REGULATIONS – 2015

DEPARTMENT OF
INFORMATION TECHNOLOGY

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

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**THEORY COURSES**

**PRACTICAL COURSES**

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**THEORY COURSES**

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TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE - 71

## PROGRAMME ELECTIVE COURSES

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SFC – Specific Foundation Course, PCC – Programme Core Course, PEC – Programme Elective Course, OEC – Open Elective Course

¥ Common to CS and CN, £ Common to HVE and CN
FORMAT FOR COURSE CODE

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15CN11C APPLIED MATHEMATICS FOR NETWORK ENGINEERS  L T P C  3 2 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Infer the concepts and properties of bessel's functions and fourier-bessel expansion. (K2)
CO2: enrich the knowledge about matrix theory (K1)
CO3: acquire the knowledge about moment generating functions and some distributions. (K1)
CO4: Interpret the concepts of two dimensional random variables (K2)
CO5: learn the various queuing models (K3)

UNIT I SPECIAL FUNCTIONS  15
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  15
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  15
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  15
Joint distributions - Marginal and Conditional distributions - Correlation and Regression, Regression Curve for means.

UNIT V QUEUEING MODELS  15

L: 45 T: 30 TOTAL: 75 PERIODS

REFERENCES
15CN12C          ADVANCED SIGNAL PROCESSING TECHNIQUES          L T P C
                                      3 0 0 3

COURSE OUTCOMES

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

CO1: summarize the basic concepts and apply in discrete random signal processing. (K3)
CO2: estimate the spectrum using parametric methods and non parametric methods. (S2)
CO3: design adaptive filters for a given application. (S5)
CO4: apply multirate signal processing fundamentals. (K3)

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.

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 - Yule-Walker equations - Solution using
Levinson-Durbin algorithm.

UNIT III  LINEAR ESTIMATION AND PREDICTION                9
Linear prediction - Forward and Backward prediction - Signal modeling - Solution of Prony’s normal equations - Least mean-squared error criterion - Wiener filter for filtering and prediction - FIR and IIR Wiener filters - Discrete Kalman filter.

UNIT IV   ADAPTIVE FILTERS                                9

UNIT V    MULTIRATE DIGITAL SIGNAL PROCESSING             9
Upsampling and down sampling - Interpolation and Decimation - Sampling rate conversion by a rational factor - Polyphase filter structures - Multistage implementation of multirate system - Application to subband coding.

L:45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the elements of digital communication systems (K2)
CO2: classify the different modulation techniques and its characteristics. (K1, S1)
CO3: explain the concept of pulse code modulation generation and its functions. (K2)
CO4: work with various linear block codes. (K4)
CO5: explain various spread spectrum technique in digital communication and its uses. (K2)

UNIT I  ELEMENTS OF DIGITAL COMMUNICATION SYSTEMS  9
Representation of Analog Signal - advantages of Digital Communication Systems – Bandwidth -
S/N tradeoff - Hartley Shannon Law - Sampling Theorem.

UNIT II  DIGITAL MODULATION TECHNIQUES  9
Digital Modulation Techniques: Introduction – ASK - ASK Modulator - Coherent ASK Detector -
Non-Coherent ASK Detector – FSK - Bandwidth and Frequency Spectrum of FSK - Non coherent
FSK Detector - Coherent FSK Detector - FSK Detection Using PLL – BPSK - Coherent PSK
Detection – QPSK - Differential PSK

UNIT III  PULSE CODE MODULATION  9
Pulse Code Modulation: PCM Generation and Reconstruction - Quantization noise - Non uniform
Quantization and Companing – DPCM - Adaptive DPCM - DM and Adaptive DM - Noise in PCM
and DM.

UNIT IV  CONVOLUTION CODED DIGITAL COMMUNICATION  9
Convolution Codes: Encoding Decoding using State - tree and trellis diagrams - Decoding using
viterbi algorithm - Comparison of Error Rates in Coded and Uncoded transmission - Linear Block
Codes: Matrix description of Linear Block Codes - Error detection and error Correction capabilities
of linear block codes - Cyclic Codes - Reed – Solomon codes.

UNIT V  SPREAD SPECTRUM MODULATION  9
Spread Spectrum Modulation: Use of Spread Spectrum - Direct Sequence Spread Spectrum
(DSSS) - Code Division Multiple Access - Ranging using DSSS - Frequency Hopping Spread
Spectrum - PN - sequences: Generation and Characteristics - Synchronization in Spread
Spectrum Systems.

L: 45 TOTAL: 45 PERIODS

REFERENCES
3. Herbert Taub. Donald L Schiling, Goutam Sana, "Principles of communication systems", 3rd
   2008.
# ADVANCED COMPUTER NETWORKS

**COURSE OUTCOMES**

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

- **CO1**: familiar with various network architectures and applications. (K3, S3, A2)
- **CO2**: explain about different characteristics of internet protocols. (K3, S3, A2)
- **CO3**: acquire knowledge on routing and switching strategies. (K2, S2, A2)
- **CO4**: describe the role of multimedia in networking. (K2, S3, A2)
- **CO5**: explain about applications and security of protocols in networking. (K2, S3, A2)

## UNIT I  REVIEW OF BASIC NETWORK ARCHITECTURES
OSI reference model - TCP/IP reference model - ATM reference model; Applications (WWW, Audio/Video Streaming, Video conference, Networked Games, Client/Server); Traffic Characterization (CBR, VBR) - Switching Paradigms – Multiplexing

## UNIT II  IP NETWORKS
Limitations of current IP Networks - Internet Protocol Version 6 (IPv6) features - IPv6 Extension Header - Quality of Service in IP - Integrated Services Architecture (ISA) - Processor Sharing - Weighted Fair Queuing (WFQ) - Random Early detection (RED) - Differentiated Services

## UNIT III MULTICAST AND INTERNETWORKING
The Multicast Backbone (MBONE) - Link State Multicast - Distance Vector Multicast - Reverse Path Broadcast - Reverse Path Multicast (RPM) - Protocol Independent Multicast (PIM) - Multiprotocol Label switching (MPLS) - Destination Based Forwarding - Explicit Routing - Virtual Private Networks (VPNs) and Tunnels

## UNIT IV MULTIMEDIA NETWORKING
Requirements on Internet - Streaming Audio and Video – Access through Web Server - Real Time Streaming Protocol (RTSP) - Voice over IP (VoIP) and Internet Phone - Packet Loss - End-to-End Delay - Delay Jitter - Fixed and Adaptive Play-out – RTP - RTCP and SIP protocols

## UNIT V CASE STUDIES AND APPLICATION

**L: 45 TOTAL: 45 PERIODS**

## TEXT BOOKS

## REFERENCES
COURSE OUTCOMES

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

CO1: identify the data communication systems, protocol layers and technologies
(K2, S3, A2)

CO2: describe the various point-to-point protocols and its functions (K2, S2, A2)

CO3: explain the various delay models in data networks with their usages. (K3, S3, A2)

CO4: discuss the principles of various multi-access communication methods in
data networks. (K3, S3, A2)

CO5: explain the principles of routing mechanism in data networks. (K3, S3, A2)

UNIT I  INTRODUCTION
Introduction to Data communication and Networks - Network Topologies - Network categories -
The OSI Model & TCP/IP Protocol Suite - Transmission media - Error Detection and Correction -
Multiple Access: Random access - Controlled access - Channelization - Local Area Networks -
High-speed LANs - Wireless LANs

UNIT II  POINT-TO-POINT PROTOCOLS AND LINKS
Introduction - The Physical Layer: Channels and Modems - ARQ: Retransmission Strategies –
Framing - Point-to-Point Protocols at the Network Layer - Broadband ISDN and the Asynchronous
Transfer Mode

UNIT III  DELAY MODELS IN DATA NETWORKS
Introduction - Queuing Models: Little's Theorem - The M / M /1 Queueing System - The M/ M/m, M/
M/ , M/ M/ m /m, and Other Markov Systems - The M/G/1 System - Time Reversibility-Burke's
Theorem - Networks of Queues-Jackson's Theorem

UNIT IV  MULTIACCESS COMMUNICATION
Introduction - Slotted Multiaccess and the Aloha System - Splitting Algorithms: Tree Algorithms -
First-Come First-Serve Splitting Algorithms - Carrier Sensing - Multiaccess Reservations - Packet
Radio Networks

UNIT V  ROUTING IN DATA NETWORKS
Introduction - Main Issues in Routing - Wide-Area Network Routing: An Overview - Network
Algorithms and Shortest Path Routing - Broadcasting Routing Information: Coping with Link
Failures - Flow Models, Optimal Routing, and Topological Design

L: 45 TOTAL: 45 PERIODS

REFERENCES
15CN16C WIRELESS NETWORKS L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain about wireless local area networks (K2,S2,A1)
CO2: explain about 3G and 2G evolution (K2,S2,A1)
CO3: describe about routing mechanism of adhoc and sensor networks (K3,S3,A2)
CO4: familiar with interworking between WLAN and 3G WWAN (K1,S2,A1)
CO5: explain about 4G technologies (K2,S2,A1)

UNIT I WIRELESS LOCAL AREA NETWORKS 9
Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer - MAC sublayer- MAC Management Sublayer - Wireless ATM - HIPERLAN- HIPERLAN-2 - WiMax- WPAN- IEEE 802.15

UNIT II 3G OVERVIEW AND 2.5G EVOLUTION 9

UNIT III ADHOC AND SENSOR NETWORKS 9

UNIT IV INTERWORKING BETWEEN WLANS AND 3G WWANS 9
Interworking objectives and requirements - Schemes to connect WLANs and 3G Networks - Session Mobility - Interworking Architectures for WLAN and GPRS - System Description - Local Multipoint Distribution Service - Multichannel Multipoint Distribution system.

UNIT V 4G AND BEYOND 9

L: 45 TOTAL: 45 PERIODS

REFERENCES
15CN17C   NETWORKING LABORATORY       L T P C
                      0 0 4  2

COURSE OUTCOMES
Upon completion of this course, the students will be able to
  CO1: implement error coding techniques. (K3)
  CO2: design MAC and routing protocols in wired and wireless environment using
        NS2 (K5,S3)
  CO3: design WLAN/LAN systems to meet out real time requirements. (K6,S3)

LIST OF EXPERIMENTS

- Implementation of Linear and Cycle Code.
- Simulation of PCM.
- Simulation of Table Driven Routing protocol.
- Simulation of On Demand Routing protocol.
- MAC protocols Wired and Wireless.
- Configuration of LAN.
- Configuration of VLAN-Tunneling.
- Configuration of WLAN.

P: 60 TOTAL: 60 PERIODS
15CN21C  WIRELESS MOBILE COMMUNICATION  L T P C

3  2 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: apply diversity techniques in wireless systems. (K4)
CO2: identify the suitable cellular systems to achieve a given GoS (Grade of Service) in coverage and blocking probability. (K2)
CO3: explain digital radio links considering various analytical and empirical models.
CO4: carry out link budget calculations. (K3,S2)
CO5: describe frequency reuse patterns for cellular communication.(K2)

UNIT I  THE WIRELESS CHANNEL
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT II  PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS

UNIT III  MULTIANTENNA COMMUNICATION

UNIT IV  MULTICARRIER MODULATION
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Subchannels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset – Case study IEEE 802.11a

UNIT V  CELLULAR CONCEPTS

REFERENCES
COURSE OUTCOMES

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

CO1: describe the basic concepts of optical communication system and the performance of different fibers. (K2)

CO2: illustrate different optical transceivers and their operations. (K4)

CO3: explain the basic concepts behind multichannel systems and issues related to their implementation. (K2)

CO4: compare and classify different dispersion management schemes. (K4)

CO5: explain the performance of different layered architectures in optical networks. (K2)

UNIT I  FIBER OPTIC WAVE GUIDES  9
Light wave generation systems - system components - optical fibers - SI, GI, fibers – modes - Dispersion in fibers - limitations due to dispersion - Fiber loss - non linear effects - Dispersion shifted and Dispersion flattened fibers.

UNIT II  OPTICAL TRANSCEIVER  9
Basic concepts - LED’s structure - spectral distribution - semiconductor lasers - gain coefficients – modes - SLM and STM operation - Transmitter design - Receiver PIN and APD diodes design - noise sensitivity and degradation - Receiver amplifier design - Basic concepts of Semiconductor Optical amplifiers and EDFA operation.

UNIT III  LIGHT WAVE AND MULTICHANNEL SYSTEM  9

UNIT IV  DISPERSION COMPENSATION  9
Limitations - Post and Pre- compensation techniques - Equalizing filters - fiber based gratings - Broadband compensation - Soliton communication system, fiber Soliton - Soliton based communication system design.

UNIT V  OPTICAL NETWORKS  9

REFERENCES
COMMUNICATION THEORY AND SYSTEMS

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

CO1: make a right choice on the signaling scheme based on their relative performance. (K4)

CO2: arrive at detailed specification for the synchronization and equalization techniques. (K1, S2)

CO3: estimate synchronization and equalization techniques. (K4)

CO4: apply the concepts of random process to communication system design. (K3)

UNIT I  RANDOM PROCESS  9

UNIT II  SIGNALING SCHEMES  9

UNIT III SIGNAL ACQUISITION & SYNCHRONIZATION  9
Receiver structure for BPSK- QPSK-QAM- Carrier Synchronization- Bit synchronization.

UNIT IV  EQUALIZATION  9
Channel Models - ISI-Eye Diagram - Receiver Front End - ML Sequence estimation - Linear Equalization - Decision Feedback Equalization.

UNIT V  INFORMATION THEORETIC LIMITS  9

L: 45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES

Upon completion of this course, the students will be able to
CO1: demonstrate various characteristics of sources, detectors and transmission using OTDM and simulators (K3,S2)
CO2: analyze various techniques used in communication through simulation (K4,S2)
CO3: demonstrate the various applications used in mobile communication environment (K5,S3)

LIST OF EXPERIMENTS

- DC characteristics of PIN PD & APD.
- PI characteristics of LED & LASER.
- Characteristics of Ultra high speed optical Soliton transmission.
- Application of optical system simulation software in a fiber optic telecommunication.
- Simulation of Modulation and Coding in a AWGN Communication Channel using Simulation Packages.
- Testing of GSM mobile station.
- Radio communication receiver.
- Testing of DECT cordless telephone.
- Parameter changes of GSM network.

P: 60 TOTAL: 60 PERIODS
The student will make at least 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 semester covering the various aspects of his/her presentation.

P: 60 TOTAL: 60 PERIODS
15CN01E SPEECH RECOGNITION AND SYNTHESIS L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain the basic characteristics of speech (K2)
CO2: describe various techniques for speech analysis and speech modeling (K2)
CO3: investigate speech processing applications like speech synthesis and speech recognition (K5)

UNIT I BASIC CONCEPTS
9

UNIT II SPEECH ANALYSIS
9

UNIT III SPEECH MODELLING
9

UNIT IV SPEECH RECOGNITION
9
Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary Continuous Speech Recognition system – acoustics and language models - Sub-word units - models for phonemes – syllables – triphones - Language models - n-grams - context dependent sub-word units.

UNIT V SPEECH SYNTHESIS
9
Text-to-speech synthesis: Concatenative and waveform synthesis methods - sub-word units for TTS - intelligibility and naturalness - role of prosody - Applications.

L: 45 TOTAL: 45 PERIODS

REFERENCES
15CN02E INFORMATION THEORY AND CODING L T P C 3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain the basic concepts of information theory, source coding, channel and
channel capacity, channel coding and relation among them. (K4)
CO2: identify the encoding and decoding techniques of text, audio and speech (S2)
CO3: apply the compression techniques to images and videos (K2)
CO4: implement the encoder and decoder of block codes or convolutional codes (K6)

UNIT I INFORMATION THEORY 9
Introduction - Measure of information - Entropy and information rate of mark-off source –
Classification of codes – Kraft-McMillan inequality - Joint and conditional entropies - Source coding
theorem - Shannon-Fano coding, Huffman coding Extended Huffman coding – Channel coding
theorem - Discrete memory less channels – BSC, BEC – Channel capacity Theorem - Shannon
limit

UNIT II SOURCE CODING: TEXT, AUDIO AND SPEECH 9
Text: Adaptive Huffman Coding - Arithmetic Coding - LZW algorithm – Audio: Perceptual coding -
Masking techniques - Psychoacoustic model - MEG Audio layers - Dolby AC3 - Speech: Channel
Vocoder, Linear Predictive Coding

UNIT III SOURCE CODING: IMAGE AND VIDEO 9
Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG –
Video Compression: Principles-I, B, P frames - Motion estimation - Motion compensation - H.261 -
MPEG standard.

UNIT IV ERROR CONTROL CODING: BLOCK CODES 9
Introduction to Error Control Coding: Introduction - Types of errors - Types of codes – Definitions:
Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes -
Hamming codes - Repetition codes - Linear block codes - Cyclic codes - Syndrome calculation -
Encoder and decoder – CRC

UNIT V ERROR CONTROL CODING: CONVOLUTIONAL CODES 9
Introduction to Convolutional codes – Time domain approach and Transform domain approach -
Convolutional Encoder Representation - Tree, State and Trellis diagrams – Distance Properties of
Convolutional Codes - Decoding of Convolutional Codes: Maximum Likelihood Detection, Viterbi
Algorithm - Principle of Turbo coding

L: 45 TOTAL: 45 PERIODS

REFERENCES
Publication.
5. Roberto Togneri, Christopher J.S deSilva, “Fundamentals of Information Theory and
15CN03E  WIRELESS SENSOR NETWORK DESIGN  L T P C  3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the sensor network architecture and principles (K2,S2,A1)
CO2: familiar with wireless channels and communication fundamentals (K2,S2,A1)
CO3: explain about MAC and routing protocols of WSN (K2,S2,A1)
CO4: describe the routing mechanism in network layer (K2,S2,A1)
CO5: explain about applications of WSN (K2,S2,A1)

UNIT I  INTRODUCTION  9
Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture, Hardware components, Energy consumption of sensor nodes, Network architecture, Sensor network scenarios, Design principles

UNIT II  PHYSICAL LAYER  9
Introduction, wireless channel and communication fundamentals, physical layer and transceiver design consideration in wireless sensor networks, Example physical Layers Bluetooth, IEEE 802.11b, WINS, µAMPS

UNIT III  DATA LINK LAYER  9
MAC protocols – fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, LEACH, PEGASIS .Embedded operating system - Introduction – TinyOS-Mate - MagnetOS-MANITS-OSPM- SenOS- PicOS

UNIT IV  NETWORK LAYER  9
Gossiping and agent-based uni cast forwarding, Energy-efficient unicast, Broadcast and multicast, geographic routing, mobile nodes, Data centric and content-based networking, Data aggregation

UNIT V  APPLICATIONS OF WSN & CASE STUDY  9

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
15CN04E ADVANCED OPERATING SYSTEMS L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the overview of process management & memory management of operating system. (K2)
CO2: demonstrate the mutual exclusion, deadlock detection and agreement protocols of distributed operating system. (K3)
CO3: explain the distributed operating system concept that includes architecture, mutual exclusion algorithms, deadlock detection algorithms and agreement protocols. (S2)
CO4: discuss the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols. (K5)
CO5: analyze the components involved in real time and mobile operating systems. (K4)

UNIT I OPERATING SYSTEM BASICS

UNIT II DISTRIBUTED OPERATING SYSTEM

UNIT III DISTRIBUTED RESOURCE MANAGEMENT

UNIT IV REAL TIME & MOBILE OPERATING SYSTEMS

UNIT V CASE STUDIES

L: 45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain the network data concepts related to social networking. (K2)
CO2: describe the Market and strategic interaction and information networks. (K2)
CO3: obtain the knowledge about social network models (K4)
CO4: identify the institutional behavior and information aggregation. (K4)

UNIT I  INTRODUCTION

UNIT II  MARKET AND STRATEGIC INTERACTION IN NETWORK

UNIT III INFORMATION NETWORKS AND THE WORLD WIDE WEB

UNIT IV  NETWORK DYNAMICS AND POPULATION MODELS
Information Cascade - Networks Effects - The Economy with Network Effects -Industries with Network goods - Advanced Materials for Positive Externalities - Power Laws - The Effect of Search Tools and Recommendations.

UNIT V  INSTITUTION AND AGGREGATE BEHAVIOR

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: discuss the various technologies of next generation networks (K2,S2,A2)
CO2: illustrate the principles of IMS and convergent management in next generation networks (K3,S4,A2)
CO3: explain the functions of IP networks and its technologies (K2,S3,A2)
CO4: explain the principles of multi service networks with MPLS technologies (K2,S3,A2)
CO5: describe various applications of next generation networks (K2,S3,A2)

UNIT I  NEXT GENERATION TECHNOLOGIES

UNIT II  IMS AND CONVERGENT MANAGEMENT

UNIT III  IP NETWORKS

UNIT IV  MUTI SERVICE NETWORKS
Origin of multi service ATM - Next Generation Multi service Networks - Next Generation Multi service ATM switching - Multi protocol Label switching Networks: Frame Based MPLS - Cell based MPLS - MPLS services and their benefits - multi service provisioning platforms (MSPP) & Multi service switching platform (MSSP)

UNIT V  SERVICES, ARCHITECTURES AND APPLICATIONS

REFERENCES
15CN07E  CLOUD COMPUTING  L T P C  3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: know the fundamentals of cloud computing (K2)
CO2: distinguish the various cloud services (K4)
CO3: explore some important cloud computing driven commercial systems such as Google Apps, Microsoft Azure and Amazon web services and other businesses cloud applications. (K2)

UNIT I  UNDERSTANDING CLOUD COMPUTING  9

UNIT II  DEVELOPING CLOUD SERVICES  9

UNIT III  CLOUD COMPUTING FOR EVERYONE  9
Centralizing Email Communications – Collaborating on Schedules – Collaborating on To-Do Lists – Collaborating Contact Lists – Cloud Computing for the Community – Collaborating on Group Projects and Events – Cloud Computing for the Corporation

UNIT IV  USING CLOUD SERVICES  9

UNIT V  OTHER WAYS TO COLLABORATE ONLINE  9

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

REFERENCE
15CN08E  NETWORK ROUTING ALGORITHMS  L T P C  
3 0 0 3

COURSE OUTCOMES  
Upon completion of this course, the students will be able to  
1) CO1: identify a suitable routing algorithm, implement it and analyze its performance. (K4)
2) CO2: design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications. (K6)

UNIT I  INTRODUCTION  9

UNIT II  INTERNET ROUTING  9

UNIT III  ROUTING IN OPTICAL WDM NETWORKS  9

UNIT IV  MOBILE - IP NETWORKS  9

UNIT V  MOBILE AD–HOC NETWORKS  9

L:45 TOTAL: 45 PERIODS

REFERENCES
15CN09E ADAPTIVE SIGNAL PROCESSING (Common to CS and CN) 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 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

UNIT II THE LMS ALGORITHM 9

UNIT III CONVENTIONAL RLS ALGORITHM 9

UNIT IV ADAPTIVE LATTICE BASED RLS ALGORITHMS 9

UNIT V FAST TRANSVERSAL AND QR DECOMPOSITION BASED RLS ALGORITHM 9

L:45 TOTAL: 45 PERIODS

REFERENCES
15CN10E   CYBER SECURITY  

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain the legal issues associated with cyber security (K2)
CO2: recognize advanced security issues and technologies (K2)
CO3: explain the various security services available for preventing threats. (S1)

UNIT I  INFORMATION SYSTEMS AND THREATS  
History of Information Systems – Importance of Information Systems – Changing Nature of 
Information System – Distributed Information Systems – Role of Internet and Web Services – 
Information System Threats – Types of Threats.

UNIT II  SECURITY IN MOBILE AND WIRELESS COMPUTING  
Introduction – Characteristics of Communication Devices - Technical and security challenges of 
Mobile devices – Security implications for organizations – Authentication service security – Laptop 
security- Principles of information security – Classification of Information and Information system – 
Confidential – Integrity – Availability.

UNIT III  SECURITY SERVICES AND METRICS  
Introduction – Cryptography – Cryptanalysis – Public Key Cryptography – Firewall Design 
Principles – An Introduction to Digital Signatures – Intruders – Network perimeter security – Virtual 
Private Network (VPN) – Security metrics categories – Classes of security metrics.

UNIT IV  CYBER CRIMES  
Introduction to cyber crime – Software privacy – Virus dissemination – Types of cyber crime – 
Preventing cyber crimes(Safety Measures) – Privacy software.

UNIT V  CYBER LAWS AND ETHICS  
Detecting cyber crime – Cyber laws – legal issues – Indian IT Act – Ethical issues in IT – copy 
rights – Ethical Hacking – Plagiarism

L: 45 TOTAL: 45 PERIODS

REFERENCES
   Education India.
2. Anukur Shree Aggarwal Prof.Sanjeev Kumar Sharma, Anuradha Tyagi.Shalu Goel 
   “Information Security and Cyber Laws”, Vayu Education of India, 2011
   Limited, New Delhi, 2010
15CN11E INFORMATION SECURITY L T P C

3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: define key terms and critical concepts of information security (K1)
CO2: enumerate the phases of the security systems development life cycle (S2)
CO3: describe the information security roles of professionals within an organization. (K2)

UNIT I INFORMATION SECURITY & NEEDS FOR SECURITY 9

UNIT II RISK MANAGEMENT & PROFESSIONAL ISSUES IN INFORMATION SECURITY 9

UNIT III CRYPTOGRAPHY 9

UNIT IV SECURITY TECHNOLOGY 9

UNIT V IMPLEMENTATION AND MAINTENANCE 9

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
15CN12E BIG DATA ANALYTICS L T P C 3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: use the statistical analysis methods to big data platform. (K2, S2, A2)
CO2: analyze problems appropriate to mining data streams. (K2, S3, A2)
CO3: apply the knowledge of clustering techniques in data mining. (K2, S3, A2)
CO4: explain about social networking data analytics. (K1, S2, A1)
CO5: use visualization techniques for distributed file systems (K2, S3, A1)

UNIT I INTRODUCTION TO BIG DATA 9

UNIT II MINING DATA STREAMS 9

UNIT III FREQUENT ITEMSETS AND CLUSTERING 9
Mining Frequent itemsets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent item sets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

UNIT IV SOCIAL NETWORKING DATA ANALYTICS 9
An introduction to social network data Analytics - Introduction, Online Social Networks: Research Issues - Research Topics in Social Networks - Data mining in social media - Data mining in a Nutshell - Social Media - Motivations for Data Mining in Social Media - Data Mining Methods for Social Media - visualizing social networks - A Taxonomy of Visualizations - The Convergence of Visualization - Interaction and Analytics

UNIT V FRAMEWORKS AND VISUALIZATION 9
MapReduce – Hadoop – Hive - MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques - interaction techniques - Systems and applications

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
15CN13E  ADVANCED WIRELESS COMMUNICATION  

COURSE OUTCOMES

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

CO1: describe various wireless channels modeling technique based on transmitter and receiver. (K2)

CO2: explain algorithms and technologies including diversity, fading, interference averaging and interference management.(K2,S1)

CO3: explain various spread spectrum technique in wireless communication. (K2,S1)

UNIT I THE WIRELESS CHANNEL 9
Overview of wireless systems - Physical modeling for wireless channels - Time and Frequency coherence - Statistical channel models – Fading - Capacity of wireless Channel - Capacity of Flat Fading Channel - Channel Distribution Information known - Channel Side Information at Receiver - Channel Side Information at Transmitter and Receiver.

UNIT II PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS 9

UNIT III DIVERSITY 9
Realization of Independent Fading Paths - Receiver Diversity - Selection Combining - Threshold Combining - Maximal-Ratio Combining - Equal Gain Combining - Transmitter Diversity - Channel known at Transmitter - Channel unknown at Transmitter - The Alamouti Scheme.

UNIT IV MULTICARRIER MODULATION 9
Data Transmission using Multiple Carriers - Multicarrier Modulation with Overlapping Sub channels - Mitigation of Subcarrier Fading - Space-time Multiplexing - Peak to Average Power Ratio-Frequency and Timing offset - Case study IEEE 802.11a.

UNIT V SPREAD SPECTRUM 9

L: 45 TOTAL: 45 PERIODS

REFERENCES

15CN14E   IMAGE PROCESSING   L T P C   3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain how images are formed, sampled, quantized and represented digitally (K2)
CO2: analyze how image are processed by discrete, linear, time-invariant systems (K4)
CO3: explain transform-domain representation of images (K3)
CO4: design median filters for image enhancement (K6)
CO5: describe the principles of image compression (K2)

UNIT I  DIGITAL IMAGE FUNDAMENTALS
Elements of digital image processing systems - Vidicon and Digital Camera working principles -
Elements of visual perception – brightness – contrast – hue – saturation - Mach Band effect -
Image sampling – Quantization – Dither - Two dimensional mathematical preliminaries.

UNIT II  IMAGE TRANSFORMS
– SVD - Wavelet transform.

UNIT III  IMAGE ENHANCEMENT AND RESTORATION
Histogram modification - Noise distributions - Spatial averaging - Directional Smoothing – Median -
Geometric mean - Harmonic mean - Contraharmonic and Yp mean filters - Design of 2D FIR filters
- Image restoration - degradation model - Unconstrained and Constrained restoration - Inverse
filtering-removal of blur caused by uniform linear motion - Wiener filtering - Geometric
transformations-spatial transformations - Gray Level interpolation

UNIT IV  IMAGE SEGMENTATION AND RECOGNITION
Image segmentation - Edge detection - Edge linking and boundary detection - Region growing -
Region splitting and Merging - Image Recognition - Patterns and pattern 13 classes - Matching by
minimum distance classifier - Matching by correlation - Neural networks - Backpropagation
network and training - Neural network to recognize shapes.

UNIT V  IMAGE COMPRESSION
Need for data compression – Huffman - Run Length Encoding - Shift codes - Arithmetic coding -
Vector Quantization - Block Truncation Coding - Transform coding - JPEG standard - JPEG 2000
– EZW – SPIHT - MPEG.

L: 45 TOTAL: 45 PERIODS

REFERENCES
   2002.
15CN15E  MULTIMEDIA COMPRESSION TECHNIQUES  L  T  P  C  
(Common to CS and CN)  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  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.

UNIT II  TEXT COMPRESSION  9
Compression techniques, Shannon-Fano coding, Huffman coding, Adaptive Huffman Coding, Arithmetic coding, Dictionary techniques, LZW family algorithms.

UNIT III  AUDIO COMPRESSION  9

UNIT IV  IMAGE COMPRESSION  9

UNIT V  VIDEO COMPRESSION  9

L: 45 TOTAL: 45 PERIODS

REFERENCES
15CN16E          EVOLUTIONARY COMPUTING                          L T P C
                                                                 3 0 0 3
(Common to HVE and CN)

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO 1: explain the basic concepts of evolutionary computation. (K2)
CO 2: classify the various representations, selection and search operations (K2)
CO 3: discuss the basics of fitness evaluation and constraint handling mechanism. (K2)
CO 4: outline the concepts of hybrid systems. (K2)
CO 5: interpret the effect of parameter setting and applications. (K3)

UNIT I          INTRODUCTION TO EVOLUTIONARY COMPUTATION           9
Introduction – Possible applications of evolutionary computations – History of evolutionary
computation – Genetic algorithms – Evolution strategic – Evolutionary programming – Derivative
methods – Stochastic processes – Modes of stochastic convergence – Schema processing –
Transform methods – Fitness landscape – Probably Approximately Correct (PAC) learning
analysis – Limitation of evolutionary computation methods – Local performance measures.

UNIT II         REPRESENTATION, SELECTION AND SEARCH OPERATORS          9
Representation – Binary strings – Real-valued vectors – Permutations – Finite-state
representation – Parse trees – Guidelines for a suitable encoding – Other representations
Selection – Proportional selection and sampling algorithms – Tournament selection – Rank based
selection – Boltzmann selection – Other selection methods – Hybrids Generation gap methods –
A comparison of selection mechanisms – Interactive evolution – Search Operators – Mutation –
recombination – Other operators.

UNIT III          FITNESS EVALUATION AND CONSTRAINT HANDLING               9
Fitness Evaluation – Encoding and decoding functions – Competitive fitness evaluation –
Complexity based fitness evaluation – Multi objective optimization – Constraint handling
techniques – Penalty functions – Decoders – Repair algorithms – Constraint preserving operators
– Other constraint handling methods – Constraint satisfaction problems – Population structures –
Niching Methods – Specification methods – Island(migration)models.

UNIT IV          HYBRID SYSTEM                                        9
Self-adaptation – Meta evolutionary approaches – Neural – Evolutionary systems – New areas for
evolutionary computation research in evolutionary systems – Fuzzy-Evolutionary Systems –
Combination with Other Optimization Methods – Combination with local search – Combination with
dynamic programming – Simulated annealing and tabu search – Comparison with existing
optimization.

UNIT V          PARAMETER SETTING AND APPLICATIONS                      9
Heuristics for Parameter setting Issues – Population size – Mutation parameters – Recombination
parameters – Implementation of Evolutionary Algorithms – Efficient implementation of algorithms –
Computation time of evolutionary operators – Applications – Classical optimization problems –
Control Identification – Scheduling – Pattern recognition – Simulation models.

L:45 TOTAL:45 PERIODS

REFERENCES
1. Thomas Back et al, “Handbook on evolutionary computation”, Institute of Physics,
15CN17E SECURITY IN WIRELESS SENSOR NETWORKS L T P C 3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe about vulnerabilities and threats in WSN (K2, S1)
CO2: explain authentication mechanisms and broadcasting techniques.(K3)
CO3: explain secure routing protocols in WSN. (K3)
CO4: describe trust based mechanisms and intrusion detection system in WSN. (K2)

UNIT I INTRODUCTION 9

UNIT II KEY MANAGEMENT PROTOCOLS AND BROADCAST AUTHENTICATION 9
Key distribution – classifications: deterministic and probabilistic; protocols: LEAP BROSK, IOS/DMBS, PIKE, SKEW; Broadcast authentication: iTesla - Certificate-Based Authentication Scheme - Basic Merkle Hash Tree Based Authentication Scheme - Enhanced Merkle Hash Tree Based Authentication Scheme - ID-Based Authentication Scheme.

UNIT III SECURE ROUTING PROTOCOLS 9
EAR – PRSA - R-LEACH - S-SPIN - Secure-SPIN - Segment transmission secure routing protocol – SONS - SS-LEACH – INSENS

UNIT IV DATA AGGREGATION, INTRUSION DETECTION AND AUTOCONFIGURATION 9
Data Aggregation – plain text based secure data aggregation – SIA, SINP, ESPDA, SSDA, WDA; cipher based secure data aggregation – CDA, HSC, Secure hierarchical data aggregation; Intrusion Detection: IHOP- SEF- DIDS - Decentralized intrusion detection; Auto Configuration – LEADS – PDAA - Dynamic address allocation.

UNIT V TRUST MANAGEMENT 9

L: 45 TOTAL: 45 PERIODS

REFERENCES
15CN18E  NEURAL NETWORKS AND ITS APPLICATIONS  L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explore the concepts of neural-network algorithms. (K3)
CO2: verify and validate various neural network models. (K5)
CO3: describe the variety of neural networks techniques. (K2)

UNIT I  BASIC LEARNING ALGORITHMS  9
Biological Neuron – Artificial Neural Model – Types of activation functions – Architecture:
Feedforward 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 –
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 Machine: 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 Stems: Dynamical Systems – Attractors and Stability – Non-linear Dynamical

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

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

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

CO1: acquire the basic knowledge of cognitive radio networks (K2, S3, A2)
CO2: describe the various capacity models and channels in cognitive radio networks (K2, S2, A2)
CO3: discuss the various spectrum sensing with OFDM techniques (K2, S3, A2)
CO4: illustrate the security principles of cognitive radio networks (K3, S3, A3)
CO5: explore advanced concepts of cognitive radio networks and their associated challenges. (K3, S3, A3)

UNIT I  INTRODUCTION

UNIT II  CAPACITY OF COGNITIVE RADIO

UNIT III  SPECTRUM SENSING
Introduction - Interference temperature for cognitive underlaying - White-space detection for cognitive interweaving - An application: spectrum sensing with OFDM - Effects of imperfect knowledge of noise power - Effects of an inaccurate model of interference - Advanced spectrum sensing techniques - Optimized spectrum exploration and exploitation: sensing and access policy design.

UNIT IV  COGNITIVE RADIO NETWORK SECURITY
Introduction - Primary-User Emulation Attacks: Spectrum Sensing in Hostile Environments - Classification of PUE Attacks - Noninteractive Localization of Primary Signal Transmitters - Robust Distributed Spectrum Sensing - Security Vulnerabilities in IEEE 802.22

UNIT V  ADVANCED CONCEPTS

REFERENCES

15CN20E  REAL TIME EMBEDDED SYSTEMS  L T P C  3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explain the applications of embedded systems (K2)
CO2: describe the memory concepts in embedded systems (K2)
CO3: demonstrate the RTOS using multiprocessing and multitasking (K4)

UNIT I  INTRODUCTION TO EMBEDDED SYSTEMS  9
Definition of Embedded System - Embedded Systems Vs General Computing Systems - History of
Embedded Systems – Classification - Major Application Areas - Purpose of Embedded Systems -
Characteristics and Quality Attributes of Embedded Systems.

UNIT II  TYPICAL EMBEDDED SYSTEM  9
Core of the Embedded System: General Purpose and Domain Specific Processors - ASICs, PLDs
- Commercial Off-The-Shelf Components (COTS) - Memory: ROM, RAM, Memory according to the
type of Interface - Memory Shadowing - Memory selection for Embedded Systems - Sensors and
Actuators - Communication Interface: Onboard and External Communication Interfaces.

UNIT III  EMBEDDED FIRMWARE  9
Reset Circuit - Brown-out Protection Circuit - Oscillator Unit - Real Time Clock - Watchdog Timer -
Embedded Firmware Design Approaches and Development Languages.

UNIT IV  RTOS BASED EMBEDDED SYSTEM DESIGN  9
Operating System Basics - Types of Operating Systems – Tasks - Process and Threads -
Multiprocessing and Multitasking - Task Scheduling.

UNIT V  TASK COMMUNICATION  9
Shared Memory - Message Passing - Remote Procedure Call and Sockets - Task
Synchronization: Task Communication/Synchronization Issues - Task Synchronization Techniques
- Device Drivers - How to Choose an RTOS.

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
15CN21E  IMAGE AND VIDEO PROCESSING  L T P C  3 0 0 3

COURSE OUTCOMES

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

CO1: describe the basic concepts of image and video processing.(K1)
CO2: apply transforms in real time images.(K3)
CO3: explain image processing techniques such as enhancement and segmentation.(K1)
CO4: illustrate various compression models.(S3)
CO5: explain various 2D motion estimation methods.(K1)

UNIT I  FUNDAMENTALS OF IMAGE PROCESSING AND IMAGE TRANSFORMS  9
Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform - Discrete Cosine Transform (DCT) - Discrete Wavelet transforms.

UNIT II  IMAGE PROCESSING TECHNIQUES  9

Image Segmentation: Segmentation concepts - point, line and Edge detection – Thresholding - region based segmentation.

UNIT III  IMAGE COMPRESSION  9

UNIT IV  BASIC STEPS OF VIDEO PROCESSING  9
Analog video - Digital Video - Time varying Image Formation models: 3D motion models - Geometric Image formation - Photometric Image formation - sampling of video signals - filtering operations

UNIT V  2-D MOTION ESTIMATION  9

L: 45 TOTAL: 45 PERIODS

REFERENCES