Fault management, performance management, Event Correlation Techniques security Management, Accounting management, Report Management, Policy Based Management Service Level Management-Network Management Tools, Network Statistics Measurement Systems – Web Based Management, XML Based Network Management - Future Directions.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students will be able to

- Analyze the issues and challenges pertaining to management of emerging network

technologies such as wired/wireless networks and high -speed internets.

- Apply network management standards to manage practical networks.
- Formulate possible approaches for managing OSI network model.
- Use on SNMP for managing the network.
- Use RMON for monitoring the behavior of the network.
- Explore the possibilities of improving the speed of the network and managing them.
- Identify the various components of network and formulate the scheme for the managing them.

REFERENCES:

1. Mani Subramanian, "Network Management Principles and practice ", Pearson Education, New Delhi, 2010.
2. STALLINGS, WILLIAM, "SNMP, SNMPv2, SNMPv3, and RMON 1 and 2," Pearson Education, 2012.
3. SalahAiidarous, Thomas Plevayk, "Telecommunications Network Management Technologies and Implementations ", eastern Economy Edition IEEE press, New Delhi, 1998.
4. Lakshmi G. Raman, "Fundamentals of Telecommunication Network Management ", Eastern Economy Edition IEEE Press, New Delhi, 1999.

NW16021 COMMUNICATION NETWORK SECURITY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the different security services , attacks and mechanisms.
- To learn different encryption and decryption algorithms.
- To provide in depth knowledge on public key encryption and hash functions.
- To expose the students to different network security practices like authentication, IP security and web security.
- To provide an insight to wireless network security.

UNIT I DATA ENCRYPTION STANDARD 9

Services – Mechanisms and Attacks – OSI security Architecture – Model for Network Security – Classical Encryption Techniques – Symmetric Cipher Model – Substitution Techniques – Transposition Techniques – Rotor Machines – Stenography – Block Ciphers and Data Encryption Standard – Simplified DES – Block Cipher Principles, Data Encryption Standard – Strength of DES – Differential and Linear Crypt Analysis, Block Cipher Design Principles – Block Cipher Modes of Operation.

UNIT II ADVANCED ENCRYPTION STANDARD 9

Advanced Encryption Standard – Evaluation Criteria for AES, AES Cipher – Contemporary Symmetric Ciphers – Triple DES, Blowfish, RC5 – Characteristics of Advanced Symmetric Block Ciphers – RC4 Stream Cipher – Confidentiality using Symmetric Encryption – Placement of Encryption Function – Traffic Confidentiality – Key Distribution and Random Number Generation.

UNIT III PUBLIC KEY ENCRYPTIONAND HASH FUNCTIONS 9

Public Key Cryptography and RSA – Principles of Public Key Cryptosystems – RSA Algorithm – Key Management and other public key cryptosystems – Key Management – Diffie–Hellman Key Exchange – Elliptic Curve Arithmetic – Elliptic Curve Cryptography –Message Authentication and Hash Functions – Authentication Requirements – Authentication Functions – Message Authentication Codes – Hash Functions and MACs; Hash Algorithms – MD5 Message Digest Algorithm, Secure Hash Algorithm RIPEMD 160, HMAC – Digital Signatures and Authentication Protocols – Digital Signature Standards.

UNIT IV NETWORK SECURITYPRACTICE 9

Authentication Applications – Kerberos – X.509 Authentication Service – Electronic Mail Security – Pretty Good Privacy – S/MIME – IP Security – IP Security Overview – IP Security Architecture –Authentication Header – Encapsulating Security Payload – Combining Security Associations –Web Security – Web Security Considerations – Secure Sockets Layer and Transport Layer Security – Secure Electronic Transaction.

UNIT V WIRELESS NETWORK SECURITY 9

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Apply different encryption and decryption algorithms for real time

applications Develop their own algorithms for key management and hashing

- Explore the possibilities of improving the security or reducing the complexity of different algorithms
- Analyze the security issues specific to wireless networks.

TEXT BOOKS:

1. William Stallings, "Network Security Essentials", 2nd edition, Prentice Hall of India New Delhi, 2004.
2. Charlie Kaufman, "Network Security Private Communication in Public World" 2nd edition,Prentice Hall of India New Delhi, 2004.

REFERENCES:

1. William Stallings, "Cryptography and Network Security", 3rd edition, Prentice Hall of India, New Delhi, 2004.
2. R.K.Nichols and P.C. Lekkas ," Wireless Security" Mc Graw Hill 2002.

CU16010 NEURALNETWORKANDAPPLICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the key aspects of basic machine learning algorithm.
- To gain knowledge in machine learning through Support vector machines and Radial basis function networks.
- To study about various committee machine based models and neurodynamics systems.
- To know about the concepts of Attractor neural networks and building blocks of adaptive resonance theory.
- To gain insight onto Self organizing maps and pulsed neuron model.

UNIT I BASIC LEARNING ALGORITHMS 9

Biological Neuron – Artificial Neural Model- Types of activation functions – Architecture: Feed forward and Feedback – Learning Process: Error Correction Learning – Memory Based Learning – Hebbian Learning – Competitive Learning - Boltzman Learning – Supervised and Unsupervised Learning – Learning Tasks: Pattern Space – Weight Space – Pattern Association –Pattern Recognition – Function Approximation – Control – Filtering - Beamforming – Memory – Adaptation – Statistical Learning Theory – Single Layer Perceptron – Perceptron Learning Algorithm – Perceptron Convergence Theorem – Least Mean Square Learning Algorithm – Multilayer Perceptron – Back Propagation Algorithm – XOR problem – Limitations of Back Propagation Algorithm.

UNIT II RADIAL-BASIS FUNCTION NETWORKS AND SUPPORT VECTOR MACHINES 9

RADIAL BASIS FUNCTION NETWORKS

Cover's Theorem on the Separability of Patterns - Exact Interpolator – Regularization Theory – Generalized Radial Basis Function Networks - Learning in Radial Basis Function Networks Applications: XOR Problem – Image Classification.

SUPPORT VECTOR MACHINES

Optimal Hyperplane for Linearly Separable Patterns and Nonseparable Patterns – Support Vector Machine for Pattern Recognition – XOR Problem - insensitive Loss Function – Support Vector Machines for Nonlinear Regression.

UNIT III COMMITTEE MACHINES 9

Ensemble Averaging – Boosting – Associative Gaussian Mixture Model – Hierarchical Mixture of Experts Model (HME) – Model Selection using a Standard. Decision Tree – A Priori and Postpriori Probabilities – Maximum Likelihood Estimation – Learning Strategies for the HME Model – EM Algorithm – Applications of EM Algorithm to HME Model.

NEURODYNAMICS SYSTEMS

Dynamical Systems – Attractors and Stability – Non-linear Dynamical Systems-Lyapunov Stability – Neurodynamical Systems – The Cohen-Grossberg Ttheorem.

UNIT IV ATTRACTOR NEURAL NETWORKS 9

Associative Learning – Attractor Neural Network Associative Memory – Linear Associative Memory – Hopfield Network.–.Content Addressable Memory – Strange Attractors and Chaos - Error Performance of Hopfield Networks - Applications of Hopfield Networks – Simulated

Annealing – Boltzmann Machine – Bidirectional Associative Memory – BAM Stability Analysis – Error Correction in BAMs - Memory Annihilation of Structured Maps in BAMS – Continuous BAMs – Adaptive BAMs – Applications.

ADAPTIVE RESONANCE THEORY:

Noise – Saturation Dilemma – Solving Noise – Saturation Dilemma – Recurrent On – center – Off surround Networks – Building Blocks of Adaptive Resonance – Substrate of Resonance Structural Details of Resonance Model – Adaptive Resonance Theory – Applications.

UNIT V SELF ORGANISING MAPS: 9

Self-organizing Map – Maximal Eigenvector Filtering – Sanger's Rule – Generalized Learning Law Competitive Learning - Vector Quantization – Mexican Hat Networks - Self-organizing Feature Maps – Applications.

PULSED NEURON MODELS:

Spiking Neuron Model – Integrate and Fire Neurons – Conductance Based Models – Computing with Spiking Neurons.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Implement support vector machine and Radial basis function networks based machine learning.
- Use committee machine based models and neurodynamics systems.
- Design various neural networks and models.

REFERENCES:

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2nd ed., Addison Wesley Longman (Singapore) Private Limited, Delhi, 2001.
3. Martin T.Hagan, Howard B.Demuth, and Mark Beale, "Neural Network Design", Thomson Learning, New Delhi, 2003.
4. James.A.Freeman and David M.Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education (Singapore) Private Limited, Delhi, 2003.

ELECTIVE VII

CU16011	ADVANCED SATELLITE BASED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Analysis of GPS system and derive the equations of triangulation studying the procedures of location finding.
- To study about sensors and error models and implement the components in subsystems
- To evaluate various Remote sensing strategy and incorporate the design using sensors accordingly.
- Study of Satellite applications & specialized services
- Analysis of IPv6 methodologies and configuration for the varied types of traffic

UNIT I NAVIGATION, TRACKING AND SAFETY SYSTEMS 9

Global Navigation Satellite Systems - Basic concepts of GPS. Space segment, Control segment, user segment, GPS constellation, GPS measurement characteristics, selective availability (AS), Anti spoofing (AS). Applications of Satelite and GPS for 3D position,Velocity,determination as function of time,Interdisciplinary applications. Regional Navigation Systems- Distress and Safety- Cospas-Sarsat- Inmarsat Distress System- Location-Based service.

UNIT II INERTIAL NAVIGATION AND DIFFERENTIAL GPS SYSTEMS 9

Introduction to Inertial Navigation- Inertial Sensors - Navigation Coordinates – System Implementations - System-Level Error Models- Introduction to Differential GPS- LADGPSWADGPS- WAAS - GEO Uplink Subsystem (GUS) - GEO Uplink Subsystem (GUS) Clock Steering Algorithms - GEO Orbit Determination – Problems.

UNIT III REMOTE SENSING SYSTEMS AND TECHNIQUES 9

Introduction - Commercial Imaging - DigitalGlobe – GeoEye - Meteorology – Meteosat – Land Observation – Landsat- Remote Sensing Data- Sensors- Overview - Optical Sensors: Cameras- Non-Optical Sensors- Image Processing - Image Interpretation- System Characteristics.

UNIT IV BROADCAST SYSTEMS 9

Introduction - Satellite Radio Systems - XM Satellite Radio Inc. - Sirius Satellite Radio –world space - Direct Multimedia Broadcast- MBCO and TU Multimedia - European Initiatives - Direct-to- Home Television - Implementation Issues - DTH Services- Representative DTH Systems – Military Multimedia Broadcasts - US Global Broadcast Service (GBS)- Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.

UNIT V SATELLITE NETWORKING SYSTEM WITH IPV6 9

Overview of IPv6 and its benefits- Migration and Coexistence- IPv6 Addressing Mechanisms- Addresses for Hosts and Routers- IPv6 Infrastructure - Routing and Route Management- Configuration Methods- Dynamic Host Configuration Protocol for IPv6 - IPv6 and Related Protocols- IPv6 Header Format- Traffic Classes.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Analyse and implement a suitable sensor in designing a subsystem Correlate varied satellite

hubs and carry out speedy communication

- Locate a point on the space designing a GPS

REFERENCES:

1. Global Positioning Systems, Inertial Navigation, and Integration. MOHINDER S. GREWAL California State University at Fullerton, A John Wiley & Sons, Inc. Publication.
2. Satellite Systems Engineering in an IPv6 Environment, Daniel Minoli, CRC Press.
3. Satellite systems for personal Applications, Madhavendra Richharia, A John Wiley and Sons, Ltd., Publication.
4. Dennis Roddy, 'Satellite Communication', McGraw Hill International, 4th Edition, 2006.
5. Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, 'Satellite Communication Systems Engineering', Prentice Hall/Pearson, 2007 (Books to be added)

CU16012	ELECTROMAGNETIC AND PHOTONIC BAND GAP STRUCTURES FOR ANTENNA ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the mathematical tool and design for designing antenna structure.
- To introduce the concepts of Electromagnetic and Photonic Band Gap
- To study different materials and its uses in EMC .
- To understand the design techniques for photonic crystals.

UNIT I MATHEMATICAL TOOLS FOREM 9

Finite difference method –Finite element method –Moment method –Transmission line matrix method -Finite difference time domain method.

UNIT II BANDGAP STRUCTURES AND CLASSIFICATIONS 9

Introduction of electromagnetic band gap structures –configuration –photonic band gap structures –configuration –Band gap characterization –classifications of EBG & PBG.

UNIT III MATERIALS AND APPLICATIONS 9

EBG & PBG materials –uses in EMC –uses in micro strip antennas –uses in wave guides – limitations of EBG & PBG -applications of EBG & PBG.

UNIT IV PHOTONIC CRYSTALS 9

The traditional multilayer film -A one dimensional photonic crystal –physical origin of photonic band gaps –evanesant modes –off axis propagation –localized modes of defects –surface states.

UNIT V DESIGN OF PHOTONIC CRYSTALS 9

Design of photonic crystals for various applications – a reflecting dielectric –a resonant cavity –a wave guide.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Demonstrate an understanding of the basic principles of finite Difference method, Transmission line matrix and finite element method.
- To design a interference free system.
- To design a photonic crystals for various applications.

REFERENCES:

1. Mathew N. O. Sadiku, Numerical Techniques in Electromagnetics, CRC Press, II edition, 2001.
2. Fanyang & Yahya Rahmat-Samii, “Electromagnetic Band gap structures in Antenna Engineering” (The Cambridge RF & microwave Engineering series)
3. Joannopoulos .J, Meade .R.D and Winn .J.N, “Photonic crystals: molding the flow of lights”, Princeton Univ. press, 1995.
4. Inoue, Ohtaka, “Photonic crystals: Physics, fabrication & application” (Springer series in optical sciences).

CU16013	OFDM SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose the students to the OFDM transmission over different types of channel and synchronization performance in time and frequency domain.
- To make the students to understand adaptive signal processing techniques for single and multi-user OFDM and peak factor reduction schemes.
- To impart knowledge on the concepts and techniques of Optical OFDM.

UNIT I OFDM TRANSMISSION OVER GAUSSIAN AND WIDEBAND CHANNELS 9

Evolution and Applications of OFDM, Choice of OFDM, Modulation, Performance over AWGN channels, Clipping amplification, AID conversion, Phase noise, Wideband channel models, Effects of time dispersive channels, Channel transfer function estimation, System performance, and Inter subcarrier cancellation.

UNIT II TIME AND FREQUENCY DOMAIN SYNCRONIZATION 9

Performance with Frequency and Timing errors, Synchronization algorithms, Comparison of frequency acquisition algorithms, BER performance with frequency synchronization, OFDM synchronization performance.

UNIT III ADAPTIVE SINGLE -AND MULTI -USER OFDM 9

Adaptive modulation, Adaptive OFDM speech system, Pre -equalization, Comparison of adaptive techniques, Power and Bit allocation algorithms, Multi user AOFDM, Block coded AOFDM.

UNIT IV PEAK FACTOR REDUCTION AND ADAPTIVE MODULATION 9

Sequences for reducing amplitude variations, Crest factor reduction mapping schemes, PMEPR analysis of OFDM systems, Adaptive modulation schemes for OFDM.

UNIT V OPTICAL OFDM 9

Basic configuration, Spectral efficiency, Transmission over SMF and MMF, IM/DD system, Optical OFDM over wireless channel, PAPR reduction techniques, Power efficient Optical OFDM ~Dispersion compensation.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Demonstrate the OFDM transmission and carryout the performance analysis with time and frequency synchronization.
- Conversant with the adaptive signal processing techniques for single and multi- user OFDM and peak factor reduction schemes.
- Demonstrate the understanding of optical OFDM over wireless channels PAPR reduction techniques.

REFERENCES:

1. Lajos Hanzo, M.Munster, B.J.Choi and T. Keller, OFDM and MC -COMA for Broadband Multiuser Communications, WLANs and Broadcasting, John Wiley & sons, IEEE press 2003.
2. Ramjee Prasad, OFDM for wireless Communication Systems, Artech House Publishers, 2004.

3. Ahmed R.S. Bahai, Burton R Saltzberg and Mustafa Ergen, Multi-carrier Digital Communications: Theory and Applications of OFDM, Springer, 2004.
4. Henrik Schulze & Christian Lueders, Theory and Applictions of OFDM and COMA: Wideband Wireless Communications, Wiley Publishers, 2005.
5. Ye Li and Gordon L. Stuber, Orthogonal Frequency Division Multiplexing for W ireless Communications, Springer, 2006
6. Richard D. J.Van Nee, Ramjee Prasad and Richard Van Nee, OFDM for wireless Multimedia Communications, Artech House Publishers, 2000.
7. Optical OFDM related articles from websites.Faulty of I and C Engg.

CU16014	RF FILTER DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of RF filter design.
- To understand the various components that constitute RF filter for wireless communication.
- To understand the basic knowledge of low pass filter and band pass filter.

UNIT I NETWORK FUNDAMENTALS 9

Filters –Types, Networks –Transfer Functions. Scattering Parameters, Modern Filters. Characteristic Function. Synthesis Example. Low pass Prototype. Approximations. Denormalization, Phase and Delay, All-pass Networks, Bounding and Asymptotic Behavior.

UNIT II REACTORS AND RESONATORS 9

Coupled Transmission Lines and Elements, Reentrance, Coax, Loading, Stab lines –Wire over Ground, Substrate Materials, Strip lines, Resonators, Evanescent Mode W ave guide, Superconductors. Modeling Discontinuities.

UNIT III TRANSFORMATIONS AND FILTERS 9

Transformation –Types, Top-C, Top-L and Shunt-C Coupled, Series and Parallel Resonators, Tubular Structure, Elliptic Band pass and Distortion. Arithmetic and Norton Transforms, Blinchikoff Flat-Delay Band pass. Pi/Tee Equivalent Networks, Dipole Equivalent Networks. Invertors. Richard's Transform, Kuroda Identities. Prototype k and q values. Radiations and Losses.

UNIT IV LOW PASS STRUCTURES 9

Stepped –Impedance All-Pole Low pass, Response Sensitivity to Element Tolerance, Stub-Line and Elliptic Low pass, Element Collisions.

UNIT V BAND PASS STRUCTURES 9

Direct and Edge-Coupled. Tapped Edge –Coupled and Hairpin Bandpass. Hairpin Resonator Self Coupling, Combline Band pass. Coupled –Microstrip Combline. Inter digital Band pass.Transmission Zeros in Combline. Stepped –Impedance Band pass. Elliptic Direct –Coupled Band pass. Evanescent Mode W ave guide Filters –Coupling, Reentrance. Filters with Arbitrary Resonator Structure. Hidden –Dielectric Resonator. Band pass Tuning Techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Design the various types of RF filters
- To improve the sharp cutoff frequencies
- Analyze the performance of the RF filters

REFERENCES:

1. HF Filter Design and Computer Simulation by Randall W. Rhea. 1994 by Noble Publishing Corporation.
2. G.Mathei.L.Young.E.M.T.Jones –Microwave Filters. Impedance-Matching networks and Coupling structures, 1980 Artech house, inc.,
3. Daniel G.Swanson. W olfgang.J.R.Hoefer –Microwave circuit modeling using EMF, 2003, Artech house inc.,Faulty of I and C Engg

CU16015 UNDERWATER ACOUSTIC SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the characteristics of Underwater Channel
- To understand the principles of SONAR
- To recognize importance of ambient noise in the sea
- To understand the challenges in underwater signal processing

UNIT I FUNDAMENTALS OF UNDERWATER ACOUSTICS 9

The Ocean acoustic environment, measuring sound level, Sources and receivers, relevant units, sound velocity in sea water, typical vertical profiles of sound velocity,Sound propagation in the Ocean-characteristic sound propagation paths-deep water and shallow water, Range dependent environment. Sound attenuation in sea water, Bottom Loss, Surface bottom and volume scattering, Snell's law for range dependent ocean.

UNIT II AMBIENT NOISE IN THE SEA 9

Sources of ambient noise-introduction, different frequency bands of ambient noise, process of surface noise generation, shallow water, variability of ambient noise, spatial coherence of ambient noise, directional characteristics of ambient noise, intermittent sources of noise-biological & non biological (rain, earthquakes, explosions and valcanos).

UNIT III SIGNALS, FILTERS AND RANDOM FUNCTIONS 9

Fourier representations, filters and noise, digital filter design techniques, temporal resolution and bandwidth of signals, signal to noise power ratio, Estimates of auto-covariance, power spectrum, cross covariance and cross spectrum.

UNIT IV CHARACTERISTICS OF SONAR SYSTEMS 9

Sonar systems, active and passive sonar equations, transducers and their directivities, Sensor array characteristics-array gain, receiving directivity index, beam patterns, shading and super directivity, adaptive beamforming.

UNIT V DSP PROCESSORS 9

Architecture of ADSP 218x, architecture of TMS 320C541X.

CASE STUDY:

1. Signal processing of ocean ambient noise data.
2. Beamforming of vertical linear array data.

TOTAL: 45 PERIODS

COURSE OUTCOMES: Upon completion of the course, the students will be able to

- Design underwater signal processing systems
  Analyze ambient noise in the sea
- Analyze the performance of underwater signal processing systems
  Apply acoustic imaging techniques to design systems

REFERENCES:

1. Principles of Underwater Sound by Robert J Urick , Third Edition, Peninsula Publishers, 2013
2. Ambient noise in the sea by Robert J.Urick,-Peninsula publishers, e-book- www.hathitrust.org.
3. Acoustical Oceanography: Principles and Applications by Clay & Medwin, 1st Edition, Wiley-Blackwell publisher.
4. Fundamental of ocean acoustics by L.M.Brekhovskikh and Yu.P.Lysanov, Third Edition, Springer, 2003.
5. Sonar signal processing by Richard O.Nielsen.
6. DAP processor manuals.