JNTUH COLLEGE OF ENGINEERING HYDERABAD

(AUTONOMOUS)

M.Tech. (Systems & Signal Processing)

ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE

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	Advanced Digital Signal Processing Lab	0	0	4	2
6	Lab 2	Speech and Image processing Lab	0	0	4	2
7		Research Methodology and IPR	2	0	0	2
8	Aud 1	Audit Course 1: English for Research Paper Writing	2	0	0	0
		Total	**16**	**0**	**8**	**18**

SEMESTER – II

S. No.	Course Type	Course Title	L	T	P	Credits
1	Core 3	Wireless Communications	3	0	0	3
2	Core 4	Wireless 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	Advanced Communication Lab	0	0	4	2
6	Lab 4	Wireless Networks Simulation Lab	0	0	4	2
7		Technical Seminar	0	0	4	2
8	Aud 2	Audit Course 2: Value Education	2	0	0	0
		Total	**14**	**0**	**12**	**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. Coding Theory and Techniques
3. Advanced Data Communications
4. Detection and Estimation Theory

Professional Elective - 2

1. Digital Signal Processors and Controllers
2. Radar Signal Processing
3. Multimedia and Signal Coding
4. Internet Protocols and Technologies.

Professional Elective – 3

1. Image and Video Processing
2. Software Defined Radio
3. Pattern Recognition and Machine Learning
4. RF Circuit Design

Professional Elective – 4

1. Communication and Networking Technologies for IOT
2. Artificial Neural Networks and Deep Learning
3. Bio-Medical Signal Processing
4. Adaptive Signal Processing

Professional Elective – 5

1. Next Generation Communication
2. Speech Signal Processing
3. Adhoc and Wireless Sensor Networks
4. System Design Aspects of IOT

Open Elective

1. 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. Acquire the Knowledge of two dimensional transforms.
2. Analyze the various two dimensional transforms.
3. Understand the significance and applications of wavelet transforms.
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, 4th 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.

CODING THEORY AND TECHNIQUES
(PE - 1)

M.Tech. I Year I-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.

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 learn about characteristics of network layer protocols and functions of interconnecting devices.
5. To study about physical and electrical characteristics of Wired LAN, serial buses and to know about architecture & layers of CAN.

Course Outcomes

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

1. Understand various transmission modes, configurations and topologies of data communication networks.
2. Analyze and compare various error detection and correction techniques of data communication networks.
3. Acquire the knowledge about the features and functions of various medium access control and network layer protocols.
4. Understand the features of WLAN, significance of communication buses, interfaces and interconnecting devices of data communication networks.

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.

Multiplexing

Multiplexing, Frequency Division Multiplexing, Synchronous and Statistical Time Division Multiplexing, OFDM.

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 Checks, Longitudinal Redundancy Checks, Error Correction- Single bit Error Correction, 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).

UNIT IV

N**etworks 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, Router as Packet Switches.

Connecting devices

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

UNIT V

Wired LANS

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

Serial Busses- Cables, Serial busses, serial versus parallel, Data and Control Signal- data frame, data rate, features, Limitations and applications of RS232, RS485, I^2C , SPI

CAN

Architecture- ISO 11898-2, ISO 11898-3, Data Transmission- ID allocation, Bit timing, Layers- Application layers, Object layer, Transfer layer, Physical layer, Frame formats- Data frame, Remote frame, Error frame, Over load frame, Ack slot, Inter frame spacing, Bit spacing, Applications.

TEXT BOOKS

1. Data Communications and Networking - B. A. Forouzan, 2nd & 5th Ed. TMH, 2013.
2. A Comprehensive Guide to controller Area Network – Wilfried Voss, Copperhill Media Corporation, 2nd Ed., 2005.

REFERENCES

1. Computer Networking: A Top-Down Approach- James Kurose & Keith Ross , 7th Ed., Pearson, 2017.
2. Serial Port Complete-COM Ports, USB Virtual Com Portsand Ports for Embedded Systems- Jan Axelson, Lakeview Research, 2nd Ed.
3. Data Communications and Computer Networks- Brijendra Singh, 2nd Ed., 2008.
4. Wireless Digital Communications-Kamilo Feher, Prentice Hall,2003.

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 CONTROLLERS
(PE- 2)

M.Tech. I Year I Semester

L	T	P	C
3	0	0	3

Prerequisite: Microprocessors and Micro Controllers

Course Objectives:
1. To provide a comprehensive understanding of various programs of DSP Processors.
2. To distinguish between the architectural difference of ARM and DSPs along with floating point capabilities.

Course Outcomes:
The students are
1. Expected to learn various DSPs and their architectural features.
2. Explore the ARM development towards the functional capabilities of DS Processing.
3. Expected to work with ASM level program using the instruction set.
4. To explore the selection criteria of DSP / ARM processors by understanding thefunctional level trade off issues.

UNIT-I: Introduction to Digital Signal Processing:
Introduction, A digital Signal — Processing system, the 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
Architectures for Programmable DSP devices:
Basic Architectural features, DSP computational building blocks, Bus Architecture andMemory, Data addressing capabilities, Address generation UNIT, programmability and program execution, speed issues, features for external interfacing. [TEXTBOOK-1]

UNIT-II: Programmable Digital Signal Processors:
Commercial Digital signal-processing Devices, 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. [TEXTBOOK-1]

UNIT-III: 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 (TEXT BOOK- 3)

UNIT-IV: Architecture of ARM Processors:

Introduction to the architecture, Programmer's model- operation modes and states, registers, special registers, floating point registers, Behaviour of the application program status register(APSR)-Integer status flags, Q status flag, GE bits, Memory system-Memory system features, memory map, stack memory, memory protection unit (MPU), Exceptions and Interrupts-what are exceptions?, nested vectored interrupt controller(NVIC), vector table, Fault handling, System control block (SCB), Debug, Reset and reset sequence.(TEXT BOOK - 2)

UNIT-V ARM Cortex-M Processor:

General information about Cortex-M3 and cortex M4 processors-Processor type, processor architecture, instruction set, block diagram, memory system, interrupt and exception support, Features of the cortex-M3 and Cortex-M4 Processors-Performance, code density, low power, memory system, memory protection unit, interrupt handling, OS support and system level features, Cortex-M4 specific features, Ease of use, Debug support, Scalability, Compatibility. [TEXTBOOK-2]

TEXTBOOKS:

1. Digital Signal Processing- Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors by Joseph Yiu, Elsevier Publications, Third edition.
3. A Practical Approach to Digital Signal Processing – K.Padmanabhan , S. Ananthi , Second Edition.

REFERENCES:

1. ARM System Developer's Guide Designing and Optimizing System Software by Andrew N. SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier Publications, 2004.

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. Acquire a knowledge in 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.
4. Analyze and Interprete the various phase coding techniques.

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.

MULTI-MEDIA AND SIGNAL CODING
(PE-2)

M.Tech. I Year I-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.

INTERNET PROTOCOLS AND TECHNOLOGIES
(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 the Underlying technologies, features and functions of Network Layer Protocols
2. To learn about User Datagram Protocol, Transmission Control Protocol and stream control Transmission protocol.
3. To learn about Modifications of Transport Layer Protocols for Ad Hoc Wireless Networks
4. To understand the techniques to improve QoS in Data Communication Networks

Course Outcomes

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

1. Understand the functions of Network Layer Protocols
2. Understand the functions Transport layer protocols.
3. Acquire the knowledge about the operation and performance of modified version of TCP protocols in Ad-hoc wireless networks.
4. Learn about various mechanisms to improve QoS in data communication networks

UNIT I

Review of Underlying Technologies: Local Area Networks - Wired LANs, Wireless LANs ,Point to Point WANS, Switched WANS, X.25, Frame Relay , ATM, Connecting Devices

Network Layer Protocols

Network Layer Services**,** Packet Switching**,** Network Layer Performance, IP Datagram, Fragmentation, Options, Checksum,ICMP, Types of Messages, Message Format, Error Reporting, Query, Checksum, IGMP, Group Management, IGMP Messages, Encapsulation, IGMP Package, , ARP, ARP Package, RARP. Mobile IP, IPv6 Protocol IPv6 Addressing, , ICMPv6 Protocol, Transition from IPv4 to IPv6,

Unit-II

IPV4 Addressing: Classful Addressing- Sub netting and Super netting. Classless Addressing- Variable Length Blocks, Sub netting, Address Allocation

Delivery, Forwarding, and Routing

Delivery, Forwarding, and Routing of IP Packets, Structure of Router, Unicast Routing- Routing Algorithms: Distance Vector Routing, Link state Routing, Path- Vector routing, Unicat Routing Potocols : Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gate way Protocol version 4 (BGP4)

UNIT III

Congestion Control and Quality of Service: Data Traffic, Congestion, Congestion Control, Quality of Service- flow characteristics, flow classes, Techniques to Improve QoS - Scheduling, Traffic Shaping, Passive Queue management Schemes – drop-tail, drop front, Random Drop Active Queue management Schemes – Early Random Drop (ERD), Random Early Detection (RED) , Resource Reservation, Admission control.

Integrated and Differentiated Services:
Integrated Services- Signaling, Flow Specification, Admission, Service Classes, Integrated Services Architecture (ISA), ISA components, ISA Services Resource Reservation (RSVP. Problems with Integrated Services, Differentiated Services-DS Field, DS configuration and Operation, Per-hop Behavior, Traffic conditioners.

UNIT IV
Transport Layer Protocols
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: 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 V
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.

TEXT BOOKS

1. TCP/IP Protocol Suite-Behrouz A. Forouzan- 4th Edition, McGraw-Hill, 2010.
2. Data Communications and Networking - B. A. Forouzan, 5th edition, TMH, 2013

REFERENCES

1. Ad Hoc Wireless Networks Architectures and Protocols C. Siva Ram Murthy B.S. Manoj, Prentice Hall, 6th Edition, 2008.
2. Computer Networking: A Top-Down Approach- James Kurose & Keith Ross , 5th Ed., Pearson, 2017.
3. Mobile Communications by Jochen H. Schiller, 2nd Edition, Pearson-Wesley, 2003.

ADVANCED DIGITAL 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)

SPEECH AND IMAGE PROCESSING LAB

M.Tech. I Year I Semester

L	T	P	C
0	0	4	2

Design an App for the following

1) Displaying various types of image files and formats
2) Transforming image (gray/RGB) to a bit planes and displaying
3) Performing the following operations on image
   i) Image resize: Effect on spatial resolution
   ii) Quantization, Dilhering, error diffusion
4) Performing the following point processing operations on image
   i) Adding / Subtracting / Multiplying / Dividing by a constant
   ii) Complement of image
   iii) Histogram Processing , Contrast Stretching, Equalization.
5) Filtering of images in Spatial domain
   i) Low Pass : Mean, Median filtering
   ii) High Pass: Laplacian filter, Laplacian of Gaussian(LOG) filter
   iii) Edge Sharpening filters: Unsharp marking, High Boost filtering
   iv) ROI processing on Images
6) Filtering of Images in Frequency domain
   i) Ideal low pass filtering
   ii) Ideal high pass filtering
   iii) Butterworth filtering
   iv) Gaussian filtering
   v) Homomorphic filtering
7) Image Restoration
   i) Generating different types of Noisy, Images : Salt and pepper, Gaussian, Speckle, Periodic
   ii) Enhancement of Salt and Pepper noisy image
   iii) Enhancement of Gaussian noisy image
   iv) Enhancement of periodic noisy Image
   v) Wiener filtering
8) Image segmentation
   i) Thresholding for converting Gray image to Binary image
   ii) Edge detection: 1st order : Robert, Sobel, Prewitt, II order : Laplacian, Canny
9) Wavelets:
   i) Applying Haar wavlet on image for different scales
   ii) High Pass filtering using wavlets
   iii) Denoising using wavlets

Cycle: 2

1) Recording speech signal with different sampling rates and quantization and saving as .wav file.
2) Framing and windowing of speech using different windows and plotting its spectrum and spectrograms.
3) Plotting the pitch contour using parallel pitch estimation
4) Extraction of LPC coefficients from speech signal in Simulink
5) Synthesis of speech signal using LPC coefficient in Simulink
6) Real time analysis speech signal with LPC coefficients using DSK 6713
7) Real time synthesis of speech signal from LPC coefficients using DSK 6713

RESEARCH METHODOLOGY AND IPR

M.Tech. I Year I Semester

L	T	P	C
2	0	0	2

Course Objectives:

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

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

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

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, data collection, analysis, interpretation, Necessary instrumentations

UNIT-II:

Effective literature studies approaches, analysis, Plagiarism, 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 and Copyright. Copyleft and Creative Commons Licensing. 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:

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TEXT BOOKS:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

REFERENCES:

1. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall , "Industrial Design", McGraw Hill, 1992.
4. Niebel , "Product Design", McGraw Hill, 1974.
5. Asimov , "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

ENGLISH FOR RESEARCH PAPER WRITING
(AUDIT COURSE-I)

M.Tech. I Year I Semester

L	T	P	C
2	0	0	0

Course Objectives: To help students:
1. Understand the essentials of writing skills and their level of readability
2. Learn about what to write in each section
3. Ensure qualitative presentation with linguistic accuracy.

Course Outcomes: Students will be able to:
1. Understand writing skills and level of readability
2. Write title, abstract, different sections in research paper
3. Develop the skills needed while writing a research paper

Syllabus

Unit 1 Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences -Being Concise and Removing Redundancy -Avoiding Ambiguity

Unit 2 Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Chapterisation

Unit 3 Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion- Conclusions-Recommendations.

Unit 4 Key skills needed for writing a Title, Abstract, and Introduction

Unit 5 Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions

Suggested Reading:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht
Heidelberg London, 2011

****

WIRELESS COMMUNICATIONS

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

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

Modulation Techniques for Mobile Radio

Geometric representation of Modulation signals, Linear Modulation Techniques-Binary Phase Shift Keying(BPSK), Differential Phase Shift Keying (DPSK), Quadrature Phase Shift Keying (QPSK), QPSK Transmission and Detection Techniques, Offset QPSK, $\pi/4$ QPSK, $\pi/4$ QPSK Transmission and Detection Techniques, Constant Envelope Modulation- Binary Frequency Shift Keying, Minimum Shift Keying (MSK), Gaussian Minimum Shift Keying (GMSK), Combined Linear and Constant Envelope Modulation Techniques- M-ary Phase Shift Keying (MPSK), M-ary Quadrature Amplitude Modulation(QAM), M-ary Frequency Shift Keying (MFSK) and OFDM, Spread Spectrum Modulation Techniques- Pseudo Noise(PN) sequences, Direct Sequence Spread Spectrum (DS-SS), Frequency Hopped Spread Spectrum (FH-SS), Performance of Direct Sequence Spread Spectrum, Performance of Frequency Hopped Spread Spectrum, Modulation Performance in Fading and Multipath Channels-Performance of Digital Modulation in Slow Flat Fading Channels, Digital Modulation in Frequency Selective Mobile Channels, Performance of $\pi/4$ DQPSK in Fading and Interference.

UNIT –V

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.

TEXT BOOKS

1. Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Wireless Communications- Andreas F. Molisch,Wiley India Pvt.Ltd
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.
3. Principles of Wireless Networks – Kaveh Pah Laven and P. Krishna Murthy, 2002, PE

WIRELESS NETWORKS

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

UNIT-I
Technologies of Wireless Networks

Introduction to Wireless Networks, Development of Wireless Networks, Diversity of Wireless Networking Technologies, Introduction to Wireless Network Architecture, Wireless Network Logical Architecture, the OSI Network Model, Network Layer Technologies, Data Link Layer Technologies, Physical Layer Technologies. Wireless Network Physical Architecture, Wireless Network Topologies ,Wireless LAN Devices ,Wireless PAN Devices ,Wireless MAN Devices

UNIT-II
Wireless WLAN & WPAN

Introduction, Fundamentals of WLANS, Technical Issues, Difference between Wired and Wireless Transmission, Network Architecture, Use of LANS, Design Goals, IEEE Standards, Data Link Layer, Physical Layer, Standard Ethernet, MAC Sublayer, Physical Layer, Changes in Standard, Bridge Ethernet, Switched Ethernet, Full-Duplex Ethernet, Fast Ethernet, Gigabit Ethernet, MAC Sublayer, Physical Layer, Ten-Gigabit Ethernet, Bluetooth, Transport Protocol Group, Middleware Protocol , Bluetooth Profiles.

UNIT-III
Wireless MAN & WAN

Introduction, cellular concepts, capacity enhancement , channel allocation algorithms, cellular Architecture, First and Second Generation Cellular Systems, third Generation cellular Systems, wireless local loop, Generic WLL Architecture , WLL Technologies, Wireless ATM, Introduction to ATM ,MAC Layer for WATM, Handoff Issues in WATM, Local Management, DLC and RLC Layers**.**

Unit- IV
AD HOC WIRELESS NETWORKS

Introduction, Issues in Ad Hoc Wireless Networks. 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, Routing Protocols-Introduction, Issues in Designing a Routing Protocol for Ad-Hoc Wireless Networks, Classification of Routing Protocols, 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.

UNIT V
Wireless Sensor Networks

Introduction, Sensor Network Architecture-Layered Architecture, Clustered Architecture, Data Dissemination-Flooding, Gossiping, Rumor Routing, Sequential Assignment Routing, Directed Diffusion, Sensor Protocols for Information via Negotiation, Cost Field Approach, Geographic Hash Table, Small Minimum Energy Communication Network, Data Gathering-Direct Transmission, Power Efficient Gathering for Sensor Information Systems, Binary Scheme, Chain based Three Level Binary Scheme, MAC Protocols for Sensor Networks-Self Organizing MAC for Sensor Networks and Eavesdrop and register, Hybrid TDMA/FDMA, CSMA based MAC protocols.

TEXT BOOKS

1. Ad Hoc Wireless Networks Architectures and Protocols C. Siva Ram Murthy B.S. Manoj, Prentice Hall, 6th Edition, 2008.
2. Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control - Jagannathan Sarangapani, CRC Press.
3 Wireless Networking Technology " From Principles to Successful Implementation by Steve Rackley First published 2007

REFERENCES

1. Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh , 1st Ed. Pearson Education.
2. WaltenegusDargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley 2010.
3. Ad Hoc and Sensor Networks Theory and Appications- Carols de Morais Cordeiro and Dharma prakash Agrawal, World Scientific
4. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

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

SOFTWARE DEFINED RADIO
(PE-3)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

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.

PATTERN RECOGNITION AND MACHINE LEARNING

(PE-3)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

UNIT-I

Introduction to Machine Learning: Human learning and its types; Machine learning and its types; well- posed learning problem; applications of machine learning; issues in machine learning.

Preparing to model: Basic data types; exploring numerical data; exploring categorical data; exploring relationship between variables; data issues and remediation; data pre-processing.

Modelling and Evaluation: Selecting a model; training model-holdout, k-fold cross-validation, bootstrap sampling; model representation and interpretability – under-fitting, over-fitting, bias-variance tradeoff; model performance evaluation – classification, regression, clustering; performance improvement.

Feature engineering: Feature construction; feature extraction; feature selection.

UNIT –II

Brief review of probability: Concept of Probability, Random Variables,Some Common Discrete Distributions:Bernoulli distributions, Binomial distribution, The multinomial and multinoulli distributions, Poission distribution, Some Common Continuous Distributions: Uniform distribution, Gaussian (normal) distribution, The laplace distribution, Multiple Random Variables: Bivariate random variables, Joint distribution Functions, Joint probability density functions, Conditional distributions, Covariance and correlation, Central Limit Theorem, Hypothesis Testing, Monte Carlo Approximation.

Bayesian Concept Learning: Bayes Theorem: Prior, Posterior, Likelihood, Bayes Theorem and Concept Learning: Brute-force Bayesian algorithm, Concept of consistent learners, Bayes optimal classifier, Naïve Bayes Classifier, Application of Naïve Bayes classifier, Handling Continuous Numeric Featurs in Naïve Bayes Classifier, Bayesian Belief Network: Independence and conditional independence, Use of the Bayesian Belief network in machine learning.

UNIT –III

Supervised learning-Classification: Examples of Supervised Learning, Classification Model, Classification Learning Steps, Common Classification Algorithms: k-Nearest Neighbour(kNN), Decision tree, Random forest model, Support vector machines.

Supervised learning-Regression: Examples of Regression, Common Regression Algorithms: Simple Linear Regression, Multi Linear Regression, Assumptions in Regression Analysis, Main Problems in Regression Analysis, Improving Accuracy of the Linear Regression Model, Polynomial Regression Model, Logistic Regression.

Unsupervised learning: Unsupervised vs Supervised Learning, Application of Unsupervised Learning, Clustering: Clustering as a machine learning task, Different types of clustering techniques, Partitioning methods, k-Medoids : a representative object-based technique, Hierarchical clustering, Density-based methods –DBSCAN, Finding Pattern using Association Rule: Definition of common terms, Association rule, The apriori algorithm for association rule learning, Build the apriori principle rules.

UNIT – IV

Basics of Neural Network: Understanding the Biological Neuron, Exploring the Artificial Neuron, Types of Activation Functions: Identity function, Threshold/step function, ReLU(Rectified Linear Unit) function, Sigmoid function, Hyperbolic tangent function, Early Implementations of ANN: McCulloch-pitts Model of Neuron, Rosenblatts perceptron, ADALINE network model, Architectures of Neural Network: Single-layer feed forward network, Multi-layer feed forward ANNs, Competitive netwok, Recurrent network, Learning Process in ANN:Number of layers, Direction of signal flow, Number of nodes in layers, Weight of interconnection between neurons, Backpropagation Algorithm.

Types of Learning: Representation Learning :Supervised neural networks and multilayer perceptron, Independent component analysis(Unsupervised),Autoencoders, Various forms of clustering, Active Learning: Heuristics for active learning, Active learning query strategies, Instance –Based Learning(Memory- Based Learning): Radial basis function, Pros and cons of instance- based learning method, Association Rule Learning Algorithm: Aprioro algorithm, Eclat algorithm, Ensemble Learning Algorithm: Bootstrap aggregation, Boosting, Gradient boosting machines(GBM), Regularization Algorithm.

UNIT – V

Introduction to Simple Deep Feed forward Neural Network, Hidden Units and their Activation Functions, Architecture Design, Regularization Methods for Deep learning: Early Slopping, Drop out.

Convolutional Neural Networks: Introduction to CNN, Convolution operation, Pooling, Normalization, Application in Computer Vision-Image Net, Sequence Modeling- VGG Net, LeNet.

Recurrent Neural Networks: RNN Topologies, Difficulty in Training RNN, Long Short Term Memory(LSTM):Architecture and Learning Strategy.

TEXT BOOKS:

1.Machine learning by Saikat Dutt, Subramanian Chandramouli, Amit K.Das Pearson Publishers,2019.
2**.** Ian Good fellow, Yoshva Bengio, Aaron Courville, Deep Learning,MIT Press,2016.

REFERENCE BOOKS:

1.Machine learning with python for everyoone by Mark E- Fenner, Pearson Publishers, 2020.
2. Introduction Neural Networks using MATLAB 6.0 – S.N. Shivanandam, S. Sumathi, S. N.Deepa, 1/e, TMH,New Delhi

RF CIRCUIT DESIGN
(PE - 3)

M.Tech. I Year II 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. Analyze the behavior of high frequency components.
2. Calculate the scattering parameters of various RF components and analyze the various filter parameters.
3. Understand the concepts of component modelling and biasing networks.
4. 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.

COMMUNICATION AND NETWORKING TECHNOLOGIES FOR IOT

(PE-4)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

UNIT-I

Introduction to IoT

Flavor of the Internet of Things, Technology of the Internet of Things & Enchanted Objects, Design Principles for Connected Devices, Calm and Ambient Technology, Web Thinking for Connected Devices, First-Class Citizens On The Internet, Thinking About Prototyping, Sketching, Familiarity, Prototypes and Production, Open Source versus Closed Source, Closed Source for Mass Market Projects, Tapping into the Community.

UNIT-II

IoT Paradigm,

Why the IoT Is Strategically Sound, Brewing and Blossoming Trends in IT Space, Envisioning the Internet of Things Era, Device-to-Device/Machine-to-Machine Integration Concept, Explaining the Aspect of Device-to-Cloud (D2C) Integration, Describing the Sensor-to-Cloud Integration Concept, Emerging IoT Flavors, Prominent IoT Realization Technologies, Cloud-to-Cloud (C2C) Integration, and Device-to-Cloud (D2C) Integration.

UNIT-III

Wireless Technologies for IoT Ecosystem

Introduction, Architecture for IoT Using Mobile Devices, Mobile Technologies for Supporting IoT Ecosystem, Energy Harvesting for Power Conservation in the IoT System, Mobile Application Development Platforms and Use of IoT, Low Power Wide Area Networking Technologies, Direct & Indirect Device Connectivity Topology of LPWAN, LoRa WaN.

UNIT-IV

Protocols for the IoT Ecosystem

Introduction, Layered Architecture for IoT, Protocol Architecture of IoT, Routing Protocol, IEEE 802.15.4, Bluetooth Low Energy, ZigBee, Protocols for IoT Service Discovery, Prominent IoT Service Discovery Products, IP Addresses, Infrastructure Protocols, Static IP Address Assignment, Dynamic IP Address Assignment, IPV6, TCP and UDP Ports, Application Layer Protocols.

Enablement Platforms for IoT Applications

IoT Building Blocks, IoT or Sensor Data Gateway, Application Enablement Platforms, IoT Application Enablement Platforms, IoT and M2M Sensor Data Platform, IoT Data Analytics Platforms, IoT Data Virtualization Platforms, IoT Edge Data Analytics.

UNIT-V

Integration Technologies of IoT

Introduction, IoT Portion for Smarter Enterprises and Environments, Sensor and Actuator Networks, IoT Device Integration Concepts, Device Profile for Web Services, Open Service Gateway, Scalability, Robustness, openHAB, Remote OSGi, Device Integration Protocols and Middleware, Data Distribution Bus, Message Queue Telemetry Transport, Extensible Messaging and Presence Protocol, Protocol Landscape for IoT.

Smart Use Cases of IoT

Introduction, Collaboration Platforms, Geospatial Platforms, Open Access to Public Data, Smart Industrial Use Cases of IoT, Smart Lighting for Energy Conservation, Smart Transportation Systems, Smart Homes/Buildings, Smarter Homes—Middleware Platforms, Smart Education Systems Using Wearable Devices

Text Books

1. "The Internet of Things Enabling, Technologies, Platforms and Applications" by Pethuru Raj and Anupama C.Raman CRC Press Taylor & Francis Group.
2. "Designing the Internet of Things " by Adrain McEwen , Hakim Cassimally Wiley 1st Edition

ARTIFICIAL NEURAL NETWORKS & DEEP LEARNING

(PE-4)

M.Tech. I Year II-Semester

L	T	P	C
3	0	0	3

UNIT-I :

Fundamental Concepts, Models & Learning Rules of Artificial Neural Systems

Artificial Neuron Models: Biological Neuron, Mcculloch-pitts Neuron Model, Activation Functions, Boltzman Neuron Model, Models of Artificial Neural Networks : Feed forward Network, Feedback Network, Neural Processing, Learning and Adaption : Supervised, Unsupervised and Reinforcement Learning.

Neural Network Learning Rules: Hebbian Learning Rule, Perception Learning Rule, Delta Learning Rule Widrow –Hoff Rule, Correlation Learning Rule, Winner –Take – All Learning Rule, Outstar Learning Rule, Summary of Learning Rules.

Single Layer Feed Forward Networks:

Classification Model, Features and Decision Regions, Discriminant Functions, linear Machine and Minimum Distance Classification, Non – Parametric Training Concept, Training and Classification Using the Discrete Perceptron: Algorithm and Examples. Single Layer Continuous Perceptron Networks for Linearly Separable Classification, Perceptron Convergence Theorem, Multi Category Single Layer Perceptron Networks.

UNIT –II

Multi Layer Feed Forward Networks:

Linearly Non- Separable, Pattern Classification, Delta Learning Rule for Multi Perception, Generalized Delta Learning Rule. Feed Forward Recall and Error Back Propagation Training ; Examples of Error Back Propagation, Training Errors, Learning Factors ; Initial Weights Cumulative Weight Adjustment Versus Incremental Updating, Steepness of Activation Function, Learning Constant, Momentum Method, Network Architecture Versus Data Representation, Necessary Number of Hidden Neurons. Application of Back Propagation Networks in Pattern Recognition and Image Processing.

UNIT –III :

Associative Memories:

Basic Concepts of Linear Associative, Basic Concepts of Dynamical Systems, Mathematical Foundation of Discrete Time Hop field Networks. Mathematical Foundation of Gradient- Type Hop Field Networks, Transient Response of Continuous Time Networks, Example Solution of Optimization Problems; Summing Networks with Digital Outputs, Minimization of the Traveling salesman tour length, Solving Simultaneous Linear Equations, Boltzman machines, Bidirectional Associative Memory; Multidirectional Associative Memory, Associative Memory of Spatio-temporal Patterns.

UNIT – IV :

Matching and Self-Organizing Networks:

Hamming net and MAXNET Unsupervised learning of clusters, Clustering and similarity measures Winner take all learning, recall mode, initializing of weights, separability limitations, Counter propagation networks, Feature mapping: Self organizing feature maps, Cluster discovery networks (ART1).

UNIT – V :

Introduction to Simple Deep Feed forward Neural Network, Hidden Units and their Activation Functions, Architecture Design, Regularization Methods for Deep learning: Early Slopping, Drop out.

Convolutional Neural Networks: Introduction to CNN, Convolution operation, Pooling, Normalization, Application in Computer Vision-Image Net, Sequence Modeling- VGG Net, LeNet.

Recurrent Neural Networks: RNN Topologies, Difficulty in Training RNN, Long Short Term Memory(LSTM):Architecture and Learning Strategy.

TEXT BOOKS:

1. Introduction to Artificial Neural Systems – J.M.Zurada, Jaico Publishers.
2. Ian Good fellow, Yoshva Bengio, Aaron Courville, Deep Learning,MIT Press,2016.
3. Introduction Neural Networks using MATLAB 6.0 – S.N. Shivanandam, S. Sumathi, S. N.Deepa, 1/e, TMH,New Delhi

REFERENCE BOOKS:

1. Elements of Artificial Neural Networks – Kishan Mehrotra, Chelkuri K. Mohan, Sanjay Ranka, Penram International.
2. Artificial Neural Network – Simon Haykin,2nd Ed., Pearson Education
3. Artificial Neural Networks – Dr.B. Yagananarayana, 1999,PHI, New Delhi.
4. Fundamental of Neural Networks- Laurene Fausett.

BIOMEDICAL SIGNAL PROCESSING
(PE-4)

M.Tech. I Year II-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.

ADAPTIVE SIGNAL PROCESSING
(PE-4)

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.

ADVANCED COMMUNICATION LAB

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.

WIRELESS NETWORKS AND SIMULATION LAB

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

VALUE EDUCATION
(AUDIT COURSE-II)

M.Tech. I Year II-Semester

L	T	P	C
2	0	0	0

Course Objectives: To help the students:
1. Understand value of education and self- development
2. Imbibe good values
3. Know about the importance of character

Course outcomes: Students will be able to:
1. Acquire knowledge about self-development
2. Learn the importance of Human values
3. Develop the overall personality

Syllabus

Unit1

Values and Self-development – Social Values and Individual Attitudes. Work Ethics, Indian Vision of Humanism. Ethical Standards and Principles. Value Judgments

Unit2

Importance of Cultivating Values. Sense of Duty. Devotion, Self-reliance, Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. National Unity. Patriotism. Love for Nature, Discipline

Unit 3

Personality and Behavior Development - Soul and Scientific Attitude- Integrity and Discipline. Punctuality- Compassion and Benevolence - Positive Thinking- Composure and Equipoise- Dignity of Labour. Universal Brotherhood and Religious Tolerance. True Friendship. Happiness Vs Suffering- Aware of Self-destructive Habits. Association and Cooperation. Eco-friendly Consciousness

Unit4

Character and Competence – Values of Scriptures- Self-management and Good health. Science of Reincarnation. Equality, Nonviolence, Humility, Role of Women- Secular Thinking- Mind your Mind, Self-control- Non Ethnocentric Behavior

Suggested Readings

1. Chakroborty, S.K. "*Values and Ethics for organizations Theory and practice*", Oxford University Press, New Delhi. 1998.
2. Dostoyevsky, Fyodor, Constance Garnett, and Ernest J. Simmons. *Crime and Punishment*. New York: Modern Library, 1950. Print.
3. Galsworthy, John. *Justice***.** Czechia, Good Press, 2019.
4. TED Talks

****

NEXT GENERATION COMMUNICATION

(PE-5)

M.Tech. II Year I-Semester

L	T	P	C
3	0	0	3

UNIT I

Second Generation (2G) and (2.5G)

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, 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 II

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 III

Fourth Generation (4G)

4G evolution, objectives of the projected 4G, advantages of 4G network technology over 3G, application s of 4G,4G Technologies , Smart antenna technique, 4G software, New technologies in cellular data networks.

UNIT IV

5G Targets and Standardization

Introduction, 5G Targets, 3 5G Technology Components, 5G Spectrum, 5G Capabilities, 5G Capacity Boost, 5G Standardization and Schedule, 5G Use Cases, Evolution Path from LTE to 5G, Mobile Data Traffic Growth. Introduction, ITU, NGMN, 3GPP Schedule and Phasing.

UNIT V

5G Technology Components & 5G Architecture

Introduction, Spectrum Utilization, Beamforming, Flexible Physical Layer and Protocols, Network Slicing, Dual Connectivity with LTE, Radio Cloud and Edge Computing, Introduction, 5G Architecture Options, 5G Core Network Architecture, 5G RAN Architecture, Network Slicing.

5G Performance

Introduction, Peak Data Rates, Practical Data Rates, Latency, Link Budgets, Coverage for Sub-6-GHz Band, Massive MIMO and Beamforming Algorithms, Packet Scheduling Algorithms, Spectral Efficiency and Capacity, Network Energy Efficiency, Traffic and Device Density,

LTE-Advanced Evolution

Introduction, Overview of LTE Evolution, LTE-Advanced Pro Technologies, 5G and LTE Benchmarking

TEXT BOOKS

1. 3G Wireless Networks- Clint Smith, P.E. Daniel Collins, 2nd Ed., 2013.
2. 5G Technologies :3 GPP New Radio Harri Holma, Antti Toskala, Takehiro Nakamura

REFERENCES

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

SPEECH SIGNAL PROCESSING

(PE-5)

M.Tech. II Year I-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** : Anatomy and physiology of Ear: Outer Ear, Middle Ear, Inner Ear, BM behavior, Electrical activity in Auditory neurons Adaptation, Sound Perception: Auditory psycho physics,Thresholds JNDs, Pitch perception, Masking, Critical bands Temporal masking, Origins of masking, Release from masking, Sound localization.

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

Introduction, Basic pattern Recognition Approach, Preprocessing, Parametric Representation, Evaluating the similarity of speech patterns, Accommodating Both spectral and temporal variability, Networks for speech recognition, Adapting to variability in speech, Language models, Search design.

UNIT – V

Automatic Speaker Recognition

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

TEXT BOOKS

1. Digital Processing of Speech Signals - L.R. Rabiner and S. W. Schafer. Pearson Education.
2. Speech Communications Human & Machine - Douglas O'Shaughnessy, 2nd Ed., EEE Press.

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

AD-HOC AND WIRELESS SENSOR NETWORKS

(PE-5)

M.Tech. II Year I-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 WLANs & WPANs.
2. To study the fundamentals of wireless Ad-Hoc Networks.
3. To study the operation and performance of various Ad-Hoc wireless network protocols.
4. To study the architecture and protocols of Wireless sensor networks.

Course Outcomes

On completion of this course student will be able to
1. Understand the design issues, protocol architecture and functions of various protocols of WLANs & WPANs.
2. Understand the design issues of Ad-Hoc networks and operation of MAC, routing and transport protocols.
3. Analyze and compare various MAC protocols, Routing protocols and transport layer protocols of Ad-Hoc networks.
4. Understand various sensor network architectures, data dissemination and data gathering methods

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-Layered Architecture, Clustered Architecture, Data Dissemination-Flooding, Gossiping, Rumor Routing, Sequential Assignment Routing, Directed Diffusion, Sensor Protocols for Information via Negotiation, Cost Field Approach, Geographic Hash Table, Small Minimum Energy Communication Network, Data Gathering-Direct Transmission, Power Efficient Gathering for Sensor Information Systems, Binary Scheme, Chain based Three Level Binary Scheme, MAC Protocols for Sensor Networks-Self Organizing MAC for Sensor Networks and Eavesdrop and register, Hybrid TDMA/FDMA, CSMA based MAC protocols, Location Discovery-Indoor localization, Sensor network localization, Quality of a Sensor Network- Coverage, Exposure, Evolving Standards.

TEXT BOOKS

1. Ad Hoc Wireless Networks Architectures and Protocols C. Siva Ram Murthy B.S. Manoj, Prentice Hall, 6th Edition, 2008.
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. Ad Hoc and Sensor Networks Theory and Appications- Carols de Morais Cordeiro and Dharma prakash Agrawal, World Scientific
3. Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer

SYSTEM DESIGN ASPECTS OF IOT
(PE- 5)

M.Tech. II Year I -Semester

L	T	P	C
3	0	0	3

Pre-requisite:

Course Objectives

The objectives of the course are to

1. Understand the concepts of Internet of Things and able to build IoT applications.
2. Learn the programming and use of Arduino and Raspberry Pi boards.
3. Known about data handling and analytics in SDN.

Course Outcomes

Upon completing this course, the student will be able to

1. Known basic protocols in sensor networks.
2. Program and configure Arduino boards for various designs.
3. Python programming and interfacing for Raspberry Pi.
4. Design IoT applications in different domains.

UNIT I

Definition and Characteristics of IoT, Physical Design of IoT: Things in IOT, IOT Protocols, Logical Design of IoT: IOT functional Blocks, Communication Models, Communication APIs, IOT levels and deployment templates, Sensor Networks, Sensors and Actuators, ADCs and DACs

Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Software defined Network (SDN) and NFV for IoT

UNIT II

Domain Specific IOTs

Home Automation: Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/ Gas detector; Smart Cities: Smart Parking, Smart Lighting,Smart Roads, Structural Health Monitoring, Surveillance, Emergency Response, Environment: Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection, Energy: Smart Grids, Renewable Energy Systems, Prognostics, Retail: Inventory Management, Smart Payments, Smart Vending Machines, Logistics: Route Generation and Scheduling, Fleet Tracking, Shipment Monitoring, Remote Vehicle Diagnostics, Agriculture: Smart Irrigation, Green House Control, Industry: Machine Diagnosis and Prognosis, Indoor Air Quality Monitor, Health and Life Style: Health and Fitness Monitoring, Wearable Electronics.

UNIT III

Arduino and IOT:

Introduction XBee module, Interfacing with XBee, Pin diagram, updating Firmware: AT Commands and API, Configuring XBee as Coordinator, Router, Building an XBee-ZB Mesh Network and Testing.

Arduino Programming: Arduino models and Clones,Arduino IDE, Integration of Sensors and Actuators with Arduino :Sketch for blinking of LED, Building an Aurdino Temperature and Humidity Sensor,Using an Arduino as a Data Collector for XBee Sensor Nodes

UNIT IV

Applied Python Programming with Raspberry Pi: Introduction to Python programming, Introduction to Raspberry Pi modules, Installing a Boot image in Pi, GPIO pins of Pi, Sketch for blinking of LED using Pi, Building an Raspberry Pi Temperature and Humidity Sensor,Building a Raspberry Barometric Pressure Sensor Node, Creating a Raspberry Pi Data Collector for XBee Sensor Nodes,

UNIT V

Data Analytics for IOT

Apache Hadoop: Map Reduce Programming Model, Hadoop Map Reduce Job Execution, Map Reduce Job Execution Workflow, Hadoop Cluster Setup, Using Hadoop MapReduce for Batch Data Analysis: Hadoop YARN, Apache Oozie: Setting up Oozie, Oozie Workflows for IoT Data Analysis, Apache Spark, Apache Storm : Setting up a Storm Cluster, Using Apache Storm for Real-time Data Analysis: REST-Based approach, WebSocket-based Approach.

TEXT BOOKS

1. Internet of Things: A Hands-on Approach, by ArshdeepBahga and Vijay Madisetti.
2. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013.

REFERENCES

1. The Internet of Things: Enabling Technologies, Platforms, and Use Cases, by Pethuru Raj and Anupama C. Raman (CRC Press)
2. Fundamentals of Wireless Sensor Networks: Theory and Practice - WaltenegusDargie, Christian Poellabauer.
3. Make sensors: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st Ed., MakerMedia, 2014.

PRINCIPLES OF SIGNAL PROCESSING
(OE- I)

M.Tech. II Year I 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