National Institute of Technology, Jamshedpur
Department of Electronics & Communication Engineering

M.Tech in Communication System Engineering
Syllabus

SEMESTER I

Adaptive Signal Processing

Unit 1

Introduction to Adaptive Filters: Definitions, Characteristics, Adaptive filter structures, Applications, Examples of adaptive systems. Adaptive linear combiner: General Description, Desired Response and Error, the performance function, gradient and minimum mean square error, and alternative expression of gradient.

Unit 2

Wiener filter, Search methods and the LMS algorithm: Wiener FIR filter (real case), Newton's type algorithm, steepest descent search and the LMS algorithm, Extension of optimal filtering to complex valued input, Complex LMS algorithm (FXLMS), sign-LMS and the normalized LMS algorithm.

Unit 3

Convergence and Stability Analyses: Convergence analysis of the gradient search algorithms, learning curve and mean square error behaviour, Weight error correlation matrix, Dynamics of the steady state mean square error (MSE), Mis adjustment and stability of excess MSE.

Unit 4

Adaptive Recursive Filters and Structures: Least square (LS) estimation, pseudo-inverse of a data matrix, optimality of LS estimation, adaptive recursive filters, RLS algorithm, and convergence analysis of RLS algorithm, Application of RLS algorithm, Lattice structures and adaptive lattice filters the adaptive Lattice Predictor.

Unit 5

Application of Adaptive Filters: Echo cancellation, Equalisation of data communication channels, Linear predictive coding and Noise cancellation, Adaptive control systems: Adaptive Model control, Adaptive inverse Control. Introduction of adaptive array and adaptive beam forming, Recent advances in adaptive filtering.

Text Books:

1. S. Haykin and T. Kailath, Adaptive Filter Theory, Pearson Education, 4th Edition, 2005.
2. B. Widrow and S. D. Sterns, Adaptive Signal Processing, Pearson Education, 2nd Indian reprint, 2002.

Advanced Digital Communication

Unit 1

Digital modulation techniques: Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature – modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ray modulation techniques, Power spectra, Bandwidth efficiency, M-array modulation formats viewed in the light of the channel capacity theorem, Effect of inter-symbol-interference, Bit verses symbol error probabilities, Synchronization, Applications

Unit 2

Coding techniques: Convolutional encoding, Convolutional encoder representation, Formulation of the convolutional decoding problem, Properties of convolutional codes: Distance property of convolutional codes, Systematic and non-systematic convolutional codes, Performance Bounds for convolutional codes, Coding gain, Other convolutional decoding algorithms, Sequential decoding, Feedback decoding, Turbo codes.

Unit 3

Communication through band limited linear filter channels: Optimum receiver for channel with ISI and AWGN, Linear equalization, Decision-feedback equalization, reduced complexity ML detectors, Iterative equalization and decoding-Turbo equalization. Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, Adaptive equalization of Trellis-coded signals, Recursive least square algorithms for adaptive equalization, Self-recovering (blind) equalization.

Unit 4

Spread spectrum signals for digital communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems.

Unit 5

Digital communication through fading multipath channels: Characterization of fading multipath channels, the effect of signal characteristics on the choice of a channel model, Frequency non-selective, Slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, Slowly fading channel, Coded wave forms for fading channels, Multiple antenna systems.

Text Book:

1. John G. Proakis and Masoud Salehi, Digital Communications, Tata McGraw-Hill, 5thEdition, 2014.
2. Simon Haykin, Digital Communications, John Wiley India Pvt., Ltd, 2008.

Reference Books:

1. K. Sam Shanmugam, Digital and Analog Communication Systems, John Wiley India Pvt. Ltd., 2012.
2. Simon Haykin,An introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2006.
3. Bernard Sklar, Digital communications, Pearson education, 2009.

Computer Communication Networks

Unit 1

Layered tasks, OSI Model, Layers in OSI model, TCP/IP Suite, Addressing, Telephone and cable networks for data transmission, Telephone networks, Dial up modem, DSL, Cable TV for data transmission.Framing, Flow and error control, Protocols, Noiseless channels and noisy channels, HDLC.

Unit 2

Random access, Controlled access, ChannelizationWired LAN, Ethernet, IEEE standards, Standard Ethernet, Changes in the standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11

Unit 3

Connecting LANs, Backbone and Virtual LANs, Connecting devices, Back bone Networks, Virtual LANsNetwork Layer, Logical addressing, Ipv4 addresses, Ipv6 addresses, Ipv4 and Ipv6 Transition from Ipv4 to Ipv6.

Unit 4

Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing protocols

Unit5

Transport layer Process to process Delivery, UDP, TCP, Domain name system, Resolution.

Reference:

1. Andrew S Tanenbaum, "Computer Network", PHI.
2. Dimitri Bertsekas & Robert Gallager, "Data Network", PHI.
3. Gilli Wates, "Computer Communication Network", McGraw- Hill.
4. William Stallings "Data & Computer Communications", 6th Edition, Pearson Education (2004).
5. Fayez Gebali, "Computer Communication Networks, Analysis and Design, 3rd Ed., North Star Digital Design, Inc., (2005).

Wireless Communication Systems

Unit 1

Wireless channel: physical modelling for wireless channels, input/output model of wireless channel, time and frequency response, statistical models

Unit 2

Point to point communication: detection in Rayleigh fading channel, time diversity, antenna diversity, frequency diversity, impact of channel uncertainty.

Unit 3

Capacity of wireless channels: AWGN channel capacity, resources of AWGN channel, Linear time invariant Gaussian channels, capacity of fading channels.

Unit 4

MIMO 1 – Spatial multiplexing and channel modeling: multiplexing capability of MIMO channels, physical modeling of MIMO channels, modeling MIMO fading channels.

Unit 5

MIMO II – Capacity and multiplexing architectures: V-BLAST, fading MIMO channel, receiver architectures, slow fading MIMO channel, DBLAST. MIMO III – Diversity multiplexing trade-off, universal code design.

Text Books:

1. David Tse, P. Viswanath, Fundamentals of wireless communication, Cambridge, 2006.
2. Andreas Molisch, Wireless communications, Wiley India Pvt Ltd., 2009.

References Books:

1. William C Y Lee, Mobile Communication Engineering: Theory and applications‖, Tata McGraw-Hill, 2008.
2. Upen Dalal, Wireless communication, Oxford Higher Education, 2009
3. Mark D Ciampa and Jorge Olenewa, Wireless Communications, Cengage, 2007.

Elective-1

Computational Intelligence

Unit 1

Introduction to Computational Intelligence: Intelligence machines, Computational intelligence paradigms, Data mining for IoT

Unit 2

Rule-Based Expert Systems and Fuzzy Expert Systems: Rule-based expert systems, Uncertainty management, Fuzzy sets and operations of fuzzy sets, Fuzzy rules and fuzzy inference, Fuzzy expert systems, Case study: fuzzy logic controller for washing machines

Unit 3

Artificial Neural Networks: Fundamental neuro-computing concepts: artificial neurons, activation functions, Neural network architectures, learning rules, Supervised learning neural networks: multi-layer feed forward neural networks, simple recurrent neural networks, time-delay neural networks, supervised learning algorithms, Unsupervised learning neural networks: self-organizing feature maps, Radial basis function networks, Deep neural networks and learning algorithms, Case study: anomaly detection for video surveillance.

Unit 4

Evolutionary computation: Chromosomes, fitness functions, and selection mechanisms, Genetic algorithms: crossover and mutation, Genetic programming, Evolution strategies, Case study: cost-sensitive control in wireless sensor networks

Unit 5

Hybrid Intelligent Systems: Neural expert systems, Neuro-fuzzy systems, Evolutionary neural networks, Applications to IoT

References:

1. M. Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Pearson/Addison Wesley, 2011.
2. A.P. Engelbrecht, Computational Intelligence: An Introduction, 2nd Edition, John Wiley & Sons, 2012.

3. H.K. Lam, S.S.H. Ling, and H.T. Nguyen, Computational Intelligence and Its Applications: Evolutionary Computation, Fuzzy Logic, Neural Network and Support Vector Machine, Imperial College Press, 2011.

Computer Vision

Unit 1

Introduction: Fundamental steps in digital image processing, Components of an image processing system, Digital Image Fundamentals: Image sampling and quantization, Some basic relationships between pixels, Linear and nonlinear operations;

Unit 2

Image Enhancement In Spatial Domain: Some basic grey level transformations, Histogram processing, Smoothing and Sharpening spatial filters, Fuzzy techniques for intensity transformations and spatial filtering; Image Enhancement In Frequency Domain : Smoothing and Sharpening frequency domain filters, Homomorphic filtering,

Unit 3

Image Restoration: Noise models, Restoration in the presence of noise only-spatial filtering, Estimating the degradation functions, Inverse filtering; Color Image Processing: Colour models, Pseudo-colour processing; Image Compression: Image compression models, Loss-less and Lossy compression.

Unit 4

Morphological Image Processing: Dilation and erosion, Opening and closing, Some basic morphological algorithms; Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Region based segmentation, Segmentation by morphological watersheds; Representation : Chain codes, Polygonal approximations, Signatures, Boundary segments, Skeletons, Description : Boundary descriptors, Shape numbers, Fourier descriptors, Statistical moments, Regional descriptors, Topological descriptors, Texture, Moment invariants, Use of principal components for description, Relational descriptors;

Unit 5

Object Recognition: Patterns and pattern classes, Recognition based on decision-theoretic methods, Matching, Optimum statistical classifiers, Neural networks, Structural Methods, Matching Shape Numbers, String Matching.

Text Books:

1. R. C. Gonzalez and R.E. Woods - Digital Image Processing, Pearson Education, 3rd edition, 2009

Reference Books:

1. A.K. Jain - Fundamentals of Digital Image Processing, Pearson Education, 2007
2. J. R. Parker- Algorithms for Image Processing and Computer Vision, Wiley and Sons, Second Edition, 2010.

RF and Microwave Integrated Circuits

Unit 1

Analysis of MIC: Introduction, Types of MICs and their technology, Propagating models, Analysis of MIC by conformal transformation, Numerical method, Hybrid mode analysis, Losses in microstrip, Introduction to slot line and coplanar waveguide.

Unit 2

Couplers and Lumped Elements in MIC: Introduction to coupled microstrip, Even and odd mode analysis, Branch line couplers, Design and fabrication of lumped elements for MICs, Comparison with distributed circuits.

Unit 3

Passive and Active Components in MIC: Ferrimagnetic substrates and inserts, Microstrip circulators, Phase shifters, Microwave transistors, Parametric diodes and amplifiers, PIN diodes, transferred electron devices, Avalanche diodes, IMPATT, BARITT devices.

Unit 4

MIC Circuits and its Applications: Introduction, Impedance transformers, Filters, High power circuits, Low power circuits, MICs in Radar and satellite.

Unit 5

Fabrication Process in MIC: Fabrication process of MMIC, Hybrid MICs, Dielectric substances, Thick film and thin film technology and materials, Testing methods, Encapsulation and mounting of devices.

References:

1. Leo G. Maloratsky, "Passive RF and Microwave Integrated circuits", Elsevier, 2004
2. Gupta K.C and Amarjit Singh, "Microwave Integrated Circuits", John Wiley, New York, 1975.
3. Hoffman R.K "Hand Book of Microwave Integrated Circuits", Artech House, Boston, 1987.

Underwater Communication

Unit 1

Introduction: Basics of underwater communication, acoustic waves as carrier, challenges in acoustic communication, sound propagation mechanism.

Unit 2

Applications of Digital Signal Processing to Sonar: Characteristics of Sonar Signal propagation, Digital signal Processing for active sonar system and digital signal processing for passive sonar systems, Signal Processing Hardware -TMS 320 Series Signal Processors, real-time implementation considerations.

Unit 3

Orthogonal Frequency division multiplexing: Key features, characteristics and principle of operation of OFDM, Channel coding and interleaving System model, Enhancement of spectral efficiencies, Transmission/ Reception of OFTD -OFDM Simulations.

Unit 4

Acoustic Modem: Underwater Wireless Modem-Sweep spread carrier signal-transmission characteristics in shallow water channel-separation of time varying multipath arrivals-Typical acoustics modems-characteristics and specifications-Applications, Acoustic Releases-Real time wireless current monitoring system.

Unit 5

Underwater Sensor Network: Underwater Networking-Ocean Sampling Networks, Pollution Monitoring, Environmental Monitoring and Tactical surveillance systems, Major challenges in design of Underwater Sensor Networks, Factors that affect the UWSN-Sensor Node Architecture-GIBS, VRAP, DABSRAPT, etc.

Text Books:

1. Underwater Communications, Marco Lanzagorta, Morgan & Claypool Publishers, 2012

References:

1. Digital Underwater Acoustic Communications – 1st Edition Lufen Xu Tianzeng Xu – Elsevier

SEMESTER II

Detection and Estimation Theory

Unit 1

Background: Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain
Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

Unit 2

Detection of Deterministic Signals: Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.
Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection

Unit 3

Nonparametric Detection: Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.

Unit 4

Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Unit 5

Signal Estimation in Discrete-Time: Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.

References:

1. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
2. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e, 1998.
3. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.

4. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.

Information Theory and Coding

Unit 1

Information Theory: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Mark-off statistical model for information source, Entropy and information rate of mark-off source
Source Coding: Encoding of the source output, Shannon's encoding algorithm. Communication Channels, Discrete communication channels, Continuous channels.

Unit 2

Fundamental Limits on Performance: Source coding theorem, Huffman coding, Discrete memory less Channels, Mutual information, Channel Capacity.
Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem.

Unit 3

Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.

Unit 4

Introduction to Error Control Coding: Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding.

Unit 5

RS codes, Golay codes, shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes, Convolution Codes, Time domain approach, Transform domain approach.

Text Books:

1. Digital and analog communication systems, K. Sam Shanmugam, John Wiley, 1996.
2. Digital communication, Simon Haykin, John Wiley, 2003.

Reference Books:

1. ITC and Cryptography, Ranjan Bose, TMH, II edition, 2007.
2. Digital Communications - Glover and Grant; Pearson Ed. 2nd Ed 2008.

Satellite & Radar Communications

Unit 1

Introduction to radar, radar block diagram and operation, radar frequencies, Applications of radar, Prediction of range performance, minimum detectable signal, receiver noise, probability density function, SNR, Integration of radar pulses, radar cross-section of targets, PRF and range ambiguities, transmitter power, system losses.

Unit 2

Doppler effect, CW radar, FM CW radar, multiple frequency CW radar. MTI radar, delay line canceller, range gated MTI radar, blind speeds, staggered PRF, limitations to the performance of MTI radar, non-coherent MTI radar.

Unit 3

Tracking radar: sequential lobbing, conical scan, monopulse amplitude comparison and phase comparison methods, Radar antennas. Radar displays, Duplexer.
Orbital aspects of Satellite Communication: Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, locating the satellite with respect to the earth, sub-satellite point, look angles, mechanics of launching a synchronous satellite, Orbital effects, Indian scenario in communication satellites.

Unit 4

Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Space craft antennas, multiple access techniques, comparison of FDMA, TDMA, CDMA.

Unit 5

Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols.

Text Books:

1. Merril. I. Skolnik, Introduction to radar systems, 2nd ed., McGraw Hill International Editions, 1981.
2. Timothy Pratt and Charles Bostian, Satellite Communications, John Wiley, 1986.
3. Toomay, Radar Principles of Radar, PHI, 2nd ed.

Reference Books:

1. Dennis Roddy, Satellite Communications, 3 rd ed., Mc GH, 2001.
2. Raja Rao, Fundamentals of Satellite communication, M. Richharia, SCS. Design Principles, Macmillan, 2nd ed., 2003.

Advanced Optical Communication

Unit 1

Introduction to optical communication: Characteristics of optical transmission media, optical fibers preparation and transmission characteristics, loss and dispersion mechanisms;

Unit 2

Correlation properties and power density spectrum of shot noise process; Laser phase noise modeling and Lorentz power spectrum of laser; Coherent optical communication systems;

Unit 3

Homodyne and heterodyne detection schemes; BER analysis: super quantum and short noise limits for homodyne PSK, synchronous and asynchronous FSK, impact of finite leaser line width on BER,

Unit 4

Polarization control and diversity schemes, frequency alignment schemes; Pulse propagation in optical fibres: propagation of chirped Gaussian pulse,

Unit 5

Concept of nonlinear polarization, nonlinear effects on pulse propagation, solution pulse propagation.

Text Books:

1. G. Keiser, Optical Fibre Communications, McGraw Hill.
2. John M. Senior, Optical Fiber Communications: Principles and Practice, PHI.

Reference Books:

1. Jones, W.B. Jones, Introduction to Optical Fiber Communications Systems, Oxford University Press.
2. A. J. Rogers, Understanding Optical Fiber Communications, Artech House.
3. J. C. Palais, Fiber optic communication, 5th edition, Prentice Hall.

Elective-2

Architecture of Digital Signal Processing

Unit 1

Overview of Digital Signal Processing: Advantages of DSP over analog systems, salient features and characteristics of DSP systems, applications of DSP systems.
Introduction to DSP Processors: Common features of DSP processors, numeric representations in DSP processor, data path of a DSP processor, memory structures in DSP processors, VLIW architecture, special addressing modes in DSP processors, pipelining concepts, on-chip peripherals found in DSP processors.

Unit 2

TMS320C5X Processors: Architecture of TMS320C5X Processors- Assembly Instructions- Addressing Modes- Pipelining and Peripherals-Lab exercises

Unit 3

TMS320C3X Processors: Architecture of TMS320C3X- Instruction Set- Addressing Modes- Data Formats- Floating Point Operation- Pipelining and Peripherals- Lab exercises

Unit 4

Black fin Processor: Introduction to Black fin processor- Architecture overview-processor core-addressing modes-instruction sets- Targeted applications - Lab exercises.

Unit 5

SHARC Processor: VLIW Architecture, SHARC, SIMD, MIMD Architectures, Application: Adaptive filters-DSP based biometry receiver-speech processing-position control system for hard disk drive-DSP based power meter.

Reference Books:

1. B. Venkatramani & M. Baskar, "Digital Signal Processor", McGraw Hill, 2000
2. Avatar Singh and S. Srinivasan, “Digital signal processing”, Thomson books, 2004
3. K.K Parhi, “VLSI DSP Systems”, John Wiley, 1999.

Antenna Theory

Unit 1

Overview of Antennas: Antenna arrays, Broadside array, end fire array, directivity of the array, 3-dimensional characteristic, Design procedure, Non uniform array, Binomial array, Chebyscheff array, Planar array, Array factor, beam width, directivity.

Unit 2

General Antennas: Travelling wave antennas, Helical Antennas, Yagi –Uda antenna, spiral antenna, Log periodic antenna, Dipole array, Design of Dipole array, Horn antennas, Sectoral horns, pyramidal horns, Corrugated horn antenna.

Unit 3

Reflector Antennas: Plane reflector, Corner reflector, Parabolic reflector, Patterns of large circular aperture, Parabolic cylinder, Cassegrain antennas, Babinet principle and complementary antennas.

Unit 4

Antenna Synthesis: Continuous sources, Schelkunoff Polynomial method, Fourier transform method, Woodward method, Taylor Line source method, Triangular, Cosine and Cosine squared amplitude distribution, Line source phase distribution, Continuous aperture sources.

Unit 5

Microstrip Antennas and Smart Antennas: Basic characteristics, Feeding techniques, Rectangular and circular patch antennas, Smart Antenna analogy –Cellular radio system evolution, Signal propagation, Antenna beamforming, Mobile Adhoc Networks (MANETs), System design.

References:

1.Constantine A Balanis, Antenna Theory –Analysis and design, Third Edition, John Wiley and Sons, 2005
2. John D Kraus, Antennas, Fourth Edition, Tata McGraw Hill, 2010
3. John L Volakis, Antenna Engineering Hand Book –Fourth Edition, Tata McGraw Hill Companies, 200

Wireless Sensor Network

Unit 1

Introduction: Architectural Elements, Basic Technology, Sensor Node, Hardware and Software, Sensor Taxonomy, Design challenges, Characteristics and requirements of WSNs, Applications.

Unit 2

Mac Protocols For WSN: Fundamentals of MAC Protocols, Performance Requirements, Common Protocols, MAC for WSN, Schedule based protocols, Random Access based Protocols, Sensor-MAC, IEEE802.15.4 LRWPAN's Standard.

Unit 3

Routing Protocols for WSN: Data Dissemination and Gathering, Challenges and Design Issues, Network Scale and Time-Varying Characteristics, Routing Strategies, Flooding and its variants.

Unit 4

Transport Control Protocols for WSN: Design Issues, Congestion Detection and Avoidance, Event-to-Sink Reliable Transport, Reliable Multi-segment Transport; Pump Slowly, Fetch Quickly, GARUDA, ATP, Congestion and Packet Loss Recovery.

Unit 5

WSN Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, localization and positioning, Sensor Tasking and Control.

References:

1. K. Sohraby, Minoli, and T. Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications", John Wiley & Sons, March 2007.
2. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, October 2007.
3. C.S. Raghavendra, K.M. Sivalingam, and T. Zanti, "Wireless Sensor Networks" Editors, Springer Verlag, Sep. 2006.
4. E.H. Callaway, Jr. Auerbach, "Wireless Sensor Networks: Architectures and Protocols", Aug. 2003.

Digital Image Processing

Unit 1

Fundamentals of Image Processing: Introduction, Steps in Image Processing Systems, Image Acquisition, Sampling and Quantization Pixel Relationships, Colour Fundamentals and Models, File Formats, Image operations Arithmetic, Geometric and Morphological.

Unit 2

Image Enhancement: Spatial Domain Grey Level Transformations Histogram Processing Spatial Filtering, Smoothing and Sharpening. Filtering in Frequency Domain, DFT, FFT, DCT, Smoothing and Sharpening filters, Homomorphic Filtering

Unit 3

Image segmentation and feature analysis: Detection of Discontinuities, Edge Operators, Edge Linking and Boundary Detection, Thresholding, Region Based Segmentation, Morphological Watersheds, Motion Segmentation, Feature Analysis and Extraction.

Unit 4

Multi-resolution Analysis and Compressions: Multi Resolution Analysis: Image Pyramids, Multi resolution expansion, Wavelet Transforms. Image Compression: Fundamentals, Models, Elements of Information Theory, Error Free Compression, Lossy Compression, Compression Standards.

Unit 5

Applications: Image Classification, Image Recognition, Image Understanding, Video Motion Analysis, Image Fusion, Steganography, Digital Compositing, Mosaics, Colour Image Processing, etc. in Bio-Medical, Machine vision/Robotics.

References:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing" Second Edition, Pearson Education (2003).
2. Milan Sonka, Vaclav Hlavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", Second Edition, Thomson Learning (2001)
3. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI (2006).
4. Sanjit K. Mitra, and G. L. Sicuranza, "Non-Linear Image Processing", Elsevier (2007).