VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE
(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Two Year Postgraduate Programme Leading to

Master of Technology (M.Tech.) Degree in

Electronics & Telecommunication Engineering

Implemented from the batch admitted in Academic Year 2014-15

VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Two Year Postgraduate Programme Leading to

Master of Technology (M.Tech.)

In

215 Electronics & Telecommunication Engineering

SEMESTER I

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours / week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1.	EC5001S	Computational Methods	3-1-0=4	4	20	20	60	3
2.	ET5001S	Statistical Theory of Communication	3-1-0=4	4	20	20	60	3
3.	ET5002T	RF Integrated Circuits	3-0-0=3	3	20	20	60	3
	ET5002P	RF Integrated Circuits LAB	0-0-2=2	1	100 % CIE			
4.	ET5003T	Modern Communication Networks	3-0-0=3	3	20	20	60	3
	ET5003P	Modern Communication Networks LAB	0-0-2=2	1	100 % CIE			
5.	ET510XS	Program Elective course 1	3-1-0=4	4	20	20	60	3
6.	ET510YT	Program Elective course 2	3-0-0=3	3	20	20	60	3
	ET510YP	Program Elective course 2 LAB	0-0-2=2	1	100 % CIE			
		Total	27	24				

SEMESTER II

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours /week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1.	EC5005S	Research Methodology	3-1-0=4	4	20	20	60	3
2.	ET5004S	Error Correcting Codes	3-1-0=4	4	20	20	60	3
3.	ET5005T	Advanced Mobile Communication	3-0-0=3	3	20	20	60	3
	ET5005P	Advanced Mobile Communication LAB	0-0-2=2	1	100 % CIE			-
4.	ET5006T	Embedded System Design	3-0-0=3	3	20	20	60	3
	ET5006P	Embedded System Design LAB	0-0-2=2	1	100 % CIE			-
5.	ET511YS	Program Elective course 3	3-0-0=3	3	20	20	60	3
6.	ET511ZT	Program Elective course 4	3-0-0=3	3	20	20	60	3
	ET511ZP	Program Elective course 4 LAB	0-0-2=2	1	100 % CIE			-
	ET5801D	Technical Seminar *	0-0-4=4	2	100 % CIE			
		Total		30	25			

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two In semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

List of Electives:

Course Codes		ELECTIVES
Program Elective Course 1	**ET5101S**	Next Generation Networks
	ET5102S	Artificial neural networks and Machine learning
	ET5103S	E-Security
Program Elective Course 2/ Course 2 LAB	**ET5104T**	Applications of DSP
	ET5104P	Applications of DSP LAB
	ET5105T	Optical Communication
	ET5105P	Optical Communication LAB
	ET5106T	Data Compression
	ET5106P	Data Compression LAB

Course Code		ELECTIVES
Program Elective Course 3	**ET5111S**	Speech Processing
	ET5112S	Microwave Communication Systems
	ET5113S	Cognitive Radio
Program Elective Course 4	**ET5114T**	Antenna Design
	ET5114T	Antenna Design
	ET5115T	Advanced DSP
	ET5115P	Advanced DSP LAB
	ET5116T	Advanced Image & Video Processing
	ET5116P	Advanced Image & Video Processing LAB

SEMESTER III and SEMESTER IV – Project work

S. No	Course Category	Course Title	Credits	Evaluation pattern	Semester
1.	Project	Stage –I Presentation	4	Graded evaluation by a committee of atleast two examiners including supervisor (guide)	III
2.	Project	Stage –II Presentation	4	Graded evaluation by a committee of atleast two examiners including supervisor (guide)	III
3	Project	Stage –III Presentation	4	Graded evaluation by a committee of atleast two examiners including guide (guide)	IV
4.	Project	Final Presentation and Viva Voce	12	Graded evaluation by a committee of atleast two examiners including supervisor (guide) and an external examiner	IV

PROGRAM EDUCATIONAL OBJECTIVES

- **To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to formulate, analyze & solve engineering problems related to Electronics Engineering.**
- **To enable students to succeed in employment, profession and/or to pursue research education in Electronics Engineering.**
- **To help students to exhibit knowledge for innovate, create and design electronic engineering systems.**
- **To inculcate in students professional and ethical attitude, effective communication skills and teamwork to become a successful professional in global perspective.**

PROGRAM OUTCOMES (POs)

At the end of Post Graduate Program, students will have

- **Sufficient knowledge of mathematics, science and Electronics Engineering and be able to apply this knowledge for modelling and solving Electronics Engineering problems using the techniques, skills and modern Electronics Engineering tools necessary for engineering practice.**
- **An ability to design, develop and test electronics systems in the areas related to analog and digital electronics, signal processing, embedded systems and VLSI design.**
- **Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.**
- **An understanding of professional and ethical responsibility and to be able to communicate effectively.**
- **Be aware of current good practices of electrical & electronic engineering for sustainable development.**
- **Ability to communicate effectively as an individual and in group.**
- **Be aware that as a professional engineer their work will have social, culture, global and environmental ramification.**

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**EC5001S**
Course Title	**COMPUTATIONAL METHODS**

COURSE OBJECTIVES

The course is designed to provide M. Tech. Students across all engineering discipline a view of using various computational techniques and tools for analysis, decision making and solution of engineering problems. Following are the course objectives:

- Students will be able to develop mathematical models of lower level engineering problems.
- Students will learn how to solve nonlinear equations numerically.
- Students will be introduced to fundamental matrix algebra concepts and shown how to solve simultaneous linear equations numerically.
- Students will learn how to curve fit (interpolation and regression) discrete date.
- Students will learn how to numerically integrate continuous and discrete functions.
- Students will learn how to numerically solve ordinary differential equations that are initial value or boundary value problems.

COURSE OUTCOMES

In the course Computational Methods, the program objectives are met as follows

- Understand the concept and steps of problem solving - mathematical modeling, solution and implementation.
- Knowledge and understanding of, and the ability to use, mathematical techniques.
- Ability to understand and apply mathematical reasoning in several different areas of mathematics.

Overview

Overview of microcomputer systems. Hardware and software principles.

Module 1: Algebraic Equations

Formulation and solution of linear system of equations, Gauss elimination, LU, QR decomposition, iteration methods (Gauss-Seidal), convergence of iteration methods, Singular value decomposition and the sensitivity of rank to small perturbation

Module 2: Interpolation & Regression Methods

Newton's divided difference, interpolation polynomials, Lagrange interpolation polynomials, Linear and non-linear regression, multiple linear regression, general linear least squares.

Module 3: Transform Techniques

Vector spaces, Basis vectors, Orthogonal/Unitary transform, Fourier transform, Laplace transform.

Module 4: Optimization Techniques for Engineers

Local and global minima, Line searches, Steepest descent method, Conjugate gradient method, Quasi Newton method, Penalty function.

Module 5: Graph Theory

Graphs and Matrices, simple graph, cyclic graph, complete graph, properties of the Laplacian matrix and relationwith graph connectivity. Non-negative matrices. Applications of graph theory to engineering problems.

Recommended Reading

1. "Numerical Methods for Engineers', Steven C. Chapra and Raymond P. Canale, McGraw Hill
2. "Probability and Statistics in Engineering and Management Studies", Hines and Montrogmery, John Willey
3. "Numerical Methods for Engineers", Santosh Gupta, New age international publishers
4. "Graphs and Matrices", R. B. Bapat, TRIM Series, Hindustan Book Agency, 2011
5. "Algebraic Graph Theory ", C. Godsil and G. Royle, Springer, New York, 2001 (AvaiLABle in Indian edition)

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5001S**
Course Title	**STATISTICAL THEORY OF COMMUNICATION**

COURSE OBJECTIVE

- The course is designed to provide a brief introduction of probability, statistics, random variables and random processes.
- Random variables and random signals will be studied with their statistical behavior.
- Game theory will also be studied for variety of problems.

COURSE OUTCOME

- Students will be able to know the fundamentals of the statistical theory and its different aspects.
- Also the statistical behavior of the random signals and random variables will be studied along with variety of queuing theory problems and their solutions.

Overview

Module 1: A Review of Scalar Random Variables

The concept of random variable, distribution formulas of random variables, expectation and moments, examples of random variables, characteristic function, second characteristic function, function of Random Variables.

Module 2: Second order random vectors

Two dimensional Random Variables, second order properties, random vectors, covariance matrices, sequences of second order Random Variables, Hilbert's spaces of second order Random Variables.

Module 3: Multidimensional Random Variables

Introduction, conditional distributions, conditional expectations, functions, moments & cumulates, normal Random vectors, convergence of Random Variables.

Module 4: Statistical description of random signals

Family of finite dimensional distribution, expectations, stationary random signals, linear filtering of random signals, periodicity, continuity of continuous time signals, point processes, second order random signals.

Module 5: Statistical models for random signals

Introduction of white noise, Random walks & Brownian motion, Gaussian signals with stationary increments, spherically invariant & circular signals.

Module 6: Mean square estimation

Introduction to statistical filtering, linear statistical filtering without constraints, sampling as estimation problem, linear statistical filtering with constraints, causality constraints, Wiener filtering, statistical filtering of continuous time signals, Taylor expansions & estimations.

Module 7: Queuing theory

Poisson points in random intervals, arrivals & departures, single server Queue, shot noise, Markov processes, discrete & continuous time Markov chains, spectra of Stochastic FM signals.

Recommended Reading

1. 'Random signals &systems', by Bernard Picinbobo.
2. 'Probability Random Variables & Stochastic Processes', by A. Papoulis.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5002T**
Course Title	**RF INTEGRATED CIRCUITS**

COURSE OBJECTIVE

- Understand Modern RFIC Architectures, parameters and terminology and study the effects of parasitic on circuit performance at RF.
- Use of graphical design techniques for RFIC design and understanding the key issues of RFIC design.
- Applications include wireless communications, active and passive remote sensing, location sensing, radar, and radio astronomy.
- This course is focused on the key concepts in having RF capability on a chip.
- To study parasitic effects and current device modeling.
- To design of high-frequency, analog integrated circuits including low noise amplifiers, voltage-controlled oscillators, phase-locked loops, mixers and power amplifiers.

COURSE OUTCOME

- Understanding of the design and analysis of radio frequency integrated circuits and systems (RFICs) for communications is the major outcome of this course.
- Understanding the enabling integrated circuit technology and devices - Understanding the differences between standard CMOS devices and high-speed, high frequency and high power devices.
- Understanding the basics of RF circuits and systems; such as nonlinearity, sensitivity, dynamic range, matching and impedance transformation networks.
- Understanding RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.
- Understanding of how to design Receiver and Transmitter architectures. Direct conversion and two-step transmitters.

Overview

Module 1: Introduction

RF design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design, nonlinearity and Time Variance, Intersymbol Interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion.

Module 2: RF Modulation

Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures. Direct conversion and two-step transmitters.

Module 3: RF Testing

RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

Module 4: BJT and MOSFET Behavior at RF Frequencies

Overview of RF Filter design and design issues in integrated RF filters, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation. Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, various mixers- working and implementation, Power Amplifier design.

Module 5:RF Circuits Design

Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators.
Module **6: Oscillators**

PLLS, Various RF synthesizer architectures and frequency dividers.

Module 7: Radio frequency Synthesizers

Recommended Reading

1. Thomas H. Lee “Design of CMOS RF Integrated Circuits” Cambridge University press 1998.
2. B. Razavi“RF Microelectronics” PHI, 1998.
3. R. Jacob Baker, H.W. Li, D.E. Boyce “CMOS Circiut Design, layout and Simulation” PHI,1998.
4. Y.P. Tsividis“Mixed Analog and Digital Devices and Technology”, TMH 1996

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5002P**
Course Title	**RF INTEGRATED CIRCUITS LAB**

COURSE OBJECTIVE

- To design and simulate Analog and Digital modulation for RF circuits.
- To get acquainted with BJT & MOSFET behavior at RF frequencies.
- Modeling of transistor & SPICE model.
- To design Low noise amplifier, Mixer, Oscillator, VCO, synthesizer & Power amplifier.

COURSE OUTCOME

- To differentiate the response of BJT and MOSFET at low frequency and RF frequency using modeling.
- To get familiarized with various RF devices, PLLs, Various RF synthesizer architectures and frequency dividers.

Overview

Experiment based on design and simulation of the following:

1. Analog and Digital modulation for RF circuits.
2. BJT & MOSFET behavior at RF analog and digital modulation for RF frequencies.
3. Modeling of transistor & SPICE model.
4. Low noise amplifier design.
5. Mixer design at Gigahertz frequencies.
6. Oscillator design.
7. VCO design.
8. RF synthesizer and frequency divider.
9. Power amplifier design.

Recommended Reading

1. Thomas H. Lee "Design of CMOS RF Integrated Circuits" Cambridge University press 1998.
2. B. Razavi"RF Microelectronics" PHI, 1998.
3. R. Jacob Baker, H.W. Li, D.E. Boyce "CMOS Circiut Design, layout and Simulation" PHI,1998.
4. Y.P. Tsividis"Mixed Analog and Digital Devices and Technology", TMH 1996

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I
Course Code	ET5003T
Course Title	MODERN COMMUNICATION NETWORKS

COURSE OBJECTIVE

- Develop an understanding of computer communication principles.
- To develop an understanding of the underlying structure of networks and how they operate.
- To describe layered communication, the process of encapsulation, and message routing in network equipped devices using appropriate protocols.
- To study Ethernet (IEEE 802.3), token ring (IEEE802.5), fiber distributed data interface (FDDI), distributed - queue dual-bus (DQDB), Frame Relay and switched multimegabit data service (SMDS).
- To study DLL and MAC layer protocols TCP & UDP protocols, IPV4, IPV6 and FTP.
- To study ATM network, features, addressing, signalling, routing, ATM header structure, management and control, BISDN.
- To Optical networks, WDM systems, cross connects, optical LAN, Optical paths and Networks.

COURSE OUTCOME

- To independently understand basic computer network technology.
- To understand and explain Data Communications System and its components.
- To identify the different types of network topologies and protocols.
- To enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
- To identify the different types of network devices and their functions within a network
- To understand and build the skills of subnetting and routing mechanisms.
- To familiarize with the basic protocols of computer networks and how they can be used to assist in network design and implementation.

Overview

Module 1: Review of Networking Concepts

Packet switched Networks : OSI and IP models, ARQ retransmission strategies. Selective repeat ARQ. Framing and standard Data Link Control protocol-HDLC, SDLC, LAPD. Queuing models in communication networks.

Ethernet (IEEE 802.3), token ring (IEEE802.5), fiber distributed data interface (FDDI), distributed - queue dual-bus (DQDB), Frame Relay and switched multimegabit data service (SMDS).

Internetworking issues: Bridges, Routers and Switched networks. Routing and Flow Control algorithms in data networks.

Module 2: Internet and TCP/IP networks

Internet protocol,IPV4,Algorithms, Multicast IP,Mobile IP,IPV6, TCP and UDP ,FTP, performance of TCP/IP Networks.

Module 3: ATM Network

ATM network, features, addressing, signalling, routing, ATM header structure, ATM adaptation layer (AAL), management and control, BISDN,Inter-networking with ATM. Optical networks, WDM systems, cross connects, opticalLAN, Optical paths and Networks.

Module 4: WIRELESS LANS, PANS AND MANS

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11-physical layer, Mac layer mechanism, CSMA/CA, Bluetooth- specification, transport layer, middleware protocol group, Bluetooth profiles, WLL –generic WLL architecture, technologies, broadband wireless access, IEEE 802.16 –differences between IEEE 802.11 and 802.16,physical layer, data link layer.

Recommended Reading

1. Leon Gracia, Widjaja, “Communication Networks”, Tata McGraw Hill,
2. Behrouz.a. Forouzan, “Data Communication and Networking”, Tata McGraw Hill
3. Jean Walrand&PravinVaraiya, “High Performance Communication Networks” ,\ Elsevier
4. Wllliam Stallings, “Wireless Communication and Networks”, Prentice Hall, 2nd edition, 2005.
5. Prentice
6. Larry L. Peterson, Bruce S. Davie, “Computer networks”, 4th Edition, Elsevier

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5003P**
Course Title	**MODERN COMMUNICATION NETWORKS LAB**

COURSE OBJECTIVE

- To perform experiments on framing sequence like bit stuffing and character stuffing.
- To implement error detecting code.
- To test different transmission flow control protocols.
- To test various routing information protocol (RIP).

COURSE OUTCOME

- To get familiarized with various routing protocols like Sliding Window Protocol, CSMA/CD, Ethernet, Token Ring Network, IP, TCP, Leaky Bucket Algorithm, ATM.
- Verification of Stop and Wait protocol, Go Back N protocol, Selective Repeat Protocol.

Overview

I. Framing Sequence

Bit Stuffing and character stuffing

II. Error Detecting Code

Cyclic Redundancy Check

III.Transmission Flow Control Protocols

Verification of Stop and Wait protocol

Verification of Go Back N protocol

Verification of Selective Repeat Protocol

IV. Routing Information protocol (RIP)

- Verification of distance vector routing algorithm
- Sliding Window Protocol and Go-back-N ARQ.
- CSMA/CD Media Access Control, Ethernet (IEEE 802.3).
- Token Ring Network.
- Transparent Bridge.

- Internet Protocol (IP).
- Transport Control Protocol (TCP).
- Leaky Bucket Algorithm (Traffic Management).
- ATM PNNI Routing.

Recommended Reading

1. Leon Gracia, Widjaja, "Communication Networks", Tata McGraw Hill,
2. Behrouz.a. Forouzan, "Data Communication and Networking", Tata McGraw Hill
3. Jean Walrand&PravinVaraiya, "High Performance Communication Networks" ,\ Elsevier
4. Wlliam Stallings, "Wireless Communication and Networks", Prentice Hall, 2nd edition, 2005.Prentice
5. Larry L. Peterson, Bruce S. Davie, "Computer networks", 4th Edition, Elsevier

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5101S**
Course Title	**NEXT GENERATION NETWORKS**

COURSE OBJECTIVE

- The course is designed to understand the motivation for and goals of next generation networks.
- To understand the technical features, applications and design consideration of new and emerging network technologies.
- To provide a comfortable understanding of applicable technology.

COURSE OUTCOME

- Students will have brief idea of technical features and design considerations of the next generation mobile networks.
- Students will be able to design a network with good capacity and efficiency.

Overview

Module 1: Introduction

Evolution of public mobile services - motivations for IP based services, Wireless IP network Architecture – 3GPP packet data network architecture, Introduction to next generation networks -Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next GenerationSociety, future Trends.

Module 2: IMS and Convergent Management

IMS Architecture - IMS services, QoS Control and Authentication, Network and Service management for NGN, IMS advantages, Next Generation OSS Architecture - standards important to OSS architecture, Information framework, OSS interaction with IMS, NGN OSS function/ information view reference model, DMTF CIM.

Module 3: MPLS AND VPN

Technology overview –MPLS &QoS, MPLS services and components – layer 2 VPN, layer 2

Internetworking, VPN services, signaling, layer 3 VPN –Technology overview, Remote Access and IPsec integration with MPLS VPN.

Module 4: Multicast

MPLS Multicast VPN overview – Applications, examples, IPv6 and MPLS - Technology overview, Future of MPLS – Integrating IP and optical networks, Future layer 3 services, future layer 2 services.

Module 5: NGN Management

Network Management and Provisioning – Configuration, Accounting, performance, security, case study for MPLS, Future enhancements – Adaptive self healing networks.

Recommended Reading

1. Thomas Plavyk, “Next generation Telecommunication Networks, Services and Management”,Wiley& IEEE Press Publications, 2002.
2. Neill Wilkinson, “Next Generation Network Services”, John Wiley Publications, 2002.
3. Monique J. Morrow, “Next Generation Networks”, CISCO Press, 2007.
4. Robert Wood, “MPLS and Next Generation Networks: Foundations for NGN and EnterpriseVirtualization", CISCO Press, 2006.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5102S**
Course Title	**ARTIFICIAL NEURAL NETWORKS AND MACHINE LEARNING**

COURSE OBJECTIVE

The course is designed to introduce the field of neural network systems and Artificial Neural Networks. The basic concepts of machine learning are also the main goal of this subject.

COURSE OUTCOME

Students will be able to understand the fundamental concepts of the neural network systems. This is a new field of research thus students will get to know about the recent trends in research fields.

Overview

Module 1: Introduction: Biological neurons and memory

Structure and function of a single neuron; Artificial Neural Networks (ANN); Typical applications of ANNs : Classification, Clustering, Vector Quantization, Pattern Recognition, Function Approximation, Forecasting, Control, Optimization.

Module 2: Supervised Learning

Single-layer networks; Perceptron-Linear separability, Training algorithm, Limitations; Multi-layer networks-Architecture, Back Propagation Algorithm (BTA) Adaptive Multi-layer networks-Architecture, training algorithms; Recurrent Networks; Feed-forward networks; Radial-Basis-Function (RBF) networks;

Module 3: Unsupervised Learning

Winner-takes-all networks; Hamming networks; Maxnet; Simple competitive learning; Vector-Quantization; Counter propagation networks; Adaptive Resonance Theory; Kohonen's Self-organizing Maps; Principal Component Analysis;

Module 4: Associated Models and Optimization Methods

Hopfield Networks, Brain-in-a-Box network; Boltzmann machine; Hopfield Networks for-TSP, Solution of simultaneous linear equations; Iterated Gradient Descent; Simulated Annealing; Genetic Algorithm.

Module 5: Introductory Material to Machine Learning and AI

Motivations for Studying ML, Supervised and Unsupervised learning, Machine Learning in the Large

Module 6: Classical and Theoretical ML Topics

Concept Learning (also called Learning from Examples), Learning from Analogy, Explanation Based Learning, Structure Learning, Reinforcement Learning, Decision Tree Learning, Decision List Learning , Oracle Based Learning, Probably Approximately Correct (PAC) Model, Boosting, Bayesian Learning: Maximum Likelihood Estimates, Parameter Estimation, Bayesian Belief Networks

Module 7: Introductory Graphical Models Based Learning

Expectation Maximization as a fundamental technique, Hidden Markov Models (HMM): Motivation for Generative Models, Forward-backward Algorithm, Baum Welch Iteration, Feature Enhanced HMM.

Module 8: Maximum Entropy Markov Models (MEMM)

Motivation for Discriminative Models, Training of MEMMs (v) Introductory Optimization Based Methods: Neural Nets, Support Vector Machines, Genetic Algorithms (v) Applications: Text Learning, Speech Processing, Data Mining, Bioinformatics.

Recommended Reading

1. Simon Haykin, "Neural Networks - A Comprehensive Foundation", Macmillan Publishing Co., New York, 1994.
2. A Cichocki and R. Unbehauen, "Neural Networks for Optimization and Signal Processing", John Wiley and Sons, 1993
3. J. M. Zurada, "Introduction to Artificial Neural Networks", (Indian edition) Jaico Publishers, Mumbai, 1997.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I
Course Code	ET5103S
Course Title	E-SECURITY

COURSE OBJECTIVE

- This course is designed to introduce the concept of E-security, which is of immense importance in the field of networking.
- The basics of network security, concept of firewalls and web security will be introduced.
- The algorithms and the management techniques will also be studied.

COURSE OUTCOME

- The students will be well acquainted with the concept of E-security.
- They will be able to understand different aspects of management and security of the networking.
- This can encourage the students to further study this field from research point of view.

Overview

Module 1: INTRODUCTION ON SECURITY

Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and avaiLABility, Security services and mechanisms, Techniques: Cryptography, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers- Steganography- Revision on Mathematics for Cryptography.

Module 2. SYMMETRIC & ASYMMETRIC KEY ALGORITHMS

Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem.

Module 3: INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT

Message Integrity, Hash functions: SHA 512, Whirlpool, Digital signatures: Digital signature Standards, Authentication: Entity Authentication: Biometrics, Key management Techniques.

Module 4. NETWORK SECURITY, FIREWALLS AND WEB SECURITY

Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall, IP Security Overview, IP security Architecture, Authentication Header, Security payload, Securityassociations, Key Management, E-mail security: PGP, MIME,S/MIME,

Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature.

Module 5. WIRELESS NETWORK SECURITY

Security Attack issues specific to Wireless systems: Worm hole, Tunnelling, DoS, WEP for Wi Finetwork, Security for Broadband networks: Secure Ad hoc Network, Secure Sensor Networks

Recommended Reading

1. Behrouz A. Forouzan," Cryptography and Network security" Tata McGraw- Hill, 2008.
2. William Stallings,"Cryptography and Network security: Principles and Practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002.
3. Atul Kahate," Cryptography and Network security", 2nd Edition, Tata McGraw-Hill, 2008.
4. R.K.Nichols and P.C. Lekkas, "Wireless Security".
5. H. Yang et al., "Security in Mobile Ad Hoc Networks: Challenges and Solution", IEEE Wireless Communications, Feb. 2004.
6. "Securing Ad Hoc Networks", IEEE Network Magazine, vol. 13, no. 6, pp.24-30, December 1999.
7. "Security of Wireless Ad Hoc Networks", http://www.cs.umd.edu/~aram/wireless/survey.pdf
8. David Boel et.al (Jan 2008), "Securing Wireless Sensor Networks – Security Architecture Journal of networks", Vol. 3. No. 1. pp. 65 -76.
9. Perrig, A., Stankovic, J., Wagner, D. (2004), "Security in Wireless Sensor Networks", Communications of the ACM, 47(6), 53-57.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5104T**
Course Title	**Applications of DSP**

COURSE OBJECTIVE

- To have a thorough understanding of time and frequency domain concepts and the associated mathematical tools which are fundamental to all DSP techniques
- To provide a thorough understanding about the practical design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

COURSE OUTCOME

- Students should be masters in analyzing discrete-time signals in the time domain and frequency domain, using different transforms.
- Students should be able to design various types of Digital Filters like FIR and IIR and implement it on processors.
- Students should be able take up advanced courses and do projects in signal processing and its applications.

Overview

Module 1: Discrete Time Signals

Discrete Time Signals, Sequences; representation of signals on orthogonal basis; Classifications; A/D and D/A conversion: sampling and quantization, antialiasing and smoothening filters, reconstruction of signals, relationship between spectra of discrete- and continuous- time representations.

Module 2: Discrete time systems:

Discrete system attributes, Analysis of LTI systems, Z-Transform, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Hilbert Transform, Implementation of Discrete Time Systems.

Module 3: FIR Digital filters:

Concept of linear phase, types, position of zeros, Design using Window method, Frequency Sampling Techniques, Park-McClellan's method etc.;

Module 4: Design of IIR Digital Filters

Design analog filters like Butterworth, Chebyshev and Elliptic Approximations; Various techniques of conversion of analog filter into digital filters like Impulse Invariant, Derivatives, Bilinear transformation, Match Z-transform and its modifications., mapping of s-plane to z-plane, limitations, Effect of finite precision numerical effect.

Module 5. DSP Processor Fundamentals

DSP processor architecture, Software developments, Selections of DSP processors, Implementation considerations, finite word length effects, real time implementation, Hardware interfacing, DSP processor architectures: TMS 320C54XX, TMS 320C67XX, Blackfin processor: Architecture overview, memory management, I/O management, On chip resources, programming considerations, Real time implementations, Applications of DSP systems Design using fixed point and floating point implementations: FIR filters

Module 6: Application of DSP to Speech and Radar signal processing

Recommended Reading

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice
5. Hall D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, J Wiley and Sons, Singapore
6. Salivahanan S, Vallavaraj A, Gnanapriya, Digital Signal Processing, Mc Graw Hill, 2nd edition

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5104P**
Course Title	**Applications of DSP LAB**

COURSE OBJECTIVE

- This course will provide a brief knowledge about MATLAB and its applications in the area of signal processing.
- To emphasize on fundamentals of Digital Signal Processing and verify theoretical aspects with the help of higher level computational languages such as MATLAB.

COURSE OUTCOME

- Students should be able to apply the different transforms for the characterizations of signals and systems.
- Students should be able to design digital filters for various applications. .

Overview

1. Characterization of LTI systems
2. Frequency response of the given Transfer function.
3. Fourier transform and Fourier series of time domain digital signal.
4. DTFT of discrete time signals.
5. Fast Fourier Transforms (FFT).
6. Design of different FIR filters.
7. Design of different IIR filters.
8. Effect of finite register length in FIR filter design.
9. Implementation of one algorithm on a DSP Processor.

Recommended Reading

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice
5. Hall D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, J Wiley and Sons, Singapore
6. Salivahanan S, Vallavaraj A, Gnanapriya, Digital Signal Processing, Mc Graw Hill, 2nd edition

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5105T**
Course Title	**OPTICAL COMMUNICATION**

COURSE OBJECTIVE

- The course is basic course of fiber optic communication.
- The optical fiber characteristics are studied with Optical transmitters and Optical receivers.
- To study System design and performance for Voice, video and data transmission.

COURSE OUTCOME

- Students will be aware of working of fiber optic devices, their performance and characteristics.
- Also fiber optic network and the components for the fiber optic network will be studied.

Overview

Module 1: Introduction

Introduction to fiber optic; light propagation, Optical fibers: modes, dispersion, low, nonlinear effects, Optical transmitters: LEDs, semiconductor lasers, transmitter design.

Module 2: Optical receivers

Photodetectors, receiver design, noise, sensitivity, System design and performance: voice, video, data transmission, Analog and digital systems, standards.

Module 3: Optical communications sytems

Broadband local area optical networks and WDM systems, Coherent communication systems, Long distance telecommunications using optical amplifiers and solutions.

Module 4: Introduction to topics of current interest

All optical networks, integrated optics, MOEMS; microwave photonics.

Module 5: Fiber optics networks

Introduction to fiber-optic networks; Components for optical networks, Broadcast and select networks; Wavelength routing networks.

Recommended Reading

1. A. Selvarajan, SubratKar, T. Srinivas, “Optical Fiber Communications, Principles and Systems”, Tata McGraw Hill, 2002.
2. G. Keiser, “Optical Fiber Communications”, 2nd Edition, McGraw Hill, 1991
3. I. P. Kaminov and T. L. Koch, “Optical Fiber Telecommunications IIIA and IIIB”, Academic Press, 1997.
4. R. Ramaswami and K. N. Sivarajan, “Optical Networks: A practical Perspective”, (2nd Ed), Morgan Kufmann Publishers 2002.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5105P**
Course Title	**OPTICAL COMMUNICATION LAB**

COURSE OBJECTIVE

- This LAB aims to introduce students to different element of fiber optic communication such as Fiber components and measurements, transmitters and detectors, fiber amplifiers, multimode fiber links, and wavelength division multiplexing.
- To reinforce fundamentals of optical communication systems. Emphasizes theory with elements of design and applications.

COURSE OUTCOME

- Understand and measure the basic properties of the propagation of light in a guided-wave dielectric optical fiber, including attenuation, coupling, and handling.
- Understand the differences between types of light sources utilized in optical systems, including bandwidth, power, modulation, and spectra, and the appropriateness of each in a given system configuration.

Overview

1. Experiments on characteristics of optical fibers, sources and detectors
2. Analog and digital link, WDM system
3. Tutorial on optical fiber system design
4. Simulation of optical fiber modes with OptiSIM
5. Optical fiber cable as a light guide
6. Fiber optic cable transmission
7. Characteristics of connectors and splices
8. Index-matching procedures
9. Fiber optic transmitter
10. Fiber termination techniques

Recommended Reading

5. A. Selvarajan, SubratKar, T. Srinivas, "Optical Fiber Communications, Principles and Systems", Tata McGraw Hill, 2002.
6. G. Keiser, "Optical Fiber Communications", 2nd Edition, McGraw Hill, 1991
7. I. P. Kaminov and T. L. Koch, "Optical Fiber Telecommunications IIIA and IIIB", Academic Press, 1997.
8. R. Ramaswami and K. N. Sivarajan, "Optical Networks: A practical Perspective", (2nd Ed), Morgan Kufmann Publishers 2002.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**EC5106T**
Course Title	**DATA COMPRESSION**

COURSE OBJECTIVE

- To study different compression techniques and coding theorems.
- To study different quantization model and compare their compression ratio.
- To study how to achieve lossless compression with significant quality and study of video and audio compression.

COURSE OUTCOME

- Students will be able to perform compression on data with significant quality and with minimum loss.
- Different type of data like audio, video, speech, etc will be analyzed and encoded with variety of techniques.

Overview

Module 1: Introduction

Introduction and Background, Source Modeling, Entropy Rate of a Source, Shannon Lossless Source Coding Theorem, Rate-Distortion Theory, The Gap Between Theory and Practice.

Module 2: Lossless Data Compression

Introduction, Entropy based methods, Huffman, Adaptive Huffman Coding, Dictionary based methods, Lempel-Ziv Coding., JEPG, JPEG 2000.

Module 3: Scalar Quantization

Introduction, types of quantization, Adaptive Quantization.

Module 4: Vector Quantization

Introduction, Preliminaries, Design Problem, Optimality Criteria, LBG Design Algorithm, Cluster based techniques.

Module 5: Audio Compression

Introduction, Speech, Speech Generation, Speech Analysis, Speech Transmission, LPC Modeling, LPC Analysis, 2.4 kbps LPC Vocoder, 4.8 kbps CELP Coder, 8.0 kbps CS-ACELP Coder, Parametrized Coding, Dolby AC-3 compression.

Module 6: Video Compression

Introduction to digital video: Types – Chromasub sampling, CCIR , HDTV Computer Video format, Video compression: Based on motion compression Motion vector search technique : Sequential, 2D logarithmic, Hierarchal search, Standards used – H.261,Comparison of MPEG and H.264 , MPEG 1,2,4,7 and File formats – DV.

Recommended Reading

1. T. M. Cover and J. A. Thomas, Elements of Information Theory.
2. A. Gersho and R. M. Gray, Vector Quantization and Signal Compression.
3. K. Sayood, Introduction to Data Compression
4. David Saloman, Data Compression: The Complete Reference.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-I**
Course Code	**ET5106P**
Course Title	**DATA COMPRESSION LAB**

COURSE OBJECTIVE

- This course will provide brief introduction on various aspects of data analysis and compression and build on it.
- The primary focus will be on applying these methodologies on real time data and system to get reasonable and necessary outcomes.

COURSE OUTCOME

- The practical approach toward data handling and analysis will be known to the students.
- Students will acquire some of the basic skills in the field of data compression which can be applied on various kinds of real-time data.

Overview

1. Basic statistical operations and methods in MATLAB using toolbox
2. Discrete Cosine Transform of time domain signals
3. Huffman coding
4. JPEG lossy using DCT
5. Principal component analysis (PCA) on 1 Dimensional Data
6. Linde-buzo Gray (LBG) algorithm for data clustering
7. Wavelet analysis and synthesis
8. Study of Wavelet Packet toolbox
9. JPEG 2000
10. Set Partitioning in hierarchical trees (SPIHT)

Recommended Reading

5. Thomas H. Lee "Design of CMOS RF Integrated Circuits" Cambridge University press 1998.
6. B. Razavi"RF Microelectronics" PHI, 1998.
7. R. Jacob Baker, H.W. Li, D.E. Boyce "CMOS Circiut Design, layout and Simulation" PHI,1998.
8. Y.P. Tsividis"Mixed Analog and Digital Devices and Technology", TMH 1996

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5004S**
Course Title	**ERROR CORRECTING CODES**

COURSE OBJECTIVE

- The course is designed to provide a brief idea of linear algebraic functions and differentiate vectors according to their properties.
- Evaluation of the performance of binary and non-binary error correcting codes.
- Study of different error correcting codes for wireless environment.

COURSE OUTCOME

- Students will be familiar with the different codes that used for encoding the data.
- To design a code with greater compression ratio and with minimum error and high signal to noise ratio.
- Different encoding algorithms for various codes will be implemented.

Overview

Module 1: Linear Abstract Algebra and Finite Fields

Groups, Fields, Rings, Vector spaces, subspaces, Galois field, Extension fields, Primitive element, primitive polynomial, GCD of polynomial, LCM of polynomial, minimal polynomial, factorization of (X^n-1) over a Galois field, construction of generator polynomial & parity check polynomial primitive n^{th} root of unity.

Module 2: Cyclic Codes

Properties, Various methods of generation and detection of cyclic codes, error detecting capability, cyclic Hamming code and Golay code.

Module 3: Binary and Non-Binary BCH codes

Binary primitive BCH codes, decoding, iterative algorithm for finding the error location polynomial, error location numbers and error correction, implementation of error correction.Q-ary linear block codes, primitive BCH codes, RS codes, decoding of BCH and RS codes.

Module 4: Convolutional Codes

Encoder and decoder, structural properties, optimum decoding of Convolutional codes, Viterbi, soft output Viterbi BCGR algorithm.

Turbo coding- encoding and decoding.

Module 5: Low Density Parity Check Codes

Encoding and detection, sum-product algorithm, simplification of sum product algorithm

Module 6: Trellis coded Modulation

Background on Signal constellation, construction and detection.

Module 7: Space-Time Coding

Fading channels and Space-Time codes, Rayleigh channel and MIMO channel, space-time block codes, space-time trellis codes.

Recommended Reading

1. Shu Lin, Daniel J.Costello, "Error Control Coding", 2nd Edition, Pearson, Reprint 2012.
2. Jorge Castineira Moreira, Patrick Guy Farrell, "Essentials of Error Control Coding", 1st Edition, Wiley, Reprint 2013.
3. Todd K. Moon, "Error Correction Coding: Mathematical Methods and Algorithms", 1st Edition, Wiley, Reprint 2013.
4. Stephen B. Wicker, "Error control systems for Digital communication & storage".

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5005T**
Course Title	**ADVANCED MOBILE COMMUNICATION**

COURSE OBJECTIVE

- To provide the student with an understanding of the Cellular concept, Frequency reuse, Hand-off strategies.
- To enable the student to analyze and design wireless and mobile cellular communication systems over a fading channel
- To provide the student with an understanding of Equalization and diversity reception techniques
- To give the student an understanding of digital cellular systems (GSM, CDMA)
- To give the student an understanding of present day cellular technologies implemented in LTE like OFDM, MIMO systems

COURSE OUTCOME

- By the end of the course, the student will be able to analyze and design wireless and mobile cellular systems.
- The student will be able to understand impairments due to multipath fading channel and be able simulate standard stochastic channel models for various environments.
- The student will be able understand the fundamental techniques to overcome the different fading effects.
- The student will have detailed understanding of current and proposed cellular technologies.
- The student will have the ability to work in advanced research wireless and mobile cellular technologies.

Overview

MODULE 1: Review of mobile radio standards and cellular concept

Evolution of Mobile radio communications – Mobile radio systems in the U.S. and around the world –Examples of Mobile radio systems. Cellular concept – Frequency reuse – Channel Assignment strategies – Handoff strategies – Interference and System capacity – Trunking and Grade of service – Improving capacity in cellular systems.

MODULE 2: Mobile radio propagation

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

MODULE 3: Mobile system and network architectures

GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM– Signal processing in GSM – GPRS network architecture – GPRS services, IS-95 The North American CDMA.

MODULE 4: Third generation mobile communication system

Need of 3G Cellular N/w, IMT 2000 Global Standard, W-CDMA Air interface, TD-SCDMA Technology, CDMA 2000 Cellular Technology.

MODULE 5: 4G Mobile communication

4G introduction and standards: IEEE 802.16, WiMAX Forum, 3GPP and IMT-Advanced; Overview of WiMAX and LTE standards and network architectures.

Recommended Reading

1. T.S. Rappaport, "Wireless Communication, principles & practice", Prentice Hall of India
2. William Stallings, "Wireless Communication and Networking", Pearson Education, 2002.
3. Raj Pandya, "Mobile and Personal Communication Systems and Services", PHI, 2001.
4. ItiSahaMisra, " Wireless Communications and Network", McGraw Hill Education Pvt. Ltd.2009

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II
Course Code	ET5004P
Course Title	ADVANCED MOBILE COMMUNICATION LAB

COURSE OBJECTIVE

- Study the basic path loss models and their effects of modern day communication links and practical link budget limitations.
- During these sessions actual practice and realization of the concepts studied would be emphasized.

COURSE OUTCOME

- Students will be able to make performance decisions on practical link establishment, problems and suggested solutions.
- Students will also be Performance measurements for link establishment.

Overview

I. Wireless Path loss - Study of Propagation Path loss Models: Indoor & Outdoor

1. Free Space Propagation – Path Loss Model
2. Multipath Fading in Cellular Mobile Communication
3. Link Budget Equation for Satellite Communication
4. Carrier to Noise Ratio in Satellite Communication
5. Outdoor Propagation – Okumura Model
6. Outdoor Propagation – Hata Model

II. Study of GSM Technology using mat LAB simulation and modules

1. Study of the Tx IQ/Rx IQ signals.
2. Performance of SIM Detection
3. GSM Data services & capability
4. Radio Resource Allocations and Scheduling in Cellular Mobile Communication

III. Study of CDMA Technology

1. Generation of Direct sequence spread spectrum (DS-SS)
2. Reception of Direct sequence spread spectrum (DS-SS)
3. Generation of frequency hoped spread spectrum (FH-SS)
4. Reception of frequency hoped spread spectrum (FH-SS)
5. Generation of Hadamard Codes

IV. Study and Implementation of RAKE Receiver

V. Design and Implementation of Equaliser.

Recommended Reading

1. T.S. Rappaport, "Wireless Communication, principles & practice", Prentice Hall of India
2. William Stallings, "Wireless Communication and Networking", Pearson Education, 2002.
3. Raj Pandya, "Mobile and Personal Communication Systems and Services", PHI, 2001.
4. ItiSahaMisra, " Wireless Communications and Network", McGraw Hill Education Pvt. Ltd.2009.
5. GSM Manual
6. CDMA Manual

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II
Course Code	ET5006T
Course Title	EMBEDDED SYSTEM DESIGN

COURSE OBJECTIVE

- To implement research oriented concepts in embedded system.
- Complete design of an embedded system with functional requirements for hardware and software components including processor, networking components, along with applications, subsystem interfaces, networking, and middleware.
- Understand inter-process communication and the role of middleware.
- Understand network protocol layers and explain the specific role of each.
- Develop standard project plans for a software development team including interface definition.
- To study different operating systems including Mobile, Embedded and RTOS.

COURSE OUTCOME

- Students should be able to design embedded systems.
- Students should understand the general process of embedded system development
- Ability to use C to develop embedded software.
- Students should be able to interface peripherals, knowledge of typical interfacing standards.
- Understanding of what an embedded system R&D project is, and the activities it involves.

Overview

Module 1. Introduction

Features of embedded system, general architecture, classification, skills required, parameters and metrics, tradeoffs, hardware and software components

Module 2.Embedded Hardware

Embedded processor requirements, features, types, organization, selection of processors, microcontrollers, selection of microcontrollers, instruction set architecture, RISC processors, Harvard architecture, super Harvard architecture, target boards, memory requirements, memory organization, parameters, types, selection of memory, tradeoffs, IO requirements, IO devices like display, keyboards, ADC, DAC, UART, modem, timer, pulse dialer, mechatronic devices, printers etc.

Module 3. Embedded software

Structure, comparison with desktop software, requirements, parameters, software developments tools, cross platform development, programming languages like embedded C, embedded C++ and JAVA, device drivers, debuggers, profilers, code optimization, Real time O.S., features, architectures, kernels objects, semaphore, mutex, shared data problems, schedulers, reentrancy, queues, mail boxes, pipes, timers, event management, intertask communication, memory managements, embedded OS. Linux, RTLinux, Palm OS, Mobile OS like Symbionetc, multiprocessor software developments, data flow graph, FSM model, petri net model, multithreading. Study and programming of RTOS like RTX5 1, VxWorks, Andriod etc.

Module 4. Embedded communication

Mobile devices communication interfaces like RS232, RS422, USB, IrDA, Ethernet, IEEE 802.11, Blue tooth, development environment, J2ME, RFID system, DSP architecture, DSP based embedded system, embedded communication systems like smart phones, smart card, mobile, lap, global positioning system, set top boxes etc.

Module 5. Embedded system design methodology

System development process, Requirements engineering, reverse engineering, design tradeoffs, co design, SOC, implementation, Integration, testing like testing on the host system, testing on target board, environmental testing, packaging, configuration management, embedded project management, embedded system fiascos.

Module 6. Embedded processors

Embedded processor models, Application specific processor like network processors, multimedia processors, industrial processors etc. Digital signal processors, superscalar processor, Advanced RISC processors, and ARM processors, DsPIC Microcontroller

Recommended Reading

1. Raj Kamal "Embedded system" Tata McGraw Hill
2. Prasad "Embedded Real time systems" Dream tech Wiley Publication.
3. David Simon, "An embedded Software Primer" Pearson Publication
4. Frank Vahid, "Embedded system — A unified Hardware Software Introduction" John Wiley and Sons.
5. Embedded System Architecture By Tammy Noergaard Elsevier publication

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5006P**
Course Title	**EMBEDDED SYSTEM DESIGN LAB**

COURSE OBJECTIVE

- Study of different Embedded Software Development Tools like Keil µvision, Proteus, Flowcode.
- To perform experiments on the Embedded Hardware Development Board.
- To perform experiments on RTX51Tiny and study its features.
- To Verify Communication Protocol like RS232,I2C, SPI, CAN, Ethernet Wired buses and Bluetooth, IrDA and Zigbee and Wifi buses.

COURSE OUTCOME

- Students should be able to do Embedded C programming.
- Students should be able to perform experiments on different development boards.
- Students should get introduced with application of embedded system in different fields.

Overview

1) Embedded Software Development Tools:-Keil µ vision 3 and 4 project management, Study How to create Embedded Project, Compile and Test Project for 8051 and it's Derivative, Testing of 8051 based project on Target Board, Programming of Flash Memory, Project on MPLAB, How to use Debugger. Flowcode.

2) Embedded Hardware Development Board:-To Study 8051 and PIC Board Architecture, Study Communication Interface of Board like RS232,USB, and JTAG.

3) Embedded C programming: - Programming of 8051, PIC , AVR and ARM in C

4) Embedded Testing:-Logic Analyzer for Embedded Testing.

5) RTOS:-Study of Various Commands of RTOS like RTX51 tiny. Free RTOS, RTLinux and programming

6) Embedded Communication System design :- Verification of Communication Protocol like RS232,I2C, SPI, CAN, Ethernet Wired buses and Bluetooth, IrDA and Zigbee and Wifi buses.

7) Real Time Programming in C, J2ME in JAVA, Symbion Programming ,Andriod Embedded system development on EDK(Xilinx) and PSOC

Recommended Reading

1. Raj Kamal "Embedded system" Tata McGraw Hill
2. Prasad "Embedded Real time systems" Dream tech Wiley Publication.
3. David Simon, "An embedded Software Primer" Pearson Publication
4. Frank Vahid, "Embedded system — A unified Hardware Software Introduction" John Wiley and Sons.
5. Embedded System Architecture By Tammy Noergaard Elsevier publication

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5111S**
Course Title	**SPEECH PROCESSING**

COURSE OBJECTIVE

- To introduce the characteristics of Speech signals and the related time and frequency domain representations.
- To introduce the different applications of speech like synthesis , coding and recognition

COURSE OUTCOME

- Students should be able analyze the speech signal and to identify the different parameters of speech signal like voiced/unvoiced, vowel/consonant, types of articulation etc.
- Students should have a basic understanding about the different applications of speech processing.

Overview

Module 1: Speech production and perception

Speech production mechanism, Auditory System and Hearing Mechanism, Classification of speech, sounds, nature of speech signal, models of speech production. Speech signal processing: purpose of speech processing, digital models for speech signal, Digital processing of speech signals, Significance, short time analysis.

Module 2: Time domain methods for speech processing

Time domain parameters of speech, methods for extracting the parameters, Zero crossings, Auto correlation function, pitch estimation.

Module 3. Frequency domain methods for speech processing

Short time Fourier analysis, filter bank analysis, spectrographic analysis, Format extraction, pitch extraction, Analysis - synthesis systems, Auditory models

Module 4: Linear predictive coding of speech

Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains.

Module 5: Speech signal analysis

Cepstral analysis of speech, Mel frequency cepstral coefficients (MFCC), format and pitch estimation

Module 6. Application of speech processing

Speech Synthesis, Speech Coding, Speech and Speaker recognition and verification. Vector quantization, Hidden Markov modeling for isolated word and continuous speech recognition.

Recommended Reading

1. Lawrence Rabiner and Ronals Schafer, "Theory and Applications of Digital Speech Processing", Prentice Hall, 2011
2. T.F. Quatieri, Discrete-Time Speech Signal Processing, Prentice Hall 2002.
3. L.T. Rabiner and R. Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.
4. Douglas O"Shaughnessy, Speech Communciations: Human and Machine, Universities Press, 2001.
5. J.L Flanagan : Speech Analysis Synthesis and Perception - SprengerVertag,
6. I.H.Witten :Principles of Computer Speech , Academic press.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5112S**
Course Title	**Microwave Communication Systems**

COURSE OBJECTIVE

- To understand the basics of the modern microwave communication systems, its parameters and terminology.
- To study the different communication systems, modulation techniques, reception system, noise considerations and performance of the systems.
- Understanding the key issues of Microwave communication systems.

COURSE OUTCOME

- Students will be able to know the performance parameters of the different propagation models and their configuration for satellite communication.
- Up link and down link frequency spectrum will also be studied.

Overview

Module 1: LOS Propagation and system performance

Introduction to LOS propagation, point to point fixed communication technologies, bandwidth and capacity of microwave LOS link.

Module 2:Active and Passive Repeater design

Active Repeater: Site acquisition, Tower issue, power.

Passive repeater: Plane reflector, back to back antenna, practical issues.

Module 3: Tropo-scatter Propogation

Tropo scatter background, Global Application, Tropo scatter path characteristics, Tropo scatter equipment, System architecture, diversity reception.

Module 4: Satellite Communication

Satellite orbit, satellite access, TDMA, FDMA, Spread spectrum modulation, earth segment and satellite application.

Module 5: Earth Station design criteria

Earth station configuration, antenna subsystem, Feed subsystem, tracking system, low noise amplifier.

Module 6: Noise Consideration

Sources of noise, effect of noise on system performance, Noise figure, noise characterization of microwave receiver, Communication link SNR calculation.

Recommended Reading

1. Satellite Communication “Fourth Edition” by Dennis Roddy.
2. World Satellite Communication and earth station by Brian Ackroyd.
3. Radio Frequency and microwave communication circuit by D. K. Mishra.
4. Microwave Radio Transmission design by Trevor Manning.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5113S**
Course Title	**COGNITIVE RADIO**

COURSE OBJECTIVE

- To study the basics of Cognitive Radio Systems. Introduction to SDR and cognitive radio architecture.
- A brief review of next generation wireless networks.

COURSE OUTCOME

- Students will be able to know parametric characterization of the cognitive radio system and their interfaces and topologies along with the spectrum allocation for XG mobile communication.

Overview

Module 1: Introduction to SDR

Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications, Antenna for Cognitive Radio.

Module 2: SDR Architecture

Essential functions of the software radio, architecture goals, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules, architecture partitions.

Module 3: Introduction To Cognitive Radios

Marking radio self-aware, the cognition cycle, organization of cognitions tasks, structuring knowledge for cognition tasks, Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations.

Module 4: Cognitive Radio Architecture

Primary Cognitive Radio functions, Behaviours, Components, A–Priori Knowledge taxonomy, observe– phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, design rules.

Module 5: Next Generation Wireless Networks

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross - layer design.

Recommended Reading

1. Alexander M. Wyglinski, MaziarNekovee and Y. Thomas Hou, “Cognitive RadioCommunications and Networks - Principles and Practice”, Elsevier Inc. 2010.
2. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley &Sons, Ltd, 2009.
3. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, “Cognitive Radio Networks – FromTheory to Practice”, Springer Series: Analog Circuits and Signal Processing, 2009.
4. J. Mitola, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”,Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
5. Simon Haykin, “Cognitive Radio: Brain –empowered wireless communications”, IEEEJournal on selected areas in communications, Feb 2005.
6. Ian F. Akyildiz, Won Yeol Lee, Mehmet C. Vuran, ShantidevMohanty, “NeXt generation /dynamic spectrum access / cognitive radio wireless networks: A Survey”, Elsevier, ComputerNetworks Journal, May 2006.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5114T**
Course Title	**ANTENNA DESIGN**

COURSE OBJECTIVES

- The course is designed to know and use standard antenna characterization parameters.
- To design simple antenna such as dipole, micro strip antenna, etc. To understand electromagnetic radiation mechanism and design the antenna with required radiation pattern.
- To understand and design antenna system for variety of communication models, RADAR and power transfer system.

COURSE OUTCOME

- Students will be able to know the aspects of the antenna design.
- To design an antenna with required parameters and models.

Overview

Module 1: Introduction

Integral Equation Methods, Axisymmetric 3D structures, Vector formulations for 3D structures, Entire-domain versus sub-sectional representations, The Finite Element Method, The Finite Element Method applied to the scalar and vector Helmholtz equations, Radiation boundary conditions for open structures.

Module 2: Antenna Fundamentals

Dipole and Loop Antennas, Antenna Parameters, Noise Temperature, Baluns.

Module 3: Numerical Modeling of Antennas

Numerical ElectromagneticCode (NEC)

Module 4: Impedance of Antennas

Reciprocity Theorems and the Induced EMF Method, The Antenna as a Boundary Value Problem, Impedance of a Waveguide-fed Aperture Antenna, Impedance of a Dipole: Pocklington Equation, Impedance by Numerical Methods: The Method of Moments, Example of General-purpose Numerical Technique:The NEC Code.

Module 5: Phased Array Antennas and Their Synthesis

Introduction to Arrays, Uniform and Nonuniform Linear Arrays, Synthesis of Linear Array Antennas, Dolph-Chebyshev Arrays, Taylor Distribution Functions.

Module 6: Microstrip Antennas

Single-mode cavity model for radiation calculations, Multi-mode cavity model for impedancecalculations, Feed Structures for Linear and Circular Polarization, Electric-field Integral Equation & Green's Functions, Design of Microstrip Patch Antennas.

Module 7: Helical Antennas

Normal-mode and Axial-mode Helical Antennas, Leaky-wave Radiation from Helices.

Recommended Reading

1. Peterson, Ray &Mittra, "*Computational Methods for Electromagnetics"*, IEEE Press, 1998.
2. Stutzman and Theile, "*Antenna Theory and Design* (3rd edition)", Wiley, 2012.
3. Milligan, T. A., "*Modern Antenna Design* (2nd edition)", Wiley-IEEE Press, 2005.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5114P**
Course Title	**ANTENNA DESIGN LAB**

COURSE OBJECTIVES

- To be familiar with the most popular antenna design programs
- To investigate the different parameters associated with the specific antenna.
- To deal with various wire antennas, dipole, loop, helix etc.
- To get close to arrays and the different parameters that controls the shape of the pattern.
- To design yagi antenna using designs graphs and software programs.
- To investigate the high directional antennas such as Horn and Reflector antennas.

COURSE OUTCOME

- Students can understand the Antenna Basics, basic Antenna parameters.
- Understands the Loop Antennas and its Radiation Resistances. Antenna Arrays and its Patterns. Basics of Maxwell equations.
- Design Concepts of Different Types of Antennas.VHF, UHF and Microwave Antennas-I&II.
- Different Kinds of Wave Propagation.
- Antenna for Special applications& antenna temperature.
- Practical design considerations of antennas.

Overview

- Study of simple dipole antenna
- Perform Polarization test, modulation test, variation of radiation pattern
- Impedance matching, stub design
- SWR measurement
- Study and design of YagiUda 3, 5, 7 element simple and folded dipole
- Study and design of phase array end fire array
- Study and design of combined collinear array
- Study and design of phase array broadside array
- Study and design of Log periodic antenna
- Study of Paraboloid reflector
- Study and design of slot and microstrip antenna
- Study of Helical antenna.

Recommended Reading

1. Constantine Balanis, "Antennas", John Willey, Prentice Hall, 1993.
2. Stutzman and Theile, "*Antenna Theory and Design* (3rd edition)", Wiley, 2012.
3. Milligan, T. A., "*Modern Antenna Design* (2nd edition)", Wiley-IEEE Press, 2005.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5115T**
Course Title	**ADVANCED DIGITAL SIGNAL PROCESSING**

COURSE OBJECTIVE

- To introduce the basic concepts of multi-rate signal processing, random process and wavelets.

COURSE OUTCOME

- Students should be able to analyze signal by splitting into different levels to obtain better frequency resolution.
- Students should be able to model the random processes.
- Students should be able apply wavelet analysis to signal and image processing applications.

Overview

Module 1: Multirate Digital Signal Processing

Sampling, Comparison of analog and digital spectrum with different sampling frequency, alising, Decimation, Interpolation, multi stage interpolators and decimators, Filter design and implementation, Application of multirate signal processing.

Module 2: Spectral Estimation for Discrete Time random processes

Definitions and representation of random process, parametric and non parametric spectral estimations; estimation of auto correlation and power density spectrum. Filtering random process, Non parametric techniques like: periodogram, modified periodogram, Barlett, Welch & Blackman-Tuckey approach, Parametric Techniques: Yule Walker Method and Power spectrum method for modeling: Autoregressive (AR), Moving Average (MA) and Autoregressive Moving average (ARMA)

Module 3: Wavelets

Review Fourier transform, Short-time Fourier transform, Introduce time frequency resolution, orthogonality and orthonormality, Continuous time wavelet transform, discrete wavelet transform, Analysis using Harr scaling and wavelet functions, refinement relations, Analysis and synthesis refinement equations, Tiling of the time-frequency plane and wavepacket analysis.

Recommended Reading

1. S.M. Kay, "Modern Spectral Estimation", Prentice hall, 1988.
2. J. G. Proakies, D.G. Manolakis, and D. Sharma, "*Digital Time Signal Processing: principles, algorithms, and applications,"* Pearson Education, 2006.
3. DaFatta, D. J., Lucas, J. G., and Hodgkiss, W. S. "*Digital Signal Processing: A system design approach*," Wiley publications, 1988.
4. R. M. Rao, and A.S. Bopardikar, "*Wavelet Transforms,"* Pearson Education, 2001.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5115P**
Course Title	**ADVANCE DSP LAB**

COURSE OBJECTIVE

- The goal of the course is to develop a complete working set of digital signal processing notions from the ground up.
- The practical models of most real time signals will be generated and verified.

COURSE OUTCOME

- Students will get the gist of Mathematical approach towards understanding the real time signals and their processing.
- The advanced methods introduced will investigate complex properties of widely available real time signals.

Overview

1. Study of random process and its properties.
2. Power spectrum estimation.
3. Yule-walker method.
4. Non-parametric models for WSS random process.
5. Autoregressive models.
6. Moving Average Models.
7. Autoregressive Moving average models.
8. Wavelelet analysis of time domain signals.
9. Wavelet Packet analysis and synthesis.
10. Multirate signal processing.

Recommended Reading

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall, 1997.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
5. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing,J Wiley and Sons, Singapore, 1988.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II**
Course Code	**ET5116T**
Course Title	**ADVANCED IMAGE AND VIDEO PROCESSING**

COURSE OBJECTIVE

- The objectives of this course are for students to learn the fundamental theories and techniques of digital image and video processing.
- To study image representation and different transforms.
- To study pre-processing of images and modeling of images.
- To understand different features of image and extraction of these features from image.
- To understand the basics of video object extractions.

COURSE OUTCOME

- Understanding of digital image processing fundamentals: hardware and software, digitization, enhancement and restoration, encoding, segmentation, feature detection.
- Ability to apply image processing techniques in both the spatial and frequency (Fourier) domains.
- Ability to apply video processing techniques to extract the objects.

Overview

Module 1: Image representation and transforms

Image Representation- Image Basis Functions- Two dimensional DFT- Discrete cosine Transform-Walsh-Hadamard transform-Wavelet transform - Construction of Wavelets-Types of wavelets principal component analysis.

Module 2: Pre-processing and modelling of images

Pre-processing of images- Histogram equalization - edge detection- Stochastic presentation of images- Stationary and Non-stationary models - Gaussian- HMM - Edge and texture models.

Module 3: Spatial feature extraction

Filtering techniques- Localized feature extraction- Boundary Descriptors-Moments- Texture

Descriptors- Co-occurrence features- Run length features- Feature selection.

Module 4: Classifiers

Maximum Likelihood Estimation- Bayesian approach- Pattern Classification by distance functions-BPN.

Module 5: Video object extraction

Static and dynamic background modelling - frame subtraction- optical flow techniques- Handling occlusion- scale and appearance changes - Shadow removal.

Recommended Reading

1. A.K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, 1989.
2. A.Bovik, “Handbook of Image and Video Processing”, 2nd Edition, Academic Press, 2005.
3. Mark Nixon and Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press,2008. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
4. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern classification”, Wiley, 2001.
5. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics & Telecommunication), SEMESTER-II
Course Code	ET5116P
Course Title	ADVANCED IMAGE AND VIDEO PROCESSING LAB

Course Objective

- To study image representation in different domains and their analysis.
- To explore algorithm and techniques involved in image processing.
- Understand the concept of image processing in computers.

Course Outcome

- Students will come to know how the processing on image and video signals takes place before it is transmitted on the communication channel.
- Various transforms will be used for the processing of these signals.

Overview

1. Introduction to Image and Video Processing.
2. 2D and 3D signals and systems, linear and shift invariant systems (convolution).
3. 2D and 3D Fourier transform, 2D and 3D discrete-Fourier transform, uniform sampling.
4. Motion estimation and its applications.
5. Image and video enhancement.
6. Image recovery (restoration, super-resolution).
7. Video recovery (restoration, super-resolution).
8. Lossless compression.
9. Image compression techniques and standards.
10. Image and video analysis (e.g., 2D and 3D segmentation, anomaly detection, clustering).

Recommended Reading

1. A.K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, 1989.
2. A.Bovik, “Handbook of Image and Video Processing”, 2nd Edition, Academic Press, 2005.
3. Mark Nixon and Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press,2008. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
4. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern classification”, Wiley, 2001.
5. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.