JNTUH COLLEGE OF ENGINEERING HYDERABAD
M.Tech. (Systems & Signal Processing) – Full Time w.e.f. 2018-19

SEMESTER – I

S. No.	Course Type	Course Title	L	T	P	Credits
1	Core 1	Transform Techniques	3	0	0	3
2	Core 2	Advanced Digital Signal Processing	3	0	0	3
3	P E - 1	Professional Elective 1	3	0	0	3
4	P E - 2	Professional Elective 2	3	0	0	3
5	Lab 1	Signal Processing Lab	0	0	4	2
6	Lab 2	Scripting Languages Lab	0	0	4	2
7		Research Methodology and IPR	2	0	0	2
8	Aud 1	Audit Course 1	2	0	0	0
		Total	**16**	**0**	**8**	**18**

SEMESTER – II

S. No.	Course Type	Course Title	L	T	P	Credits
1	Core 3	Adaptive Signal Processing	3	0	0	3
2	Core 4	Wireless Communications and Networks	3	0	0	3
3	P E – 3	Professional Elective 3	3	0	0	3
4	P E – 4	Professional Elective 4	3	0	0	3
5	Lab 3	Communications and Networks Lab	0	0	4	2
6	Lab 4	Simulation Lab	0	0	4	2
7		**Mini Project with Seminar**	0	0	4	2
8	Aud 2	Audit Course 2	2	0	0	0
		Total	**16**	**0**	**8**	**18**

SEMESTER – III

S. No.	Course Type / Code	Course Title	L	T	P	Credits
1	P E – 5	Professional Elective 5	3	0	0	3
2	O E	Open Elective	3	0	0	3
3	Dissertation	Dissertation Phase - I	0	0	20	10
		Total	**06**	**0**	**20**	**16**

SEMESTER – IV

S. No.	Course Type / Code	Course Title	L	T	P	Credits
1	Dissertation	Dissertation Phase - II	--	--	32	16
		Total	**--**	**--**	**--**	**16**

Professional Elective – 1

1. Random Processes and Queuing Theory
2. Bio-Medical Signal Processing
3. Advanced Data Communications
4. Detection and Estimation Theory

Professional Elective - 2

1. Digital Signal Processors and Architectures
2. Radar Signal Processing
3. VLSI Signal Processing
4. TCP/IP and ATM Networks

Professional Elective – 3

1. Image and Video Processing
2. Pattern Recognition and Machine Learning
3. Coding Theory and Techniques
4. Speech and Audio Signal Processing

Professional Elective – 4

1. Communication Technologies
2. Spread Spectrum Communications
3. Adhoc and Wireless Sensor Networks
4. Multimedia and Signal Coding

Professional Elective – 5

1. High Performance Networks
2. Software Defined Radio
3. Soft Computing Techniques
4. RF Circuit Design

Open Elective

Principles of Signal Processing

TRANSFORM TECHNIQUES

M.Tech. I Year I-Semester

L	T	P	C
3	0	0	3

Prerequisite: None

Course Objectives

1. To learn basics of two dimensional transform.
2. Understand the various two dimensional transform definition, properties and applications.
3. Understand the design of filter Bank structure.
4. To learn the fundamentals of wavelet transform and special wavelets.

Course Outcomes

On completion of this course student will be able to:

1. The student will learn basics of two dimensional transforms.
2. Understand the definition, properties and applications of various two dimensional transform.
3. Understand the basic concepts of wavelet transform.
4. Understand the special topics such as wavelet packets, Bi-orthogonal wavelets e.t.c.

UNIT -I

Fourier Analysis: Vector space, Hilbert spaces, Fourier basis, FT- Limitations of Fourier Analysis, Need for time-frequency analysis, DFT, 2D-DFT: Definition, Properties and Applications, IDFT, Hilbert Transform, STFT.

UNIT -II

Transforms: Walsh, Hadamard, Haar and Slant Transforms, DCT, DST, KLT,– definition, properties and applications

UNIT -III

Continuous Wavelet Transform (CWT): Short comings of STFT, Need for wavelets, Wavelet Basis- Concept of Scale and its relation with frequency, Continuous time wavelet Transform Equation- Series Expansion using Wavelets- CWT- Tiling of time scale plane for CWT. Important Wavelets: Haar, Mexican Hat, Meyer, Shannon, Daubechies.

UNIT -IV

Multi Rate Analysis and DWT: Need for Scaling function – Multi Resolution Analysis, Two-Channel Filter Banks, Perfect Reconstruction Condition, Relationship between Filter Banks and Wavelet Basis, DWT, Structure of DWT Filter Banks, Daubechies Wavelet Function, Applications of DWT.

UNIT -V

Special Topics: Wavelet Packet Transform, Multidimensional Wavelets, Bi-orthogonal basis- B-Splines, Lifting Scheme of Wavelet Generation, Multi Wavelets

TEXT BOOKS

1. Wavelet Transforms-Introduction theory and applications -Raghuveer M.Rao and Ajit S. Bopardikar, Pearson Edu, Asia, New Delhi, 2003.
2. "Insight into Wavelets from Theory to practice ", Soman. K. P, Ramachandran. K.I, Printice Hall India, First Edition, 2004.

REFERENCES

1. "Fundamentals of Wavelets- Theory, Algorithms and Applications", Jaideva C Goswami, Andrew K Chan, John Wiley & Sons, Inc, Singapore, 1999.
2. "Wavelets and sub-band coding", Vetterli M. Kovacevic, PJI, 1995.
3. "Introduction to Wavelets and Wavelet Transforms", C. Sydney Burrus, PHI, First Edition, 1997.
4. "A Wavelet Tour of Signal Processing", Stephen G. Mallat,. Academic Press, Second Edition, 2008.

ADVANCED DIGITAL SIGNAL PROCESSING

M.Tech. I Year I-Semester

L	T	P	C
3	0	0	3

Prerequisite: Digital Signal Processing

Course Objectives

The objectives of this course are to:

1. Understand the implementation of digital filters using various structures and study the advantages & disadvantages of implementation structures.
2. Study various parametric and non-parametric methods of power spectrum estimation.
3. Understand the effects of finite word length in hardware implementation of IIR filters and FFT.
4. Understand the concepts of Multirate signal Processing and their applications.

Course Outcomes

On completion of this course student will be able to:

1. Implement a filter in various forms.
2. Estimate the power spectrum of signal corrupted by noise using Non-Parametric or Parametric methods.
3. Understand finite word length effects in IIR filters and FFT.
4. Implement Multirate systems and understand the applications of Multirate signal processing.

UNIT –I

Review of DFT, FFT, IIR Filters and FIR Filters: Introduction to filter structures (IIR & FIR), Implementation of Digital Filters, specifically 2^{nd} Order Narrow Band Filter and 1^{st} Order All Pass Filter, Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

UNIT -II

Non-Parametric Methods: Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods

UNIT - III

Parametric Methods: Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

UNIT –IV

Multi Rate Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling

Rate Conversion, Filter design & Implementation for sampling rate conversion. Examples of up-sampling using an All Pass Filter.

UNIT –V

Applications of Multi Rate Signal Processing: Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.

TEXT BOOKS

1. Digital Signal Processing: Principles, Algorithms & Applications - J.G.Proakis & D. G. Manolakis, 4^{th} Ed., PHI.
2. Discrete Time signal processing - Alan V Oppenheim & Ronald W Schaffer, PHI.

REFERENCES

1. Modern spectral Estimation: Theory & Application – S. M .Kay, PHI, 1988.
2. Multi Rate Systems and Filter Banks – P.P.Vaidyanathan – Pearson Education.
3. DSP – A Practical Approach – Emmanuel C. Ifeacher, Barrie. W. Jervis, 2 Ed., Pearson Education.

RANDOM PROCESSES AND QUEUING THEORY
(PE-1)

M.Tech. I Year I-Semester

L	T	P	C
3	0	0	3

Prerequisite: Probability Theory & Stochastic Processes

Course Objectives

The main objectives of the course are:

1. To explore in the random process and queuing theory useful for Computer and communication Networks.
2. Understand Random variables as an intrinsic need for the analysis of random phenomena.
3. To understand the modeling of telecommunication networks using appropriate queuing process.
4. To know the need of Markov chains and queuing theory in communication networks.

Course Outcomes

Students will be able to**:**

1. Evaluate and apply moments and Characteristics functions.
2. Understand the concept of random process spectral density of stationary process.
3. Understand the concepts of Markov Chains and queuing theory.
4. Understand the concepts of M| M|1, M|M|1|K, M|G|1 queuing Process.

UNIT I

Random Variable

Random Variables-Basic Definitions and properties, Sum of independent random variables, Minimum and Maximum of random variables, Comparisons between random variables, Moments of the random variables, Random variables in the field of telecommunications, Transformations of random variables-The probability generating function, the characteristic function of a pdf, The Laplace Transform of a pdf, Methods for the generation of random variables- Method of the inverse of the distribution function, Method of the transformation.

UNIT II

Random Processes

The Random Process Concept, Concept of Stationarity and Statistical Independence, First Order Stationary Processes, Second Order and Wide Sense Stationary, (N-Order) and Strict Sense Stationarity, Time Averages and Ergodicity, Mean Ergodic Processes, Correlation Ergodic Processes, Autocorrelation Function and its Properties, Cross Correlation function and its properties, Covariance Functions, The Power Spectrum- Properties, Relationship between Power spectrum and Autocorrelation function.

UNIT III

Markov Chains and Queuing Theory

Queues, Poisson arrival process- Sum of independent Poisson processes, Random splitting of a Poisson process, Compound Poisson processes, Birth death Markov chains, Formulation of Hidden Markov Model (HMM), building, evaluation and decoding of HMM, Notations for

Queuing systems, The Little Theorem, M/M/1 queue analysis, M/M/1/K queue analysis, M/M/S queue analysis, M/M/S/S queue analysis, The M/M/∞ queue analysis, Distribution of the queuing delays in the FIFO case- M/M/1 case, M/M/S case.

UNIT IV

M/G/1 Queuing Theory

M/G/1 queue, M/G/1 system delay distribution in the FIFO case, Laplace Transform numerical inversion method, Generalizations of the M/G/1 theory, Different imbedding instants in the M/G/1 theory, M/G/1 with geometrically distributed messages.

UNIT V

Local Area Network Analysis

Introduction, Contention based protocols- Aloha, Slotted Aloha, Aloha Protocol with ideal capture effect, CSMA Schemes, Demand assignment protocols-Polling protocol, Token passing protocol, Analysis of token and polling Schemes, R-Aloha, PRMA protocol, Comparisons between CSMA/CD and Token Protocols, Fixed assignment Protocols- FDMA, TDMA, Resource reuse in cellular systems, CDMA.

TEXTBOOKS

1. Probability, Random Variables & Random Signal Principles-Peyton Z. Peebles, TMH, 4th Edition,2001.
2. Queuing Theory and Telecommunications Networks and Applications, Springer, Giovanni Giambene, 2014.

REFERENCES

1. Probability, Random Variables and Stochastic Processes – Athanasios Papoulis, S. Unnikrishna Pillai – TMH, 2008
2. Probability and Random Processes with Applications to Signal Processing – Henry Stark, John W. Woods, 3rd Edition, Pearson, 2003
3. Probability and Stochastic Processes – A Friendly Introduction for Electrical and Computer Engineers – Roy D. Yates, David J. Goodman.2014
4. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, 1978, PHI.

BIOMEDICAL SIGNAL PROCESSING
(PE-1)

M.Tech. I Year I-Semester

L	T	P	C
3	0	0	3

Prerequisite: Advanced Digital Signal Processing

Course Objectives

The main objectives of the course are:

1. To use basic probability theory to model random signals in terms of Random Processes.
2. To understand various cardilogical signal processing techniques and noise cancellation techniques.
3. To understand estimation of signals using Prony's and least square and linear prediction methods.
4. To comprehend EEG signals, modeling and sleep stages.

Course Outcomes

After studying the course, each student is expected to be able to:

1. Use probability theory to model random processes.
2. Compare various lossless and lossy data compression techniques.
3. Compare various ECG processing and noise cancellation techniques.
4. Model and estimate EEG signals and various sleep stages.

UNIT -I

Random Processes: Stationary random process, Ergodicity, Power spectral density and autocorrelation function of random processes. Noise power spectral density analysis, Noise bandwidth and noise figure of systems.

UNIT -II

Data Compression Techniques: Lossy and Lossless data reduction Algorithms. ECG data compression using Turning point, AZTEC, CORTES, Huffman coding, vector quantisation, DICOM Standards

UNIT -III

Cardiological Signal Processing: Pre-processing, QRS Detection Methods, Rhythm analysis, Arrhythmia Detection Algorithms, Automated ECG Analysis, ECG Pattern Recognition.
Adaptive Noise Cancelling: Principles of Adaptive Noise Cancelling, Adaptive Noise Cancelling with the LMS Adaptation Algorithm, Noise Cancelling Method to Enhance ECG Monitoring, Fetal ECG Monitoring.

UNIT -IV

Signal Averaging, Polishing: Mean and trend removal, Prony's method, Prony's Method based on the Least Squares Estimate, Linear prediction, Yule – Walker (Y –W) equations, Analysis of Evoked Potentials.

UNIT -V

Neurological Signal Processing: Modelling of EEG Signals, Detection of spikes and spindles Detection of Alpha, Beta and Gamma Waves. Auto Regressive (A.R.) modelling of seizure EEG. Sleep Stage analysis, Inverse Filtering, Least squares and polynomial modelling.

TEXT BOOKS

1. Probability, Random Variables & Random Signal Principles – Peyton Z. Peebles, 4th Ed., TMH,2009,.
2. Biomedical Signal Processing- Principles and Techniques - D. C. Reddy, TMH, 2005.

REFERENCES

1. Digital Bio Dignal Processing - Weitkunat R, Elsevier, 1991,.
2. Biomedical Signal Processing -Vol. I Time & Frequency Analysis - Cohen.A, , CRC Press, 1986.
3. Biomedical Digital Signal Processing: C-Language Experiments and Laboratory Experiments, Willis J.Tompkins, PHI, 1998.

ADVANCED DATA COMMUNICATIONS
(PE – 1)

M.Tech. I Year I-Semester

L	T	P	C
3	0	0	3

Prerequisite: Digital Communication

Course Objectives

The main objectives of the course are:

1. To learn about basics of Data Communication networks, different protocols, standards and layering concepts.
2. To study about error detection and correction techniques.
3. To know about link layer, point to point, Medium Access and Control sub layer protocols.
4. To know about Switching circuits, Multiplexing and Spectrum Spreading techniques for data transmission.

Course Outcomes

At the end of the course, the student will be able to:

1. Understand the concepts of Networks and data link layer.
2. Acquire the knowledge of error detection, forward and reverse error correction techniques.
3. Compare the performance of different MAC protocols like Aloha, CSMA, CSMA/CA, TDMA, FDMA & CDMA.
4. Understand the significance of Switching circuits and characteristics of Wired LANs

UNIT I

Data Communications, Networks and Network Types, Internet History, Standards and Administration, Protocol Layering, TCP/IP protocol suite, OSI Model. Digital Data Transmission, DTE-DCE interface.

Data Link Layer

Introduction, Data Link Layer, Nodes and Links, Services, Categories of Links, sub layers, Link Layer Addressing, Address Resolution Protocol.

UNIT II

Error Detection and Correction

Types of Errors, Redundancy, detection versus correction, Coding Block Coding: Error Detection, Vertical redundancy cheeks, longitudinal redundancy cheeks, Error Correction, Error correction single bit, Hamming code.

Cyclic Codes

Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials, Cyclic Code Analysis, Advantage of Cyclic Codes, Checksum

Data Link Control: DLC Services, Data Link Layer Protocols, HDLC, Point to Point Protocol

UNIT III

Media Access Control (MAC) Sub Layer

Random Access, ALOHA, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA),Controlled Access- Reservation, Polling- Token Passing,

Channelization - Frequency Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA).

Wired LANS

Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Giga bit Ethernet

UNIT IV

Switching

Introduction to Switching, Circuit Switched Networks, Packet Switching, Structure of switch

Multiplexing

Multiplexing, Frequency Division Multiplexing, Time Division Multiplexing.

Spectrum Spreading

Spread Spectrum-Frequency Hopping Spread Spectrum and Direct Sequence Spread Spectrum

Connecting devices

Passive Hubs, Repeaters, Active Hubs, Bridges, Two Layer Switches, Routers, Three Layer Switches, Gateway, Backbone Networks.

UNIT V

Networks Layer

Packetizing, Routing and Forwarding, Packet Switching, Network Layer Performance, IPv4 Address, Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution(NATF), Forwarding of IP Packets, Forwarding based on Destination Address, Forwarding based on Label, Routing as Packet Switches.

Unicast Routing

Introduction, Routing Algorithms-Distance Vector Routing, Link State Routing, Path Vector Routing, Unicast Routing Protocols- Routing Information Protocol(RIP), Open Short Path First .

TEXT BOOKS

1. Data Communications and Networking - B. A. Forouzan, 5th Ed., TMH, 2013.
2. Data and Computer Communications - William Stallings, 8th Ed., PHI, 2007.

REFERENCES

1. Data Communications and Computer Networks - Prakash C. Gupta, PHI, 2006.
2. Data Communications and Networking - B. A. Forouzan, 2nd Ed., TMH, 2013.
3. Data Communications and Computer Networks- Brijendra Singh, 2nd Ed., 2008.

DETECTION AND ESTIMATION THEORY
(PE-1)

M.Tech. I Year I-Semester

L	T	P	C
3	0	0	3

Prerequisite: Probability Theory and Stochastic Processes

Course Objectives

The main objectives of the course are:

1. The main objective of this course is to provide basic estimation and detection background for engineering applications.
2. This course provides the main concepts and algorithms for detection and estimation theory.
3. Students learn the statistics and estimating the parameters of Random Process from detection.
4. To apply estimation methods for real time engineering problems.

Course Outcomes

On completion of this course student will be able to

1. Understand the basic Random Process and detection methods.
2. Known the significance of Probability of error
3. Learn about basic estimation methods and filters
4. Measure the statistical parameters for random processes

UNIT –I

Random Processes

Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

UNIT –II

Detection Theory

Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III

Linear Minimum Mean-Square Error Filtering

Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV

Statistics

Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

UNIT –V

Estimating the Parameters of Random Processes from Data

Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS

1. Random Signals: Detection, Estimation and Data Analysis – K. Sam Shanmugan & A.M. Breipohl, Wiley India Pvt. Ltd, 2011.
2. Random Processes: Filtering, Estimation and Detection – Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCES

1. Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay, Prentice Hall, USA, 1998.
2. Introduction to Statistical Signal Processing with Applications – Srinath, Rajasekaran, Viswanathan, 2003, PHI.
3. Statistical Signal Processing: Detection, Estimation and Time Series Analysis – Louis L.Scharf, 1991, Addison Wesley.
4. Signal Processing: Discrete Spectral Analysis – Detection & Estimation – Mischa Schwartz, Leonard Shaw, 1975, Mc Graw Hill.

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES
(PE- 2)

M.Tech. I Year I Semester **L T P C**
3 0 0 3

Prerequisite: Digital Signal Processing

Course Objectives
The main objectives of the course are:
1. To provide a comprehensive understanding of various programs of Digital Signal Processors.
2. To distinguish between the architectural differences of ARM and DSPs along with floating point capabilities.
3. To explore architecture and functionality of various DSP Processors and can able to write programs.
4. To known about the connectivity of interfacing devices with processors.

Course Outcomes
Upon completing this course, the student will be able to:
1. Understand the various processing operations on Digital signals.
2. Know the architecture of DSP Processors TMS320C54XX, ADSP 2100, 2181 and Blackfin Processor.
3. Run the programs on DSP Processors.
4. Interface Memory and I/O devices with DSP Processors.

UNIT –I
Fundamentals of Digital Signal Processing
Digital signal-processing system, Sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and Interpolation, Computational Accuracy in DSP Implementations-Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT –II
Architectures for Programmable DSP Devices
Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT -III
Programmable Digital Signal Processors
Commercial Digital Signal-Processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT –IV

Analog Devices Family of DSP Devices

Analog Devices Family of DSP Devices – ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. Introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals

UNIT –V

Interfacing Memory and I/O Peripherals to Programmable DSP Devices

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS

1. Digital Signal Processing: Principles, Algorithms & Applications – J.G. Proakis & D.G. Manolakis, 4th Ed., PHI,2006.
2. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

REFERENCES

1. A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2009.
2. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, TMH, 2002.
3. DSP Processor Fundamentals, Architectures & Features – Lapsley et al., S. Chand & Co. 2000.

RADAR SIGNAL PROCESSING
(PE-2)

M.Tech. I Year I Semester

L	T	P	C
3	0	0	3

Prerequisite: Radar Systems

Course Objectives

The main objectives of the course are:

1. This course emphasis on the principles of Radar Systems and Signal Processing techniques.
2. Ability to understand the various parameters of Radar like pdf , prf.
3. Acquire knowledge about pulse compression Radar.
4. To study the phase coding Techniques.

Course Outcomes

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

1. Understand the principles of Radar Systems.
2. Learn the appropriate model, calculate system performance parameters and assess the limitations of particular systems.
3. Understand the concepts of pulse compression Radar.

UNIT -I

Introduction

Radar, Radar Block Diagram, Radar Equation, Detection of Signals in Noise, Receiver Noise and the Signal to Ratio.

UNIT –II

Radar Equation

Probability Density Function, Probability of Detection and False Alarm, Radar Cross Section of Targets, Transmitter Power, PRF and Antenna Parameters, CFAR Receiver.

UNIT –III

Waveform Selection

Radar Ambiguity Function and Ambiguity Diagram – Principles and Properties; Specific Cases – Ideal Case, Single Pulse of Sine Wave, Periodic Pulse Train, Single Linear FM Pulse.

UNIT -IV

Pulse Compression in Radar Signals

Introduction, Significance, Types, Linear FM Pulse Compression – Block Diagram, Characteristics, Reduction of Time Side lobes, Stretch Techniques, Generation and Decoding of FM Waveforms.

UNIT –V

Phase Coding Techniques

Principles, Binary Phase Coding, Barker Codes, Maximal Length Sequences (MLS/LRS/PN), Block Diagram of a Phase Coded CW Radar.

TEXT BOOKS

1. Radar Handbook - M.I. Skolnik, 2nd Ed., 1991, McGraw Hill.
2. Radar Design Principles: Signal Processing and the Environment - Fred E. Nathanson, 2nd Ed.,1999, PHI.
3. Introduction to Radar Systems - M.I. Skolnik, 3rd Ed., 2001, TMH.

REFERENCES

1. Radar Principles - Peyton Z. Peebles, Jr., 2004, John Wiley.
2. Radar Signal Processing and Adaptive Systems - R. Nitzberg, 1999, Artech House.
3. Radar Design Principles - F.E. Nathanson, 1st Ed., 1969, McGraw Hill.

VLSI SIGNAL PROCESSING
(PE- 2)

M.Tech. I Year I Semester

L	T	P	C
3	0	0	3

Prerequisite: VLSI Technology, Digital Signal Processing

Course Objectives
The objectives of this course are to:
1. Introduce techniques for the existing DSP structures to suit VLSI implementations.
2. Introduce efficient design of DSP architectures suitable for VLSI.
3. Understand various fast convolution techniques.
4. Understand low power processors for signal processing and wireless applications

Course Outcomes
On successful completion of the module, students will be able to:
1. Ability to modify the existing or new DSP architectures suitable for VLSI.
2. Understand the concepts of folding and unfolding algorithms and applications.
3. Ability to implement fast convolution algorithms.
4. Low power design aspects of processors for signal processing and wireless applications.

UNIT -I
Introduction to DSP
Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms
Pipelining and Parallel Processing
Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power
Retiming
Introduction, Definitions and Properties, Solving System of Inequalities, Retiming Techniques

UNIT –II
Folding and Unfolding
Folding- Introduction, Folding Transform, Register minimization Techniques, Register minimization in folded architectures, folding of Multirate systems
Unfolding- Introduction, An Algorithm for Unfolding, Properties of Unfolding, critical Path, Unfolding and Retiming, Applications of Unfolding

UNIT -III
Systolic Architecture Design
Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations contain Delays.

UNIT -IV

Fast Convolution

Introduction – Cook-Toom Algorithm – Winograd algorithm – Iterated Convolution – Cyclic Convolution – Design of Fast Convolution algorithm by Inspection

UNIT -V

Low Power Design

Scaling Vs Power Consumption, Power Analysis, Power Reduction techniques, Power Estimation Approaches

Programmable DSP

Evaluation of Programmable Digital Signal Processors, DSP Processors for Mobile and Wireless Communications, Processors for Multimedia Signal Processing

TEXT BOOKS

1. VLSI Digital Signal Processing- System Design and Implementation – Keshab K. Parthi, Wiley Inter Science, 1998.
2. VLSI and Modern Signal processing – Kung S. Y, H. J. While House, T. Kailath, Prentice Hall, 1985.

REFERENCES

1. Design of Analog – Digital VLSI Circuits for Telecommunications and Signal Processing – Jose E. France, Yannis Tsividis, Prentice Hall, 1994.
2. VLSI Digital Signal Processing – Medisetti V. K, IEEE Press (NY), 1995.

TCP/IP AND ATM NETWORKS
(PE- 2)

M.Tech. I Year I Semester

L	T	P	C
3	0	0	3

Prerequisite: Computer Networks

Course Objectives

The main objectives of the course are:

1. To study Network Layer Protocols, Next Generation IP protocols
2. To learn about User Datagram Protocol, Transmission Control Protocol and stream control Transmission protocol.
3. To understand techniques to improve QoS
4. To learn about Transport Layer Protocols for Ad Hoc Wireless Networks .
5. To study the features of ATM networks and various Interconnection Networks

Course Outcomes

At the end of the course, the student will be able to:

1. Get the concept of Network Layer Protocols and Transport Layer Protocols.
2. Understand and analyze about UDP, TCP AND SCTP protocols, flow and error control techniques.
3. Learn congestion control mechanisms and techniques to improve Quality of Service in switched networks
4. To understand the performance of TCP in Ad-hoc networks and various modified versions of TCP in ad-hoc networks
5. To understand features of Virtual circuit networks like ATM networks and their applications Design and analyze various types of Inter connection Networks,

UNIT I

Network Layer

Network Layer Services**,** Packet switching**,** , Network Layer Performance, IPv4 Addresses, Internet protocol(IP), ICMP v4, IPv6 Addressing, IPv6 protocol, ICMPv6 protocol, Transition from IPv4to IPv6,Mobile IP

Forwarding of IP Packets, Delivery- Direct Versus Indirect Delivery, Forwarding- Forwarding Techniques, Forwarding Process, Routing Table, Unicast routing- Routing algorithms, Unicast routing protocols, Multicast routing, Multicasting basics.

UNIT II

Transport Layer

Introduction to Transport Layer, Transport layer services, Connectionless Versus Connection Oriented Protocols, Transport Layer Protocols: Simple Protocols, Stop and Wait Protocols, Go Back N Protocol, Selective Repeat Protocol, Bidirectional Protocols: Piggybacking Transport layer protocols Services and Port Numbers.

UDP, TCP and SCTP

User Datagram Protocol (UDP)

User Datagram, UDP Services, UDP Applications

Transmission Control Protocol (TCP)

TCP Services, TCP Features, Segments, TCP Connection, State Transition Diagram, Windows in TCP, Flow and Error Control, TCP Timers,

SCTP: SCTP Services, SCTP Features, Packet Format, An SCTP Association SCTP Flow and Error Control

UNIT III

Traditional TCP

Congestion Control, Additive Increase Multiplicative Decrease (AIMD), Slow Start, Fast recovery, fast retransmit

TCP in Wireless Domain

Traditional TCP, TCP over wireless**,** Snoop TCP , TCP-Unaware Link Layer Indirect TCP, Mobile TCP, Explicit Loss Notification, WTCP, TCP SACK , Transaction-Oriented TCP

Transport Layer Protocols for Ad Hoc Wireless Networks

TCP Over Ad Hoc Wireless Networks- Feedback-Based TCP, TCP with Explicit Link Failure Notification, TCP-Bus, Ad Hoc TCP, Split TCP.

UNIT IV

Congestion Control and Quality of Service

Quality of Service- Flow Characteristics, Flow Classes, Techniques to Improve QoS- Scheduling, Traffic Shaping, Resource Reservation, Admission Control, Integrated Services- Signaling, Flow Specification, Admission, Service Classes, RSVP, Problems with Integrated Services , Differentiated Services.

Queue Management

Passive-Drop trial, Drop front, Random drop, Active- early Random drop, Random Early detection.

UNIT V

ATM Networks

ATM-Design Goals, Problems, Architecture, Switching, ATM Layers

SONET/SDH

Architecture, SONET Layers, SONET Frames, STS Multiplexing, SONET Networks

Interconnection Networks

Introduction, Banyan Networks, Properties, Crossbar switch, Three stage Class Networks, Rearrangeable Networks, Folding algorithm, Benes Networks, Lopping algorithm, Bit allocation algorithm.

TEXT BOOKS

1. Data Communications and Networking - B. A.Forouzan, 5th edition, TMH, 2013.
2. Mobile Communications by Jochen H. Schiller, 2nd Edition, Pearson-Wesley, 2003.
3. Ad Hoc Wireless networks: Architectures and Protocols- C. Siva Ram Murthy and B. S.Manoj, PHI, 2004

REFERENCES

1. ATM Fundamentals –N.N Biswas, Adventure Books,1998
2. Data Communications and Computer Networks - Prakash C. Gupta, PHI, 2006.
3. Data and Computer Communications - William Stallings, 8th ed., PHI, 2007.

SIGNAL PROCESSING LABORATORY

M.Tech. I Year I Semester

L	T	P	C
0	0	4	2

Note:

A. Minimum of 10 Experiments have to be conducted

1. Basic Operations on Signals, Generation of Various Signals and finding its FFT.
2. Program to verify Decimation and Interpolation of a given Sequences.
3. Program to Convert CD data into DVD data
4. Generation of Dual Tone Multiple Frequency (DTMF) Signals
5. Plot the Periodogram of a Noisy Signal and estimate PSD using Periodogram and Modified Periodogram methods
6. Estimation of Power Spectrum using Bartlett and Welch methods
7. Verification of Autocorrelation Theorem
8. Parametric methods (Yule-Walker and Burg) of Power Spectrum Estimation
9. Estimation of data series using Nth order Forward Predictor and comparing to the Original Signal
10. Design of LPC filter using Levinson-Durbin Algorithm
11. Computation of Reflection Coefficients using Schur Algorithm
12. To study Finite Length Effects using Simulink
13. ECG signal compression
14. Design and verification of Matched filter
15. Adaptive Noise Cancellation using Simulink
16. Design and Simulation of Notch Filter to remove 60Hz Hum/any unwanted frequency component of given Signal (Speech/ECG)

SCRIPTING LANGUAGES LABORATORY

M.Tech. I Year II-Semester

L	T	P	C
0	0	4	2

Prerequisites: Students should install Python on Linux platform.

List of Programs

Part: I
Preliminary Exercises:

1. To demonstrate different number data types in Python.
2. To perform different Arithmetic Operations on numbers in Python.
3. To create, concatenate and print a string and accessing sub-string from a given string.
4. Write a python script to print the current date in the following format "Sun May 29 02:26:23 IST 2017"
5. To demonstrate working with dictionaries in python.
6. To find largest of three numbers.
7. Write a Python program to construct the a pattern, using a nested for loop.
8. Write a Python script that prints prime numbers less than 20.
9. To convert temperatures to and from Celsius, Fahrenheit.

Part: II

10. To create, append, and remove lists in python.
11. To demonstrate working with tuples in python.
12. To find factorial of a number using Recursion.
13. Write a Python class to implement pow(x, n)
14. Write a script named copyfile.py. This script should prompt the user for the names of two text files. The contents of the first file should be input and written to the second file.
15. Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.
16. Write a Python class to find the frequency of each alphabet (of any language) in the given text document.

RESEARCH METHODOLOGY AND IPR

M.Tech. I Year I Semester

L	T	P	C
2	0	0	2

Course Objectives

1. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
2. Follow research related information
3. Understanding that when IPR would take such important place in growth of individuals and nation, it is needless to emphasis the need of information about intellectual Property Right to be promoted among students in general & engineering in particular.
4. Understand that IPR protection leads to economic growth and social benefits

Course Outcomes

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research problem formulation.
3. Understand the IPR protection provides incentive top inverters for further research work and investment in R & D.
4. Understand that IPR protection leads to creation of new and better products.

UNIT I

Meaning of research problem, sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, approaches of investigation of solutions for research problem.

UNIT II

Data collection, analysis, interpretation, necessary instrumentations, Effective literature studies approaches, analysis Plagiarism, and Research ethics

UNIT III

Effective technical writing, how to write report, paper, Developing a research proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT IV

Nature of Intellectual property

Patents, Designs, Trade, Copyright, copy left, copy right, creative commence, Process of Patenting and Development - technological research, innovation, patenting, development. International Scenario- International cooperation on intellectual property, Procedure for grants of patents, Patenting under PCT.

UNIT V

Patents Rights

Scope of Patents Rights, Licensing and transfer of technology, Patents information and databases, Geographical Indications, Administration of Patent System, New developments in

IPR - IPR of Biological Systems, Computer Software etc., Traditional Knowledge Case Studies.

REFERENCES

1. Stuart Melville and Wayne Goddard, " Research methodology: An introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, " Research methodology: An introduction"
3. Ranjit Kumar, 2ND Edition, " Research methodology: A Step by Step Guide for beginners"
4. Halbert, " Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall, " Industrial Design", McGraw Hill, 1992.
6. Niebel, " Product Design", McgRAW Hill, 1974.
7. Asimov, " Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age". 2016.
9. T. Ramappa, " Intellectual Property Rights Under WTO", S. Chand, 2008

ADAPTIVE SIGNAL PROCESSING

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Digital Signal Processing

Course Objectives

The main objectives of the course are:

1. This course focuses on problems algorithms and solutions for processing signals in an manner that is responsive to a changing environment.
2. To develop systems on recursive, model based estimation methods taking the advantage of the statistical properties of the received signals.
3. To analyze the performance of adaptive filters and considers the application of the theory to a variety of practical problems such as beam forming and echo cancellation signal.
4. To understand innovation process, Kalman filter theory and estimation of state using the innovation process, concept of Kalman Gain and Filtering.

Course Outcomes

After studying the course, the student is expected to be able to :

1. Design and apply optimal minimum mean square estimators and in particular linear estimators.
2. Understand and compute their expected performance and verify it.
3. Design, implement and apply Wiener Filters (FIR, non-casual, causal) and evaluate their performance.
4. To understand innovation process, Kalman filter theory and estimation of state using the Innovation Process, concept of Kalman Gain and Filtering.
5. Design, implement and apply LMS, RLS and Kalman filters to given applications.

UNIT –I

Introduction to Adaptive Systems

Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response Performance function - Gradient & Mean Square Error.

UNIT –II

Development of Adaptive Filter Theory & Searching the Performance surface

Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonally - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance - Minimum Mean Square Error.

UNIT –III

Steepest Descent Algorithms

Searching the performance surface – Methods & Ideas of Gradient Search methods - Gradient Searching Algorithm & its Solution - Stability & Rate of convergence - Learning Curves Gradient Search by Newton’s Method, Method of Steepest Descent, Comparison of Learning Curves.

UNIT –IV

LMS Algorithm & Applications

Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm.

Applications: Noise cancellation – Cancellation of echoes in long distance telephone circuits, Adaptive Beam forming.

UNIT –V

Kalman Filtering

Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Examples using Kalman filtering.

TEXT BOOKS

1. Adaptive Signal Processing - Bernard Widrow, Samuel D.Strearns, PE, 2005.
2. Adaptive Filter Theory - Simon Haykin-, 4th Ed., PE Asia 2002.

REFERENCES

1. Optimum signal processing: An introduction - Sophocles.J.Orfamadis, 2 Ed., McGraw-Hill, Newyork, 1988.
2. Adaptive signal processing-Theory and Applications, S.Thomas Alexander, Springer – Verlag, 1986.
3. Siganl analysis – Candy, Mc Graw Hill Int. Student Edition
4. James V. Candy, Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988.

WIRELESS COMMUNICATIONS AND NETWORKS

M.Tech. I Year II-Semester **L T P C**

3 0 0 3

Prerequisite: Digital Communications

Course objectives

The course objectives are:

1. To provide the students with the fundamental treatment about many practical and theoretical concepts that forms basic of wireless communications.
2. To equip the students with various kinds of wireless networks and its operations.
3. To provide an analytical perspective on the design and analysis of the traditional and emerging wireless networks, and to discuss the nature of, and solution methods to, the fundamental problems in wireless networking.
4. To train students to understand the architecture and operation of various wireless wide area networks such as GSM, IS-95, GPRS and SMS.

Course Outcomes

Upon completion of the course, the student will be able to:

1. Understand cellular system design concepts.
2. Analyze various multiple access schemes used in wireless communication.
3. Demonstrate wireless Local and Wide area networks and their specifications.
4. Familiar with some of the existing and emerging wireless standards.
5. Understand the concept of orthogonal frequency division multiplexing.

UNIT -I

The Cellular Concept-System Design Fundamentals

Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

UNIT –II

Mobile Radio Propagation: Large-Scale Path Loss

Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Rice Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

UNIT –III

Mobile Radio Propagation: Small –Scale Fading and Multipath

Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received

power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT -IV

Equalization and Diversity

Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT -V

Wireless Networks

Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11,IEEE 802.11 Medium Access Control, Comparision of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

TEXT BOOKS

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE
4. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

REFERENCES

1. Wireless Digital Communications – Kamilo Feher, 1999, PHI.
2. Wireless Communication and Networking – William Stallings, 2003, PHI.

IMAGE AND VIDEO PROCESSING
(PE – 3)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Digital Signal Processing

Course Objectives

1. The student will be able to understand the quality improvement methods of Image.
2. To study the basic digital image and video filter operations.
3. Understand the fundamentals of Image Compression.
4. Understand the Representation of video, principles and methods of motion estimation.

Course Outcomes

On completion of this course student will be able to

1. Learn the image representation, and fundamental processing steps of an image.
2. Know the different enhancement techniques in both spatial and frequency domains.
3. Understand the importance of compression and different compression techniques.
4. Learn the representation, modeling and motion estimation of Video.

UNIT – I

Fundamentals of Image Processing and Image Transforms

Basic steps of Image Processing System Sampling and Quantization of an image, Basic relationship between pixels.

Image Segmentation

Segmentation concepts, Point, Line and Edge Detection, Thresholding, Region based segmentation.

UNIT – II

Image Enhancement

Spatial domain methods: Histogram processing, Fundamentals of Spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

Frequency domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, Selective filtering.

UNIT – III

Image Compression

Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, , Bit plane coding, Transform coding, Predictive coding, Wavelet coding, Lossy Predictive coding, JPEG Standards.

UNIT - IV

Basic Steps of Video Processing

Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT – V

2-D Motion Estimation

Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

TEXT BOOKS

1. Digital Image Processing – Gonzaleze and Woods, 4rd Ed., Pearson, 2018.
2. Digital Video Processing – M. Tekalp, Prentice Hall International

REFRENCE BOOKS

1. Video Processing and Communication – Yao Wang, Joem Ostermann and Ya–quin Zhang. 1st Ed., PH Int.
2. Digital Image Processing – S.Jayaraman, S.Esakkirajan, T.Veera Kumar –TMH, 2009

PATTERN RECOGNITION AND MACHINE LEARNING
(PE - 3)

M.Tech. I Year II-Semester **L T P C**

3 0 0 3

Prerequisite: NIL

Course Objectives

1. The student will be able to understand the mathematical formulation of patterns.
2. To study the various linear models.
3. Understand the basic classifiers.
4. Can able to distinguish different models.

Course Outcomes

On completion of this course student will be able to

1. Learn the basics of pattern classes and functionality.
2. Construct the various linear models.
3. Understand the importance kernel methods.
4. Learn the Markov and Mixed models.

UNIT-I

Introduction to Pattern recognition

Mathematical Formulation and Basic Functional Equation, Reduction of Dimensionality, Experiments in Pattern Classification, Backward Procedure for Both Feature Ordering- and Pattern Classification, Suboptimal Sequential Pattern Recognition , Nonparametric Design of Sequential Pattern Classifiers , Analysis of Optimal Performance and a Multiclass Generalization

UNIT-II

Linear Models

Linear Basis Function Models -Maximum likelihood and least squares, Geometry of least squares , Sequential learning, Regularized least squares, Multiple outputs , The Bias-Variance Decomposition, Bayesian Linear Regression -Parameter distribution, Predictive ,Equivalent , Bayesian Model Comparison, Probabilistic Generative Models-Continuous inputs , Maximum likelihood solution, Discrete features, Exponential family, Probabilistic Discriminative Models - Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions

UNIT-III

Kernel Methods

Constructing Kernels, Radial Basis Function Networks - Nadaraya-Watson model, Gaussian Processes -Linear regression revisited, Gaussian processes for regression, Learning the hyper parameters, Automatic relevance determination, Gaussian processes for classification, Laplace approximation, Connection to neural networks, Sparse Kernel Machines- Maximum Margin Classifiers, Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, SVMs for regression, Computational learning theory, Relevance Vector Machines- RVM for regression, Analysis of sparsity, RVM for classification

UNIT-IV

Graphical Models

Bayesian Networks, Example: Polynomial regression, Generative models, Discrete variables, Linear-Gaussian models, Conditional Independence- Three example graphs, D-separation, Markov Random Fields -Conditional independence properties, Factorization properties, Illustration: Image de-noising, Relation to directed graphs, Inference in Graphical Models- Inference on a chain, Trees, Factor graphs, The sum-product algorithm, The max-sum algorithm, Exact inference in general graphs, Loopy belief propagation, Learning the graph structure.

UNIT-V

Mixture Models and EM algorithm

K-means Clustering-Image segmentation and compression, Mixtures of Gaussians-Maximum likelihood, EM for Gaussian mixtures, An Alternative View of EM- Gaussian mixtures revisited, Relation to K-means, Mixtures of Bernoulli distributions, EM for Bayesian linear regression, The EM Algorithm in General, Combining Models- Tree-based Models, Conditional Mixture Models- Mixtures of linear regression models, Mixtures of logistic models, Mixtures of experts.

TEXT BOOKS

1. Sequential methods in Pattern Recognition and Machine Learning-K.S.Fu, Academic Press, volume no.52.
2. Pattern Recognition and Machine Learning- C. Bishop-Springer,2006.

REFERENCES

1. Pattern Classification- Richard o. Duda, Peter E. hart, David G. Stork, John Wiley& Sons, 2nd Ed., 2001.
2. The elements of Statistical Learning- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, Springer, 2nd Ed., 2009.

CODING THEORY AND TECHNIQUES
(PE - 3)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Digital Communications

Course Objectives
1. To acquire the knowledge in measurement of information and errors.
2. T study the generation of various code methods.
3. To study the various application of codes.

Course Outcomes
On completion of this course student will be able to

1. Learning the measurement of information and errors.
2. Obtain knowledge in designing Linear Block Codes and Cyclic codes.
3. Construct tree and trellies diagrams for convolution codes
4. Design the Turbo codes and Space time codes and also their applications

UNIT – I
Coding for Reliable Digital Transmission and storage
Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

Linear Block Codes
Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system

UNIT - II
Cyclic Codes
Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding ,Cyclic Hamming Codes, Shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

UNIT – III

Convolutional Codes

Encoding of Convolutional Codes, Structural and Distance Properties, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

UNIT – IV

Turbo Codes

LDPC Codes- Codes based on sparse graphs, Decoding for binary erasure channel, Log-likelihood algebra, Brief propagation, Product codes, Iterative decoding of product codes, Concatenated convolutional codes- Parallel concatenation, The UMTS Turbo code, Serial concatenation, Parallel concatenation, Turbo decoding

UNIT - V

Space-Time Codes

Introduction, Digital modulation schemes, Diversity, Orthogonal space- Time Block codes, Alamouti's schemes, Extension to more than Two Transmit Antennas, Simulation Results, Spatial Multiplexing : General Concept, Iterative APP Preprocessing and Per-layer Decoding, Linear Multilayer Detection, Original BLAST Detection, QL Decomposition and Interface Cancellation, Performance of Multi – Layer Detection Schemes, Unified Description by Linear Dispersion Codes.

TEXT BOOKS

1. Error Control Coding- Fundamentals and Applications –Shu Lin, Daniel J.Costello,Jr, Prentice Hall, Inc.
2. Error Correcting Coding Theory-Man Young Rhee, McGraw-Hill,1989.

REFERENCES

1. Digital Communications-Fundamental and Application - Bernard Sklar, PE.
2. Digital Communications- John G. Proakis, 5th ed. TMH, 2008.
3. Error Correction Coding – Mathematical Methods and Algorithms – Todd K.Moon, Wiley India, 2006.
4. Information Theory, Coding and Cryptography – Ranjan Bose, 2nd Edition, TMH, 2009.

SPEECH AND AUDIO SIGNAL PROCESSING
(PE-3)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Advanced Digital Signal Processing

Course Objectives

The objectives of this course are to make the student

1. Understand the anatomy and Physiology of Speech Production system
2. To analyze the speech in time domain and extract various time domain parameters
3. To study various Speech Signal Processing applications viz: Speech Enhancement, Speech Recognition, Speaker Recognition.
4. To study various Audio coding techniques based on perceptual modeling of the human ear.

Course Outcomes

On completion of this course student will be able to

1. Model an electrical equivalent of Speech Production system.
2. Extract the LPC coefficients that can be used to Synthesize or compress the speech.
3. Design a Homomorphic Vocoder for coding and decoding of speech.
4. Understand the concepts of Speech and Spreakar Recognization systems.
5. Design basic audio coding methods for audio signal.

UNIT – I

Fundamentals of Digital Speech Processing: Anatomy & Physiology of Speech Organs, The Process of Speech Production, The Acoustic theory of speech production- Uniform lossless tube model, effect of losses in vocal tract, effect of radiation at lips, Digital models for speech signals. **Perception** : Anatomical pathways from the Ear to the Perception of Sound, The Peripheral Auditory system, Hair Cell and Auditory Nerve Functions, Properties of the Auditory Nerve. Block schematics of the Peripheral Auditory system.

UNIT – II

Time Domain models for Speech Processing: Introduction – Window considerations, Short time energy, average magnitude, average zero crossing rate, Speech vs Silence discrimination using energy and zero crossing, pitch period estimation using a parallel processing approach, the

short time autocorrelation function, average magnitude difference function, pitch period estimation using the autocorrelation function.

Linear Predictive Coding (LPC) Analysis : Basic principles of Linear Predictive Analysis : The Autocorrelation Method, The Covariance method, Solution of LPC Equations : Cholesky Decomposition Solution for Covariance Method, Durbin's Recursive Solution for the Autocorrelation Equations, comparison between the methods of solution of the LPC Analysis Equations, Applications of LPC Parameters : Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.

UNIT – III

Homomorphic Speech Processing

Introduction , Homomorphic Systems for Convolution : Properties of the Complex Cepstrum, Computational Considerations , The Complex Cepstrum of Speech, Pitch Detection , Formant Estimation, The Homomorphic Vocoder.

Speech Enhancement

Speech enhancement techniques : Single Microphone Approach, Spectral Subtraction, Enhancement by re-synthesis, Comb filter, Wiener filter, Multi Microphone Approach.

UNIT – IV

Automatic Speech Recognition

Basic pattern recognition approaches, parametric representation of Speech, Evaluating the similarity of Speech patterns, Isolated digit Recognition System, Continuous word Recognition system. Elements of HMM, Training & Testing of Speech using HMM.

Automatic Speaker Recognition

Recognition techniques, Features that distinguish speakers, MFCC, delta MFCC, Speaker Recognition Systems: Speaker Verification System , Speaker Identification System, Performance Metrics.

UNIT – V

Audio Coding

Lossless Audio Coding, Lossy Audio coding, Psychoacoustics , ISO-MPEG-1 Audio coding , MPEG - 2 Audio coding, MPEG - 2 Advanced Audio Coding, MPEG - 4 Audio Coding.

TEXT BOOKS

1. Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2. Digital Audio Signal Processing – Udo Zolzer, 2nd Edition, Wiley.

REFERNCES

1. Discrete Time Speech Signal Processing: Principles and Practice - Thomas F. Quateri, 1st Ed., PE.
2. Digital Processing of Speech Signals. L.R Rabinar and R W Jhaung, PHI, 1978.
3. Speech Communications: Human & Machine - Douglas O'Shaughnessy, 2nd Ed., EEE Press.

4. Speech & Audio Signal Processing- Ben Gold & Nelson Morgan, 1st Ed., Wiley

COMMUNICATION TECHNOLOGIES
(PE-4)

M.Tech. I Year II Semester

L	T	P	C
3	0	0	3

Pre-requisite: None

Course Objectives

1. To know about Second Generation and Third Generation Cellular technologies
2. To study the Evolution Generation(2.5G) technology platforms,
3. To learn about OFDM modulation technique and their evaluation parameters.
4. To understand UWB wireless channels, data modulation and its features.

Course Outcomes

Upon completing this course, the student will be able to
1. Compare various Generation technologies and their architectures.
2. Understand evolution of Generations and data transmission.
3. Get the knowledge of OFDM and evaluate the performance using channel model and SNR, issues regarding OFDM.
4. Acquire the knowledge about UWB wireless channels, data modulation and their features.

UNIT I
Second Generation (2G)
Overview, Enhancements over 1G Systems, Integration with Existing 1G Systems, GSM, IS-136 System Description, IS-95 System Description, iDEN (Integrated Dispatch Enhanced Network), CDPD

UNIT II
Evolution Generation (2.5G)
Enhancements over 2G, Technology Platforms, General Packet Radio Service, (GPRS), Enhanced Data Rates for Global Evolution (EDGE),High-Speed Circuit Switched Data (HSCSD), CDMA2000 (1XRTT), WAP, Migration Path from 2G to 2.5G to 3G,

UNIT III
Third Generation (3G)

Universal Mobile Telecommunications Service (UMTS), UMTS Services, The UMTS Air Interface, Overview of the 3GPP Release 1999 Network Architecture, Overview of the 3GPP Release 4 Network Architecture, Overview of the 3GPP Release 5 All-IP Network Architecture, Overview CDMA2000, Commonality Between, DMA/CDMA2000/CDM

UNIT IV
OFDM
Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues – PAPR, Frequency and Timing Offset Issues, 4G standards.

UNIT V
UWB
UWB Definition and Features, UWB Wireless Channels, UWB Data Modulation, Uniform Pulse Train.

TEXT BOOKS

1. 3G Wireless Networks- Clint Smith, P.E. Daniel Collins, 2nd Ed., 2013.

REFERENCES

1. 3G Networks Architecture- Protocols and Procedures- Sumith Kaseara, Nishit Narang, MGH, 2004.
2. Mobile Cellular Communication , Gottapu Sasibhuhsana Rao, PEARSON, 2013.

SPREAD SPECTRUM COMMUNICATIONS
(PE – 4)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Digital Communications

Course Objectives

The objectives of this course are to make the student

1. Understand the concept of Spread Spectrum and study various types of Spread spectrum sequences and their generation.
2. Understand the principles of Code Division Multiple Access (CDMA) and use of Spread spectrum concept in CDMA
3. Understand various Code tracing loops for optimum tracking of wideband signals viz spread spectrum signals
4. Understand the procedure for synchronization of receiver for receiving the Spread spectrum signal.
5. Study the performance of spread spectrum systems in Jamming environment, systems with Forward Error Correction and Multiuser detection in CDMA cellular radio.

Course Outcomes

On completion of this course student will be able to

1. Generate various types of Spread spectrum sequences and can simulate CDMA system (Both Transmitter & Receiver).
2. Analyze the performance of Spread spectrum systems in Jamming environment and systems with Forward Error Correction.
3. Can provide detection and cancellation schemes for Multi-user's in CDMA cellular radio.

UNIT -I

Introduction to Spread Spectrum Systems

Fundamental Concepts of Spread Spectrum Systems, Pseudo Noise Sequences, Direct Sequence Spread Spectrum, Frequency Hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access.

Binary Shift Register Sequences for Spread Spectrum Systems
Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximal Length Sequences, Gold Codes.

UNIT -II
Code Tracking Loops
Introduction, Optimum Tracking of Wideband Signals, Base Band Delay-Lock Tracking Loop, Tau-Dither Non- Coherent Tracking Loop, Double Dither Non-Coherent Tracking Loop.

UNIT -III
Initial Synchronization of the Receiver Spreading Code
Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter, Synchronization by Estimated the Received Spreading Code.

UNIT -IV
Cellular Code Division Multiple Access (CDMA) Principles
Introduction, Wide Band Mobile Channel, The Cellular CDMA System, Single User Receiver in a Multi User Channel, CDMA System Capacity,
Multi-User Detection in CDMA Cellular Radio
Optimal Multi-User Detection, Linear Suboptimal Detectors, Interference Combat Detection Schemes, Interference Cancellation Techniques.

UNIT -V
Performance of Spread Spectrum Systems in Jamming Environments
Spread Spectrum
Communication System Model, Performance of Spread Spectrum Systems without Coding.
Performance of Spread Spectrum Systems with Forward Error Correction
Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit-Error Rate.

TEXT BOOKS

1. Rodger E Ziemer, Roger L. Peterson and David E Borth - "Introduction to Spread Spectrum Communication- Pearson, 1st Edition, 1995.
2. Mosa Ali Abu-Rgheff – "Introduction to CDMA Wireless Communications." Elsevier Publications, 2008.

REFERENCES

1. George R. Cooper, Clare D. Mc Gillem - "Modern Communication and Spread Spectrum," McGraw Hill, 1986.
2. Andrew j. Viterbi - "CDMA: Principles of spread spectrum communication," Pearson Education, 1st Edition, 1995.
3. Kamilo Feher - "Wireless Digital Communications," PHI, 2009.
4. Andrew Richardson - "WCDMA Design Handbook," Cambridge University Press, 2005.

5. Steve Lee - Spread Spectrum CDMA, McGraw Hill, 2002.

AD-HOC AND WIRELESS SENSOR NETWORKS
(PE- 4)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Wireless Sensor Networks

Course Objectives

The objectives of this course are to make the student
1. To study the fundamentals of wireless Ad-Hoc Networks.
2. To study the operation and performance of various Adhoc wireless network protocols.
3. To study the architecture and protocols of Wireless sensor networks.

Course Outcomes

On completion of this course student will be able to
1. Students will be able to understand the basis of Ad-hoc wireless networks.
2. Students will be able to understand design, operation and the performance of MAC layer protocols of Adhoc wireless networks.
3. Students will be able to understand design, operation and the performance of routing protocol of Adhoc wireless network.
4. Students will be able to understand design, operation and the performance of transport layer protocol of Adhoc wireless networks.
5. Students will be able to understand sensor network Architecture and will be able to distinguish between protocols used in Adhoc wireless network and wireless sensor networks.

UNIT - I

Wireless LANs and PANs: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards, HIPERLAN Standard, Bluetooth, Home RF.

AD HOC WIRELESS NETWORKS: Introduction, Issues in Ad Hoc Wireless Networks.

UNIT - II

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation

Mechanisms, Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocols that use Directional Antennas, Other MAC Protocols.

UNIT - III

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – Demand Routing Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT – IV

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for Ad Hoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT – V

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS

1. Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press.

REFERENCES

1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh , 1st Ed. Pearson Education.
2. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

MULTI-MEDIA AND SIGNAL CODING
(PE-4)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

Prerequisite: Artificial Neural Networks and Fuzzy Systems.

Course Objectives

This course makes the students to Understand
1. Various image & video processing algorithms.
2. Various video compression techniques.
3. Various audio compression techniques.

Course Outcomes

On completion of this course the students will be able to
1. Represent and convert various colour models.
2. Simulate various video compression image techniques and can suggest the appropriate video compression techniques for specific application.
3. Simulate various audio compression techniques and can suggest the appropriate audio compression method for specific application.

UNIT -I
Introduction to Multimedia
Multimedia, World Wide Web, Overview of Multimedia Tools, Multimedia Authoring, Graphics/ Image Data Types, and File Formats.

Color in Image and Video
Color Science – Image Formation, Camera Systems, Gamma Correction, Color Matching Functions, CIE Chromaticity Diagram, Color Monitor Specifications, Out-of-Gamut Colors, White Point Correction, XYZ to RGB Transform, Transform with Gamma Correction, L*A*B* Color Model. Color Models in Images – RGB Color Model for CRT Displays, Subtractive Color: CMY Color Model, Transformation from RGB to CMY, Under Color Removal: CMYK System, Printer Gamuts, Color Models in Video – Video Color Transforms, YUV Color Model, YIQ Color Model, Ycbcr Color Model.

UNIT -II

Video Concepts

Types of Video Signals, Analog Video, Digital Video.

Audio Concepts

Digitization of Sound, Quantization and Transmission of Audio.

UNIT -III

Compression Algorithms

Lossless Compression Algorithms

Run Length Coding, Variable Length Coding, Arithmetic Coding, Lossless JPEG, Image Compression.

Lossy Image Compression Algorithms: Transform Coding: KLT And DCT Coding, Wavelet Based Coding.

Image Compression Standards: JPEG and JPEG2000.

UNIT -IV

Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261- Intra-Frame and Inter-Frame Coding, Quantization, Encoder and Decoder, Overview of MPEG1 and MPEG2.

UNIT -V

Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders – Phase Insensitivity, Channel Vocoder, Formant Vocoder, Linear Predictive Coding, CELP, Hybrid Excitation Vocoders, MPEG Audio – MPEG Layers, MPEG Audio Strategy, MPEG Audio Compression Algorithms, MPEG-2 AAC, MPEG-4 Audio.

TEXT BOOKS

1. Fundamentals of Multimedia – Ze- Nian Li, Mark S. Drew, PHI, 2010.
2. Multimedia Signals & Systems – Mrinal Kr. Mandal Springer International Edition 1st Edition, 2009

REFERENCES

1. Multimedia Communication Systems – Techniques, Stds& Netwroks K.R. Rao, Zorans. Bojkoric, Dragorad A.Milovanovic, 1st Edition, 2002.
2. Fundamentals of Multimedia Ze- Nian Li, Mark S.Drew, Pearson Education (LPE), 1st Edition, 2009.
3. Multimedia Systems John F. Koegel Bufond Pearson Education (LPE), 1st Edition, 2003.
4. Digital Video Processing – A. Murat Tekalp, PHI, 1996.
5. Video Processing and Communications – Yaowang, Jorn Ostermann, Ya-QinZhang, Pearson, 2002.
6. Judith Jeffocate, "*Printmedia in practice (Theory and Applications)*", PHI, 1998.

COMMUNICATION AND NETWORKS LABORATORY

M.Tech. I Year II Semester

L	T	P	C
0	0	4	2

List of Programs

1. Simulation and analysis of MAC Layer protocols.
2. Simulation and analysis of various topologies.
3. Simulation and analysis of wired routing protocols.
4. Simulation and analysis of wireless routing protocols.
5. Simulation and analysis of various security attacks.
6. Analysis of log files and provides the intruder statistics.
7. Simulation of Queue Management Schemes.
8. Evaluation of DES, AES and Triple-DES.
9. Evaluation of Substitution and Transposition ciphers.
10. Study of I2C and UART protocols.
11. Setting up of node to emulate RPL border router protocol
12. Collecting sensor values of remote nodes using RPL border router

SIMULATION LABORATORY

M.Tech. I Year II-Semester

L	T	P	C
0	0	4	2

Note:

Minimum of 10 Experiments have to be conducted

1. Plotting the Sensor data over a specific time interval
2. Simulate spatially separated target signal in the presence of Additive Correlated White Noise.
3. Simulate spatially separated target signal in the presence of Additive Uncorrelated White Noise.
4. Simulate spatially separated target signal in the presence of Additive Correlated Colored Noise.
5. Design a two class classifier using SVM/ Bayes classifier
6. Evaluate the performance of Bayes/ MAP estimator.
7. Error correcting coding in CDMA Mobile communication system.
8. Capturing and tracking of GOLD sequence in CDMA system.
9. Study of Satellite Azimuth & Elevation using sky Plot Window.
10. Study of Global Positioning System Applications.
11. Estimation of data series using Nth order forward predictor and comparing to the original signal.

HIGH PERFORMANCE NETWORKS
(PE-5)

M.Tech. I Year III-Semester

L	T	P	C
3	0	0	3

Prerequisite: Computer Networks

Course Objectives

At the end of the course, the students will be able to:

1. Understand the architecture and functioning of wireless LANs and Adhoc Networks.
2. Know the importance of QoS and techniques to improve QoS in wired and Adhoc Networks.
3. Understand the Mac and Network layer QoS solutions
4. Understand various QoS models and energy management techniques in adhoc wireless networks.
5. Understand the architecture, functioning and protocols of wireless sensor networks and the recent advances in wireless networks.

Course Outcomes

After completing this course the student must demonstrate the knowledge and ability to

1. Analyze Mac and Network layers of wireless LANs.
2. Understand the various techniques to improve QoS issues and challenges in providing QoS in Wireless networks.
3. Analyze and compare Mac and Network layer QoS Solutions
4. Compare the performance of various QoS models and energy management techniques suggested for adhoc networks.
5. Analyze and compare various data dissemination techniques of wireless sensor networks and also understand the functioning of ultra wide band radio communications and wireless fidelity systems.

UNIT I

Wireless LANs

Fundamentals of WLANs, Technical Issues, Differences Between Wireless and Wired Transmission, Use of WLANs, Design Goals, Network Architecture, Infrastructure Based Versus Ad Hoc LANs Components in a TypicalIEEE802.11 Network, Services Offered by a TypicalIEEE802.11 Network,, IEEE802.11 standard, , MAC Sub layer, Addressing Mechanism, Physical Layer

Ad Hoc Wireless Networks

Cellular and Ad hoc Wireless Networks, Application of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks

UNIT II

Quality of Service(QoS) Techniques to Improve QoS Scheduling, Traffic Shaping, Resource Reservation, Admission Control, Integrated Services- Signaling, Flow Specification, Admission, Service Classes, RSVP, Problems with Integrated Services , Differentiated Services

Quality of Service in Ad Hoc Wireless Networks

Real-Time Traffic Support in Ad Hoc Wireless Networks, QoS Parameters in Ad Hoc Wireless Networks, Issues and Challenges In Providing QoS in Ad Hoc Wireless Networks, Classifications of QoS solutions- Classifications of QoS Approaches, Layer-Wise Classification of Existing QoS Solutions

UNIT III

MAC layer and Network Layer QoS Solutions

MAC Layer Solutions

Cluster TDMA, IEEE802.11e, IEEE802.11, MAC Protocols- Distributed Coordination Function, Point Coordination Function, QoS Support Mechanisms of IEEE802.11e, Enhanced Distributed Coordination Function, Hybrid Coordination Function

Network Layer Solutions
QoS Routing Protocols, Ticket-Based QoS Routing Protocol, Predictive Location-Based QoS Routing Protocol, Trigger-Based Distributed QoS Routing Protocol, QoS-Enabled Ad Hoc On-Demand Distance Vector Routing Protocol, Bandwidth Routing Protocol, On-Demand QoS Routing Protocol, On-Demand Link-State Multipath QoS Routing Protocol, Asynchronous Slot Allocation Strategies

UNIT IV
QoS Models
QoS frame work for Ad Hoc Wireless Networks. QoS Models, QoS Resource Reservation Signaling, INSIGNIA, INORA, SWAN Models.

Energy management in Ad hoc wireless networks
Need for Energy management in Adhoc wireless networks, classification of Energy management schemes, Battery management schemes Transmission power management schemes

UNIT V
Wireless Sensor Networks
Introduction, Application of Sensor Network , Comparison with Ad hoc Wireless Networks, Issues and challenges in Designing a Sensor Network, Sensor Network Architecture, Layer Architecture, Cluster Architecture, Data Dissemination: Flooding, Gossiping, Rumor Routing, Sequential Assignment Routing, Direct Diffusion, Sensor Protocols for Information via Negotiation, Data Gathering, Direct Transmission, Power Efficient Gathering for Sensor Information Systems, Binary Scheme, Chain Based Three-Level Scheme.

Ultra-Wide-Band Radio Communication
Operation of UWB Systems, A Comparison of UWB with Other Technologies, Major Issues in UWB, Physical Layer, MAC Layer, Advantages and Disadvantages of UWB
Wireless Fidelity Systems, Systems, Issues, Security, Authentication, Quality of Service (QoS),Economics of Wi-Fi, Spectrum Issues, Interoperability of Wi-Fi Systems

TEXT BOOKS

1. Ad Hoc Wireless Networks Architectures and Protocols C. Siva Ram Murthy B.S. Manoj, Prentice Hall, 6th Ed, 2008.
2. Data Communications and Networking - B. A. Forouzan, 5th Ed., TMH, 2013.

REFERENCES

1. Ad Hoc and Sensor Networks Theory and Appications- Carols de Morais Cordeiro and Dharma prakash Agrawal, World Scientific

2. Wireless and Mobile Networks Concepts and Protocols- Dr. Sunil Kumar S. Manvi and Mahabaleshwar S. Kakkasageri.
3. Computer Networks, Andrew S. Tanenbaum, 4 th Ed., Prentice Hall.
4. Data and Computer Communications - William Stallings, 8th Ed., PHI, 2007.

SOFTWARE DEFINED RADIO
(PE-5)

M.Tech. I Year III-Semester **L T P C**

Prerequisite: TCP/ IP, Digital Signal Processing

Course Objectives

The objectives of this course is

1. To provide fundamentals and state of the art concepts in software defined radio.

Course Outcomes

On completion of this course, the students:

1. Understand the design principles of software defined radio.
2. Understand the analog RF components as front end block in implementation of SDR.
3. Understand digital hardware architectures and development methods.
4. Understand the radio recourse management in heterogeneous networks.
5. Understand the object oriented representation of radio and network resources.

UNIT –I

Introduction

The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.

UNIT –II

Profile and Radio Resource Management

Communication Profiles- Introduction, Communication Profiles, Terminal Profile, Service Profile , Network Profile, User Profile, Communication Profile Architecture, Profile Data Structure, XML Structure, Distribution of Profile Data, Access to Profile Data, Management of Communication Profiles, Communication Classmarks, Dynamic Classmarks for Reconfigurable Terminals, Compression and Coding, Meta Profile Data

UNIT –III

Radio Resource Management in Heterogeneous Networks

Introduction, Definition of Radio Resource Management, Radio Resource Units over RRM Phases, RRM Challenges and Approaches, RRM Modelling and Investigation Approaches, Investigations of JRRM in Heterogeneous Networks, Measuring Gain in the Upper Bound Due to JRRM, Circuit-Switched System, Packet-Switched System, Functions and Principles of JRRM, General Architecture of JRRM, Detailed RRM Functions in Sub-Networks and Overall Systems

UNIT –IV

Reconfiguration of the Network Elements

Introduction, Reconfiguration of Base Stations and Mobile Terminals, Abstract Modelling of Reconfigurable Devices, the Role of Local Intelligence in Reconfiguration, Performance Issues, Classification and Rating of Reconfigurable Hardware, Processing Elements, Connection Elements, Global Interconnect Networks, Hierarchical Interconnect Networks, Installing a New Configuration, Applying Reconfiguration Strategies, Reconfiguration Based on Comparison, Resource Recycling, Flexible Workload Management at the Physical Layer, Optimized Reconfiguration, Optimization Parameters and Algorithms, Optimization Algorithms, Specific Reconfiguration Requirements, Reconfiguring Base Stations, Reconfiguring Mobile Terminals

UNIT –V

Object – Oriented Representation of Radios and Network Resources

Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System.

Case Studies in Software Radio Design

Introduction and Historical Perspective, SPEAK easy- JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT.

TEXT BOOKS

1. Software Defined Radio Architecture System and Functions- Markus Dillinger, Kambiz Madani, WILEY, 2003.
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, Wiley Publications, 2002.

REFERENCES

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, PEA Publication, 2002.
2. Software Defined Radio for 3G - Paul Burns, Artech House, 2002.
3. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger, Kambiz Madani, Nancy Alonistioti, Wiley, 2003.
4. Software Radio Architecture: Object Oriented Approaches to wireless System Enginering – Joseph Mitola, III, John Wiley & Sons, 2000.

SOFT COMPUTING TECHNIQUES
(PE - 5)

M.Tech. I Year III-Semester

L	T	P	C
3	0	0	3

Pre-requisite: NIL

Course Objectives

1. To learn design concepts of neural networks.
2. Know the associative memory and ART architectures.
3. Familiarize with utility of fuzzy logic and genetic algorithm.

Course Outcomes

Upon completing this course, the student will be able to

1. Design feed forward and backward neural network architectures.
2. Understand the architectures of associate memory and ART architectures.
3. Utilize fuzzy logic concepts and genetic algorithm.
4. Learn about various types of hybrid systems.

UNIT – I

Fundamentals of Neural Networks & Feed Forward Networks

Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network :The Perceptron Model, Multilayer Feed Forward Neural Network :Architecture of a Back Propagation Network(BPN), The Solution, Backpropagation Learning, Selection of various Parameters in BPN. Application of Back propagation Networks in Pattern Recognition & Image Processing.

UNIT – II

Associative Memories & ART Neural Networks

Basic concepts of Linear Associative, Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks (HPF), Mathematical Foundation of Gradient-Type Hopfield Networks, Transient response of Continuous Time Networks, Applications of HPF in Solution of Optimization Problem: Minimization of the Traveling salesman tour length, Summing networks with digital outputs, Solving Simultaneous Linear Equations, Bidirectional Associative Memory Networks; Cluster Structure, Vector Quantization, Classical ART Networks, Simplified ART Architecture.

UNIT – III

Fuzzy Logic & Systems

Fuzzy sets, Crisp Relations, Fuzzy Relations, Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Defuzzification Methods, Applications: Greg Viot's Fuzzy Cruise Controller, Air Conditioner Controller.

UNIT – IV

Genetic Algorithms

Basic Concepts of Genetic Algorithms (GA), Biological background, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithm.

UNIT – V

Hybrid Systems

Types of Hybrid Systems, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrid, Genetic Algorithm based BPN: GA Based weight Determination, Fuzzy Back Propagation Networks: LR-type fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BPN, Inference by fuzzy BPN.

TEXT BOOKS

1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications - S.Rajasekaran, G.A. Vijayalakshmi Pai, PHI, 2011.
3. Genetic Algorithms by David E. Gold Berg, Pearson Education India, 2006.
4. Neural Networks & Fuzzy Sytems- Kosko.B., PHI, Delhi, 1994.

REFERENCES

1. Artificial Neural Networks - Dr. B. Yagananarayana, , PHI, 1999.
2. An introduction to Genetic Algorithms - Mitchell Melanie, MIT Press, 1998
3. Fuzzy Sets, Uncertainty and Information- Klir G.J. & Folger. T. A., PHI, Delhi, 1993.

RF CIRCUIT DESIGN

M.Tech. I Year III Semester **L T P C**

3 0 0 3

Pre-requisite: NIL

Course Objectives

1. Learn the concepts of RF frequency analysis and component modelling.
2. To give understanding of various types of RF filter circuits.
3. To familiarize the Concept of RF amplifiers and oscillators.

Course Outcomes

Upon completing this course, the student will be able to

1. Understand High Frequency Analysis.
2. Understand the concepts of component modelling and biasing networks.
3. Design the various RF filters, amplifiers, oscillators and mixers.

UNIT I

Introduction

Importance of RF design dimensions and units frequency spectrum RF behavior of passive components: high frequency resistors, high frequency capacitors, high frequency inductor. chip components and circuit board Considerations chip resistors chip capacitors and surface mount inductors.

UNIT II

RF filter design

Scattering parameters: definition, meaning chain, scattering matrix, conversion between S- and Z-parameters, signal flow chart modeling, generalization basic resonator and filter configurations: low pass, high pass, band pass and band stop type filters-filter implementation using unit element and kuroda's identities transformations-coupled filters

UNIT III

Active RF component modeling

RF diode models: nonlinear and linear models transistor models: large signal and small signal BJT models, large signal and small signal FET models-scattering parameters device characterization.

Matching and biasing networks

Impedance Matching using discrete components: Two component matching networks, Forbidden regions, frequency response and quality factor, T and PI matching networks-amplifier classes of operation and biasing networks: classes of operation and efficiency of amplifiers, biasing networks for BJT, biasing networks for FET.

UNIT IV

RF transistor amplifier design

Characteristics of amplifier-amplifier power relations RF sources, transducers power gain, additional power relations-stability consideration: stability circles, unconditional stability and stabilization methods-unilateral and bilateral design for constant gain noise figure circles-constant VSWR circles.

UNIT V

RF oscillators and mixers

Basic oscillator models: Negative resistance oscillator, feedback oscillator design, design steps, quads oscillators- fixed frequency, high frequency oscillator- basic characteristics of mixers: concepts, frequency domain considerations, single ended mixer design, single and double balanced mixers.

TEXTBOOKS

1. RF circuit design- theory and applications - Reinhold Ludwig Pavel bsetchko- pearson education India 2000
2. Radio frequency and microwave communication circuits- analysis and design- devendra k Mishra- wiley student edition- john wiley and sons inc

REFERENCES

1. Radiofrequency and microwave electronics mathew m rarmaneah PEI
2. RF circuit design christoper BOWIK Cheryl aijuni and john butler elsevier science 2008
3. Secrets of RF circuit design joseph jcarr tmh 2000
4. Design of RF and microwave amplifiers and oscillators peter lD
7. Madison abrief artech house 2000.
5. The design of cMOS radio frequency integrated circuits thomas h Lee 2/e Cambridge University Press 2004.

PRINCIPLES OF SIGNAL PROCESSING
(OE- I)

M.Tech. I Year III Semester **L T P C**

3 0 0 3

Pre-requisite: NIL

Course Objectives

1. This gives the basics of Signals and Systems required for all Engineering related courses.
2. To understand the basic characteristics of LTI systems
3. To know the signal transmission requirements.
4. This gives basic understanding of signal statistical properties and noise source concepts.

Course Outcomes

Upon completing this course, the student will be able to

1. Differentiate various signal functions.
2. Understand the characteristics of linear time invariant systems.
3. Understand the concepts sampling theorem.
4. Determine the Spectral and temporal characteristics of Signals.
5. Understand the concepts of Noise in Communication systems.

UNIT I

Signal Analysis: Analogy between Vectors and Signals, Orthogonal Signal Space, Signal approximation using Orthogonal functions, Mean Square Error, Closed or complete set of Orthogonal functions, Orthogonality in Complex functions, Classification of Signals and systems, Exponential and Sinusoidal signals, Concepts of Impulse function, Unit Step function, Signum function.

UNIT II

Signal Transmission through Linear Systems

Linear System, Impulse response, Response of a Linear System, Linear Time Invariant(LTI) System, Linear Time Variant (LTV) System, Transfer function of a LTI System, Filter characteristic of Linear System, Distortion less transmission through a system, Signal bandwidth, System Bandwidth, Ideal LPF, HPF, and BPF characteristics, Convolution and Correlation of Signals, Concept of convolution in Time domain and Frequency domain, Graphical representation of Convolution.

UNIT III

Sampling theorem: Graphical and analytical proof for Band Limited Signals, Impulse Sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Introduction to Band Pass Sampling.

UNIT IV

Temporal characteristics of signals: Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Time Averages and Ergodicity, Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Cross-Correlation Function and Its Properties. Power Spectrum and its Properties, Relationship between Power Spectrum and Autocorrelation Function.

UNIT V

Noise sources: Resistive/Thermal Noise Source, Arbitrary Noise Sources, Effective Noise Temperature, Noise equivalent bandwidth, Average Noise Figures, Average Noise Figure of

cascaded networks, Narrow Band noise, Quadrature representation of narrow band noise & its properties.

TEXT BOOKS

1. Signals, Systems & Communications - B.P. Lathi, B.S. Publications, 2013.
2. Probability, Random Variables & Random Signal Principles - Peyton Z. Peebles, TMH, 4th Ed., 2001.

REFERENCES

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawabi, 2 Ed.
2. Fundamentals of Signals and Systems - Michel J. Robert, MGH, 2008.
3. Random Processes for Engineers-Bruce Hajck, Cambridge unipress,2015
4. Statistical Theory of Communication – S.P Eugene Xavier, New Age Publications, 2003