## AFFILIATED INSTITUTIONS
### ANNA UNIVERSITY, CHENNAI
#### REGULATIONS - 2013
##### M.E. ELECTRONICS AND COMMUNICATION ENGINEERING
###### CURRICULUM I TO IV SEMESTERS (FULL TIME)

### SEMESTER I

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### LIST OF ELECTIVES

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OBJECTIVES:
- To develop the ability to use the concepts of Linear algebra and Special functions for solving problems related to Networks.
- To formulate and construct a mathematical model for a linear programming problem in real life situation;
- To expose the students to solve ordinary differential equations by various techniques.

OUTCOMES:
- To achieve an understanding of the basic concepts of algebraic equations and method of solving them.
- To familiarize the students with special functions and solve problems associated with Engineering applications.

UNIT I  LINEAR ALGEBRA  12

UNIT II  LINEAR PROGRAMMING  12
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT III  ORDINARY DIFFERENTIAL EQUATIONS  12
Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

UNIT IV  TWO DIMENSIONAL RANDOM VARIABLES  12
Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT V  QUEUEING MODELS  12

TOTAL: 45+15=60 PERIODS

REFERENCES:
OBJECTIVES:
The purpose of this course is to provide in-depth treatment on methods and techniques in
- discrete-time signal transforms, digital filter design, optimal filtering
- power spectrum estimation, multi-rate digital signal processing
- DSP architectures which are of importance in the areas of signal processing, control and communications.

OUTCOMES:
Students should be able to:
- To design adaptive filters for a given application
- To design multirate DSP systems.

UNIT I  DISCRETE RANDOM SIGNAL PROCESSING

UNIT II  SPECTRUM ESTIMATION

UNIT III  LINEAR ESTIMATION AND PREDICTION

UNIT IV  ADAPTIVE FILTERS

UNIT V  MULTIRATE DIGITAL SIGNAL PROCESSING
Mathematical description of change of sampling rate - Interpolation and Decimation - Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

REFERENCES:
VL7101  VLSI SIGNAL PROCESSING  L T P C
3 0 0 3

OBJECTIVES
- To understand the various VLSI architectures for digital signal processing.
- To know the techniques of critical path and algorithmic strength reduction in the filter structures.
- To study the performance parameters, viz. area, speed and power.

OUTCOMES
- To be able to design architectures for DSP algorithms.
- To be able to optimize design in terms of area, speed and power.
- To be able to incorporate pipeline based architectures in the design.
- To be able to carry out HDL simulation of various DSP algorithms.

UNIT I  INTRODUCTION

UNIT II  METHODS OF CRITICAL PATH REDUCTION
Binary Adders – Binary Multipliers – Multiply-Accumulator (MAC) and sum of product (SOP) – Pipelining and parallel processing – retiming – unfolding – systolic architecture design.

UNIT III  ALGORITHMIC STRENGTH REDUCTION METHODS AND RECURSIVE FILTER DESIGN
Fast convolution-pipelined and parallel processing of recursive and adaptive filters – fast IIR filters design.

UNIT IV  DESIGN OF PIPELINED DIGITAL FILTERS

UNIT V  SYNCHRONOUS ASYNCHRONOUS PIPELINING AND PROGRAMMABLE DSP

TOTAL: 45 PERIODS

REFERENCES:

NC7101  HIGH PERFORMANCE NETWORKS  L T P C
3 0 0 3

OBJECTIVES:
- To develop a comprehensive understanding of multimedia networking.
- To study the types of VPN and tunneling protocols for security.
- To learn about network security in many layers and network management.

UNIT I  INTRODUCTION
Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing.SONET – DWDM – DSL – ISDN – BISDN, ATM.
UNIT II  MULTIMEDIA NETWORKING APPLICATIONS  9
Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services.

UNIT III  ADVANCED NETWORKS CONCEPTS  9

UNIT IV  TRAFFIC MODELLING  8
Little’s theorem, Need for modeling , Poisson modeling and its failure, Non - poisson models, Network performance evaluation.

UNIT V  NETWORK SECURITY AND MANAGEMENT  10

REFERENCES:

CU7102  ADVANCED DIGITAL COMMUNICATION TECHNIQUES  L T P C
3 0 0 3

OBJECTIVES:
• To understand the basics of signal-space analysis and digital transmission.
• To understand the coherent and noncoherent receivers and its impact on different channel characteristics.
• To understand Orthogonal Frequency Division Multiplexing.
• To understand the different block coded and convolutional coded digital communication systems..
• To understand the different Equalizers.

UNIT I  COHERENT AND NON-COHHERENT COMMUNICATION  9
UNIT II EQUALIZATION TECHNIQUES
Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals-
Equalization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization –
Adaptive Equalization algorithms.

UNIT III BLOCK CODED DIGITAL COMMUNICATION
Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal –
Shannon’s channel coding theorem; Channel capacity; Matched filter; Concepts of Spread
spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes;
Hammning; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION
Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram –
Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold
methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

UNIT V OFDM
Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM
signal processing; Peak Power Problem: PAP reduction schemes- Clipping, Filtering, Coding and
Scrambling.

OUTCOMES:
Upon Completion of the course, the students will be able to
• Develop the ability to understand the concepts of signal space analysis coherent and non-
coherent receivers.
• Comprehend the generation of OFDM signals and the processing of the signals.
• Possess knowledge on different block codes and convolutional codes.
• Conceptually appreciate different Equalization techniques.

REFERENCES:
1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and
2003.

EL7111 COMMUNICATION AND SIGNAL PROCESSING LABORATORY
(SDR platform based)
OBJECTIVE
• To develop skills for implementing various modulations, coding and equalization schemes on a
SDR platform.

OUTCOMES
• To be able to design and implement synchronization schemes for communication system.
• To be able to design and implement equalization schemes.
• To be able to design and implement various digital modulation schemes.
• To be able to use SDR platform for design of communication systems.
### Sl. No. | Details of Experiment | Details of Equipment / Instrument Required for a batch of 25 Students
--- | --- | ---
1. | Pulse Shaping, Timing & Frequency Synchronization | Name: Set - PC + SDR Board Quantity: 12 sets
2. | BPSK Modulation and Demodulation | Name: Set - PC + SDR Board Quantity: 12 sets
3. | Differential BPSK | Name: Set - PC + SDR Board Quantity: 12 sets
4. | QPSK Modulation and Demodulation | Name: Set - PC + SDR Board Quantity: 12 sets
5. | 16-QAM | Name: Set - PC + SDR Board Quantity: 12 sets
6. | LMS based linear Channel Equalization | Name: Set - PC + SDR Board Quantity: 12 sets
7. | Decision Feedback Equalizer | Name: Set - PC + SDR Board Quantity: 12 sets
8. | Mini Project | Name: Set - PC + SDR Board Quantity: 12 sets

TOTAL: 45 PERIODS

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**AP7202 ASIC AND FPGA DESIGN**

**OBJECTIVES:**
- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC.
- To analyse the synthesis, Simulation and testing of systems.
- To understand the design issues of SOC.
- To know about different high performance algorithms and its applications in ASICs.

**UNIT I**

**OVERVIEW OF ASIC AND PLD**
9
Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices : ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs

**UNIT II**

**ASIC PHYSICAL DESIGN**
9
System partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing : global routing - detailed routing - special routing - circuit extraction - DRC

**UNIT III**

**LOGIC SYNTHESIS, SIMULATION AND TESTING**
9

**UNIT IV**

**FPGA**
9
Field Programmable gate arrays- Logic blocks, routing architecture, Design flow technology - mapping for FPGAs, Xilinx XC4000 - ALTERA’s FLEX 8000/10000, ACTEL’s ACT-1,2,3 and their speed performance
Case studies: Altera MAX 5000 and 7000 - Altera MAX 9000 – Spartan II and Virtex II FPGAs - Apex and Cyclone FPGAs
UNIT V  SOC DESIGN
Design Methodologies – Processes and Flows - Embedded software development for SOC –
Techniques for SOC Testing – Configurable SOC – Hardware / Software codesign
Case studies: Digital camera, Bluetooth radio / modem, SDRAM and USB

TOTAL: 45 PERIODS

REFERENCES:
2. S. Trimberger, Field Programmable Gate Array Technology, Edr, Kluwer Academic
   1995.
   Hall, 1994.
6. S. Brown, R. Francis, J. Rose, Z. Vrancic, Field Programmable Gate Array, Kluwer Pubin,
7. J. Old Field, R. Dorf, Field Programmable Gate Arrays, John Wiley & Sons, Newyork,
   1995.
8. Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach,
11. F. Nekoogar, Timing Verification of Application-Specific Integrated Circuits (ASICs).

CU7202  MIC AND RF SYSTEM DESIGN  L T P C
3  0  0  3

OBJECTIVES:
1. To understand the fundamentals of RF radio system design.
2. To understand the various components that constitute an RF radio system for wireless
   Communications.
3. To know the basic analysis techniques needed for evaluating the performance of an RF radio
   system for Wireless applications.

UNIT I  CMOS PHYSICS, TRANSCEIVER ECIFICATIONS AND
ARCHITECTURES
CMOS: Introduction to MOSFET Physics – Noise: Thermal, shot, flicker, popcorn noise
transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR,
Phase noise - Specification distribution over a communication link Transceiver Architectures:
Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct up
conversion, Two step up conversion

UNIT II  IMPEDANCE MATCHING AND AMPLIFIERS
S-parameters with Smith chart – Passive IC components - Impedance matching networks
Amplifiers: Common Gate, Common Source Amplifiers – OC Time constants in bandwidth
estimation and enhancement – High frequency amplifier design Low Noise Amplifiers: Power
match and Noise match – Single ended and Differential LNAs – Terminated with Resistors and
Source Degeneration LNAs.
UNIT III  FEEDBACK SYSTEMS AND POWER AMPLIFIERS

UNIT IV  RF FILTER DESIGN, OSCILLATOR, MIXER
Overview-basic resonator and filter configuration-special filter realizations-filter implementation. Basic oscillator model-high frequency oscillator configuration-basic characteristics of mixers-phase locked loops-RF directional couplers hybrid couplers-detector and demodulator circuits.

UNIT V  MIC COMPONENTS, ANTENNAS AND MEASUREMENT TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES:
• To be able to design RF circuits
• To be able to analyse the performance of RF circuits

REFERENCES:

EL7211  DIGITAL SYSTEM DESIGN LABORATORY

VHDL / VERILOG BASED EXPERIMENTS
1. Design and implementation of serial and parallel adders
2. Design and implementation of magnitude comparator
3. Design and implementation of Radix -8 Booth multiplier
4. Design and implementation of 4-bit asynchronous and synchronous counters
5. Design and implementation of 4 x 4 bit RAM
6. Design and implementation of universal shift register
7. Design and implementation of 4 bit ALU
8. Design and implementation of sequence detector using D-FFs
9. Design and implementation of PRBS
10. Design and implementation of NCO
11. Design and implementation of linear convolution
12. Design and implementation of DLL

TOTAL: 45 PERIODS
OBJECTIVES:
- To introduce different types of signaling in digital telephony
- To introduce various transmission schemes for telephony and broadband
- To introduce methods of modeling and analysis techniques for data transmission

OUTCOME:
To design transmission and switching systems to meet the required blocking probability.

UNIT I  INTRODUCTION
Overview of existing Voice, Data and Multimedia Networks and Services; Review of Basic Communication principles; Synchronous and Asynchronous transmission, Line Codes

UNIT II  TRUNK TRANSMISSION
Multiplexing & Framing - types and standards; Trunk signaling; Optical Transmission-line codes and Muxing: SONET/SDH; ATM; Microwave and Satellite Systems.

UNIT III  LOCAL LOOP TRANSMISSION
The Analog Local Loop; ISDN local loop; DSL and ADSL; Wireless Local Loop; Fiber in the loop; Mobile and Satellite Phone local loop.

UNIT IV  SWITCHING
Evolution; Space switching, Time switching and Combination Switching; Blocking and Delay characteristics; Message ,Packet and ATM switching; Advances in switching techniques – shared memory fast packet switches, shared medium fast packet switches and space division fast packet switches, Photonic switching- Optical TDM, WDM.

UNIT V  TELETRAFFIC ENGINEERING
Telecom Network Modeling; Arrival Process; Network Blocking performance; Delay Networks -- Queing system analysis and delay performance.

REFERENCES:

TOTAL: 45 PERIODS

CU7009  NEURAL NETWORKS AND APPLICATIONS

UNIT I  BASIC LEARNING ALGORITHMS
UNIT II  RADIAL-BASIS FUNCTION NETWORKS AND SUPPORT VECTOR MACHINES
RADIAL BASIS FUNCTION NETWORKS  

SUPPORT VECTOR MACHINES

UNIT III  COMMITTEE MACHINES

NEURODYNAMICS SYSTEMS

UNIT IV  ATTRACTOR NEURAL NETWORKS:

ADAPTIVE RESONANCE THEORY:
Noise-Saturation Dilemma - Solving Noise-Saturation Dilemma – Recurrent On-center – Off surround Networks – Building Blocks of Adaptive Resonance – Substrate of Resonance Structural Details of Resonance Model – Adaptive Resonance Theory – Applications

UNIT V  SELF ORGANISING MAPS:

PULSED NEURON MODELS:

TOTAL: 45 PERIODS

REFERENCES:
OBJECTIVES

- To learn the key aspects of Soft computing and Neural networks.
- To know about the components and building block hypothesis of Genetic algorithm.
- To understand the features of neural network and its applications
- To study the fuzzy logic components
- To gain insight onto Neuro Fuzzy modeling and control.
- To gain knowledge in machine learning through Support vector machines.

UNIT I  INTRODUCTION TO SOFT COMPUTING
Evolution of Computing - Soft Computing Constituents – From Conventional AI to Computational Intelligence - Machine Learning Basics

UNIT II  GENETIC ALGORITHMS
Introduction, Building block hypothesis, working principle, Basic operators and Terminologies like individual, gene, encoding, fitness function and reproduction, Genetic modeling: Significance of Genetic operators, Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator, GA optimization problems, JSPP (Job Shop Scheduling Problem), TSP (Travelling Salesman Problem), Differences & similarities between GA & other traditional methods, Applications of GA.

UNIT III  NEURAL NETWORKS

UNIT IV  FUZZY LOGIC

UNIT V  NEURO-FUZZY MODELING

TOTAL : 45 PERIODS

OUTCOMES

- Implement machine learning through Neural networks.
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Write Genetic Algorithm to solve the optimization problem

REFERENCES:

9. Eiben and Smith “Introduction to Evolutionary Computing” Springer

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**OBJECTIVES:**
To provide in-depth knowledge about
- Searching Techniques
- Knowledge Representation
- Learning

**OUTCOMES:**
Students will be able to
- Explain Uniform search strategies and searching with partial information
- Understand Backtracking, Local and Adversarial Search
- Describe Learning decision trees
- Explain Probabilistic language processing

**UNIT I  INTRODUCTION**
8

**UNIT II  SEARCHING TECHNIQUES**
10
Informed search strategies — heuristic function — local search algorithms and optimistic problems — local search in continuous spaces — online search agents and unknown environments — Constraint satisfaction problems (CSP) — Backtracking search and Local search — Structure of problems — Adversarial Search — Games — Optimal decisions in games — Alpha — Beta Pruning — imperfect real-time decision — games that include an element of chance.

**UNIT III  KNOWLEDGE REPRESENTATION**
10
First order logic - syntax and semantics — Using first order logic — Knowledge engineering — Inference — prepositional versus first order logic — unification and lifting — forward chaining — backward chaining — Resolution — Knowledge representation — Ontological Engineering — Categories and objects — Actions — Simulation and events — Mental events and mental objects.

**UNIT IV  LEARNING**
9
UNIT V APPLICATIONS

REFERENCES:

TOTAL: 45 PERIODS

CP7204 ADVANCED OPERATING SYSTEMS

OBJECTIVES:
- To learn the fundamentals of Operating Systems
- To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols
- To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols
- To know the components and management aspects of Real time, Mobile operating systems

UNIT I FUNDAMENTALS OF OPERATING SYSTEMS

UNIT II DISTRIBUTED OPERATING SYSTEMS

UNIT III DISTRIBUTED RESOURCE MANAGEMENT

UNIT IV REAL TIME AND MOBILE OPERATING SYSTEMS

UNIT V CASE STUDIES

TOTAL: 45 PERIODS
OUTCOMES:
Upon Completion of the course, the students should be able to:
- Discuss the various synchronization, scheduling and memory management issues
- Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system
- Discuss the various resource management techniques for distributed systems
- Identify the different features of real time and mobile operating systems
- Install and use available open source kernel
- Modify existing open source kernels in terms of functionality or features used

REFERENCES:

DS7201 ADVANCED DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

OBJECTIVES:
- To understand the image fundamentals and mathematical transforms necessary for image processing and to study the image enhancement techniques.
- To understand the image segmentation and representation techniques.
- To understand how image are analyzed to extract features of interest.
- To introduce the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets.

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING
Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT II SEGMENTATION
Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods

UNIT III FEATURE EXTRACTION
First and second order edge detection operators, Phase congruency, Localized feature extraction-detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Runlength features, Fractal model based features, Gabor filter, wavelet features.
UNIT IV REGISTRATION AND IMAGE FUSION

Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature correspondence-Point pattern matching, Line matching, region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling- Nearest Neighbour and Cubic Splines
Image Fusion-Overview of image fusion, pixel fusion, Multire solution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT V 3D IMAGE VISUALIZATION

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL :45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to

- To understand image formation and the role human visual system plays in perception of gray and color image data.
- To apply image processing techniques in both the spatial and frequency (Fourier) domains.
- To design image analysis techniques in the form of image segmentation and to evaluate the methodologies for segmentation.
- To conduct independent study and analysis of feature extraction techniques.
- To understand the concepts of image registration and image fusion.
- To analyze the constraints in image processing when dealing with 3D data sets and to apply image processing algorithms in practical applications.

TEXT BOOKS:

REFERENCES:

NC7002 MULTIMEDIA COMPRESSION TECHNIQUES

OBJECTIVES:
To provide in-depth knowledge about
- Data Compression
- Text Compression and Audio Compression
- Image and Video Compression

OUTCOMES:
Students will be able to
- Explain Scalar quantization theory and Rate distribution Theory
- Understand different coding techniques
- Describe Contour based compression and Motion estimation techniques
UNIT I INTRODUCTION

UNIT II TEXT COMPRESSION

UNIT III AUDIO COMPRESSION

UNIT IV IMAGE COMPRESSION

UNIT V VIDEO COMPRESSION

TOTAL: 45 PERIODS

REFERENCES:

EL7002 MACHINE VISION

OBJECTIVES:
- To impart knowledge about Digital Image Processing and Segmentation
- To equip the students with Boundary Detection
- To know about Image Representation, Matching and Inference
OUTCOMES:
Students will be able to
- Understand different types of Image transforms and Models
- Explain Image smoothening, Sharpening and Encoding
- Describe Boundary representation

UNIT I DIGITAL IMAGE PROCESSING FUNDAMENTALS 9
Digital image representation – an image model – digital image processing transforms – overview of L-transforms – transforms and Fourier Transforms

UNIT II IMAGE PROCESSING & SEGMENTATION 9

UNIT III BOUNDARY DETECTION 9
Edge finding – surface orientation – optical flow – design – growing

UNIT IV IMAGE REPRESENTATION 9
Texture – texture as pattern recognition problem – two and three dimensional geometric structures – boundary representation- regions representation – shape properties – knowledge representation and use

UNIT V MATCHING AND INFERENCE 9

TOTAL: 45 PERIODS

REFERENCES:
UNIT II  TMS320C5X PROCESSOR  9
Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III  TMS320C6X PROCESSOR  9

UNIT IV  ADSP PROCESSORS  9
Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT V  ADVANCED PROCESSORS  9

TOTAL: 45 PERIODS

REFERENCES:
4. Rulph Chassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, A JOHN WILEY & SONS, INC., PUBLICATION, 2005

CU7001 REAL TIME EMBEDDED SYSTEMS  L T P C
3 0 0 3

UNIT I  INTRODUCTION TO EMBEDDED COMPUTING  9
Complex systems and microprocessors – Design example: Model train controller – Embedded system design process – Formalism for system design – Instruction sets Preliminaries – ARM Processor – CPU: Programming input and output – Supervisor mode, exception and traps – Coprocessor – Memory system mechanism – CPU performance – CPU power consumption.

UNIT II  COMPUTING PLATFORM AND DESIGN ANALYSIS  9
CPU buses – Memory devices – I/O devices – Component interfacing – Design with microprocessors – Development and Debugging – Program design – Model of programs – Assembly and Linking – Basic compilation techniques – Analysis and optimization of execution time, power, energy, program size – Program validation and testing.

UNIT III  PROCESS AND OPERATING SYSTEMS  9

UNIT IV  HARDWARE ACCELERATES & NETWORKS  9
Accelerators – Accelerated system design – Distributed Embedded Architecture – Networks for Embedded Systems – Network based design – Internet enabled systems.
UNIT V  CASE STUDY  9
Hardware and software co-design - Data Compressor - Software Modem – Personal Digital Assistants – Set–Top–Box. – System-on-Silicon – FOSS Tools for embedded system development.

REFERENCES:

TOTAL: 45 PERIODS

DS7010  MICROCONTROLLER SYSTEM DESIGN AND ANALYSIS  L  T  P  C  3  0  0  3

UNIT I  8051 ARCHITECTURE  9

UNIT II  8051 PROGRAMMING  9

UNIT III  PIC MICROCONTROLLER  9

UNIT IV  PERIPHERAL OF PIC MICROCONTROLLER  9

UNIT V  SYSTEM DESIGN – CASE STUDY  9

REFERENCES:

CP7030 ROBOTICS

OBJECTIVES

- To understand robot locomotion and mobile robot kinematics
- To understand perception in robotics
- To understand mobile robot localization
- To understand mobile robot mapping
- To understand simultaneous localization and mapping (SLAM)
- To understand robot planning and navigation

UNIT I LOCOMOTION AND KINEMATICS

UNIT II ROBOT PERCEPTION

UNIT III MOBILE ROBOT LOCALIZATION

UNIT IV MOBILE ROBOT MAPPING

UNIT V PLANNING AND NAVIGATION
Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms.

TOTAL : 45 PERIODS

OUTCOMES:
Upon Completion of the course, the students will be able to
- Explain robot locomotion
- Apply kinematics models and constraints
- Implement vision algorithms for robotics
- Implement robot localization techniques
- Implement robot mapping techniques
- Implement SLAM algorithms
- Explain planning and navigation in robotics
REFERENCES:

AP7012 NANO ELECTRONICS

OBJECTIVES:
1. To learn and understand basic concepts of Nano electronics.
2. To know the techniques of fabrication and measurement.
3. To gain knowledge about Nanostructure devices and logic devices.

UNIT I INTRODUCTION TO NANOELECTRONICS

UNIT II FABRICATION AND MEASUREMENT TECHNIQUES
Growth, fabrication, and measurement techniques for nanostructures- Bulk crystal and heterostructure growth- Nanolithography, etching, and other means for fabrication of nanostructures and nanodevices- Techniques for characterization of nanostructures- Spontaneous formation and ordering of nanostructures- Clusters and nanocrystals- Methods of nanotube growth-Chemical and biological methods for nanoscale fabrication- Fabrication of nano-electromechanical systems

UNIT III PROPERTIES

UNIT IV NANO STRUCTURE DEVICES
UNIT V     LOGIC DEVICES AND APPLICATIONS

REFERENCES:
4. Korkin, Anatoli; Rosei, Federico (Eds.), “Nanoelectronics and Photonics”, Springer 2008

EL7003     WIRELESS COMMUNICATION AND NETWORKING

OBJECTIVES:
• Understand various types of local area networks including 802.11, Hyperlan and WiMax networks and wide area networks.
• Understand various wireless networking standards such as 2.5G and 3G.
• To interwork between WLAN and WWAN.
• To have a good understanding of emerging wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

OUTCOMES:
On successful completion of this course, student will be able to
• Understand the concepts of LAN, WAN and various wireless standards.
• Work with different wireless networks.
• Familiarize with advanced wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

UNIT I     WIRELESS LOCAL AREA NETWORKS
Introduction to wireless LANs - IEEE 802.11 WLANs - Physical Layer- MAC sub-layer- MAC Management Sub-layer- Wireless ATM - HIPERLAN- HIPERLAN-2, WiMax.

UNIT II     3G OVERVIEW &2.5G EVOLUTION
Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, CDMA2000 overview- Radio and Network components, Network structure, Radio network, TD-CDMA, TD-SCDMA.
UNIT III INTERWORKING BETWEEN WLANS AND 3G WWANS
Interworking objectives and requirements, Schemes to connect WLANs and 3GNetworks, Session Mobility, Interworking Architectures for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution system.

UNIT IV ADHOC & SENSOR NETWORKS
Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks- Classification, MAC and Routing protocols.

UNIT V COOPERATIVE WIRELESS NETWORKS
Introduction- User cooperation and cognitive systems- Relay channels- A general three node relay channel- Wireless relay channel- User cooperation in wireless networks- Two user cooperative network- Cooperative wireless network- Multi-hop relay channel.

TOTAL:45 PERIODS

REFERENCES:

EL7004 CRYPTOGRAPHY AND NETWORK SECURITY L T P C
3 0 0 3

OBJECTIVES:
1. To provide practical survey of principles and practices of Cryptography and network security.
2. To gain knowledge on basic issues to be addressed by network security capability.
3. To introduce the principles of number theory and the practice of network security and cryptographic algorithms.
4. To gain Knowledge on different encryption and decryption schemas.
5. To provide basic concepts about system security and attacks.

OUTCOMES:
2. Cryptographic Algorithm- Construction of the security within the software design or software deployment.
3. Security Terminologies- Speaking cogently about security using the terms of art.
4. Security Authentication- Making the data transmission security by the process of Authentication.
5. System security- Evaluation of the security among the systems by making the firewall and security standards efficient.
UNIT I  INTRODUCTION AND NUMBER THEORY  9

UNIT II  PUBLIC KEY ENCRYPTION  9

UNIT III  MESSAGE AUTHENTICATION  9

UNIT IV  NETWORK SECURITY PRACTICE  9

UNIT V  SYSTEM SECURITY  9

TOTAL:45 PERIODS

REFERENCES:

EL7005  BROADBAND ACCESS TECHNOLOGIES  L T P C
BROADBAND ACCESS TECHNOLOGIES  3 0 0 3

OBJECTIVES:
- To gain insight and understand current and emerging wired and wireless Internet access technologies.
- Learn the current technology trends and system standards as well as emerging technologies for next generation broadband access networks.

OUTCOMES:
Upon successful completion of this course the student will be able to:
- Understand the importance of broadband networking services and technologies.
- Describe and compare the different broadband network access techniques of Digital Subscriber Line (DSL), cable modem service, optical fiber based access, and broadband wireless access techniques of WiFi and WiMAX networks.
- List and provide a high-level discussion on the important broadband core network technologies of MPLS and IP multicast and discuss IP QoS control mechanisms including RSVP and DiffServe.
• Identify the relationship between broadband networking and the IP Multimedia Sub-system (IMS) and discuss the operation of IMS.
• Discuss the important broadband services of VoIP, IPTV, streaming video, and VoD.

UNIT I
Introduction to Broadband Networking: Services and Technology - Broadband Access Technologies: Digital Subscriber Line (ADSL, HDSL, RADSL, VDSL, And G.lite)

UNIT II
Access network architecture (DSLAM, ATM) - Modulation technologies (DMT) Cable Modem Service - Headend and regional network architecture (Cable Modem Termination System – CMTS, Hybrid Fiber Coax networks – HFC) - Cable Labs initiatives (DOCSIS. Packet Cable, Cable Home)

UNIT III
Optical Fiber-based Networks - Passive Optical Network (PON) architecture (Optical line termination, optical network terminals) - Standards (BPON, GPON, and EPON) Fixed and Mobile WiMAX: Architecture - Standards (IEEE 802.15, 802.16) Services - Comparison of broadband access techniques

UNIT IV

UNIT V

REFERENCES:
3. Broadband Optical Access Networks By Leonid G. Kazovsky; Ning Cheng; Wei-Tao Shaw; David Gutierrez; Shing-Wa Wong Publisher: Wiley-Interscience

TOTAL: 45 PERIODS

NC7001  NETWORK ROUTING ALGORITHMS  L T P C  3 0 0 3

OBJECTIVES:
• To expose the students to the layered architecture for communication networks and the specific functionality of the network layer.
• To enable the student to understand the basic principles of routing and the manner this is implemented in conventional networks and the evolving routing algorithms based on Internetworking requirements, optical backbone and the wireless access part of the network.
• To enable the student to understand the different routing algorithms existing and their performance characteristics.
UNIT I  INTRODUCTION

UNIT II  INTERNET ROUTING
Interior protocol : Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III  ROUTING IN OPTICAL WDM NETWORKS
Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting-Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms- AG, MWPG.

UNIT IV  MOBILE - IP NETWORKS

UNIT V  MOBILE AD –HOC NETWORKS
Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
- Given the network and user requirements and the type of channel over which the network has to operate, the student would be in a position to apply his knowledge for identifying a suitable routing algorithm, implementing it and analyzing its performance.
- The student would also be able to design a new algorithm or modify an existing algorithm to satisfy the evolving demands in the network and by the user applications.
OBJECTIVES

- To understand the issues involved in mobile communication system design and analysis.
- To understand the concept of frequency reuse.
- To understand the characteristics of wireless channels.
- To acquire knowledge in different modulation schemes and its error probability in wireless system.
- To know the fundamental limits on the capacity of wireless channels.
- To understand the diversity concepts.

OUTCOMES:

- To apply diversity techniques in wireless systems.
- To design cellular systems to achieve a given GoS (Grade of Service) in coverage and blocking probability.
- To design digital radio links considering various analytical and empirical models.
- To carry out link budget calculations.
- To be able to design frequency reuse patterns for cellular communication.

UNIT I  THE WIRELESS CHANNEL
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT II  PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS

UNIT III  MULTIANTENNA COMMUNICATION

UNIT IV  MULTICARRIER MODULATION
Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Subchannels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset – Case study IEEE 802.11a

UNIT V  CELLULAR CONCEPTS

REFERENCES:

TOTAL:45 PERIODS
CU7003 DIGITAL COMMUNICATION RECEIVERS L T P C 3 0 0 3

UNIT I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES 9
Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

UNIT II OPTIMUM RECEIVERS FOR AWGN CHANNEL 9
Correlation demodulator, matched filter, maximum likelihood sequence detector, optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for Maryland correlated binary signals.

UNIT III RECEIVERS FOR FADING CHANNELS 9
Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection and synchronization parameter estimation, coded waveform for fading channel.

UNIT IV SYNCHRONIZATION TECHNIQUES 9
Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

UNIT V ADAPTIVE EQUALIZATION 9

TOTAL : 45 PERIODS

REFERENCES:

CU7103 OPTICAL NETWORKS L T P C 3 0 0 3

UNIT I OPTICAL SYSTEM COMPONENTS 9
Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 9
Introduction to Optical Networks; SONET / SDH standards, Metropolitan Area Networks, Layered Architecture; Broadcast and Select Networks–Topologies for Broadcast Networks, Media Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9
The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength Assignment [RWA], Virtual topology design, Wavelength Routing Testbeds, Architectural variations.
UNIT IV  PACKET SWITCHING AND ACCESS NETWORKS

UNIT V  NETWORK DESIGN AND MANAGEMENT
Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL : 45 PERIODS

REFERENCES:

CU7004  DETECTION AND ESTIMATION THEORY

OBJECTIVES:
1. To enable the student to understand the basic principles of random signal processing, spectral estimation methods and their applications.
2. To enable the student to understand the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.

UNIT I  DISCRETE RANDOM SIGNAL PROCESSING

UNIT II  SPECTRAL ESTIMATION
Estimation of spectra from finite duration signals, Nonparametric methods – Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods – ARMA, AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.

UNIT III  DETECTION AND ESTIMATION CRITERIA
Detection criteria : Bayes detection techniques, MAP, ML— detection of M-ary signals, Neyman Peason, minimax decision criteria. Estimation: linear estimators, non-linear estimators, Bayes, MAP,ML, properties of estimators, phase and amplitude estimation.

UNIT IV  SYNCHRONIZATION
Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.
UNIT V RECEIVERS FOR AWGN AND FADING CHANNELS
Optimum receivers for AWGN channel - Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
1. The student would be able to demonstrate an understanding of the basic principles of random signal processing, spectral estimation methods and their applications.
2. The student would be able to demonstrate an understanding of the different signal detection and estimation methods used in communication system design and the implications of proper synchronization methods for proper functioning of the system.
3. The student would be in a position to apply his knowledge for designing a baseband system addressing the channel impairments.

AP7301 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

OBJECTIVES:
- To understand the basics of EMI
- To study EMI Sources
- To understand EMI problems
- To understand Solution methods in PCB
- To understand Measurement technique for emission
- To understand Measurement technique for immunity

UNIT I EMI/EMC CONCEPTS
EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

UNIT II EMI COUPLING PRINCIPLES
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling, cross talk; Field to cable coupling; Power mains and Power supply coupling.

UNIT III EMI CONTROL TECHNIQUES
Shielding- Shielding Material-Shielding integrity at discontinuities, Filtering- Characteristics of Filters-Impedance and Lumped element filters-Telephone line filter, Power line filter design, Filter installation and Evaluation, Grounding- Measurement of Ground resistance-system grounding for EMI/EMC-Cable shielded grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control. EMI gaskets
UNIT IV   EMC DESIGN OF PCBS
EMI Suppression Cables-Absorptive, ribbon cables-Devices-Transient protection hybrid circuits, Component selection and mounting; PCB trace impedance; Routing; Cross talk control- Electromagnetic Pulse-Noise from relays and switches, Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

UNIT V   EMI MEASUREMENTS AND STANDARDS
Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462. Frequency assignment - spectrum conversation. British VDE standards, Euro norms standards in japan - comparisons. EN Emission and Susceptibility standards and Specifications.

TOTAL: 45 PERIODS

OUTCOMES
Upon Completion of the course, the students will be able to
• To design a EMI free system
• To reduce system level crosstalk
• To design high speed Printed Circuit board with minimum interference
• To make our world free from unwanted electromagnetic environment

REFERENCES:
3. Henry W.Ott.,"Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science  

CU7002   MEMS AND NEMS  L T P C
3   0 0 3

OBJECTIVES:
• To introducing the concepts of microelectro mechanical devices.
• To know the fabrication process of Microsystems.
• To know the design concepts of micro sensors and micro actuators.
• To introducing concepts of quantum mechanics and nano systems.

UNIT I   OVERVIEW AND INTRODUCTION
New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals

UNIT II   MEMS FABRICATION TECHNOLOGIES
UNIT III  MICRO SENSORS
MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT IV  MICRO ACTUATORS
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators

UNIT V  NANOSYSTEMS AND QUANTUM MECHANICS
Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodingier Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits

TOTAL: 45 PERIODS

REFERENCES:
4. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006,

CU7101  ADVANCED RADIATION SYSTEMS
UNIT I  ANTENNA FUNDAMENTALS
Antenna fundamental parameters , Radiation integrals , Radiation from surface and line current distributions – dipole, monopole, loop antenna; Mobile phone antenna- base station, hand set antenna; Image; Induction , reciprocity theorem, Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques.

UNIT II  RADIATION FROM APERTURES
Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.

UNIT III  ARRAYS
Introduction-General structure of phased array, linear array theory, variation of gain as a function of pointing direction, effects of phase quantization, frequency scanned arrays, analog beam forming matrices-Active modules, digital beam forming, MEMS technology in phased arrays-Retro directive and self phased arrays.

UNIT IV  MICRO STRIP ANTENNA
Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from transmission line model, cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of microstrip array antenna.
UNIT V  EMC ANTENNA AND ANTENNA MEASUREMENTS

Concept of EMC measuring antenna; Receiver and Transmitter antenna factors; Log periodic dipole, Biconical, Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

TOTAL: 45 PERIODS

REFERENCES:

DS7301 SPEECH AND AUDIO SIGNAL PROCESSING L T P C 3 0 0 3

OBJECTIVES:
1. To study the basic concepts of speech and audio.
2. To study the analysis of various M-band filter banks for audio coding
3. To learn various transform coders for audio coding.
4. To study the speech processing methods in time and frequency domain

UNIT I  MECHANICS OF SPEECH AND AUDIO

UNIT II  TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS

UNIT III  AUDIO CODING AND TRANSFORM CODERS
UNIT IV  TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING  
Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods

HOMOMORPHIC SPEECH ANALYSIS:

UNIT V  LINEAR PREDICTIVE ANALYSIS OF SPEECH  

TOTAL: 45 PERIODS

REFERENCES:

DS7003  ARRAY SIGNAL PROCESSING  
UNIT I  INTRODUCTION  
Antenna parameters, Basic Antenna elements, Array Fundamentals- Element pattern, directive gain, Directivity, Power Gain, Polarization, array pattern, array gain, array taper efficiency, Pencil beam array, linear array synthesis-schelknoff ’s polynomial array, binomial array, chebyshev array, Microstrip patch array, Noise in communication.

UNIT II  SPATIAL SIGNALS AND SENSOR ARRAYS  

UNIT III  SPATIAL FREQUENCY  
Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering, sectorization, switched beam, phased antenna array, adaptive antenna array and adaptive signal processing application, Beam Forming. Spatially white signal. Introduction to microphone array signal processing

UNIT IV  DIRECTION OF ARRIVAL ESTIMATION  

UNIT V  APPLICATIONS OF ARRAY SIGNAL PROCESSING  
RADAR, Sonar, Seismic, Acoustics, Wireless Communications and networks and Radio Ztronomy signal processing applications

TOTAL: 45 PERIODS
REFERENCES:

UNIT I  SIGNAL, SYSTEM AND SPECTRUM  9

UNIT II  TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION  9
Time series analysis – linear prediction models, process order estimation, lattice representation, non stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation – Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT III  ADAPTIVE FILTERING AND WAVELET DETECTION  9

UNIT IV  BIOSIGNAL CLASSIFICATION AND RECOGNITION  9

UNIT V  TIME FREQUENCY AND MULTIVARIATE ANALYSIS  9
Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis analysis-PCA, ICA

REFERENCES:

TOTAL: 45 PERIODS