Bansilal Ramnath Agarwal Charitable Trust’s
Vishwakarma Institute of Technology, Pune – 411037
(An Autonomous Institute affiliated to University of Pune)

Structure and Syllabus of

M. E. (Electronics and Telecommunication)

Pattern ‘A13’

Effective from Academic Year 2013-14

Prepared by: - Board of Studies in Electronics Engineering

Approved by: - Academic Board,

Vishwakarma Institute of Technology, Pune

Signed by,

Chairman – BOS    Chairman – Academic Board
## Department of Electronics Engineering

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**Semester III**

**Course Structure**

**Course Syllabi For Courses - Semester I**

**Theory Course**

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* CT (Unit 1) 1 hour 30 marks converted to 10 marks + HA (minimum 3) – Total 30 marks converted to 10 marks = 20 marks
  MSE – 2 hours 60 marks converted to 30 marks (Unit 2 & 3)
  ESE – 3 hours 100 marks converted to 50 marks (Unit 1 to 6)

# L- Lecture, P-Practical, ISA – In Semester Assessment, ESA – End Semester Assessment, CT- Class Test,
MSE – Mid Semester Examination, HA- Home Assignment, CA – Continuous Assessment,ESE – End Semester Examination

15 12 25
Department of Electronics Engineering

EC 50101: ADVANCED ENGINEERING MATHEMATICS

Course Objective:
The course aims at getting the students acquainted with mathematical tools essential for

i. Modelling of systems

ii. Optimized solutions for signal processing problems

The course forms the prerequisite for other subjects included in the structure.

Course Outcome:
At the end of the course students will be equipped with knowledge of mathematical methods tools required for system modelling, estimation, optimization and analysis.

Unit 1: Vector Spaces and Function Spaces                              (8 Hr)
Vector Spaces, Subspaces, Linear independence, Basis and Dimension. Inner product spaces, projection, least square, orthogonal basis, Gram Schmidt orthogonalization process, function spaces.

Unit 2: Matrices and its Applications                                  (6 Hr)

Unit 3: System of Dequations, Phase Plane, Stability                (6 Hr)
Basic concepts and theory, Homogeneous System of linear differential equations with constant coefficients, some applications, Phase Plane, Critical Points and Stability.

Unit 4: Probability and Random Variables                               (8 Hr)
Probability, Different probability spaces; Distribution functions and their decomposition; Expectation and its properties, conditional statistics, conditional distributions and joint distribution and density functions.

Unit 5: Stochastic Process                                             (6 Hr)
General concept, definition, properties and classifications, systems with stochastic inputs, power spectrum, digital processes

Unit 6: Wavelet Transforms                                             (6 Hr)
Distributions, delta function, Windowed Fourier Transform, Introduction to wavelets, properties of wavelets, Wavelet transform, Multiresolution analysis, Orthonormal wavelet basis.

Total Contact Hours: 40
Text/Reference Books

2. Linear Algebra – David c. Lay (Pearson Education.)
5. Introduction to probability Models,(Third edition) - Sheldon M. Ross.
EC 50102: ADVANCED DIGITAL SIGNAL PROCESSING

Course Objectives:

i. To provide inputs regarding multirate DSP
ii. To give inputs regarding adaptive filters and its applications
iii. To provide concepts of linear prediction
iv. To provide estimation of power spectra
v. To learn basic architecture of a typical DSP processor

Course Outcomes: Upon learning the course the student will be able to

i. Learn the concepts of decimation and interpolation
ii. Apply the concept of adaptive filtering.
iii. Implement the principles of linear prediction
iv. Perform DSP based applications on DSP processors

Unit 1: Random Signals (7Hrs)
Review of deterministic signals, random signals; Correlation Function; Power spectra; DT domain random signals; Time averages for DT random process

Unit 2: Multirate DSP (7Hrs)
Decimation, Interpolation; Design of practical sampling rate conversion; Software implementation of sampling rate converters; Sample rate conversion using poly-phase filter structure; Efficient D/A conversion in Hi-Fi System

Unit 3: Adaptive Filters (7Hrs)
Necessity, Adaptive filters as noise cancellers; Configuration of adaptive filters; Main components of adaptive filters; Adaptive algorithms: LMS, RLS; adaptive filtering for ocular artifacts from the human EEG; Adaptive telephone echo cancellation

Unit 4: Linear Prediction and Optimum Linear Filters (7Hrs)
Lattice structures; Innovation representation of random signals; Rational power spectra, AR, MA, ARMA; Forward and backward linear prediction; Wiener filter for filtering and prediction; Solution of the normal equation – Levinson – Durbin Algorithm

Unit 5: Power Spectrum Estimation (7Hrs)
Correlation and Correlogram; Estimation of spectra from finite duration observation of signals; Estimation of autocorrelation and power spectrum of random signals; Non-parametric methods for power spectrum estimation – Bartlett & Welch method

Unit 6: Architectures for DSPs (5Hrs)

Basic generic architectures, Harward Architecture; Introduction to SHARC, pipelining, MAC; Special instructions, on-chip memory; Fixed and Floating point DSPs; Case study of TMS320C54XX or TMS320C6XXX; Implementation of basic DS algorithms Decimation and Interpolation

Total Contact Hours: 40

Text Books:


Reference Books:

1. P P Vaidyanathan “Multirate systems and filter banks”, PHI
EC 50103: DIGITAL INTEGRATED CIRCUIT DESIGN

Course Objectives: This course will focus on

i. Key elements of semiconductor physics,

ii. Predominant CMOS technology and circuit style,

iii. The challenges of digital VLSI design,

iv. Conceptual thinking and design methodology over detailed circuit analysis techniques.

Course Outcomes:

i. Students will be able to design & simulate logic gates in VLSI.

ii. Students will able to design and simulate a small digital circuit/system.

Unit 1: Static CMOS Inverter (8Hrs)
MOS device physics, threshold voltage, body bias, I-V characteristics and design equations, the actual device – secondary and short-channel effects, MOS SPICE models. The Static CMOS Inverter — An Intuitive Perspective, The Static Behavior, Switching Threshold, Noise Margins, static and dynamic power consumption, introduction to layout.

Unit 2: Combinational Logic – Static and Dynamic Design (9Hrs)
CMOS Logic structures – Pseudo NMOS, Complementary CMOS, Ratioed Logic, Pass-Transistor Logic, and Transmission Gate with examples, Dynamic Logic – Basic Principle, DOMINO, NORA, Speed and power dissipation of dynamic logic gate, Issues in dynamic design, cascading dynamic gates, layout of few combinational/sequential circuits, Euler path to optimize layout.

Unit 3: Sequential Logic Circuits - Static and Dynamic Design (5Hrs)
The bi-stability principle, CMOS Clocked Latches, CMOS Multiplexer based Latches, Flip-flops, Clocked CMOS Logic (C²MOS), TSPC Latches, pipelining of logic blocks.

Unit 4: Integrated Memories (6Hrs)
Static Random-Access Memories, Static Random-Access 6-T Memory Cell, design equations, DRAM cells, Sense Amplifier, Read-Only Memories- NAND and NOR structures, CAM.

Unit 5: Logical Efforts (6Hrs)
Delay and Electrical Efforts of a gate, defining logical efforts, Multi-stage logic network, Choosing path, applying logical efforts to design circuit for speed.

Unit 6: Modern MOS Devices (6Hrs)
Technology node – concept and scaling, effect of scaling on performance of device and circuit, LDD MOSFET, sub-micron MOSFET, SOI MOSFET, FinFET, Multi-gate MOSFETs.
Total Contact Hours: 40

Reference/Textbooks:
5) Logical Effort by Sutherland.
LIST OF ELECTIVES

Elective-I

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<td>EC52103</td>
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Course Objectives:
i. To provide students with the basic principles of radio frequency (RF) circuit design.

ii. To introduce the students to topics such as fundamental transmission line theory, HF circuit behavior, designing matching networks, amplifiers, filters etc.

iii. To prepare the students for careers in the communication domain.

Course Outcomes:
i. The students will gain the basic knowledge of RF circuit design.

ii. The students will become competent to work in the field of communication.

Unit 1: Introduction
Introduction to RF, RF behavior of passive components, Skin effect, Transistor at RF, HF model of transistor, RF FET models, RF diode models, RF transistor data sheet, Y- and s-parameters.

Unit 2: Transmission Line Analysis
Transmission line analysis, types of transmission lines, equivalent circuit representation, transmission line equations – general and lossless, sourced and loaded transmission lines, termination conditions, microstrip transmission lines.

Unit 3: Smith Chart & Parameters
Introduction to Smith chart, impedance matching, impedance transformation, admittance transformation, parallel & series connection of components in circuits, interconnection networks, Y parameters, s-parameters, signal flow chart modeling.

Unit 4: RF Amplifier Design
Transistor biasing, stability considerations, design of LNA, broadband amplifiers, multistage amplifiers, high power amplifiers using Smith chart.

Unit 5: Filter Design
Basic resonator and filter configurations, insertion loss, high pass filter design, band pass filter design, band reject filter design, effects of finite Q, loaded Q, frequency and impedance scaling.
Unit 6: RF Transformer Design (6Hrs)

Applications of RF transformer, transformer circuits and impedance relationships, transformer performance characteristics, insertion loss and frequency bandwidth, impedance and return loss, RF equivalent circuit of transformer, center tapped transformers – impedance relationships, amplitude and phase balance

Total Contact Hours: 40

Text Books:

2. RF Circuit Design Chris Bowick Newness Publication

Reference Books:

1. RF Microelectronics Behzad Razavi Prentice Hall
3. www.minicircuits.com
ELECTIVE-I
EC52102: DIGITAL IMAGE PROCESSING AND MACHINE VISION

Course Objectives:

i. To learn the fundamentals of gray scale image processing
ii. Understands the fundamentals of gray scale image processing
iii. Understands the significance of image processing in solving the real world problems.

Course Outcomes:

i. Student will learn the mathematics behind the image processing
ii. Student will Understands the significance of image processing and will be able to solve the problems in image processing

Unit 1: Visual Preliminaries and Image Transformation (8Hrs)
Introduction, brightness adaptation and contrast, activity and contour, texture and pattern discrimination. Monochrome vision model. Geometric model of an image, basic transformations, perspective projection

Unit 2: Image Transforms (8Hrs)
2-D Fourier transform, Discrete cosine transform, K-L Transform, Walsh Transform, Hadamard Transform

Unit 3: Image Enhancement (6Hrs)

Unit 4: Image Restoration (6Hrs)
Minimum mean-square error restoration, least-square error restoration, constrained least-square error restoration, restoration by singular value decomposition, restoration by homomorphic filtering.

Unit 5: Image Analysis: Segmentation (6Hrs)
Region extraction, pixel based approach: feature thresholding, optimum threshold, threshold selection methods, multilevel thresholding, basic primary & Secondary gray level &Binary morphological operations

Unit 6: Image Analysis (6Hrs)
Edge detection, derivative operators: Sobel, Prewitt, Canny, second order derivative, line detection. Object shape measures

Total Contact Hours: 40
Department of Electronics Engineering

Text Books:


Reference Books:

2. Syntactic Pattern Recognition: An Introduction, R.C.Gonzalez and M.G.Thomason
3. Pattern Classification and Scene Analysis, R.O. Duda and P.E. Hart, Wiley 1973
Objective: To provide a strong foundation of fundamental concepts in Artificial Intelligence

i. To provide a basic exposition to the goals and methods of Artificial Intelligence.

ii. To enable the student to apply these techniques in applications which involve perception, reasoning and learning.

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

i. Explain AI representations and applications

ii. Classify ISA Hierarchy

iii. Elucidate expert system using architecture and case studies

Unit 1: Introduction to Artificial Intelligence (5Hrs)
AI task domain, problem representation in AI, Problem characteristics, in-max search procedure, game playing using AI.

Unit 2: Searching Techniques (8Hrs)
AI and search process, brute force search and heuristic search techniques, application to various game playing, optimal decision in game, constrain satisfaction and their applications.

Unit 3: Knowledge Representation (6Hrs)
Hierarchy knowledge, type of knowledge, knowledge representation, methods for knowledge representation, predicate logic, weak slot and filler structure, strong slot and filler structure.

Unit 4: Planning (6Hrs)

Unit 5: Neural Networks (8Hrs)

Unit 6: Expert Systems (7Hrs)
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Representing and using Domain Knowledge, Expert System Shells, Explanation and Knowledge Acquisition. Human expert behaviours, Expert system components, structure of expert system, the production system, how expert system work, and Expert system development for particular application.


Total Contact Hours: 40

Text Books:

1. Elain Rich and Kerin Knight, “Artificial Intelligence”, TMH Publication

Reference Books:

Elective-II

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<td>Embedded Systems</td>
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ELECTIVE-II
EC52104: BIOMEDICAL ENGINEERING

Course Objectives: With widespread use and requirements of medical instruments, this course gives knowledge of the principle of operation and design of biomedical instruments.

i. To learn how to measure physical/chemical/biological variables relevant to medicine and biology using state-of-the-art instrumentation.

ii. To give the introductory idea about human physiology system which is very important with respect to design consideration

iii. To become aware of real-life contemporary biomedical problems that can be addressed by various methods.

iv. To understand the mathematical and physical foundations of biomedical engineering and how these are applied to the design of biomedical instruments, the analysis of biological systems, and the technological advancement for health care.

Course Outcomes: By the end of the course students will be able to

i. Design instruments useful to the medical community.

ii. Evaluate alternate assumptions, approaches, procedures, tradeoffs, and results related to engineering and biological problems.

iii. Design a variety of electronic and/or computer-based devices

iv. Design of software for applications including biomedical instrumentation, medical imaging, physiological measurement, biomedical signal processing, rehabilitation engineering and medical informatics.

Unit 1: Introduction (6 Hrs)
Origins of Bioelectric signals, Electrocardiogram (ECG), Electromyogram (EMG); Recording Electrodes- Silver-silver Electrodes, Electrodes for ECG, EEG and EMG; Physiological Transducers- Pressure Transducers, Temperature sensors, Pulse sensors; Sources of bioelectric potential, resting potential, action potential, propagation of action potentials in nerves; rhythmic excitation of heart.

Unit 2: Cardiovascular Measurements (8 Hrs)

Unit 3: Medical Image Processing (8 Hrs)
Department of Electronics Engineering

Basic Principles, Image operations, Radiography and CT: X-rays - interaction of X-ray beam with
tissue, ray detection, data acquisition in CT, Images reconstruction, computed axial tomography,
generation of CT, spiral CT, mammography.

Unit 4: Advances in Medical Imaging (6 Hrs)
Magnetic Resonance Imaging: Introduction, principles of MRI, MRI instrumentation, image
acquisition and reconstruction techniques, Application of MRI. Ultra Sound in Medicine:
Introduction, ultrasonic transducers and types, transmitter and detector principles, probe design,
principles of image formation. Display system: principles of A-mode, B mode and M-mode display.

Unit 5: Medical Signal Processing (6 Hrs)
Cardiological signal processing: QRS detection methods. Rhythm analysis. Arrhythmia detection
algorithms. Automated ECG analysis. ECG pattern reconition. Data compression techniques: ECG
acquisition and transmission. Reduction algorithms. Turning point AZTEC, CORES, and the KL
transform.

Unit 6: Bio Telemetry (6 Hrs)
Bio-telemetry and Instrumentation for clinical laboratory, Introduction to biotelemetry, physiological
parameters adaptable to biotelemetry, the components of biotelemetry system, implantable units,
applications of telemetry in patient care.

Total Contact Hours: 40

Text Book:
1. Biomedical Instrumentation and Measurements – Cromwell, Weibell, Pfeiffer – Pearson
4. Biomedical Signal Analysis case study approach”, Rangaraj M Rangayyan
Department of Electronics Engineering

ELECTIVE-II

EC52105: VEHICULAR AD HOC NETWORKS

Course Objectives:

i. To give exposure to state of the art in VANETs

ii. To understand VANETs which now open new vistas for internet access, distributed gaming and the fast growing Mobile entertainment industry.

iii. To understand VANETs to promote Traffic Safety.

Course Outcomes:

i. Graduate students and practitioners who intend to do work in VANETs can work on key research challenges.

ii. Get overview of simulation tools used in VANETs.

Unit 1: Introduction to Vehicular Ad Hoc Networks (VANETs) (6Hrs)
Traffic Monitoring, Causes of congestion, Traffic Monitoring Data, Common Applications of Traffic Data, Commonly used sensor technology, Detection methods,

Unit 2: Models for Traffic flow and Vehicle Motion (8Hrs)
Models for Longitudinal Vehicle Movement, Lane changes situations, Simulating Vehicle-to-Vehicle and Infrastructure-to-Vehicle Communication

Unit 3: Networking Issues (8Hrs)
Routing in MANET, Applicability of MANET Routing to Vehicular Environment, Routing protocols for VANET.

Unit 4: Delay-Tolerant Networks in VANETs (6Hrs)
Deterministic/Stochastic Delay-Tolerant Routing, Vehicle Traffic Model, Vehicle-Roadside Data Access, Data Dissemination in VANETs

Unit 5: Localization in Vehicular Ad-Hoc Networks (6Hrs)
Localization-Aware VANET applications, Localization Techniques for VANETs, Data Fusion in VANET Localization Systems

Unit 6: Vehicular Applications (6Hrs) Safety related vehicular applications, use of Infrastructure in VANETs, Vehicular Network Simulators, Vehicular Mobility Models.

Total Contact Hours: 40
Department of Electronics Engineering

Text Books:
3. Selected Papers about Vehicular Ad Hoc Networks (VANETs).

Reference Books:
Course Objectives:

i. To study embedded network protocols
ii. To study embedded processors
iii. To study architecture of RTOS

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

i. Explain the general structure of a real-time system
ii. Design ARM based embedded systems
iii. Design DSP based embedded systems

Unit 1: Introduction to Embedded system (6Hrs)
Embedded system overview, Design matrices, Processor technology, IC technology Design technology, Design productivity gap

Unit 2: Embedded Processor 1: ARM (8Hrs)
ARM processor: Introduction Features and architecture, Processor modes, Register organization, Exceptions and its handling, Addressing modes, ARM and THUMB instruction sets, programming, Co-processor interface.

Unit 3: Embedded Processor 2: DSP Processor (8Hrs)
TMS320C67XX 32 bit floating point DSP Processor: Introduction, features and architecture, Applications, Addressing modes, Memory architecture, External memory accesses, Pipeline operation, Hardware tools: DSP (DSKs-DSP starter kit) and other DSP boards, Software tools: Code composer studio

Unit 4: Embedded Communication Protocols (6Hrs)

Unit 5: Overview of Operating System (6Hrs)
Introduction to OS, Basic Principles - Operating System structures, Process management and Inter Process, Communication, Memory management, I/O subsystem, File System Organization, POSIX Thread Programming, Real Time Scheduling

Unit 6: Real Time Operating System (6Hrs)
Total Contact Hours: 40

Text Books:

Reference Books:
1. "Embedded System Design" – Frank Vahid/ Tony Givargis
4. “Programming for Embedded Systems” Dreamteach Software team
6. FSM Labs documents on RTLinux
ELECTIVE-II
EC52107: SPEECH PROCESSING

Course Objectives:

i. To introduce the fundamentals of speech signal processing.
ii. To present basic principles of speech analysis and speech recognition.
iii. To study speech enhancement, speech coding and speech recognition.

Course Outcomes: Students should be able to

i. Express the speech signal in terms of its time and frequency domain representations and the different ways in which it can be modeled.
ii. Gain the knowledge of simple features used in speech classification applications.
iii. Implement components of speech processing systems like speaker recognition etc. in MATLAB.

Unit 1: Speech Production & Hearing

Anatomy & physiology of speech organs, articulatory, acoustic phonetics, acoustic theory of speech-production, prosody. Anatomy & physiology of ear, sound perception, speech perception, models of speech perception, vowel perception, consonant perception.

Unit 2: Speech Analysis

Short time speech analysis, time domain parameters, frequency domain analysis, LPC analysis, pitch estimation cepstral analysis.

Unit 3: Speech Coding

Quantization, redundancies, waveform coding, Linear Prediction coding, Transform domain coding of speech, VQ coders.

Unit 4: Speech Synthesis

Principles, synthesis methods, text to speech synthesis, synthesis by rule, prosody in synthesis, speech transformations and applications.

Unit 5: Speech Recognition

Speech recognition approach, parametric representation, evaluation of speech patterns, various models of speech recognition, Application.

Unit 6: Speaker Identification

Acoustic parameters, Similarity measures, Text-independent speaker verification, Text-prompted speaker verification, Identification, verification, and the decision threshold.

Total Contact Hours: 40
Text Books/Reference Books:
2. Furi S., "Digital Speech Processing, Synthesis & Recognition".
3. Lawrence Rabiner & Bing Hwang Juang, "Fundamental of Speech Recognition", Pearson Education.
1. ADVANCED DIGITAL SIGNAL PROCESSING

**Course Objectives:**

i. To give inputs regarding adaptive filters and its applications

ii. To learn basic architecture of a typical DSP processor

**Course Outcomes:** Upon learning the course the student will be able to

i. Apply the concept of adaptive filtering

ii. Perform DSP based applications on DSP processors

**List of Experiments**

1. Unique Decodability Test
2. Golomb coding
3. Arithmetic coding
4. Lz77 Dictionary Coding
5. Uniform & Jayant quantizer
6. Study of various file formats: Audio, GIF, PNG
7. Transform Coding
8. Applications: Text, Audio, Image, Video Compression
2. DIGITAL INTEGRATED CIRCUIT DESIGN

Course Objectives:

i. To focus on the challenges of digital VLSI design,

ii. To focus on conceptual thinking and design methodology over detailed circuit analysis techniques.

Course Outcomes: Upon learning the course the student will be able to

i. Students will be able to design & simulate logic gates in VLSI.

ii. Students will able to design and simulate a small digital circuit/system

List of Experiments

1. Introduction to EDA tools- coding, simulation, synthesis, timing analysis and implementation in an FPGA

2. Binary adders and Mac

3. CORDIC

4. FIR Filter

5. IIR filter

6. Simulation of IVs

7. Understanding significance of DELTA delay in HDL

8. Layout of a combinational system
Semester – II
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EC 50104: SIGNAL CODING AND COMPRESSION TECHNIQUES

Course Objectives:

i. To give inputs regarding Information Theory & coding techniques.
ii. Understand the structures of the codes through the practical and appreciate the applications in signal processing.
iii. To understand the basics of Data compression and quantization techniques
iv. To know the transform coding basics

Course Outcomes:

i. Students should be able to apply the lossy and lossless compression techniques to audio signal, Image and Videos

Unit 1: Information Theory & Source Coding (7Hrs)
Introduction, Information & Entropy, Probability & Markov models; Uniquely decodable codes, Prefix codes, Source Coding Theorem, Shannon Fanon, Huffman codes

Unit 2: Huffman Coding (7Hrs)
Optimality of Huffman Codes, Extended Huffman codes, Adaptive Huffman codes, Golomb & Rice codes, Applications of Huffman coding

Unit 3: Lossless Coding (8Hrs)

Unit 4: Scalar & Vector Quantization (7Hrs)
Uniform Quantizer, Adaptive Quantizer – Forward & Backward adaptive quantizer, Jayant quantizer, non-uniform quantizer, vector quantization

Unit 5: Transform Coding (7Hrs)
Necessity of transforms, Discrete Cosine Transform, Walsh, Hadamard transform, KL transform, Quantization and coding of transform coefficients, JPEG image compression.
Unit 6: Data Compression Applications

Applications – Text Compression, Image compression, Audio & Video Compression.

Total Contact Hours: 40

Text Books
2. Khalid Sayood, ‘Introduction to Data Compression’, Elsvier publication, 3rd edition,

Reference Books
EC 50105: PATTERN RECOGNITION

Course Objectives:
   i. Provides an introduction to classical pattern recognition
   ii. The students should learn to choose an appropriate classifier for a pattern recognition problem.

Course Outcomes:
   i. Student will understand the classical pattern recognition
   ii. Student will be able to select the appropriate classifier for a pattern recognition problem

Unit 1: Basics of pattern recognition (8 Hrs)
Machine perception, Pattern recognition systems, design cycle, learning and adaptation. Case studies of Pattern recognition, Probability: Introduction, probability of events, random variables, Joint distributions and densities, moments of random variables, estimation of parameters from samples, minimum risk estimators

Unit 2: Bayesian decision theory (8 Hrs)
Bayesian Decision theory continuous and discrete features, minimum error rate classification, classification discriminant function, Parameter estimation methods like Maximum-Likelihood estimation, Gaussian mixture models, Expectation maximization method, and Bayesian estimation. Bayesian belief network

Unit 3: Nonparametric Techniques (6Hrs)
Parzen window method, K-Nearest Neighbour method, metrics and Nearest-Neighbor Classification. Fuzzy Classification

Unit 4: Linear Discriminant Function based Classifiers (6Hrs)
Linear discriminant function and decision surface, Perception, Support vector machines. Multi-category generalization

Unit 5: Unsupervised Learning and Clustering (6Hrs)

Unit 6: Applications of Pattern Recognition (6Hrs)
Applications such as Character recognition, Face recognition, Iris flower classification, number plate recognition etc.

**Total Contact Hours: 40**

**Text Books:**

**Reference Books:**
**EC 50106: WIRELESS AD-HOC NETWORKS**

**Course Objectives:**

i. To study different wireless ad-hoc networks

ii. To understand the co-existence issues in heterogeneous networks.

iii. To learn performance analysis of Wireless ad-hoc networks

**Course Outcomes:**

On completion of the course, the student can

i. Understand the wireless ad-hoc network standards.

ii. List the factors affecting the Qos in heterogeneous networks

iii. Implement the Qos improvement techniques

**Unit 1: Introduction**


**Unit 2: Wireless Local Area Networks (WLANs)**

Wireless LAN standards, architectures, modulation schemes, MAC layer, media access protocols, MAC layer Management, hidden nodes, collision avoidance, Data and voice transmission over Wireless LANs.

**Unit 3: Wireless Personal Area Networks (WPANs)**

Wireless PAN specifications, Network topologies, Architecture, the physical layer, MAC sub layer, Media Access protocol, channel access Management, association, disassociation, synchronization, GTS allocation and Management.

**Unit 4: Heterogeneous Wireless Networks**

Co-existence of wired and wireless networks, collocated, co-existed wireless networks, impact of WIFI traffic on WPANs, Wireless co-existence between WLANs and WPANs, interference mitigation, performance analysis of high density wireless networks.

**Unit 5: Qos and Security in Wireless ad-hoc Networks**

(6Hrs)
Department of Electronics Engineering

Qos parameters, measurement of Qos parameters, Qos improvement techniques: collision avoidance, congestion control, wireless security standards.

Unit 6: Case Study of Wireless Ad-Hoc Network Applications (6Hrs)

Smart home, remote health monitoring, industrial control, remote metering, and agriculture applications. Future trends in wireless ad-hoc networks

Total Contact Hours: 40

Text Books:
2. IEEE standard for Information Technology, Part:15.4 -2009

Reference Books:
1. IEEE standards for LANs, WPANs
2. Relevant technical papers from standard International Journals
**LIST OF ELECTIVES**

**Elective-III**

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<td>VLSI Signal Processing</td>
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<td>EC52110</td>
<td>Wavelet Theory and Applications</td>
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<td>EC52111</td>
<td>Antenna Theory</td>
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ELECTIVE-III
EC52108: DATA COMMUNICATION AND NETWORKING

Course Objectives:

i. To provide a conceptual foundation for the study of data communications
ii. To develop an understanding in basic hardware and software environments for data communications and computer networks
iii. To provide knowledge about basics of Network Management and standards.
iv. To provide the basics of Network Management Tools and Systems

Course Outcomes: The course outcomes are as follows:

i. Students are expected to know about various protocols, models in networks.
ii. Students are able to design, implement and analyze simple computer networks.
iii. Identify, formulate and solve network engineering problems.
iv. Operations of TCP/UDP, SNMP, RMON etc.
v. Knowledge of contemporary issues in computer networks

Unit 1: Data Communication Overview (6Hrs)
Internet Architecture: Architectural concepts in ISO’s OSI layered model, layering in the Internet. TCP/IP protocol stack. Transport layer-TCP and UDP, Network layer-IP, routing, inter-networking. Data link layer, ARQ schemes, multiple access, LANs.

Unit 2: Network Management Overview (8Hrs)

Unit 3: Network Management Standards and Models (8Hrs)

Unit 4: SNMP (6Hrs)
Department of Electronics Engineering

Unit 5: SNMP & RMON (6Hrs)

Major Changes in SNMP V2 and V3 SNMP Management: RMON – Remote Monitoring, SMI & MIB, RMON1, RMOPN2, ATM Remote Monitoring, Case Study of Internet Traffic Using RMON.

Unit 6: Network Management Tools and Systems (6Hrs)


Total Contact Hours: 40

Text Book/Reference Books:

1. Data Communications and Networking – Behrouz A. Forouzan. TMH.
ELECTIVE-III

EC52109: VLSI SIGNAL PROCESSING

Objectives:

i. To expose the students to the concepts of Pipeline and Parallel Processing in VLSI.

ii. To provide knowledge of realization of DSP system in VLSI.

Outcomes:

i. Students will be able to design DSP system in VLSI

ii. Students will be able to design low power system.

Unit 1: Introduction to DSP Systems, Pipelining and Parallel Processing of FIR Filters


Unit 2: Retiming in Unfolded and Folded Architectures.

Retiming, Retiming techniques – Unfolding –Algorithm for unfolding-Properties of unfolding-Applications of unfolding – folding transformation, register minimization technique, register minimization in folded architectures - folding of multi rate systems

Unit 3: Systolic Structure and Fast Convolution Algorithms

Systolic architecture design – methodology, FIR systolic array, selection of scheduling vector, matrix to matrix multiplication , 2D systolic array design, systolic design for space representation containing delays – fast convolution algorithms – cook-toom algorithm-modified cook-toom algorithm.

Unit 4: Pipelining and Parallel processing of IIR Filter and Round Off Noise


Unit 5: Bit Level Arithmetic

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Baugh-Wooley multiplier ,Booth Multiplier, Bit serial FIR filter, Bit serial IIR filter.

Unit 6: Synchronous and Asynchronous Pipelining

(6Hrs)
Department of Electronics Engineering
Synchronous Pipelining and Clocking styles, Clock skew and clock distribution - Edge triggered single phase clocking - Two phase clocking - Clock distribution, Wave Pipelining Asynchronous pipelining.

Total Contact Hours: 40

TEXT BOOK:

References:
Department of Electronics Engineering

ELECTIVE-III

EC52110: WAVELET THEORY AND APPLICATIONS

Course Objectives:
i. Provide fundamental signal processing techniques important to many communications and multimedia subjects.
ii. Understand concepts, theory and algorithms behind wavelets from an interdisciplinary perspective and able to make use of wavelets for various applications.

Course Outcomes:
i. Student will be able to understand basic theory of wavelet transform and concepts of using wavelets for various signal processing applications.
ii. Student will get necessary background for advance studies in digital signal processing and other multimedia signal processing subjects.

Unit 1: Continuous Wavelet Transform (6 Hrs)
Introduction to wavelet transform, comparison with DFT and DCT. Introduction to time-frequency analysis, Definition of CWT, properties of continuous wavelet transform, CWT as correlation, CWT as an operator, Inverse CWT.

Unit 2: Discrete Wavelet Transform (6 Hrs)
Approximation of Vectors in linear vector subspaces, Basis for approximating sub spaces and Haar Scaling function, Digital filter implementation of Haar Wavelet Decomposition.

Unit 3: Multi-resolution Analysis and Filter Banks (8 Hrs)
Definition of MRA, Construction of general orthonormal MRA, Wavelet Basis for MRA, Digital Filtering Interpretation, Examplew s of Orthogonal Basis-generating Wavelets, Interpreting orthonormal MRAs for Discrete time Signal.

Unit 4: Different Families of Wavelets (8 Hrs)
Introduction to time frequency analysis Different families of wavelets, mathematical preliminaries, windowed Fourier transform, short-time Fourier transform, Harr wavelet, Daubechies Wavelets, Wavelet packet analysis, Harr wavelet packets, introduction to orthogonal and bi-orthogonal wavelets.

Unit 5: Wavelet Transform and Data Compression (6 Hrs)
Transform Coding, Image compression using DTWT, Audio Compression, and Video Coding using MRA.

Unit 6: Applications of Wavelet Transform (6 Hrs)
Department of Electronics Engineering

Application of wavelet theory to signal de-noising, transient detection, speckle removal, edge detection and object isolation, image fusion, image enhancement, feature extraction, communication applications like scaling functions as signaling pulses and multi-tone modulation.

Total Contact Hours: 40

Text Books:
2. "Insight Into Wavelets - From Theory to Practice", by K P Soman, K I Ramchandran PHI publication (2nd edition), Prentice Hall of India.

Reference Books:
2. Ten lectures on wavelets – by Daubechies I (CBMS-NSF, SIAM, 1982).
Course Objectives: The student will acquire the following skills

i. Know & use standard antenna characterization.
ii. Design simple antennas & antenna arrays.

Course Outcomes: The students will be able to design and analyze antennas.

Unit 1: Antenna Introduction (6Hrs)
Types of antennas, Radiation Mechanism, Current distribution on a thin wire antenna.

Unit 2: Fundamental Parameters of Antenna (8Hrs)
Radiation patterns, Directivity, Gain, Antenna efficiency, Half-power beamwidth, Beam efficiency, Bandwidth, Polarization, Input impedance, Antenna radiation efficiency, Maximum directivity & maximum effective area, Friss transmission equation & radar range equation.

Unit 3: Radiation Integrals & Auxiliary Potential Functions (6Hrs)
Vector potential A & F, Electric & magnetic fields for current sources, Far-field radiation, Duality theorem, Reciprocity & Reaction theorems

Unit 4: Linear Wire Antennas (7Hrs)
Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, Half wavelength dipole, Linear elements near or on infinite perfect conductors, Ground effects.

Unit 5: Loop Antennas (7Hrs)
Small circular loop, Circular loop with constant current & non-uniform current, Ground & earth curvature effects, Polygonal loop antennas, Ferrite loop, Mobile communications systems applications.

Unit 6: Arrays (6Hrs)
Department of Electronics Engineering

Two element array, N-element linear array (Uniform amplitude & spacing, directivity, 3-D characteristics), Design procedure, Rectangular to polar graphical solution, N-element linear array (Uniform spacing & non-uniform amplitude), Superdirectivity, Planar array – design considerations, Circular array.

Total Contact Hours: 40

Text Books:
1. Antenna Theory – Analysis & Design
   Constantine Balanis, Wiley Publication
2. Antennas – For All Applications
   Kraus, Marhefka, Khan, Tata McGraw Hill

Reference Books:
1. Practical Antenna Handbook
   Joseph Carr McGraw Hill
Elective-IV

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<tr>
<td>EC52113</td>
<td>Artificial Neural Network and Fuzzy Logic</td>
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Department of Electronics Engineering

ELECTIVE-IV

EC52112: NANOTECHNOLOGY

Course Objectives:
   i. To expose the students to the concepts of Nanotechnology
   ii. To provide comprehensive knowledge of Semiconductor nanostructures and Nanoelectronics.

Course Outcomes:
   i. Students will understand the concepts of Nanotechnology
   ii. Students will get comprehensive knowledge of Semiconductor nanostructures and Nanoelectronics.

Unit 1: Introduction, Characterization of Non-materials (8 Hrs)


Characterization of Non-materials:
Microscopy techniques (SEM, TEM; STM, AFM), spectroscopy techniques, XRD etc

Unit 2: Physics of Non-materials (8 Hrs)

Coverage of physics of materials appropriate for applications to nanotechnology.
Basics of Quantum Mechanics: Schrodinger equation, the postulates of quantum mechanics
Quantization of energy: Particle in a box, Heisenberg Uncertainty principle, quantum measurement
One-dimensional Schrodinger Equation: Bound and unbound states, one dimensional barrier problems (Quantum tunneling, Band gap in periodic lattice)

Unit 3: Fabrication of Non-materials (8 Hrs)

Top-down and Bottom-up approaches.

Top-Down Methods: Milling, lithographic processes, machining
Bottom-up Methods: Vapor phase deposition methods (PVD, CVD etc), plasma-assisted deposition methods (PECVD), MBE, MOVPE, Liquid phase methods (various chemical synthesis methods), colloidal methods, electrode position, templated growth methods, self-assembly techniques.

Semiconductor nanostructures: Overview, quantum wells, quantum wires and quantum dots. Fabrication techniques such as epitaxial techniques (MBE,MOVPE), lithography (electron-beam lithography), colloidal techniques (sol-gel synthesis etc), self-assembly techniques etc.
Department of Electronics Engineering

Unit 4: Nanoelectronics I: Physical properties of nanoscale structure (Mainly Section 1.1 of Dragoman):  
(8 Hrs)
Energy subbands and density of states in nanoscale structures, electron transport in low-dimensional structures, resistance of a ballistic conductor, electron tunneling, resonant tunneling, coulomb blockade

Unit 5: Nanoelectronics II: Nanoelectronic Devices  
(8 Hrs)
Resonant tunneling diodes, field-effect transistors, potential-effect transistors, single-electron-transfer devices, LEDs and lasers, nanoelectromechanical system devices

Total Contact Hours: 40

Textbooks:

Reference Books:
5. Poole, C.P. Jr; Owens, F.J. 'Introduction to Nanotechnology', Wiley India, 2006.
ELECTIVE-IV
EC52113: ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC

Course Objectives:

i. To expose the students to the concepts of artificial neural networks

ii. To provide comprehensive knowledge of fuzzy logic control.

iii. Provide adequate knowledge of application of ANN and fuzzy logic control to real time systems.

Course Outcomes:

i. Students will be able to design neural networks for classification.

ii. Students will able to perform operations of fuzzy arithmetic and understand the concept of fuzziness.

Unit 1: Introduction to Artificial Neural Networks (8Hrs)

Unit 2: Radial Basis Function Networks For Pattern Classification (8Hrs)

Unit 3: Associative Memories (6Hrs)
Associative memory, self organization map, optimization model, Paradigms of Associative Memory, Pattern Mathematics, General Concepts of Associative Memory Bidirectional Associative Memory (BAM) Architecture, Adaptive Linear neuron (Adaline), Multiple adaline.

Unit 4: Fuzzy Set Theory (7Hrs)
Classical sets, fuzzy sets, Crisp and Fuzzy relations, Properties of membership functions, Logic and fuzzy systems, Fuzzy relation equations, rule based reduction methods, Decision making with fuzzy information, Fuzzy arithmetic and extension principle.

Unit 5: Fuzzy Neuro Systems (7Hrs)
Department of Electronics Engineering


Unit 6: Applications of Fuzzy Logic


Total Contact Hours: 40

Text Books:
4) George J. Klir, Bo Yuan, Fuzzy Sets and Fuzzy Logic, Prentice Hall India, 1997
5) Rajasekharan and Pai, “Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications” – PHI Publication.

Reference Books:
1. SIGNAL CODING & COMPRESSION TECHNIQUES

Course Objectives:

i. To give inputs regarding Information Theory & coding techniques.

ii. Understand the structures of the codes through the practical and appreciate the applications in signal processing.

Course Outcomes:

i. Students should be able to apply the lossy and lossless compression techniques to audio signal, Image and Videos

List of Experiments

1. Unique Decodability Test
2. Golomb coding
3. Arithmetic coding
4. Lz77 Dictionary Coding
5. Uniform & Jayant quantizer
6. Study of various file formats: Audio, GIF, PNG
7. Transform Coding
8. Applications: Text, Audio, Image, Video Compression
2. WIRELESS ADHOC NETWORK

Course Objectives:

i. To study different wireless ad-hoc networks
ii. To understand the co-existence issues in heterogeneous networks.
iii. To learn performance analysis of Wireless ad-hoc networks

Course Outcomes: On completion of the course, the student can

i. Measure the interference of the WIFI.
ii. Measure the RSSI and Link Quality of the ad-hoc Networks
iii. Implement the Qos improvement techniques

List of Experiments

1. WiFi interference measurement.
2. Packet Delivery Ratio (PDR) measurement of WPANs
3. Analyse the WLAN interference on WPAN
4. Wireless Ad-hoc network implementation
5. Wireless network performance analysis
6. RSSI and Link Quality measurement
7. Collision avoidance
8. Congestion control
9. Qos measurement for high density WPAN
10. Course Project.
EC 57703: TECHNICAL SEMINAR-I

A technical seminar based on relevant disciplinary or inter disciplinary topic is to be presented by every candidate during the second semester. The selection of the topic should be based on references from reputed International Journals such as Elsevier, Science Direct, IEEE transactions, IET transactions, SPIE transactions etc. only. The approval of the Department Head/ Coordinator prior to commencement of work and presentation is essential. The student is expected to produce a report based on the work carried out. The presentation, report and work done during the term supported by the documentation forms the basis of assessment.
Semester – III
### Semester III

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*Student is expected to work around 40 hours per week as Self Stud*
DEPARTMENT OPEN ELECTIVE-IV
EC62101: DESIGN AND ANALYSIS OF EXPERIMENTS

Course Objectives: Student should be able to understand

i. Use of statistics for experimental design

ii. Statistical analysis of experimental data to draw meaningful conclusions

Course Outcomes: Students will able to apply statistical concepts for

i. Identify relationships between cause and effect.

ii. Providing an understanding of interactions among causative factors.

iii. Hypothesis testing

Unit 1: Statistical Concepts (6 Hrs)

Strategy of experimentation, applications of experimental design, characterizing a process, optimizing a process variable, principles of experimental design replication, randomization, blocking, design guidelines, statistical techniques in experimentation

Unit 2: Simple Comparative Experiments (7 Hrs)

Probability distributions, Mean, variance, expected values, sampling and sampling distributions, properties of sample, mean, variance, degrees of freedom, normal distribution, standard normal distribution, Chi square distribution, t distribution, f distribution, hypothesis testing, confidence intervals

Unit 3: Experiments with Single Factor (7 Hrs)

Analysis of Variance (ANOVA), fixed effect and random effect model, analysis of fixed effect model, decomposition of total sum of squares, Cochrans theorem, model adequacy checking, normal probability plot, plot of residuals versus fitted values

Unit 4: Factorial Design (7 Hrs)

Basic definitions and principles, advantages of factorials, two factor factorial design, statistical analysis of fixed effect model, analysis of variance table for two factor factorial design fixed effect model, degrees of freedom
Unit 5: Regression Models (6 Hrs)
Linear regression model, simple and multiple regression analysis, estimation of parameters, predicted values, least squares fit, residuals and diagnostics

Unit 6: Randomized Block Design (7 Hrs)
Basic definitions and principles, randomized complete block design, statistical analysis of RCBD, model adequacy checking, balanced incomplete block design, statistical analysis of BIBD

Total Contact Hours: 40

Text Books:
1. Design and analysis of experiments, Douglas Montgomery, Wiley India, (2007)

Reference Books:
EC 67702: DISSERTATION STAGE 1

It is based on Literature survey and paper work carried out in the identified Project area. Project planning and execution till the Dissertation Stage-I examination will be considered.

EC 67701: TECHNICAL SEMINAR-II

A technical seminar based on relevant disciplinary or inter disciplinary topic is to be presented by every candidate during the Third semester. The selection of the topic should be based on references from reputed International Journals such as Elsevier, Science Direct, IEEE transactions, IET transactions, SPIE transactions etc. only. The approval of the Department Head/ Coordinator prior to commencement of work and presentation is essential. The student is expected to produce a report based on the work carried out. The presentation, report and work done during the term supported by the documentation forms the basis of assessment.
Semester – IV
### Semester IV

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# - Student is expected to work around 40 hours per week as Self Study
EC 67703: DISSERTATION STAGE-II

Final defence in front of the panel constituted as per the Institute rules and guidelines.