NATIONAL ENGINEERING COLLEGE
(An Autonomous Institution – Affiliated to Anna University Chennai)
K.R.NAGAR, KOVILPATTI – 628 503
www.nec.edu.in

REGULATIONS - 2015

DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI OF
M.E. – COMMUNICATION SYSTEMS
### SEMESTER I

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SFC – Specific Foundation Course, PCC – Programme Core Course, PEC – Programme Elective Course, OEC – Open Elective Course
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15CM11C APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Explain the concepts and properties of Bessel’s functions and Fourier-Bessel expansion. (K2)
CO 2: Enrich the knowledge about matrix Theory. (K2)
CO 3: Acquire the knowledge of moment generating functions and distributions. (K1)
CO 4: Explain the concepts of two dimensional random variables. (K2)
CO 5: Discuss the various queuing models. (K1)

UNIT I SPECIAL FUNCTIONS
Bessel’s equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion.

UNIT II ADVANCED MATRIX THEORY
Eigen-values using QR transformations - Generalized eigen vectors - Canonical forms - Singular value decomposition and applications - Pseudo inverse - Least square approximations.

UNIT III ONE DIMENSIONAL RANDOM VARIABLES
Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Uniform, Exponential, Gamma and Normal distributions.

UNIT IV TWO DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and Conditional distributions – Correlation and Regression, Regression Curve for means.

UNIT V QUEUEING MODELS

L:45 T:30 TOTAL: 75 PERIODS

REFERENCES
15CM12C  ADVANCED DIGITAL SIGNAL PROCESSING  
(L Common to CS, HVE and C&I) L T P C 3 0 0 3

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Discuss the essentials for the postgraduate level research in the area of statistical signal processing. (K1-K2)
CO 2: Model random signals and determine its solution. (K1-K3)
CO 3: Estimate the coefficient for perfect reproduction filter for both the stationary and non-stationary signals. (K1- K3)
CO 4: Design FIR and IIR adaptive filters using adaptive algorithms. (K1- K4)
CO 5: Estimate the power spectrum for discrete random signals using classical and non-classical methods. (K1- K3)

UNIT I  DISCRETE RANDOM SIGNAL PROCESSING

UNIT II  SIGNAL MODELING
Least Squares method, Padé approximations, Prony’s method – Pole zero modeling, All pole modeling, Linear prediction, Forward and Backward prediction, Finite data records, stochastic models, Solution of Prony’s normal equations – Levinson Durbin recursion.

UNIT III  WIENER FILTERING

UNIT IV  ADAPTIVE FILTERS

UNIT V  SPECTRAL ESTIMATION
Nonparametric methods - Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods - ARMA, AR and MA model based spectral estimation

L:45 TOTAL: 45 PERIODS

REFERENCES
15CM13C ADVANCED RADIATION SYSTEMS L T P C 
3 0 0 3

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Determine the fundamental parameters for antenna design and derive the 
radiated fields using radiation integral. (K1-K3)
CO 2: Design wire antennas and loop antennas.(K1-K4)
CO 3: Analyze and synthesis of array antennas and explore the concepts of aperture 
antennas. (K1-K3)
CO 4: Develop microstrip and smart antennas.(K1-K5)
CO 5: Measure the antenna parameters. (K1-K4)

UNIT I ANTENNA FUNDAMENTALS 9
Types of Antennas, Radiation Mechanism, Fundamental Parameters of Antennas, Radiation 
Integrals, Vector Potential and Radiated Fields for Electric and Magnetic Current Sources, 
Solution of Vector Potential Wave Equation, Far-Field Radiation, Duality, Reciprocity and 
Reaction Theorems.

UNIT II WIRE AND LOOP ANTENNAS 9
WIRE ANTENNAS: Infinitesimal dipole, Finite length dipole, half-wavelength dipole, Image 
Theory, Vertical and Horizontal electrical dipoles. LOOP ANTENNAS: small circular loop, 
polygonal loop antennas, ferrite loop, Wire and loop antennas for Mobile communication.

UNIT III ARRAY AND APPERTURE ANTENNAS 9
ARRAY ANTENNAS: Two-element array, N-element linear array: uniform amplitude and 
spacing, directivity, Antenna Synthesis using Schelkunoff polynomial method and Fourier 
transform method. APERTURE ANTENNAS: Field equivalence principle, radiation 
equations, Rectangular apertures, Circular apertures, Babinet’s principle, Slot Antenna, E-
plane and H-plane sectoral Horn Antennas.

UNIT IV MICROSTRIP AND SMART ANTENNAS 9
MICROSTRIP ANTENNAS: Basic Characteristics, Feeding Methods, Rectangular Patch, 
Circular Patch, Quality Factor, Bandwidth, and Efficiency. SMART ANTENNAS: Analogy, 
cellular radio systems evolution, Signal propagation.

UNIT V ANTENNA MEASUREMENTS 9
Antenna Ranges, Radiation Patterns, Gain Measurements, Directivity Measurements, 
Radiation Efficiency, Impedance Measurements, Current Measurements, Polarization 
Measurements, Scale Model Measurements

L:45 TOTAL: 45 PERIODS

REFERENCES
Inter science, 2005.
15CM14C OPTICAL COMMUNICATION NETWORKS

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

CO 1: Describe the optical networks components for optical network Communication (K1-K2)

CO 2: Analyze various Network architecture and topologies for optical networks. (K4)

CO 3: Evaluate the issues in the network design and operation for wavelength routing in optical networks. (K1-K5)

UNIT I OPTICAL SYSTEM COMPONENTS

UNIT II OPTICAL NETWORK ARCHITECTURES
Introduction to Optical Networks; SONET / SDH, Metropolitan Area Networks, Layered Architecture; Broadcast and Select Networks, Topologies for Broadcast Networks, Media-Access Control Protocols, Test beds for Broadcast & Select WDM.

UNIT III WAVELENGTH ROUTING NETWORKS
The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Test beds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS

UNIT V NETWORK DESIGN AND MANAGEMENT
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.

L:45 TOTAL: 45 PERIODS

REFERENCES
15CM15C MOBILE COMMUNICATION SYSTEMS AND STANDARDS L T P C

3 0 0 3

COURSE OUTCOMES
Upon completion of this course, students will be able to:
CO 1: Discuss the basic fundamental concept of mobile and wireless Communication. (K1-K2)
CO 2: Explain the different standards evolved in mobile communication. (K1–K2)
CO 3: Analyze the radio channels. (K1-K4)
CO 4: Describe the communication technologies and networks adapted. (K1–K2)

UNIT I CELLULAR CONCEPT
Cellular concept – Frequency reuse – Handoff strategies – Interference and System capacity – Trunking and Grade of service – Improving capacity in cellular systems - Channel Assignment strategies.

UNIT II WIRELESS FADING CHANNEL
Small-scale multipath propagation – Impulse response of a multipath channel – Parameters of mobile multipath channel – Types of small-scale fading – Rayleigh and Rician distributions – Statistical models for multipath fading channels.

UNIT III GSM, GPRS STANDARDS
GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM – Signal processing in GSM – GPRS network architecture – GPRS services and features.

UNIT IV 3G EVOLUTION

UNIT V 4G STANDARDS AND EVOLUTION
Multiple access techniques – OFDMA/MIMO/SC-FDMA, OFDM/MIMO – Wireless networking – Design issues in personal wireless systems – Cordless systems and Wireless Local Loop (WLL).

L:45 TOTAL: 45 PERIODS

REFERENCES
15CM16C  CRYPTOGRAPHY AND NETWORK SECURITY  L  T  P  C  
3  0  0  3

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Describe the need for security and the various security techniques. (K1-K2)
CO 2: Explain the various symmetric and asymmetric key algorithms. (K1-K2)
CO 3: Apply suitable authentication functions to ensure authentication. (K1-K3)
CO 4: Provide solutions for security at the system level. (K1-K5)
CO 5: Elaborate security protocols for Adhoc wireless network. (K1-K2)

UNIT I   INTRODUCTION ON SECURITY  9
Security Goals – Types of Attacks: Passive attack – active attack – attacks on confidentiality
– Integrity and availability – Security services and mechanisms – Cryptography Techniques
– Substitutional and Transposition Ciphers- Steganography.

UNIT II   SYMMETRIC AND ASYMMETRIC KEY ALGORITHMS  9
Stream and Block Ciphers – Data Encryption Standards (DES) – Advanced Encryption
Standard (AES) – Block Cipher modes of operation- RC4 – principle of asymmetric key
algorithms – RSA Cryptosystem – Diffie Hellmen Key Exchanging algorithm.

UNIT III   INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT  9
Message Integrity – Hash functions – SHA-1 – Digital signatures – Digital signature
standards Authentication – Message Authentication Code - Kerberos – Entity Authentication
– Biometrics – Key management Techniques.

UNIT IV   NETWORK SECURITY  9
Introduction on Firewalls – Types of Firewalls – Firewall Configuration and Limitation of
Firewall – IP Security Overview – IP security Architecture – Authentication Header –

UNIT V   SECURITY PROTOCOLS FOR ADHOC WIRELESS NETWORK  9
Security in Adhoc wireless networks – Requirements – Issues and Challenges – Attacks in
various layers – Key Management. Secure Routing Protocols – Requirements –
Authenticated Routing for Adhoc Networks - Security Aware AODV Protocol.

L:45  TOTAL: 45 PERIODS

REFERENCES
3. C.Siva Ram Murthy, B.S.Manoj, “Adhoc Wireless Networks: Architectures and
5. Stuart McClure, Joel Scambray and George Kurtz, “Hacking Exposed: Network
15CM17C COMMUNICATION SYSTEM LABORATORY – I

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

CO 1: Utilize advanced software tools for digital signal processing applications. (K1-K3)
CO 2: Design transform based compression algorithms. (K1-K4)
CO 3: Design error detection and error correction codes. (K1-K4)
CO 4: Determine the fundamental parameters of antennas. (K1-K3)
CO 5: Evaluate the performance of an optical communication link. (K1-K4)
CO 6: Evaluate the performance of digital modulation schemes. (K1-K4)

LIST OF EXPERIMENTS
1. Power spectrum estimation using MATLAB
2. Channel equalizer design with least mean square algorithm and recursive least square algorithm using MATLAB
3. DCT and DWT based compression techniques using MATLAB & LABVIEW
4. Object tracking with Kalman filter using MATLAB
5. Design of Adaptive filters using MATLAB and LABVIEW
6. Performance Evaluation of digital modulation schemes using MATLAB and LABVIEW
7. Implementation of error detection and error correcting codes.
8. Performance evaluation of Digital Data Transmission through Fiber Optic Link
9. Radiation Pattern measurement for wire, aperture and array antennas.
10. Simulation of Microstrip Antennas.

P:60 TOTAL: 60 PERIODS
COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Describe the mathematical model of SISO wireless channel. (K1-K2)
CO 2: Calculate the capacity of wireless channel. (K1-K3)
CO 3: Illustrate the V-BLAST and D-BLAST multiplexing architectures. (K1-K3)
CO 4: Describe the mathematical model of MIMO wireless channel. (K1-K2)
CO 5: Design a system in multiuser environment. (K1-K6)

UNIT I THE WIRELESS CHANNEL AND CAPACITY OF WIRELESS CHANNELS
Overview of wireless systems, Physical modeling for wireless channels, Time and Frequency coherence, Statistical channel models, AWGN channel capacity, Capacity of fading channels: Capacity of Flat Fading Channel, Channel Distribution Information known, Channel Side Information at Receiver, Channel Side Information at Transmitter and Receiver, Capacity of Frequency Selective Fading channels.

UNIT II SPATIAL MULTIPLEXING AND CHANNEL MODELING

UNIT III CAPACITY AND MULTIPLEXING ARCHITECTURES
The V-BLAST architecture, Fast fading MIMO channel: Capacity with CSI at receiver, Performance gains, Full CSI, Receiver architectures: Linear decorrelator, Successive cancellation, Linear MMSE receiver, slow fading MIMO channel, D-BLAST architecture.

UNIT IV DIVERSITY–MULTIPLEXING TRADEOFF
Diversity–multiplexing tradeoff: Formulation, Scalar Rayleigh channel, Parallel Rayleigh channel, MISO Rayleigh channel, 2x2 MIMO Rayleigh channel, MIMO Independent identically distributed Rayleigh channel.

UNIT V MIMO MULTIUSER COMMUNICATION
Uplink with multiple receive antennas, MIMO uplink, Downlink with multiple transmit antennas, MIMO downlink, Multiple antennas in cellular networks: a system view.

REFERENCES
15CM22C  HIGH SPEED COMMUNICATION NETWORKS  L  T  P  C
                      3  2  0  4

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Explain the state-of-the-art in network protocols and architectures. (K1-K2)
CO 2: Discuss the issues in providing Quality of Service to multimedia networking applications. (K1- K2)
CO 3: Describe the advanced network concepts for high performance communication networks. (K1- K3)
CO 4: Model the network of queues from the basics of queuing theory. (K1-K2)
CO 5: Explain the concepts of network security and management. (K1-K3)

UNIT I  INTRODUCTION  15

UNIT II  MULTIMEDIA NETWORKING APPLICATIONS  15
Streaming stored Audio and Video – Best effort service – Protocols for real time interactive applications – Providing Multiple Classes of Service – Providing Quality of Service Guarantees.

UNIT III  ADVANCED NETWORKS CONCEPTS  15

UNIT IV  TRAFFIC MODELLING  15

UNIT V  NETWORK SECURITY AND MANAGEMENT  15

L:45 T:30 TOTAL: 75 PERIODS

REFERENCES
15CM23C  MICROWAVE INTEGRATED CIRCUITS  

L  T  P  C  
3  0  0  3

COURSE OUTCOMES

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

CO 1: Describe the intricacies in the design of microwave circuits. (K1)
CO 2: Analyze the RF networks and from design a matching Networks and filters (K1-K4)
CO 3: Design Amplifier and Oscillator (K1- K3)
CO 4: Configure various Control circuits and Mixers. (K1- K3)
CO 5: Discuss about the state of art in MIC technology. (K1- K2)

UNIT I  INTRODUCTION TO MICROWAVE CIRCUITS  
Definitions – Frequency Bands – Lumped versus Distributed Circuits - Behavior of finite
length transmission lines – General Characteristics of PC Boards – Transmission Lines on
PC Boards – Passives made from Transmission Lines – Resonators - Combiners, Splitters
and Couplers.

UNIT II  MATCHING NETWORKS AND FILTER DESIGN  
Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters,
High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching
Circuits using Lumped Elements, Matching Network Design using Distributed Elements,
Filter design.

UNIT III  AMPLIFIERS AND OSCILLATORS  
Amplifiers: Stability considerations in active networks – Gain Consideration in Amplifiers –
Noise Consideration in active networks – Broadband Amplifier design – Low Noise Amplifier
Design, Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and
stability considerations of Microwave Transistor Oscillators.

UNIT IV  MIXERS AND CONTROL CIRCUITS  
Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended
Mixers – Single Balanced Mixers - Sub Harmonic Diode Mixers ,Microwave Diodes , Phase
Shifters – PIN Diode Attenuators.

UNIT V  MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES  
Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip
Module Technology - Fabrication Techniques, Miniaturization techniques, Introduction to
SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic
measurements, experimental field probing techniques.

L:45  TOTAL: 45 PERIODS

REFERENCES
    Education, 2nd Edition 2002
3.  Guillermo Gonzalez “Microwave Transistor Amplifiers – Analysis and Design”, 2nd
    York, 1975.
COURSE OUTCOMES
Upon completion of the course, the students will be able to

CO 1: Apply the knowledge of basic RF Electronics for realizing any RF System. (K1-K2)
CO 2: Analyze the impedance matching networks and amplifiers. (K1 –K3)
CO 3: Design an RF power amplifier. (K1- K4)
CO 4: State PLL and Frequency synthesizer for different RF applications. (K1- K3)
CO 5: Design RF mixers and Oscillators. (K1- K4)

UNIT I  CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES

UNIT II  IMPEDANCE MATCHING AND AMPLIFIERS
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  RF POWER AMPLIFIERS AND FEEDBACK SYSTEMS
Feedback Systems: Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation Power Amplifiers: General model, Class D, E, F and S amplifiers, Linearization Techniques, Efficiency boosting techniques, ACPR metric, Design considerations.

UNIT IV  PLL AND FREQUENCY SYNTHESIZERS
PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge Pumps Frequency Synthesizers: Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

UNIT V  MIXERS AND OSCILLATORS

L:45  TOTAL: 45 PERIODS

REFERENCES
15CM25C COMMUNICATION SYSTEM LABORATORY – II L T P C
0 0 4 2

COURSE OUTCOMES
Upon completion of this course, students will be able to:
CO 1: Design digital transceiver. (K1- K3)
CO 2: Design algorithms for network security and routing. (K1- K3)
CO 3: Design compression, segmentation and pattern classification algorithms. (K1- K3)
CO 4: Utilize GPS receiver for object tracking and navigation. (K1- K2)
CO 5: Determine fundamental parameters of transmission lines and microwave integrated circuits. (K1- K2)

LIST OF EXPERIMENTS
1. Implementation of wireless communication system using USRP
2. Implementation of Advanced Encryption Standard
3. Simulation of EZW-SPIHT Image coding algorithm using MATLAB
4. Real time implementation of tracking and navigation using GPS.
5. Simulation of transmission lines and microwave integrated circuits.
6. Simulation of image segmentation and pattern classification using MATLAB and LABVIEW.

P:60 TOTAL: 60 PERIODS
15CM26C RESEARCH PAPER AND PATENT REVIEW - SEMINAR  

L  T  P  C  
0  0  4  2

The student will make atleast two technical presentations on current topics related to the specialization. The same will be assessed by a committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation.

P:60 TOTAL: 60 PERIODS
15CM01E DATA HIDING AND ETHICAL HACKING

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

CO 1: Describe the purpose of Data hiding in various applications. (K1- K2)
CO 2: Identify security vulnerabilities and weaknesses in the target applications. (K1- K3)
CO 3: Analyze how security controls can be improved to prevent hackers gaining access to networked environments. (K1- K4)
CO 4: Implement the impact of hacking in real time machines. (K1- K4)

UNIT I DATA HIDING IN MULTIMEDIA AND MOBILE DEVICES
History of Secret Writing - Steganography - Multimedia Data Hiding - Data Hiding in Digital Audio and Video - Data Hiding Among Android Mobile Devices - StegDroid- Apple iOS Data Hiding - Mobile Device Data Hiding Applications.

UNIT II DATA HIDING IN OPERATING SYSTEMS AND NETWORKS

UNIT III BASICS OF ETHICAL HACKING
Introduction to Ethical Hacking, Ethics, and Legality - Reconnaissance - Foot printing - Social Engineering - Scanning - Enumeration - Password Cracking - Escalating Privileges - Hiding Files.

UNIT IV NETWORK SNIFFING AND WEB HACKING

UNIT V SYSTEM HACKING

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

CO 1: Explain the concepts of pipelining, parallel processing. (K1- K3)
CO 2: Apply optimization techniques to design IIR and FIR filters. (K1- K3)
CO 3: Discuss scaling and round-off noise issues and their impact on performance. (K1- K2)
CO 4: Explain the concepts of numerical strength reduction and wave pipelining. (K1- K3)

UNIT I DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING
Introduction – Representations of DSP algorithms - Iteration Bound - data flow graph representations, loop bound and iteration bound, Longest path Matrix algorithm; Pipelining and parallel processing - Pipelining of FIR digital filters, parallel processing, pipelining and parallel processing for low power.

UNIT II RETILING, UNFOLDING AND RANK ORDER FILTERS
Retiming - definitions and properties; Unfolding - an algorithm for Unfolding, properties of unfolding, parallel processing application; Algorithmic strength reduction in filters and transforms - 2-parallel FIR filter, 2-parallel fast FIR filter, parallel architectures for rank-order filters, Odd- Even Merge- Sort architecture, parallel rank-order filters.

UNIT III FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS
Fast convolution - Cook-Toom algorithm, modified Cook-Toom algorithm; Pipelined and parallel recursive filters - inefficient/efficient single channel interleaving, Look Ahead pipelining in first- order IIR filters, Look-Ahead pipelining with power-of-two decomposition, Clustered Look-Ahead pipelining, parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters.

UNIT IV ROUNDOFF NOISE AND BIT-LEVEL ARITHMETIC ARCHITECTURES
Scaling and roundoff noise- scaling operation, roundoff noise, state variable description of digital filters, scaling and roundoff noise computation, roundoff noise in pipelined first-order IIR filters; Bit- Level Arithmetic Architectures- parallel multipliers with sign extension, parallel carry-ripple array multipliers, parallel carry-save multiplier, 4x 4 bit Baugh- Wooley carry-save multiplication, design of Lyon's bit-serial multipliers using Horner's rule.

UNIT V NUMERICAL STRENGTH REDUCTION AND WAVE PIPELINING
Numerical Strength Reduction - subexpression elimination, multiple constant multiplications, iterative matching, Two-phase clock generator, clock skew in edge triggered single-phase clocking, two-phase clocking, wave pipelining.

REFERENCES
15CM03E ADVANCED DIGITAL IMAGE PROCESSING

COURSE OUTCOMES
Upon completion of this course, students will be able to:
CO 1: Develop new Image Processing algorithms for real-time applications in different domains (K1- K3)
CO 2: Develop hybrid techniques to solve problems in different applications (K1- K3)

UNIT I DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS

UNIT II IMAGE ENHANCEMENT AND RESTORATION

UNIT III IMAGE SEGMENTATION AND REPRESENTATION
Edge detection - Edge linking and boundary detection - Thresholding - Region based segmentation - Region growing - Region splitting and Merging - Segmentation by morphological watersheds - basic concepts - Dam construction - Watershed segmentation algorithm, Boundary representation: chair codes - Polygonal approximation - Boundary segments - boundary descriptors: Simple descriptors - Fourier descriptors - Regional descriptors - Relational descriptors - Texture representation.

UNIT IV PATTERN RECOGNITION

UNIT V APPLICATIONS OF IMAGE PROCESSING
Image Registration - Image Fusion (Mosaics) - Image Denoising - Object Detection - Target detection and tracking - Content based image retrieval- Water marking- Steganography - Stegnalysis - Video Motion Analysis.

REFERENCES
15CM04E  MULTIMEDIA COMPRESSION TECHNIQUES (Common to CS and CN) L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, students will be able to:
CO 1: Describe fundamentals concepts and characteristics of text audio, image and video. (K1- K3)
CO 2: Analyze various types of text compression techniques (K1- K4)
CO 3: Express several types of audio and speech compression techniques. (K1- K3)
CO 4: Compare the different image compression techniques. (K1- K4)
CO 5: Illustrate the principles and standards for video compression. (K1- K4)

UNIT I INTRODUCTION
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.

UNIT II TEXT COMPRESSION
Compression techniques, Shannon-Fano coding, Huffman coding, Adaptive Huffman Coding, Arithmetic coding, Dictionary techniques, LZW family algorithms.

UNIT III AUDIO COMPRESSION

UNIT IV IMAGE COMPRESSION

UNIT V VIDEO COMPRESSION

REFERENCES
COURSE OUTCOMES
Upon completion of this course, students will be able to:
CO 1: Determine the Sparse representation (K1- K3)
CO 2: Analyze Nonlinear Multiscale Transforms for sparsity (K1- K4)
CO 3: Develop an in-depth understanding in Compressive sensing (K1- K4)

UNIT I SPARSITY AND WAVELET 9
Sparse Representation: Sparsity, Sparsity Terminologies, Underdetermined Linear Systems
- Regularization - Convexity - L1-Minimization - Moving to Sparse Solutions - The L0 Norm
and Implications - The P0 Problem in sparse signal processing. Fourier to Wavelets, From
Wavelets to Over complete Representations - The Discrete Wavelet Transform.

UNIT II WAVELET PACKETS AND REDUNDANT WAVELET TRANSFORM 9
The Undecimated Wavelet Transform - Partially Decimated Wavelet Transform - The Dual-
Tree Complex Wavelet Transform - Starlet Transform - Nonorthogonal Filter Bank Design:
Positive Reconstruction Filters - Reconstruction from the HaarUndecimated Coefficients.

UNIT III NONLINEAR MULTISCALE TRANSFORMS 9
Decimated Nonlinear Transform - Multiresolution Based on the Median Transform - Guided
Numerical Experiments - The Ridgelet and Curvelet Transforms: The Continuous Ridgelet
Transform - The Rectopolar Ridgelet Transform - The Orthonormal Finite Ridgelet
Transform - Sparse Representation by Ridgelets - The First-Generation Curvelet Transform
- Sparse Representation by First-Generation Curvelets.

UNIT IV LINEAR INVERSE PROBLEMS 9
Sparsity-Regularized Linear Inverse Problems - Monotone Operator Splitting Framework -
Selected Problems and Algorithms - Sparsity Penalty with Analysis Prior - Other Sparsity
Regularized Inverse Problems General Discussion: Sparsity, Inverse Problems and Iterative
Thresholding.

UNIT V COMPRESSIVE SENSING 9
Incoherence and Sparsity, Sensing Protocol Stable Compressed Sensing Designing Good
Matrices: Random Sensing Sensing with Redundant Dictionaries Compressed Sensing in
Space Science Guided Numerical Experiments.

L:45  TOTAL: 45 PERIODS

REFERENCES
   processing Wavelets, Curvelets, Morphological Diversity”, Cambridge University
15CM06E VIDEO SURVEILLANCE SYSTEMS L T P C 3 0 0 3

COURSE OUTCOMES
 Upon completion of this course, students will be able to:
 CO 1: Distinguish different image sensors and different cameras used video surveillance systems (K1- K4)
 CO 2: Analyze various segmentation and detection techniques in video surveillance. (K1- K4)
 CO 3: Apply video tracking algorithms for intelligent surveillance applications (K1- K3)
 CO 4: Compare several video analyzing techniques (K1- K4)
 CO 5: Describe several video surveillance applications. (K1- K2)

UNIT I DIGITAL VIDEO HARDWARE 9
Worldwide Video Standards (NTSC, PAL, SECAM), Interlaced and Progressive Scan, Resolution, Color models in video - YUV, YIQ, YCbCr, Refraction, optics, F-Stop, Shutter speed, Depth of field, Digital image sensors - CCD vs CMOS, Manual, auto focus, power requirements, Day and night cameras, Infra-red and thermal technologies, Indoor/ Outdoor cameras, Fixed/PTZ/ Moving cameras, CCTV.

UNIT II MOTION SEGMENTATION AND DETECTION 9
Scene Change detection, Spatiotemporal Change detection - Change detection using two frames - Temporal integration - Combination with spatial segmentation - Motion Segmentation - Dominant Motion Segmentation - Multiple Motion Segmentation-Motion estimation algorithm - Global motion estimation- Block matching Phase correlation Optical flow - MAP Estimation of Dense motion.

UNIT III FRAMEWORK FOR VIDEO ANALYSIS 9
Image and Video features- Statistical, Content based, Compressed domain- Video Shot analysis- Shot boundary detection, key frame extraction, Play/Break segmentation, Audio Marker detection, Video Marker Detection, Video representation for scripted and unscripted contents.

UNIT IV VIDEO TRACKING AND BEHAVIOUR ANALYSIS 9
Video Tracking- Design of Video Tracker- Challenges- Main Components- Single Target Tracking- Multiple Target Tracking- Interactive vs automated target tracking Behaviour Analysis of individuals-Learning based behavior analysis- SVM learning- Behaviour analysis of human groups- People count and crowd density estimation.

UNIT V VIDEO SURVEILLANCE SYSTEMS APPLICATIONS 9

REFERENCES
15CM07E  COGNITIVE RADIO TECHNIQUES  L  T  P  C
3  0  0  3

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

CO 1: Discuss the basic fundamental concept, design and application of Software Defined Radio. (K1- K2)
CO 2: Describe the basic fundamentals of Cognitive Radio and its Challenges. (K1- K2)
CO 3: Identify different Spectrum sensing methods in Cognitive Radio. (K1- K2)

UNIT I  SOFTWARE DEFINED RADIO  9

UNIT II  SDR AS PLATFORM FOR COGNITIVE RADIO  9

UNIT III  COGNITIVE RADIO TECHNOLOGY  9

UNIT IV  CR- TECHNICAL CHALLENGES  9
Design Challenges associated with CR – Hardware requirements – Hidden primary user problem – detecting spread spectrum primary users – sensing duration and frequency – security.

UNIT V  SPECTRUM SENSING  9

L:45  TOTAL: 45 PERIODS

REFERENCES
15CM08E  MULTI USER DETECTION  

COURSE OUTCOMES
Upon successful completion of the course, the students will be able to
CO 1: Discuss the major interference of multi-access channels, and the key signal processing techniques to overcome them. (K1- K2)
CO 2: Identify and describe the main components of multiuser detectors present in existing and emerging wireless systems. (K1- K2)
CO 3: Apply the various multiuser signal processing techniques to research work. (K1- K3)
CO 4: Design new methodologies based on the underlying principles of multiuser techniques, and evaluate the performance of various designs. (K1- K4)
CO 5: Implement the advanced detection techniques for industry, solving social problems etc. (K1- K4)

UNIT I  MULTIPLE ACCESS AND SINGLE USER DETECTION  

UNIT II  LINEAR MULTIUSER DETECTION  

UNIT III  ADAPTIVE LINEAR MULTIUSER DETECTION  

UNIT IV  DECISION-DRIVEN MULTIUSER DETECTION  
Linear versus nonlinear multiuser detection – Successive cancellation – SIC and PIC schemes – Multistage detection – conventional first stage, decorrelating first stage – Decision feedback multiuser detection – Asynchronous decision feedback.

UNIT V  MULTIUSER DETECTION FOR WIRELESS NETWORKS  
Overview of future generation wireless networks – Cross layer design – Multiuser detection for next generation wireless networks – Multiuser detection in cross layer design – Introduction to radio resource allocation – Access control, power control and multiuser detection – Multiuser detection in adhoc networks.

L:45  TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Discuss different nonlinearities in Optical fiber. (K1- K2)
CO 2: Illustrate the importance of phase modulation in nonlinear fiber optics. (K1- K3)
CO 3: Compare different types of optical Solitons. (K1- K3)
CO 4: Summarize the applications of Solitons in optical communication system. (K1- K3)

UNIT I FIBER NONLINEARITIES

UNIT II GROUP VELOCITY DISPERSION AND PHASE MODULATION

UNIT III OPTICAL SOLITONS

UNIT IV SOLITON LASERS

UNIT V APPLICATIONS OF SOLITONS
DMS for single channel transmission, WDM transmission, Pulse compression, Soliton Switching, Solitons in fibers with gratings, Fiber interferometers, Soliton Light wave systems.

REFERENCES
15CM10E  OPTICAL NETWORK AND PHOTONIC SWITCHING  L  T  P  C
3  0  0  3

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Discuss the basic elements of optical fiber transmission link, fiber modes
configurations and structures. (K1-K2)
CO 2: Discuss the different kind of losses, signal distortion in optical wave guide.
(K1-K2)
CO 3: Demonstrate various optical source materials, LED structures and fiber optical
receivers such as PIN, APD diodes, operational principles of WDM and
Solitons. (K1-K4)
CO 4: Identify the errors in the Fiber and measure the attenuation. (K1-K2)

UNIT I  INTRODUCTION TO OPTICAL NETWORKS
Introduction: Multiplexing Techniques – First and Second Generation Optical networks –
Telecom Networks Overview, Telecom Business Models, Roles of three fields in Optical
Networking- TE vs, NE vs, NP Wave length – Division Multiplexing – Intermodal dispersion
– Chromatic dispersion – non Linear effects.

UNIT II  OPTICAL NETWORK COMPONENTS
Couplers – Isolators and Circulators, Multiplexers and filters, Fiber gratings, MZ
interferometers – arrayed waveguide gratings – optical amplifiers: SOA, EDFA and Raman
Amplifier – switches and wavelength converters – Add/Drop Multiplexer – optical cross
connect.

UNIT III  OPTICAL ACCESS NETWORKS
Introduction – Overview of PON Technologies – Ethernet PON (EPON) – access Networks,
Fiber to the Cuyb (FTTC) – SONET/SDH, archiecture of optical transport networks (OTNs).

UNIT IV  ROUTING AND WAVELENGTH ASSIGNMENT
routing – Routing and wavelength assignment - LTD and RWA problems.

UNIT V  PHOTONIC SWITCHING
Photonic Packet Switching, OTDM, Multiplexing and Demultiplexing, Synchronization,
Broadcast OTDM networks, Switch-based networks. Header and Packet Format, Typical
Contention Resolution in OPS Networks, Test beds KEOPS, NTT's Optical ATM switches.

REFERENCES
2007.
3. Rajiv Ramaswami.Kumar, N.Sivaranjan, “Optical Networks A Practical Perspective”,
COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Discuss the design issues in sensor networks. (K1-K2)
CO 2: Explain the different types of MAC protocols. (K1-K2)
CO 3: Discuss the different types of routing protocols. (K1-K2)
CO 4: Expose to the protocol stack issues in sensor networks. (K1-K3)
CO 5: Describe the architecture and protocols of wireless sensor networks. (K1-K2)

UNIT I INTRODUCTION

UNIT II ARCHITECTURES
Single node architecture – Hardware components – Energy consumption of sensor nodes – Network architecture – Sensor network scenarios – Design challenges in wireless sensor networks – Optimization goals and Figure of merit – Gateway concepts.

UNIT III NETWORKING OF SENSORS
Physical layer and Transceiver design considerations – MAC protocols for wireless sensor networks – Low duty cycle protocols and wake up radio concepts – Schedule based protocols – Contention based protocols.

UNIT IV INFRASTRUCTURE ESTABLISHMENT

UNIT V SENSOR NETWORK PLATFORMS AND TOOLS
Operating systems for wireless sensor networks – Tiny OS – Programming challenges – Sensor node examples: EYES, Berkeley and Mica Motes – Case study: Forest fire detection, Habitat monitoring and Medical applications.

REFERENCES
15CM12E MULTICASTING TECHNIQUES IN MANET  
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**COURSE OUTCOMES**

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

CO 1: Discuss the fundamentals of Communication Paradigms in MANETs. (K1-K2)

CO 2: Discuss the various multicast routing protocols and routing techniques in MANETs. (K1-K2)

CO 3: Evaluate the Energy Management techniques in MANETs. (K1-K5)

**UNIT I ROUTING IN MANETS**


**UNIT II COMMUNICATION TECHNIQUES**


**UNIT III MULTICAST ROUTING PROTOCOL**


**UNIT IV ENERGY MANAGEMENT**


**UNIT V CASE STUDIES**

Multicast Trees- Stateless Multicasting- Scalable Multicasting- Genetic Algorithm in Multicast routing- Location based multicast address.

L:45 TOTAL: 45 PERIODS

**REFERENCES**

15CM13E FPGA BASED COMMUNICATION SYSTEM DESIGN

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Write HDL program for the given task. (K1-K3)
CO 2: Discuss the concepts of programmable logic devices. (K1-K2)
CO 3: Explain the architecture of various FPGAs (K1-K2)
CO 4: Design FPGA based DSP and Communication algorithms. (K1-K6)

UNIT I INTRODUCTION TO HDL

UNIT II PROGRAMMABLE LOGIC DEVICES
Basic Concepts, Programming Technologies – Programmable Logic Array (PLA),
Programmable Array Logic (PAL), Programmable Logic Array (PLA), Design of State
Machine using ASM Chart as a design Tool.

UNIT III FIELD PROGRAMMABLE GATE ARRAYS
Introduction – FPGA Technology – DSP Technology Requirement – Design Implementation
– FPGA Architectures – Xilinx – Altera Flex – Design Principles using FPGAs –
Implementing DSP Functions in FPGA - Applications of FPGA to Software Radio.

UNIT IV DIGITAL SIGNAL PROCESSING WITH FPGAS
Design of Binary Adders, Multipliers and Dividers- Design of FIR Filters – Design of IIR
Filters – Multirate Signal Processing – Decimation – Interpolation – Polyphase
Decomposition – Multistage Decimator – Filter Banks – DFT and FFT Algorithms – Error
Control and Cryptography – Modulation and Demodulation – FPGA design of LMS
Algorithm.

UNIT V SOFTWARE RADIO
Block Diagram of Software Radio –Numerically controlled oscillator – Digital Up converters –
Digital Down Converters and demodulators – Universal Modulator and Demodulator using
CORDIC. Incoherent Demodulation – digital approach for I and Q generation, Special
Sampling Schemes. CIC filters, Residue number system and high speed filters using RNS.
Down Conversion using discrete Hilbert Transform. Undersampling receivers, Coherent
Demodulation Schemes.

L:45 TOTAL: 45 PERIODS

REFERENCES
3. Uwe Meyer Baese, “Digital Signal Processing with Field Programmable Gate Arrays”,
Pearson Education Asia, 2002.
15CM14E SPEECH PROCESSING

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Describe different representation of speech waveform (K1-K2)
CO 2: Categorize time domain and frequency domain methods for speech
processing. (K1-K4)
CO 3: Summarize linear predictive analysis of speech. (K1-K5)
CO 4: Explain in various applications of speech and audio signal processing. (K1-K4)

UNIT I MECHANICS OF SPEECH
Speech production: Mechanism of speech production, Acoustic phonetics – Digital models
for speech signals - Representations of speech waveform: Sampling speech signals, basics
of quantization, delta modulation, and Differential PCM – Auditory perception: psycho
acoustics.

UNIT II TIME DOMAIN METHODS FOR SPEECH PROCESSING
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 Auto Correlation Function – Pitch period estimation using Auto Correlation
Function.

UNIT III FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING
Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling
rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis -
Analysis synthesis systems: Phase vocoder, Channel Vocoder - Homomorphic speech
analysis: Cepstral analysis of Speech, Formant and Pitch Estimation, Homomorphic
Vocoders.

UNIT IV LINEAR PREDICTIVE ANALYSIS OF SPEECH
Basic Principles of linear predictive analysis – Auto correlation method – Covariance
method – Solution of LPC equations – Cholesky method – Durbin’s Recursive algorithm, –
Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis
– VELP – CELP.

UNIT V APPLICATION OF SPEECH AND AUDIO SIGNAL PROCESSING
Algorithms: Dynamic time warping, K-means clusering and Vector quantization, Gaussian
mixture modeling, hidden Markov modeling - Automatic Speech Recognition: Feature
Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition,
Language models - Speaker identification and verification – Voice response system –
Speech synthesis: basics of articulatory, source-filter, and concatenative synthesis – VOIP.

L:45 TOTAL: 45 PERIODS

REFERENCES
and Sons Inc., Singapore, 2004
15CM15E  PATTERN RECOGNITION TECHNIQUES AND APPLICATIONS  

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Identify the applications of Neural Networks (K1-K2)
CO 2: Apply Image Understanding concepts to Recognition (K1-K3)
CO 3: Analyze the Classification and Segmentation Problems (K1-K4)

UNIT I  PATTERN RECOGNITION CONCEPTS  
Patterns and Pattern Recognition, Pattern Recognition System- significance, Configurations. Representation of Patterns and Machine Recognition, Machine Intelligence, Computing Methods, Applications.

UNIT II  SUPERVISED, SEMI SUPERVISED LEARNING  
Non-Parametric Classification: Decision theoretic Classification-Decision Surfaces, Discriminant Functions and their types, Potential Functions. Discriminant Function Training- Weight Space, Training Procedure, Training Methods, Statistical Discriminant Functions-Statistical Design Theory-Problem Formulation, Optimal functions, Semi Supervised methods- Transductive Support Vector Machines (TSVMs), Semi- Supervised Learning in Structured Output Spaces

UNIT III  CLUSTERING ANALYSIS AND UNSUPERVISED LEARNING, DIMENSIONALITY REDUCTION  
Introduction to Clustering, Clustering with Unknown Number of Classes and Known Number of Classes, Evaluation of Clustering Results, Graph Theoretical Methods, Mixture Statistics and Unsupervised Learning. Dimensionality Reduction: Feature Selection for Multivariate Gaussian Data, Feature Ordering, Canonical Analysis, Optimum Classification, Non-parametric Feature Selection.

UNIT IV  NEURAL NETWORKS  
Multilayer Perceptron-Preliminaries, Pattern Mapping, Radial Basis Function Networks-Training, Formulation for Pattern Classification, Comparison of RBF with Multilayer Perceptron, Hamming Net and Kohonen Self-Organizing Feature Map, Hopfield Model.

UNIT V  IMAGE UNDERSTANDING CONTROL STRATEGIES  
Image Understanding Control Strategies - Parallel and Serial Processing Control, Hierarchical Control, Bottom Up Control Strategies, Model Based Control Strategies, Combined Control Strategies, Non- hierarchical Control, Active Contour Models, Point Distribution Models, Pattern Recognition Methods in Image Understanding, Scene Labeling and Constraint Propagation, Semantic Image Segmentation and Understanding.

L:45  TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of the course students able to
- CO 1: Describe time-frequency structure, and duplex schemes. (K1-K2)
- CO 2: Illustrate about synchronization signals and reference signals. (K1-K3)
- CO 3: Apply different channel coding schemes in LTE. (K1-K3)
- CO 4: Determine spatial multiplexing and transmission modes in LTE. (K1-K4)
- CO 5: Design propagation channel models. (K1-K6)

UNIT I PHYSICAL TRANSMISSION RESOURCES
Overview of Time-Frequency Structure, Duplex Schemes: Frequency-Division Duplex, Time-Divison Duplex, Channel structure and Bandwidths: Channel bandwidths, User Equipment(UE) radio access capabilities, Frame and Slot structure: Physical resource block, slot structure, Downlink distributed transmission.

UNIT II CELL SEARCH AND REFERENCE SIGNALS
Downlink frame structure, Synchronization signals: Primary synchronization signal, secondary synchronization, Zadoff-Chu sequences, Downlink reference signals: Cell-specific reference signals, MBSFN refence signals, UE-specific reference signals, PN sequence, PN sequence generation in LTE, Channel Estimation and detection methods.

UNIT III CHANNEL CODING AND LINK ADAPTATION
Channel Coding: LDPC codes, Channel coding schemes in LTE, Cyclic redundancy Check, Codebook segmentation, Turbo coding, Tail-biting convolutional code, Circular-buffer rate matching for Turbo code, Codebook concatenation, Channel interleaver, Link Adaptation: CQI feedback in LTE.

UNIT IV TRANSMISSION MODES IN LTE
Codewords and Layer mapping, Downlink transmission modes, Single antenna mode – Space Frequency block code, MIMO Precoding, CDD-based precoding, open-loop and closed loop spatial multiplexing – Beamforming, Link Adaptation: CQI feedback in LTE.

UNIT V PRACTICAL DEPLOYMENT ASPECTS

REFERENCES
5. 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures", 2011
15CM17E MICRO ELECTRO MECHANICAL SYSTEMS L T P C
3 0 0 3

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

CO 1: Discuss the principles of micro fabrication to the development of micromechanical devices and the design of micro systems (K1- K2)

CO 2: State the principles of energy transduction, sensing and actuation on a microscopic scale. (K1- K2)

CO 3: Appreciate the effects of scaling, and the similarities and differences between micromechanical assemblies and macroscopic machines. (K1- K4)

CO 4: Analyze and model the behavior of micro electromechanical devices and systems (K1- K4)

UNIT I INTRODUCTION TO MEMS
MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro fabrication

UNIT II MECHANICS FOR MEMS DESIGN
Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

UNIT III ELECTRO STATIC DESIGN
Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. bistable actuators.

UNIT IV CIRCUIT AND SYSTEM ISSUES
Electronic Interfaces, Feedback systems, Noise , Circuit and system issues, Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Modeling of MEMS systems, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS
Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Memes – design basics, case study – Capacitive RF MEMS switch, performance issues.

L:45 TOTAL: 45 PERIODS

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

CO 1: Discuss the fundamentals and operation of Next generation TV Networks. (K1 – K2)

CO 2: Describe the various models and standards of IPTV. (K1 – K2)

CO 3: Deploy IPTV techniques on various networks. (K1 – K4)

CO 4: Discuss various security attacks on IPTV (K1 – K2)

CO 5: Evaluate various real time IPTV models. (K1 – K5)

UNIT I NEXT GENERATION TV NETWORK

UNIT II DIGITAL RIGHTS MANAGEMENT

UNIT III SERVICES AND TECHNOLOGIES

UNIT IV MULTIMEDIA SECURITY
UNIT V  CASE STUDY  9

L:45  TOTAL: 45 PERIODS

REFERENCES
15CM19E  ADAPTIVE SIGNAL PROCESSING  L  T  P  C
(Common to CS and CN)  3  0  0  3

COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Describe the fundamentals of adaptive filtering (K1 – K2)
CO 2: Design the LMS filter for different applications (K1 – K4)
CO 3: Design an adaptive filter based on conventional RLS algorithm (K1 – K4)
CO 4: Design an adaptive filter based on fast traversal, adaptive lattice and QR
decomposition based RLS algorithms (K1 – K4)

UNIT I  FUNDAMENTALS OF ADAPTIVE FILTERING  9
Signal Representation - Correlation Matrix – Wiener Filter - Linearly Constrained Wiener
Filter – Mean Square Error Surface – Bias and Consistency – Newton Algorithm – Steepest
Descent Algorithm – Applications: System Identification, Signal Enhancement, Signal
Prediction, Channel Equalization.

UNIT II  THE LMS ALGORITHM  9
The LMS algorithm – properties – Behavior in nonstationary environments – Applications -
LMS Newton Algorithm –Normalized LMS – Transform Domain LMS – Affine Projection
Algorithm.

UNIT III  CONVENTIONAL RLS ALGORITHM  9
Recursive Least Squares Algorithm – Properties: Orthogonality principle, Relation between
Least Squares and Wiener Solutions, Influence of the Deterministic Autocorrelation
Initialization, Steady state behavior of coefficient vector, Coefficient-Error-Vector Covariance
Matrix, Behavior of the Error Signal, Excess mean square error and Misadjustment –
Behavior in Nonstationary Environments.

UNIT IV  ADAPTIVE LATTICE BASED RLS ALGORITHMS  9
Recursive Least Square Prediction – Order updating Equations – Time updating Equations
Lattice RLS algorithm – Error Feedback Lattice RLS Algorithm

UNIT V  FAST TRANSVERSAL AND QR DECOMPOSITION BASED RLS ALGORITHM  9
Stabilized Fast Transversal RLS Algorithm – Triangularization using QR Decomposition:
Initialization Process, Input data matrix triangularization, QR Decomposition RLS algorithm –
Systolic Array Implementation – Implementation Issues - Fast QR-RLS Algorithm

L:45  TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES

Upon completion of the course, the students will be able to
CO 1: Describe the Medical image fundamentals and its reconstruction (K1-K2)
CO 2: Describe medical image formats and its processing (K1-K2)
CO 3: Discuss the image registration and visualization (K1-K2)
CO 4: Classify the medical image segmentation procedures (K1-K3)
CO 5: Explain ultrasound, PET and SPECT imaging methods (K1-K4)

UNIT I INTRODUCTION
Introduction to medical imaging technology, systems, and modalities. Brief history; importance; applications; trends; challenges. Medical Image Formation Principles: X-Ray physics; X-Ray generation, attenuation, scattering; dose Basic principles of CT; reconstruction methods; artifacts; CT hardware. Magnetic Resonance Imaging (MRI), Mathematics of MR; spin physics; NMR spectroscopy; imaging principles and hardware.

UNIT II STORAGE AND PROCESSING
Medical Image Storage, Archiving and Communication Systems and Formats Picture archiving and communication system (PACS); Formats: DICOM Radiology Information Systems (RIS) and Hospital Information Systems (HIS). Medical Image Processing, Enhancement, Filtering Basic image processing algorithms Thresholding; contrast enhancement; SNR characteristics; filtering; histogram modeling.

UNIT III IMAGE REGISTRATION AND VISUALIZATION
Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Medical image fusion, Image visualization –2D display methods, 3D display methods, virtual reality based interactive visualization. Image artifacts.

UNIT IV SEGMENTATION AND CLASSIFICATION
Medical Image Segmentation - Histogram-based methods; Region growing and watersheds; Markov Random Field models; active contours; model-based segmentation. Multi-scale segmentation; semi-automated methods; clustering-based methods; classification-based methods; atlas-guided approaches; multi-model segmentation. Medical Image Registration Intensity-based methods; cost functions; optimization techniques.

UNIT V NUCLEAR IMAGING
PET and SPECT Ultrasound Imaging methods; mathematical principles; resolution; noise effect; 3D imaging; positron emission tomography; single photon emission tomography; ultrasound imaging; applications. Medical Image Search and Retrieval Current technology in medical image search, content-based image retrieval, new trends: ontologies. Applications. Other Applications of Medical Imaging Validation, Image Guided Surgery, Image Guided Therapy, Computer Aided Diagnosis/Diagnostic Support Systems.

L:45 TOTAL: 45 PERIODS
REFERENCES
COURSE OUTCOMES
Upon completion of the course, the students will be able to
CO 1: Choose the desired transforms for different image processing application. (K1-K3)
CO 2: Analyze Wavelet Packets. (K1 –K4)
CO 3: Design Wavelets for specific application. (K1- K5)

UNIT I VECTOR SPACES AND SIGNAL SPACES

UNIT II MULTI RESOLUTION ANALYSIS
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
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, Sine, Gaussian, Bi-Orthogonal) - Tiling of time -scale plane for CWT.

UNIT IV DISCRETE WAVELET TRANSFORMS

UNIT V WAVELET APPLICATIONS

REFERENCES

L:45 TOTAL: 45 PERIODS
15CM22E MOBILE ADHOC NETWORKS

COURSE OUTCOMES

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

CO 1: Explain the MAC address spoofing concepts and basics of networks. (K1 –K2)
CO 2: Describe the routing principles and Adhoc network types. (K1 –K2)
CO 3: Discuss the operation principles of WSN. (K1 –K2)
CO 4: Explain the routing principles of WSN. (K1 –K2)
CO 5: Describe the IEEE standards, MESH networks and its heterogeneous models. (K1 –K2)

UNIT I ADHOC MAC

UNIT II ADHOC NETWORK ROUTING AND TCP

UNIT III WSN – MAC

UNIT IV WSN ROUTING, LOCALIZATION AND QoS

UNIT V MESH NETWORKS

L:45 TOTAL: 45 PERIODS

REFERENCES

15CM23E DESIGN AND DEPLOYMENT OF WIRELESS SENSOR NETWORK 3 0 0 3

COURSE OUTCOMES
Upon successful completion of the course, the students will be able to
CO 1: Describe the deployment approach and clustering in detail. (K1-K2)
CO 2: Explain the various sensor coverage models and optimization problems for coverage control. (K1-K2)
CO 3: Discuss the critical Sensor Density, Activity Scheduling and Movement strategy problem in WSN. (K1-K2)
CO 4: Examines the barrier Coverage problems and Energy harvesting in WSN. (K1-K4)
CO 5: Apply knowledge of wireless sensor networks to various application areas. (K1-K3)

UNIT I DEPLOYMENT MECHANISMS AND CLUSTERING TECHNIQUES 9

UNIT II COVERAGE CONTROL AND TARGET COVERAGE PROBLEMS 9

UNIT III AREA COVERAGE PROBLEMS 9

UNIT IV BARRIER COVERAGE PROBLEMS AND ENERGY EFFICIENCY 9

UNIT V CASE STUDIES 9
Volcano Monitoring: Addressing Data Quality through Iterative Deployment - VoxNet: Reducing Latency in High Data Rate Applications - Failure Is Inevitable: The Trade-off between Missing Data and Maintenance, Glacier Monitoring: Deploying Custom Hardware in Harsh Environments.

L:45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES

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

CO 1: Discuss about the basic principles and challenges of VANET. (K1 –K2)
CO 2: Discuss about link layer protocols and wireless access technologies. (K1 –K2)
CO 3: Build working knowledge on various routing protocols and connectivity techniques. (K1 –K4)
CO 4: Discuss about emerging security issues, Description of modeling issues and mathematical analysis using various encryption schemes techniques in VANET. (K1 –K3)
CO 5: Describe various mobility models and simulation techniques of VANET in wireless Environment. (K1 –K2)

UNIT I INTRODUCTION TO VANET


UNIT II VANET LINK LAYER PROTOCOLS


UNIT III RESEARCH CHALLENGES IN VANET


UNIT IV DATA SECURITY IN VANET


UNIT V MOBILITY MODELS AND SIMULATION TECHNIQUES IN VANET

Mobility Models: Random Models, Flow Models, Traffic Models, Trace or survey - based Models and Behavioral Model - Overview of Simulators for VANETs - General Features of VANET Simulators - Simulator Architecture - Types of Simulators: Mobility Simulator, Network Simulator, VANET Simulator

L:45 TOTAL: 45 PERIODS
REFERENCES