PCS19101 **ADVANCED DIGITAL SIGNAL PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand theory of different filters and algorithms
- understand theory of multi rate DSP, solve numerical problems and write algorithms
- understand theory of prediction and solution of normal equations.
- understand DSP algorithms.
- know the applications of DSP and radar

UNIT I DSP FILTERS AND ALGORITHM **9**

Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.

UNIT II SAMPLING CONVERSION **9**

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub band coding.

UNIT III DSP FILTERS **9**

Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

UNIT IV DSP ALGORITHMS **9**

Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

UNIT V IMAGE PROCESSING APPLICATIONS **9**

Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand theory of different filters and algorithms
- know the theory of multi rate DSP, solve numerical problems and write algorithms
- understand theory of prediction and solution of normal equations
- know the DSP algorithms
- acquire the knowledge inapplications of DSP at block level

REFERENCES

1 J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall,2007.

2 N. J. Fliege, "Multirate Digital Signal Processing:

3 Bruce W. Suter, "Multi rate and Wavelet Signal Processing",1st Edition, Academic Press,1997.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3

PCS19102 ADVANCED RADIATION SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the relation between the fields and be familiar with antenna arrays.
- understand signal propagation at radio frequencies and study aperture and reflector antennas.
- introduce the basics of micro strip patch antennas and its analysis.
- know about antenna arrays and its parameter measurement.
- learn the special antenna arrays and their applications.

UNIT I ANTENNA FUNDAMENTALS 9

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 9

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 ARRAY ANTENNA 9

Linear array - uniform array, end fire and broad side array, gain, beam width, side lobe level; Two dimensional uniform array; Phased array, beam scanning, grating lobe, feed network, Linear array synthesis techniques - Binomial and Chebyshev distributions.

UNIT IV HORN, MICROSTRIP, REFLECTOR ANTENNAS 9

E and H plane sectoral Horns- Pyramidal horns- Conical and corrugated Horns- Micro strip antennas - feeding methods. Rectangular patch- Transmission line model-Parabolic Reflector antennas - Prime focus and Cassegrain reflectors- Equivalent focal Length of Cassegrain antennas- Spill over and taper efficiencies- Optimum illumination

UNIT V EMC ANTENNA AND ANTENNA MEASUREMENTS 9

Concept of EMC measuring antenna; Tx and Rx antenna factors; Log periodic dipole, Bi-conical, Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand various antenna parameters
- get knowledge of aperture antennas and the field associated with it
- design micro strip patch antennas and its simulation using software

- apply the applications of array antennas
- perform measurement of antenna parameters and design special array antennas

REFERENCES

1. Balanis.A, “Antenna Theory Analysis and Design”, John Wiley and Sons, New York, 1982.
2. Krauss.J.D, “Antennas”, II edition, John Wiley and sons, New York, 1997.
3. I.J. Bahl and P. Bhartia,” Microstrip Antennas”, Artech House, Inc., 1980.
4. W.L.Stutzman and G.A.Thiele, “Antenna Theory and Design”, 2ndedition, John Wiley& Sons Inc., 1998.
5. Jordan. E.C, “ Electromagnetic waves and Radiating systems”. PHI 2003

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

SEMESTER II

PCS19201 **BROADBAND WIRELESS TECHNOLOGY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know about MIMO channel model & capacity
- understand concepts of MIMO diversity and spatial multiplexing
- learn Massive MIMO system
- know milli meter wave communication
- know about software defined radio and cognitive radio

UNIT I INFORMATION THEORETIC ASPECTS OF MIMO **9**

Review of SISO fading communication channels, MIMO Channel models, Classical id and extended channels, Frequency selective and correlated channels models, Capacity of MIMO channels, Erogodic and outage capacity, capacity bounds and influence of channel properties on the capacity.

UNIT II MIMO DIVERSITY AND SPATIAL MULTIPLEXING **9**

Sources and types of diversity, analysis under Rayleigh fading, Diversity and channel knowledge. Alamouti space time code. MIMO spatial multiplexing: Space time receivers, ML, ZF, MMSE and Sphere decoding, BLAST receivers and Diversity multiplexing trade - off.

UNIT III MASSIVE MIMO SYSTEM **9**

Introduction - MIMO for LTE, capacity of massive MIMO, Pilot Design for massive MIMO, Resource allocation and transceivers design, Base band and RF implementation, Channel Models.

UNIT IV MILLIMETER WAVE COMMUNICATION **9**

Spectrum regulation, Channel propagation, Hardware technology for MMW systems, architecture and mobility, Beam forming techniques, Beam finding, Physical layer techniques - Duplex scheme and Transmission Scheme.

UNIT V SOFTWARE DEFINED RADIO AND COGNITIVE RADIO **9**

SDR - Definition, Origin, key characteristic, hardware and software architecture, waveforms. Cognitive Radio - Definitions, Cognitive theories, architectures, Cognitive radio as self-controlling system, Ontology based cognitive radio.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- analyse MIMO system and its capacity
- know spatial multiplexing
- discuss milli meter wave communication.
- know about massive MIMO system
- demonstrate software defined radio and cognitive radio

REFERENCES

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Cambridge University Press2005.
2. Hamid Jafarkhani, "Space - Time Coding: Theory and Practices", Cambridge University Press 2005.
3. Mischa Dohler, Jose F. Monserrat Afif Osseiran " 5G Mobile and Wireless Communication Technology", Cambridge University Press2016.
4. Mieczyslaw M Kokar, Lezek Lechowicz, "Cognitive Radio Interoperability through Waveform Reconfiguration" ARTECH House2016.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PCS19202 **MIC AND RF SYSTEM DESIGN** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn about CMOS MOSFET physics
- understand various impedance transformers and biasing network
- learn about feedback system and power amplifiers
- study the basic RF components and the basic RF mixers and oscillators
- acquire knowledge of RF filters and RF synthesizer

UNIT I CMOS PHYSICS TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES **9**

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, Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct up conversion, Two step up conversion schemes.

UNIT II IMPEDANCE MATCHING AND AMPLIFIERS **9**

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 Schemes.

UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS **9**

Feedback Systems: Stability of feedback systems: Gain and phase margin, Root-locus techniques – Time and Frequency domain considerations , Compensation Power Amplifiers: General model – Class A, AB, B, C, D, E and F amplifiers – Linearization Techniques – Efficiency boosting techniques – ACPR metric – Design considerations.

UNIT IV RF FILTER , OSCILLATOR, MIXER **9**

Over view – 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 **9**

Introduction to MICs, Fabrication Technology, Advantages and applications, MIC components- Micro strip components, Coplanar Circuits: Transistors, Switches, active filters. Coplanar microwave amplifiers: LNA design and Medium power amplifiers.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- knows about CMOS physics
- know the analysis of the impedance transformation
- know about matching and biasing networks
- gain knowledge in operation of RF oscillators and mixers and their design
- identify the MIC component

REFERENCES

1 T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004.

2 Reinhold Ludwig and Powel Bretchko, "RF Circuit Design – Theory and Applications", Pearson Education Asia, 2006

3 B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PCS19204 RF AND NETWORKS LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- provide experience in simulation and implementation of the mobility models and various protocols
- provide the comprehensive analysis of communication signals
- learn about the antennas and VCO design and RF link
- understand the concept of ZIGBEE and Bluetooth
- focus on various systems for performance evaluation using GLOMOSIM/NS2

LIST OF EXPERIMENTS

1. Transmission line parameters – Measurement using Network Analyzer.
2. Design and characterization of Antennas using ADS/IE3D/HFSS.
3. Spectral Characterization of communication signals (using Spectrum Analyzer).
4. LNA / Mixer / VCO design and characterization using ADS/IE3D/HFSS.
5. Design and budget analysis of communication links using ADS/IE3D/HFSS.
6. Study of a RF link.
7. Simulation and performance evaluation of entity mobility models using GLOMOSIM / NS2 (Random walk, random way point)
8. Simulation and performance evaluation of Ad-hoc routing protocols using GLOMOSIM / NS2 (DSR, AODV, ZRP)
9. Simulation and performance evaluation of Wireless MAC protocols using NS2.
10. Mini Projects using Simulation Tools

COURSE OUTCOMES **TOTAL: 60 PERIODS**

Upon the completion of the course, the students will be able to

- understand the basic concepts of communication and RF link
- analyze the characteristics of communication signals and simulation and performance evaluation of various protocols
- design antennas using VCO, Mixer
- design a network aimed ZIGBEE/Bluetooth
- know the performances of various protocols using GLOMOSIM/NS2

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	3	-	-	-	3	3

PCS19203 **MINI PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- get real time exposure to design problems to solve them using design principles.
- understand properties and functions of different Components and apply them according to functional and structural requirements.
- get hands-on training in Simulation modeling techniques.
- work as a team to develop team spirit and communication, exchange creative ideas, improve self-learning and planning skills.
- give an opportunity to the student to achieve integrated communication design to develop a system.

GUIDELINE FOR REVIEW AND EVALUATION

Each students works under a project supervisor. The product system /component(s) to be designed may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the student which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners.

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- use the design principles and develop conceptual design of communication system
- select appropriate material to suit the functional requirement of the system.
- workout the simulation projects using software.
- work as a team to develop an idea.
- design a system with a view to fulfill social, economic , environmental, legal and safety aspects in the course of development of the product.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PROGRAMME ELECTIVE I

PCS19151 **DATA COMPRESSION TECHNIQUES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the various compression and quantization techniques.
- discuss various data compression algorithms and compare their efficiency in terms of speed.
- analyse different compression techniques and standards for image and video
- compare various video compression standards.
- apply knowledge for identifying a suitable strategy for compression of text, image and video

UNIT I INTRODUCTION **9**

Multimedia data - features — Storage requirements for multimedia - Need for Compression - Taxonomy of compression – Metrics – Quantitative and Qualitative techniques - Overview of source coding – Scalar quantization - Adaptive - Vector quantization

UNIT II TEXT COMPRESSION **9**

Characteristics of text data – RLE, Huffmann coding – Adaptive Huffmann Coding – Arithmetic coding — Dictionary techniques – static and adaptive- diagram coding – LZW algorithm - GIF, TIF, JBIG, JBIG2.

UNIT III AUDIO COMPRESSION **9**

Fundamental concepts of digital audio - Audio compression techniques –μ Law and A- Law companding - PCM, DPCM, DM, ADM - sub-band coding – Application to speech coding – G.722 – MPEG audio – MP3 - Model based coding – Channel Vocoders – LPC - Formant and CELP coders.

UNIT IV IMAGE COMPRESSION **9**

Image data representation - Predictive techniques – DPCM: Optimal Predictors and Optimal Quantizers –Transform Coding – JPEG Standard – Sub-band coding – QMF Filters - Wavelet based compression – EZW, SPIHT coders – JPEG 2000 standard – File formats.

UNIT V VIDEO COMPRESSION **9**

Fundamental concepts of video – digital video signal - video formats – AVI, FLV, MP4, Real media - Motion estimation and compensation Techniques, Full search motion estimation methods – MPEG Video Compression standards: MPEG – 1, 2, 4, 7 and 21 — H.26X Standard - Packet Video.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- discuss various data compression algorithms and compare their efficiency in terms of speed.
- analyse different compression techniques and standards for image and video
- compare various video compression standards.
- apply knowledge for identifying a suitable strategy for compression of text, image and video
- Know various compression and quantization techniques.

REFERENCES

1. Khalid Sayood, " Introduction to Data Compression", Morgan Kauffman HarcourtIndia, 4th Edition, 2012.
2. David Salomon, " Data Compression – The Complete Reference", Springer Verlag New York Inc., 2nd Edition, 2012.
3. Mark S. Drew,Ze-Nian Li, JiangchuanLiu ," Fundamentals of Multimedia", Prentice Hall of India, 1st Edition, 2014.
4. Yun Q.Shi, Huifang Sun, " Image and Video Compression for Multimedia Engineering-Fundamentals, Algorithms & Standards", CRC press, 2003.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PCS19152 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- learn the basics of EMI and EMC Environment, EMI specification standards and limits
- understand the EMI and EMC coupling principles
- study the control techniques involved in electromagnetic interference
- learn about EMC design of PCBs
- know about EMI measurements

UNIT I EMI PRINCIPLES AND STANDARDS **9**

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, Time domain Vs Frequency domain EMI ESD; Radiation Hazards, Units of specifications, Civilian standards - FCC, CISPR, IEC, EN, Military standards - MIL STD 461D/462.

UNIT II EMI COUPLING PRINCIPLES **9**

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 **9**

Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control - Test beds for ESD and EFT.

UNIT IV EMC DESIGN OF PCBS **9**

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models.

UNIT V EMI MEASUREMENTS **9**

4G features and challenges, Technology path, IMS Architecture, Convergent Devices, 4G technologies, Advanced Broadband Wireless Access and Services, Multimedia, MVNO.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand the analytical concepts of EMI and EMC
- find solution to EMI sources.
- find solution to EMI problems in PCB level.
- measure emission immunity level from different systems to couple with different standards.
- design and implement EMI system

REFERENCES

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 1996.

2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter SciencePublications, John Wiley and Sons, New York, 1988.

3.Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artechhourse, Norwood,1986.

4. C.R.Paul, "Introduction to Electromagnetic Compatibility", John Wiley and Sons, Inc, 1992.

5. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PCS19153 **ADVANCED DIGITAL IMAGE PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- demonstrate knowledge of image acquisition, digitization and spatial filters for enhancement
- employ colour image processing techniques
- apply morphological image processing algorithms
- apply segmentation algorithms and descriptors for image processing
- apply compression, watermarking and steganography algorithms to images

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING 9

Elements of Visual Perception- Image acquisition, digitization- Histogram - Image enhancement – Spatial filters for smoothing and sharpening – Discrete 2D transforms - DFT, DCT, Walsh-Hadamard, Slant, KL, Wavelet Transform – Haar wavelet.

UNIT II COLOR IMAGE PROCESSSING 9

Colour Image Fundamentals-Colour Models- RGB, CMY, CMYK and HSI Colour Models-Pseudocolour Image Processing - Intensity Slicing- Intensity to Colour transformations -Basics of Colour Image Processing- Colour Transformation - Colour Image Smoothing and Sharpening- Colour Segmentation - Noise in Colour Images.

UNIT III MORPHOLOGICAL IMAGE PROCESSING 9

Preliminaries- Basic Concepts from Set Theory-Logic Operations Involving Binary Images - Dilation and Erosion –Opening and Closing - Hit-or-Miss Transformation - Basic Morphological Algorithms -Boundary Extraction- Region Filling- Extraction of Connected Components- Convex Hull- Thinning-Thickening-Skeletons- Pruning- - Gray-Scale Morphology.

UNIT IV SEGMENTATION, REPRESENTATION AND DESCRIPTION 9

Edge Detection - Edge Linking and Boundary Detection -Thresholding- Segmentation by Morphological Watershed Segmentation Algorithm - Use of Markers- Representation and Boundary Descriptors.

UNIT V OBJECT RECOGNITION AND IMAGE PROCESSING APPLICATIONS 9

Patterns and Pattern Classes -Recognition Based on Decision-Theoretic Methods -Matching - Optimum Statistical Classifiers- Neural Networks, Fuzzy Systems - GA. Image compression- JPEG, JPEG2000 JBIG standards - Watermarking – Steganography

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- demonstrate knowledge of image acquisition, digitization and spatial filters for enhancement
- employ colour image processing techniques.
- apply morphological image processing algorithms.
- know segmentation algorithms and descriptors for image processing.
- apply compression, watermarking and steganography algorithms to images.

REFERENCES

1. Rafael C. Gonzalez, "Digital Image Processing", Pearson Education, Inc., 3rd Edition, 2008.
2. MilmanSonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision",
3. Khalid Sayood, "Data Compression", Morgan Kaufmann Publishers (Elsevier)., 3rd Edition, 2006
4. Rafael C. Gonzalez, Richards E.Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PCS19154 **MEMS AND NEMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- introduce the concepts of micro electro mechanical devices.
- know the fabrication process of Microsystems.
- know the design concepts of micro sensors.
- know the design concepts of micro actuators
- familiarize concepts of quantum mechanics and nano systems.

UNIT I OVERVIEW **9**

New trends in Engineering and Science: Micro and Nano scale systems, Introduction to Design of MEMS and NEMS, MEMS and NEMS – Applications, Devices and structures. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT II MEMSFABRICATION TECHNOLOGIES **9**

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MICROSENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Micro sensors. Case study: Piezo-resistive pressure sensor

UNIT IV MICROACTUATORS **9**

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 ANDQUANTUM MECHANICS **9**

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- analyse micro electro mechanical devices
- Fabricate a microsystem
- explain about micro sensors
- explain micro actuators
- outline nano systems and Quantum mechanics

REFERENCES

1. Chang Liu, “Foundations of MEMS”, Pearson education India limited,2006.
2. Marc Madou, “Fundamentals of Micro fabrication”, CRC press1997.
3. Stephen D. Senturia,” Micro system Design”, Kluwer AcademicPublishers,2001
4. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures” CRC Press, 2002.
5. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill,2002.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PROGRAMME ELECTIVE II

PCS19251 FIBER OPTIC NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the concepts of basic optical system components
- understand the concepts of optical networks and its architecture
- know the fundamental concepts on wavelength routing networks
- introduce the concepts on packet switching and access networks
- understand the concepts of network management and survivability

UNIT I OPTICAL SYSTEM COMPONENTS 9

Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Connectors, Splicing, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters

UNIT II OPTICAL NETWORK ARCHITECTURE 9

Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies, Media-Access Control Protocols and Test beds; Wavelength Routing Architecture, Performance of WDM + EDFA System, Solitons.

UNIT III WAVELENGTH ROUTING NETWORKS 9

WDM Network Elements; WDM Network Design - Cost tradeoffs - Virtual Topology Design-Routing and wavelength assignment, Statistical Dimensioning Models.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Header Processing, Buffering, Burst Switching, Test beds; Access Networks.

UNIT V NETWORK MANAGEMENT AND SURVIVABILITY 9

Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface; network Survivability- Protection in SONET / SDH and IP Networks, Optical layer Protection, Interworking between layers.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand the concepts of basic optical system components
- identify the various modules for design of optical communication systems
- determine the performance of a given optical fiber communication link
- understand the concepts of packet switching and access networks
- learn the concepts of network management and survivability

REFERENCES

1. Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Rajiv Harcourt Asia Pte Ltd., Second Edition 2006.
2. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", Prentice Hall of India, Ist Edition, 2002.
3. Gerd Keiser, "Optical Fiber Communication" McGraw –Hill International, Singapore, 4th edition. 2011.
4. John M. Senior, "Introduction to Optical Fiber Communications", Pearson / Prentice Hall.
5. Harry J.R Dutton, "Understanding Optical Communications", IBM Corporation, International Technical Support Organization.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

PCS19252 MILLIMETER WAVE COMMUNICATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the fundamentals of Millimeter wave devices and circuits.
- know about the millimeter devices & circuits
- understand the various components of Millimeter wave Communication systems.
- learn about mm wave MIMO systems
- know the antenna design at Millimetre wave frequencies

UNIT I INTRODUCTION 9

Millimetre wave characteristics- millimetre wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimetre wave communications.

UNIT II MM WAVE DEVICES AND CIRCUITS 9

Millimetre wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.

UNIT III MM WAVE COMMUNICATION SYSTEMS 9

Modulations for millimetre wave communications: OOK, PSK, FSK, QAM, OFDM, Millimetre wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimetre wave calibration, production and manufacture, Millimetre wave design considerations.

UNIT IV MM WAVE MIMO SYSTEMS 9

Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.

UNIT V ANTENNAS FOR MM WAVE SYSTEMS 9

Antenna beam width, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand millimeter devices and circuits
- understand the millimeter wave devices & circuits
- design antenna for Millimeter wave frequencies
- understand the milli meter wave MIMO systems
- knowledge of Millimetre wave technology

REFERENCES

1. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014.
3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

PCS19253 PATTERN RECOGNITION AND MACHINE LEARNING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the fundamental of pattern classifier
- know about various clustering concepts
- originate the various structural pattern recognition and feature extraction
- understand the basic of concept learning and decision trees
- explore recent advances in pattern recognition

UNIT I PATTERN CLASSIFIER 9

Overview of Pattern recognition – Discriminant functions – Supervised learning –Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions –Minimum distance pattern classifier.

UNIT II CLUSTERING 9

Clustering for unsupervised learning and classification -Clustering concept – C-means algorithm – Hierarchical clustering procedures -Graph theoretic approach to pattern clustering -Validity of clusters

UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION 9

KL Transforms – Feature selection through functional approximation – Binary selection -Elements of formal grammars - Syntactic description - Stochastic grammars –Structural representation.

UNIT IV INTRODUCTION, CONCEPT LEARNING ANDDECISION TREES 9

Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Version Spaces and Candidate Elimination Algorithm – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search

UNIT V RECENTADVANCES 9

Neural network structures for pattern recognition -Neural network based pattern associators – Unsupervised learning in neural pattern recognition -Self organizing networks -Fuzzy logic -Fuzzy pattern classifiers -Pattern classification using Genetic Algorithms.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- classify the data and identify the patterns.
- explain about clustering & its validity
- utilize the given data set to extract and select features for Pattern recognition.
- describe the decision tree and concept learning.
- discuss on recent advances in pattern recognition.

REFERENCES

1. Duda R.O., and Hart.P.E., Pattern Classification and Scene Analysis, Wiley, New York,1973.
2. Morton Nadier and Eric Smith P., Pattern Recognition Engineering, John Wiley & Sons, New York,1993.
3. Narasimha Murty M and Susheela Devi V, "Pattern Recognition – An Algorithmic Approach", Springer, Universities Press,2011
4. Robert J.Schalkoff, Pattern Recognition : Statistical, Structural and Neural Approaches, John Wiley &Sons Inc., New York,2007.
5. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition),2013.
6. Tou and Gonzalez, Pattern Recognition Principles, Wesley Publication Company, London, 1974.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

PCS19254 **INTERNET OF THINGS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the fundamentals of Internet of Things
- understand the IoT architecture
- learn about the basics of IoT protocols
- build a small low cost embedded system using RaspberryPi.
- apply the concept of Internet of Things in the real world scenario.

UNIT I INTRODUCTION TO IoT **9**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

UNIT II IoT ARCHITECTURE **9**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model- Domain model - information model - functional model - communication model - IoT reference architecture.

UNIT III IoT PROTOCOLS **9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security.

UNIT IV BUILDING IoT WITH RASPBERRY PI AND ARDUINO **9**

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms -Arduino

UNIT V CASE STUDIES ANDREAL-WORLDAPPLICATIONS **9**

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT -Amazon Web Services for IoT.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, the student should be able to

- analyze various protocols for IoT
- develop web services to access/control IoT devices.
- design a portable IoT using RasperryPi
- deploy an IoT application and connect to the cloud.
- analyze applications of IoT in real time scenario

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things -introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO2	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	3	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	3	3	3

PROGRAMME ELECTIVE III

PCS19351 **SATELLITE COMMUNICATION** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- introduce the elements of satellite
- introduce the concepts of various modulation schemes
- educate about link design of satellite
- understand space link and interference
- learn about navigation of satellite

UNIT I ELEMENTS OF SATELLITE COMMUNICATION 9

Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – different Communication subsystems, Bandwidth allocation.

UNIT II TRANSMISSION, MULTIPLEXING, MODULATION, MULTIPLE ACCESS AND CODING 9

Different modulation and Multiplexing Schemes - Multiple Access Techniques – FDMA, TDMA, CDMA, and DAMA - Coding Schemes.

UNIT III SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV SPACE LINKS 9

The Space Link, Satellite Link Design - Satellite uplink -down link power Budget, Basic Transmission Theory, System Noise Temp, G/T Ratio, Noise Figure, Downlink Design, Design of Satellite Links for Specified C/N - Microwave Propagation on Satellite-Earth Paths.

UNIT V SERVICES AND APPLICATIONS 9

Mixed and mobile services - Multimedia satellite services - Advanced applications based on satellite platforms-INTELSAT series - INSAT, VSAT, Remote Sensing - Mobile satellite service: GSM. GPS, INMARSAT, Navigation System, DTH, E-mail, Video conferencing and Internet connectivity.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand the basic satellite concepts and elements
- understand the working principle of satellite
- know satellite link design
- know about link design of satellite and satellite application
- gain knowledge about navigation and global positioning

REFERENCES

1. D.Roddy, "Satellite Communication", McGraw Hill, 2006.
2. Tri T Ha, "Digital Satellite Communication", McGraw Hill, 1990..
3. B.N.Agarwal, "Design of Geosynchronous Spacecraft", Prentice Hall, 1993

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PCS19352 **OPTIMIZATION TECHNIQUES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- explain the theory of optimization techniques.
- learn about linear programing
- learn about non linear programing
- understand dynamic programing process
- analyze and apply appropriate optimization algorithms for solving problems

UNIT I CLASSICAL OPTIMIZATION TECHNIQUES **9**

Single variable optimization, multivariable optimization with no constraints, multivariable optimization with equality constraints, multivariable optimization with inequality constraints, convex programming problem.

UNIT II LINEAR PROGRAMMING **9**

Simplex method, Duality, Non-Simplex Method, Integer Linear Programming

UNIT III NONLINEAR PROGRAMMING **9**

Elimination methods, Interpolation methods, Unconstrained optimization techniques - Direct search methods - Indirect search methods, Constrained Optimization methods – Direct methods, Indirect methods.

UNIT IV DYNAMIC PROGRAMMING **9**

Multistage decision process, Concept of sub optimization and principle of optimality, computational procedure in dynamic programming.

UNIT V MODERN OPTIMIZATION METHODS **9**

Simulated annealing, Particle Swarm optimization, Ant colony optimization, Bee colony optimization, Cuckoo Search, Bat Algorithms, Firefly Algorithms.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- elucidate classical optimization techniques
- Analyse linear programming
- Explain non-linear programming

- Apply the concepts of dynamic programming
- Execute modern optimization methodologies

REFERENCES

1. Singiresu S Rao, "Engineering Optimization: Theory and Practice**",** 4th Edition, John Wiley and Sons, 2009
2. Xin-Sie Yang, "Nature Inspired Optimization Techniques", Elsevier, 2014.
3. Edwin K P Chong and Stanislaw S Zak, "An Introduction to Optimization", Fourth Edition, John Wiley and Sons, 2013

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PCS19353 **DIGITAL COMMUNICATION RECEIVERS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts of digital communication, modulation techniques and spectral characteristics
- analyse the optimum characteristics of receivers used in digital communication
- understand the characteristics of fading channel
- learn various synchronization techniques
- study about the various equalization algorithms

UNIT I REVIEW OF DIGITAL COMMUNICATION TECHNIQUES 9

Base band and band pass communication; signal space representation, linear and nonlinear modulation techniques, 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 M-ary and correlated binary signals.

UNIT III RECEIVERS FOR FADING CHANNELS 9

Characterization of fading multiple channels, statistical models, slow fading, frequency selective fading,, diversity technique, RAKE demodulator, 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

Zero forcing algorithm, LMS algorithm, adaptive decision-feedback equalizer and Equalization of Trellis-coded signals. Kalman algorithm, blind equalizers and stochastic gradient algorithm.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- know the digital communication and spectral characteristics of digital communication
- design the basic requirements of receiver
- understand the various techniques to overcome the effect of fading channel

- synchronize various synchronization techniques in digital communication
- explain different algorithms & adaptive decision

REFERENCES

1. Heinrich Meyer, Mare Moeneclacy, Stefan. A. Fechtel, "Digital communication receivers", Vol I &Vol II, John Wiley, New York, 1997.
2. John.G.Proakis, “Digital communication”, 4th Edition, McGraw-Hill, New York, 2001.
3. E.A.Lee and D.G. Messerschmitt, “Digital communication", 2nd Edition, Allied Publishers, NewDelhi, 1994.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PCS19354 **SOFT COMPUTING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- analyze the concepts of neural network theory
- understand fuzzy logic concepts
- understand optimization algorithms.
- understand advanced neuro fuzzy modeling concepts
- apply neural networks, fuzzy logic and genetic algorithms for optimization problems

UNIT I ARTIFICIAL NEURAL NETWORKS **9**

Supervised learning Neural networks-Introduction, Perception- Adaline, Back propagation- Multi layer perception- Unsupervised learning and other Neural networks-Introduction, Competitive learning networks, Kohenen self-organizing networks, Learning vector quantization, Hebbian learning, Hopfield network , Content addressable nature, Binary Hopfield network, Continuous-valued Hopfield network , Travelling Sales person problem

UNIT II FUZZY SET THEORY **9**

Fuzzy sets, Basic definitions and terminology, Member function formulation & parameterization, Fuzzy rules , fuzzy reasoning - Extension principle, Fuzzy relation, Fuzzy inference systems: Mamdani model, Sugeno model. Tsukamoto model, Input space partitioning, Fuzzy modelling

UNIT III OPTIMIZATION **9**

Derivative based optimization-Descent methods, Method of steepest descent, Classical Newtons method, Step-size determination; Derivative free optimization- Genetic algorithm, Simulated annealing, Random search, Downhill search.

UNIT IV ADVANCED NEURO-FUZZY MODELLING **9**

Classification and regression trees, decision tress, Cart algorithm – Data clustering algorithms: K-means clustering, Fuzzy C-means clustering, Mountain clustering, Subtractive clustering – rule base structure, Input space partitioning, rule based organization, focus set based rule combination; Neuro- fuzzy control: Feedback Control Systems, Expert Control, Inverse Learning, Specialized Learning, Back propagation through real time Recurrent Learning

UNIT V GENETIC ALGORITHM **9**

Fundamentals of genetic algorithm- Basic concepts - Encoding – Binary, Octal, Hex, Permutation, Value and tree, Reproduction- Roulette-wheel selection, Boltzman selection, Tournament selection, Rank selection, Steady state selection, Crossover single site, Two point, Multi point, Uniform and

matrix, Crossover rate, Inversion, Deletion and duplication, Deletion and Regeneration, Segregation, Crossover, Mutation, Generational cycle

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- classify optimization algorithms.
- explain the concepts of neural network theory.
- discuss the principles of genetic algorithms.
- apply neural networks, fuzzy logic and genetic algorithms for optimization problems
- develop neuro fuzzy models for real-time applications.

REFERENCES

1. Jang J.S.R., Sun C.T and Mizutani E, "Neuro Fuzzy and Soft computing", Pearson education, Singapore 2004.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural networks, Fuzzy logic, and Genetic Algorithms", Prentice Hall of India, 2003.
3. David E.Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, Asia,2002
4. .Laurene Fauseett, "Fundamentals of Neural Networks", Prentice Hall India, New Delhi, 2004.
5. Timothy J.Ross, "Fuzzy Logic Engineering Applications", McGrawHill, NewYork, 2011.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	-	-	-	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	3

PROGRAMME ELECTIVE IV

PCS19451 **NETWORK ROUTING ALGORITHMS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the state-of-the-art in network protocols, routing algorithms and its applications
- introduce the various internet routing algorithms
- familiarize the various aspects of routing algorithm
- gain in-depth knowledge about the routing protocol and congestion controls
- study the concept of mobile ADHOC networks

UNIT I LAYER ARCHITECTURE AND ROUTING **9**

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

UNIT II INTERNET ROUTING **9**

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

UNIT III ROUTING IN OPTICAL WDM NETWORKS **9**

Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting- Benefits and Issues, Light path Migration, Rerouting Schemes, Algorithms- AG, MWPG.

UNIT IV MOBILE - IP NETWORKS **9**

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based: Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).

UNIT V MOBILE AD-HOC NETWORKS **9**

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). Study of Network Simulator NS – 2.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- know OSI and TCP/IP architecture and its routing
- understand different routing protocol
- get an idea in routing in optical WDM networks
- know different mobile IP networks
- understand different routing algorithms in MANET

REFERENCES

1. William Stallings, "High speed networks and Internets Performance and Quality of Service", IInd Edition, Pearson Education Asia. Reprint India 2002.
2. M. Steen Strub, "Routing in Communication network", Prentice –Hall International, Newyork
3. S. Keshav, "An engineering approach to computer networking", Addison Wesley 1999

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO2	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO3	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO4	3	3	3	3	3	3	-	-	3	-	-	-	3	3

PCS19452 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn basis of programmable DSPs
- learn TMS320C5X processor
- learn TMS320C6X processor
- knows about advanced DSP processor
- advanced DSP architectures and some applications

UNIT I FUNDAMENTALS OFPROGRAMMABLE DSPs 9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT II TMS320C5XPROCESSOR 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 TMS320C6XPROCESSOR 9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

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

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- understand the fundamentals of DSP
- demonstrate TMS 320C5X Processor
- demonstrate TMS 320C6X Processor
- understand ADSP 21XX processor and its assembly language
- analyse advanced processor operation and its features.

REFERE1NCES

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, cengage Learning India Private Limited, Delhi 2012.
2. B.Venkataramani and M.Bhaskar, "Digital Signal Processors –Architecture
3. Programming and Applications" – Tata McGraw – Hill Publishing Company Limited. NewDelhi, 2003.
4. User guides Texas Instrumentation, Analog Devices, Motorola.

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO2	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO3	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO4	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO5	3	-	3	-	3	-	-	-	-	-	3	-	3	3

PCS19453 MOBILE COMMUNICATION SYSTEMS AND STANDARDS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the evolution of mobile communication
- understand the cellular concepts and channel assignment
- learn about mobile radio propagation
- compare and analyse different cellular standards
- analyze various access techniques used in wireless communication networks

UNIT I INTRODUCTION TO MOBILE COMMUNICATION SYSTEMS 9

Evolution of Mobile radio communications – Mobile radio systems in the U.S. and around the world – Examples of Mobile radio systems.

UNIT II CELLULAR CONCEPT 9

Cellular concept – Frequency reuse – Channel Assignment strategies – Handoff strategies – Interference and System capacity – Trunking and Grade of service – Improving capacity in cellular systems.

UNIT III MOBILE RADIO PROPAGATION 9

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

UNIT IV GSM, GPRS, 3G STANDARDS 9

GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM – Signal processing in GSM – GPRS network architecture – GPRS services and features – 3G UMTS network architecture – UMTS services and features.

UNIT V MULTIPLE ACCESS TECHNIQUES AND WIRELESS NETWORKING 9

Multiple access techniques – FDMA, TDMA, TDMA/FDD, CDMA, SDMA and OFDMA/MIMO/SC-FDMA, MIMO/SOFDMA, OFDM/MIMO, HCSDMA/ TDD/MIMO – Wireless networking – Design issues in personal wireless systems – Cordless systems and Wireless Local Loop (WLL) – IEEE 802.16 Fixed Broadband Wireless Access standard, WIMAX, HSPA, LTE and LTE Advanced standards – Mobile IP and Wireless Application Protocol.

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, student will be able to

- analyse the mobile radio in US and around the world
- explain the basic cellular communication concepts.
- explain about mobile radio propogation
- compare and analyse different cellular standards.
- have clear idea on different multiple access technique and wireless networking

REFERENCES

1. Rappaport, T.S., "Wireless Communications, Principles and Practice", 2nd Edition, Prentice Hall, NJ, 2002.
2. William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Education, 2005.
3. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, "An Introduction to GSM", Artech House Publishers,1998.

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO2	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO3	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO4	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO5	3	-	3	-	3	-	-	-	-	-	3	-	3	3

PCS19454 **RADAR SIGNAL PROCESSING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts of Radar systems
- learn the concepts of radar signal models
- illustrate the concepts of Sampling and Quantization of pulsed radar signals
- understand radar waveforms concepts
- learn Doppler processing and its issues

UNIT I INTRODUCTION TORADAR SYSTEMS **9**

Basic radar function, elements of pulsed radar, review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing

UNIT II SIGNAL MODELS **9**

Components of a radar signal, amplitude models, types of clutters, noise model and signal-to noise ratio, jamming, frequency models: the doppler shift, spatial models, spectral model

UNIT III SAMPLING AND QUANTIZATION OF PULSEDRADARSIGNALS **9**

Domains and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting the pulse repetition interval, sampling the doppler

UNIT IV RADAR WAVEFORMS **9**

Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range sidelobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency codes

UNIT V DOPPLER PROCESSING **9**

Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing

TOTAL PERIODS: 45

COURSE OUTCOMES

Upon completion of the course, the students will be able to

- explain the principles of elements and functions involved in radar signal processing.
- describe different types of radar signal waveforms.
- explain about sampling and quantization concepts
- have in depth knowledge in radar waveforms
- analyze on Doppler processing and its issues

REFERENCES

1.Francois Le Chevalier, "Principles of Radar and Sonar Signal Processing", ArtechHouse

2.Fred E. Nathanson, "Radar Design Principles-Signal Processing and the Environment", ,PHI

3.Michael O Kolawole, Radar systems, Peak Detection a tracking, 2010, Elseveir Introduction to Radar Systems 3rd Edition, Skolnik, McGrawHill.

4.Peyton Z. Peebles, "Radar Principles", 2009 Wiley India

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO2	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO3	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO4	3	-	3	-	3	-	-	-	-	-	3	-	3	3
CO5	3	-	3	-	3	-	-	-	-	-	3	-	3	3

PCS16301 **ADVANCED SIGNAL PROCESSING** **3 2 0 4**

COURSE OBJECTIVES

- To know about the DSP systems, pipelining and parallel processing of FIR filters.
- To learn about retiming, algorithmic strength reduction.
- To gain knowledge about fast convolution, pipelining and parallel processing of IIR filters.
- To know about numerical strength reduction, synchronous, wave and asynchronous pipelining.
- To provide an in-depth knowledge of scaling, round-off noise, bit-level arithmetic architectures.

UNIT I INTRODUCTION TO DSP SYSTEMS, PIPELINING AND PARALLEL PROCESSING OF FIR FILTERS **15**

Introduction to DSP systems - Typical DSP algorithms - Data flow and Dependence graphs -critical path – loop bound - iteration bound - longest path matrix algorithm - Pipelining and Parallel processing of FIR filters- filters - Pipelining and Parallel processing for low power.

UNIT II RETIMING, ALGORITHMIC STRENGTH REDUCTION **15**

Retiming – definitions and properties, Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application, Algorithmic strength reduction in filters and transforms, 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture, rank-order filters, Odd-Even merge- sort architecture, parallel rank order filters, Parallel rank order filters.

UNIT III FAST CONVOLUTION, PIPELINING AND PARALLEL PROCESSING OF IIR FILTERS **15**

Fast convolution - Cook-Toom algorithm - modified Cook-Toom algorithm - Pipelined and parallel recursive filters - Look-Ahead pipelining in first-order IIR filters - Look-Ahead pipelining with powerof-2 decomposition Clustered look-ahead pipelining - Parallel processing of IIR filters - combined pipelining and parallel processing of IIR filters.

UNIT IV NUMERICAL STRENGTH REDUCTION, SYNCHRONOUS, WAVE AND ASYNCHRONOUS PIPELINING **15**

Numerical strength reduction - sub expression elimination - multiple constant multiplication -, iterative matching -synchronous pipelining and clocking styles - clock skew in edge-triggered single phase clocking - two- phase clocking, wave pipelining - Asynchronous pipelining bundled data versus dual rail protocol.

UNIT V SCALING, ROUND-OFF NOISE, BIT-LEVEL ARITHMETIC ARCHITECTURES **15**

Scaling and round-off noise - scaling operation, round-off noise - state variable description of digital filters – Scaling and round-off noise computation - round-off noise in pipelined IIR filters - Bit-level arithmetic Architectures - parallel multipliers with sign extension - parallel carry-ripple and carry-save multipliers - Design of Lyon's bit-serial multipliers using Horner's rule - bit-serial FIR filter - CSD representation - CSD multiplication using Horner's rule for precision improvement - Distributed Arithmetic fundamentals and FIR filters.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- Gain knowledge about the DSP systems, pipelining and parallel processing of FIR filters
- Justify about Retiming, algorithmic strength reduction
- Gain knowledge about fast convolution, pipelining and parallel processing of IIR filters
- Analysis about numerical strength reduction, synchronous, wave and asynchronous pipelining
- Gain in-depth knowledge of scaling, round-off noise, bit-level arithmetic architectures

REFERENCES

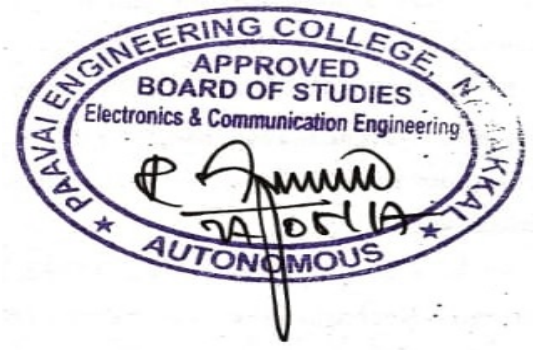
1. Keshab K. Parhi, "VLSI Digital Signal Processing Systems, Design and implementation", Wiley Interscience, first edition (reprint), 2008.
2. U. Meyer – Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, third edition, 2007.
3. Rogger Woods, John MCallister, Richard Turner and Ying Yi, "FPGA – based Implementation of Signal Processing Systems", John Wiley & Sons, first edition, 2008.

WEB LINKS

1. http://people.ece.umn.edu/users/parhi/wiley.pdf
2. http://www.wiley.com/legacy/wileychi/commstech/parhi.html

CO-PO Mapping:

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO2	3	3	3	3	3	-	-	-	3	-	-	-	3	3
CO3	3	-	-	3	3	3	-	-	-	-	-	-	3	3
CO4	3	-	-	3	3	-	-	-	-	-	-	-	3	3
CO5	3	-	-	3	3	-	-	-	-	-	-	-	3	3



PCS16551 **HIGH PERFORMANCE NETWORKS** **3 0 0 3**

COURSE OBJECTIVES

- To develop a sound knowledge on high performance networks.
- To inculcate a comprehensive understanding of multimedia networking.
- To study the wireless and mobile networks
- To learn about network performance evaluation
- To understand various network security in computer networks

UNIT I INTRODUCTION **9**

History of Communication Networks- Networking Principles-Future Networks-High Performance Networks-The Internet and TCP/IP Networks,-Packet Switched Networks- Circuit Switched Networks- Asynchronous Transfer mode.

UNIT II MULTIMEDIA NETWORKING **9**

Multimedia Networking Applications- Streaming stored Audio and Video,-Best effort service- Protocols for real time interactive applications-Distributing Multimedia: Content Distribution Networks- Beyond Best Effort-Scheduling

UNIT III WIRELESS AND MOBILE NETWORKS **9**

Introduction- Wireless links and network characteristics- Wi-Fi:802.11 Wireless LANs-Cellular Internet Access, Mobility management: Principle- Mobile IP- Managing Mobility in cellular Networks- Wireless and Mobility: Impact on Higher-layer protocols

UNIT IV COMPRESSION AND NETWORK PERFORMANCE EVALUATION **9**

Foundations of compression, Audio compression, Video Compression, Network performance evaluation-Monitoring, SNMP-CMOT and RMON- Models and Analysis- Simulation.

UNIT V SECURITY IN COMPUTER NETWORKS **9**

Principles of cryptography – Authentication – integrity – key distribution and certification – Access control: fire

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Explain the concept of introduction of various network Topology
- Discuss about the knowledge about the use of network in multimedia field
- Evaluate the various advanced techniques used in networking
- Evaluate the various ways of compression and evaluation of networks
- Discuss about the concept of network security in computer networks

REFERENCES

1. JeanWalrand, PravinVaraiya, “High performance communication network”, Morgan Kaufmann Publishers. Inc, second edition, 2000
2. James F Kurose & Keith W Ross, “Computer Networking- A top down approach featuring the internet”, Pearson, third edition, 2006.

3. JeanWalrand, “Communication networks”, McGraw Hill, second edition 2002.
4. LEOM-GarCIA, WIDJAJA, “Communication networks”, TMH, seventh reprint 2002.
5. Hersent Gurle& petit, “IP Telephony, Packet Pored Multimedia communication Systems”, Pearson education, 2003.
6. Nader F.Mir, “Computer and Communication Networks”, first edition, 2010.
7. Larryl.Peterson& Bruce S.David, “Computer Networks: A System Approach”, 1996.

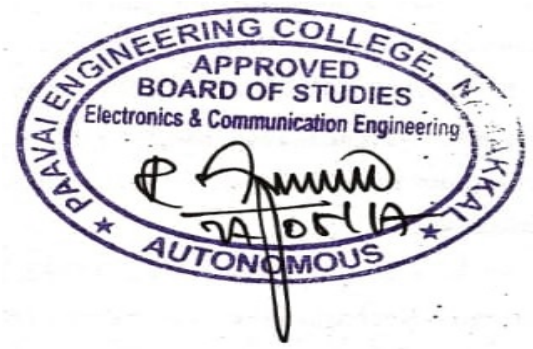
WEB LINKS

1. www.nptelvideos.in/2012/11/high-performance-computing.html
2. www.iitvideos.blog.com

CO-PO Mapping:

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

	Programme Outcomes(POs)													
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO2	3	3	3	3	3	-	-	-	3	-	-	-	3	3
CO3	3	-	-	3	3	3	-	-	-	-	-	-	3	3
CO4	3	-	-	3	3	-	-	-	-	-	-	-	3	3
CO5	3	-	-	3	3	-	-	-	-	-	-	-	3	3



PCS16552 **SPEECH PROCESSING AND SYNTHESIS** **3 0 0 3**

COURSE OBJECTIVES

- To understand the mathematical foundations needed for speech processing
- To understand the basic concepts and algorithms of speech processing and synthesis
- To familiarize the students with the various speech signal representation, coding and recognition techniques
- To appreciate the use of speech processing in current technologies and to expose the students to real– world

UNIT I FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction - Spoken Language Structure - Phonetics and Phonology - Syllables and Words -Syntax andSemantics - Probability, Statistics and Information Theory -Probability Theory - Estimation Theory – Significance Testing - Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING **9**

Overview of Digital Signal Processing -Speech Signal Representations -Short time Fourier Analysis – Acoustic Model of Speech Production - Linear Predictive Coding - Cepstral Processing - Formant Frequencies - The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues –Limitations Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques

UNIT IV TEXT ANALYSIS **9**

Lexicon-Document Structure Detection -Text Normalization -Linguistic Analysis - Homograph Disambiguation Morphological Analysis - Letter-to-sound Conversion - Prosody - Generation schematic –-Speaking Style-Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V SPEECH SYNTHESIS **9**

Attributes - Formant Speech Synthesis -Concatenative Speech Synthesis - Prosodic Modification of Speech - Source-filter Models for Prosody Modification - Evaluation of TTS Systems

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Identify the various temporal, spectral and cepstral features required for identifying speech unit word
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
- Justify the use of formant and concatenative approaches to speech synthesis
- Identify the apt approach of speech synthesis depending on the language to be processed
- Determine the various encoding techniques for representing speech.

REFERENCES

1. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, “Spoken Language Processing – A guide to Theory, Algorithm and System Development”, Prentice Hall PTR, 2001.
2. Thomas F.Quatieri, “Discrete-Time Speech Signal Processing”, Pearson Education, 2002.

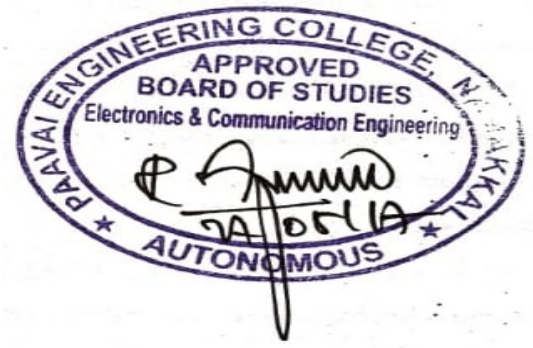
3. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Prentice Hall Signal Processing Series, 1993.
4. Sadaoki Furui, “Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)”, Marcel Dekker, 2000
5. Joseph Mariani, “Language and Speech Processing”, Wiley, 2009.

WEB LINKS

1. mohitgoel4u.blogspot.com/p/speech-signal-processing.htm
2. http://nptel.ac.in/syllabus/117104023/
3. http://onlinevideolecture.com/?course_id=374
4. https://www.youtube.com/watch?v=Xjzm7S_kBU
5. https://www.youtube.com/watch?v=Xjzm7S_kBU

CO-PO Mapping:

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
Programme Outcomes(POs)														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	-	-	3	-	-	-	3	3
CO2	3	3	3	3	3	-	-	-	3	-	-	-	3	3
CO3	3	-	-	3	3	3	-	-	-	-	-	-	3	3
CO4	3	-	-	3	3	-	-	-	-	-	-	-	3	3
CO5	3	-	-	3	3	-	-	-	-	-	-	-	3	3



PCS16553 DSP PROCESSOR ARCHITECTURE AND PROGRAMMING 3 0 0 3

COURSE OBJECTIVES

- To know about digital signal processor basics
- To understand the third generation DSP architecture and programming skills
- To learn about advanced DSP architectures and some applications.

UNIT I INTRODUCTION OF PROGRAMMABLE DSPS 9

Multiplier and Multiplier accumulator - Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi ported Memory -VLIW architecture- Pipelining -Special Addressing modes in P-DSPs - On chip Peripherals.

UNIT II TMS320C5X PROCESSOR 9

Architecture -Assembly language syntax - Addressing modes - Assembly language Instructions – Pipe line structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III ARCHITECTURES FOR PROGRAMMABLE DIGITAL SIGNAL PROCESSING DEVICES 9

Introduction - Basic Architectural features -DSP Computational Building blocks - Bus Architecture and MemoryData Addressing Capabilities – Address Generation Unit – Programmability and Program Execution .

UNIT IV ADSP PROCESSORS 9

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

UNIT V ADVANCED PROCESSORS 9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6XArchitecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Gain in-depth knowledge of programmable DSPS
- Gain knowledge about ADSPS and advanced processors
- Gain knowledge about ALP for advanced processors

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1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications”, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, “Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx”, cengage Learning India Private Limited, Delhi 2012.

3. User guides Texas Instrumentation, Analog Devices, Motorola.
4. Rulph Chassaing, “Digital Signal Processing and Applications with the C6713 and C6416 DSK”, John Wiley & Sons, Inc., Publication, 2005.

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CO-PO Mapping:

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
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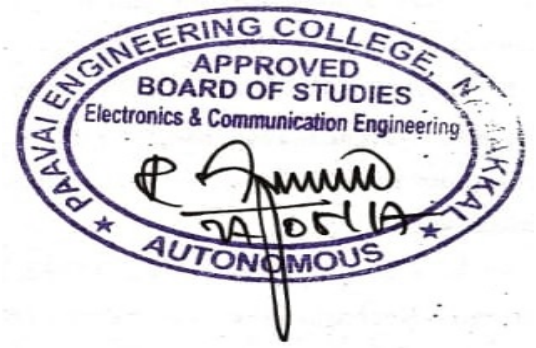
CO1	3	3	-	-	3	-	-	-	-	-	-	-	3	3
CO2	3	3	-	-	3	-	-	-	-	-	-	-	3	3
CO3	3	3	-	-	3	-	-	-	-	-	-	-	3	3



PCS16554 **NEURAL NETWORK AND APPLICATIONS** **3 0 0 3**

COURSE OBJECTIVES

- To study the concepts of biological and artificial neurons
- To explore the fundamentals of various algorithms related to supervised neural network and their applications
- To explore the applications of various algorithms related to Genetic algorithms and SVM

UNIT I LEARNING ALGORITHMS **9**

Biological Neuron - Artificial Neural Model - Types of activation functions - Architecture: Feed forward and Feedback - Learning Process: Error Correction Learning -Memory Based Learning - Hebbian Learning Competitive Learning - Boltzman Learning - Supervised and Unsupervised Learning -Learning Tasks: Pattern Space - Weight Space - Pattern Association - Pattern Recognition - Function Approximation -Control - Filtering

UNIT II RADIAL BASIS FUNCTION NETWORKS AND SUPPORT VECTOR MACHINES **9**

RADIAL BASIS FUNCTION NETWORKS

Exact Interpolator – Regularization Theory – Generalized Radial Basis Function Networks - Learning in Radial Basis Function Networks - Applications: XOR Problem – Image Classification Support Vector Machines: Optimal Hyper plane for Linearly Separable Patterns and Non separable Patterns Support Vector Machine for Pattern Recognition – XOR Problem - -insensitive Loss Function – Support Vector Machines for Nonlinear Regression

UNIT III ATTRACTOR NEURAL NETWORKS **9**

Associative Learning – Attractor Neural Network Associative Memory – Linear Associative Memory – Hopfield Network – Content Addressable Memory – Strange Attractors and Chaos - Error Performance of Hopfield Networks- Applications of Hopfield Networks – Simulated Annealing – Boltzmann Machine –Bidirectional Associative Memory – BAM Stability Analysis – Error Correction in BAMs - Memory Annihilation of Structured Maps in BAMS – Continuous BAMs – Adaptive BAMs – Applications.

UNIT IV ADAPTIVE RESONANCE THEORY **9**

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 ORGANIZING MAPS AND NEOCOGNITRON **9**

Self-organizing Map - Maximal Eigenvector Filtering - Sanger's Rule - Generalized Learning Law –-Competitive Learning - Vector Quantization – Mexican Hat Networks - Self-organizing Feature Maps – Applications. Architecture of Neocognitron - Data processing and performance of Neocognitron - Architecture of spatio – temporal networks for speech recognition.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Evaluate the basics of neural networks.
- Identify the concepts of radial basis functions.
- Gain knowledge about bidirectional associative memory.
- Trace the principles of resonance theory.
- Gain in-depth knowledge about self-organizing maps.

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1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Addison Wesley Longman (Singapore) Private Limited, Delhi, second edition, 2001.
3. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Education 2003.
4. SimonHaykin, "Neural Networks: A Comprehensive Foundation", second edition, Prentice Hall India, 2002.
5. MartinT.Hagan, Howard B. Demuth, and Mark Beale, "Neural Network Design", Thomson Learning, New Delhi, 2003.

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3. www.cse.iitd.ac.in/~saroj/AI/ai2013/L22.ppt

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CO4	3	-	-	3	3	-	-	-	-	-	-	-	3	3
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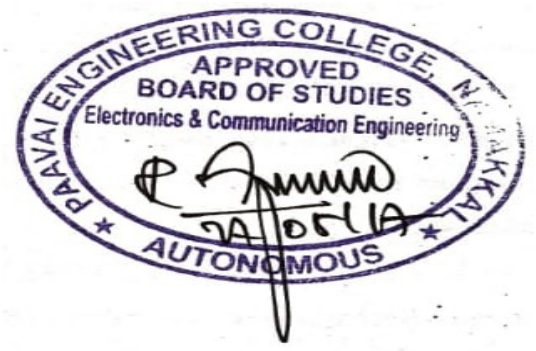

PCS16651 WAVELET TRANSFORMS AND APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of vector analysis.
- To learn the concepts of multi resolution analysis.
- To study the properties of continuous wavelet transforms.
- To characterize filter bank and sub band coding principles.
- To study the various image compression techniques

UNIT I MATHEMATICAL FUNDAMENTALS 9

Linear spaces – Vectors and vector spaces – Basis functions – Dimensions –Orthogonality and biorthogonalilty– Local basis and Riesz basis – Discrete linear normed space – Approximation by orthogonal projection – Matrixalgebra and linear transformation..

UNIT II MULTI RESOLUTION ANALYSIS 9

Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal MRA- Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.

UNIT III CONTINUOUS WAVELET TRANSFORMS 9

Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal) – Tiling of Time – Scale Plane for CWT.

UNIT IV DISCRETE WAVELET TRANSFORMS 9

Filter Bank and Sub Band Coding Principles -Wavelet Filters- Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients -Choice of Wavelet Function Coefficients - Derivations of Daubechies Wavelets- Mallat's Algorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Poly phase Matrix Factorization –Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z – Domain.

UNIT V TRANSFORMS AND ITS APPLICATIONS 9

Wavelet methods for signal processing- Image Compression Techniques: EZWSPHIT Coding -Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions – Edge Detection and Object Isolation Image Fusion, and Object Detection.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Apply the fundamentals of vector analysis.
- Know the concepts of multi resolution analysis.
- Determine the properties of continuous wavelet transforms.
- Apply the knowledge of filter bank and sub band coding principles.
- Evaluate the various image compression techniques.

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1. Rao R.M and A.S.Bopardikar, “Wavelet Transforms Introduction to theory and Applications”, Pearson Education, Asia, 2000.
2. J.C.Goswami and A. K. Chan, “Fundamentals of wavelets: Theory, Algorithms and Applications”, Wiley Inter science Publication, John Wiley & Sons Inc., 1999.
3. M. Vetterli, J.Kovacevic, “Wavelets and subband coding”, Prentice Hall Inc, 1995.
4. Stephen G. Mallat, “A wavelet tour of signal processing”, second edition Academic Press, 2000.
5. Soman K.P and Ramachandran K.I, “Insight into Wavelets from Theory to practice”, Prentice Hall, 2004.

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2. http://cau.ac.kr/~mhhgtx/courses/AdvancedMath/references/FTandApplications.pdf

CO-PO Mapping:

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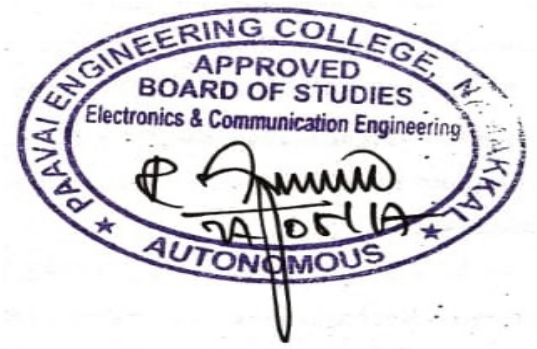

PCS16652 **SMART ANTENNAS** **3 0 0 3**

COURSE OBJECTIVES

- To gain fundamental knowledge of smart antennas
- To learn about narrow and broad band processing
- To study about adaptive processing
- To provide in-depth knowledge of direction of arrival estimation methods
- To understand diversity combining

UNIT I INTRODUCTION **9**

Historical development of smart antennas- Antenna gain, Antenna Pattern, Antenna bore sight, Phased array antenna, power pattern, beam steered and weighted arrays, beam steered circular arrays, rectangular planar arrays- fixed beam arrays- retro directive arrays, degree of freedom, optimal antenna, adaptive antennas, smart antenna - key benefits of smart antenna technology, wide band smart antennas, Digital radio receiver techniques and software radio for smart antennas.

UNIT II NARROW AND BROAD BAND PROCESSING **9**

Signal model conventional beam former- null steering beam former-optimal beam former-Optimization using reference signal, beam space processing -Tapped delay line structure, Partitioned realization, Derivative constrained processor, Digital beam forming, Broad band processing using DFT method.

UNIT III ADAPTIVE PROCESSING **9**

Sample matrix inversion algorithm, unconstrained LMS algorithm, normalized LMS algorithm, Constrained LMS algorithm, Perturbation algorithms, neural network approach, Adaptive beam space processing - Implementation issues.

UNIT IV DIRECTION OF ARRIVAL ESTIMATION METHODS **9**

Fundamentals of matrix algebra-array correlation matrix- AOA estimation methods- Spectral estimation methods- Bartlett method and Capon method, linear prediction method, Maximum Entropy method, Maximum Likelihood method, PHD method, Min-norm method, Eigen Structure methods, Music Algorithm -root Music and cyclic music algorithm, the ESPRIT algorithm.

UNIT V DIVERSITY COMBINING **9**

Spatial Diversity selection combiner - Switched diversity combiner – Equal gain combiner - Maximumratio combiner - Optical combiner.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Explain the fundamentals of smart antennas
- Gain knowledge about narrow, broad band and adaptive processing
- Gain in-depth knowledge of direction of arrival estimation methods
- Analyze diversity combining.
- Gain in-depth knowledge antenna design.

REFERENCES

1. Lal Chand Godara, “Smart Antennas” CRC press, 2004
2. Joseph C Liberti. Jr and Theodore S Rappaport, “Smart Antennas for Wireless Communication: IS-95 and Third Generation CDMA Applications”, Prentice Hall 1999.
3. Frank B.Gross, “ Smart Antennas for Wireless Communications”, McGraw Hill, 2005
4. Balanis, “Antennas”, John Wiley and Sons, 2005
5. IEEE Transaction on Antenna and Wave Propagation

WEB LINKS

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CO-PO Mapping:

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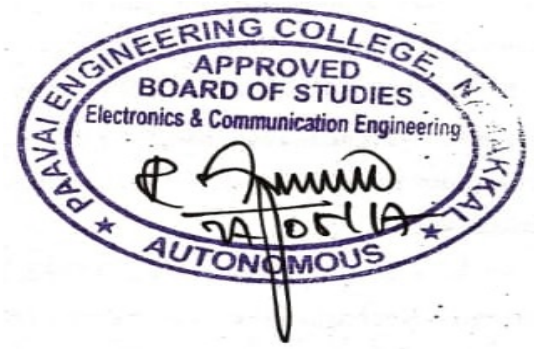

PCS16653 **INTERNET WORKING MULTIMEDIA** **3 0 0 3**

COURSE OBJECTIVES

- To provide in-depth knowledge about multimedia networking
- To gain knowledge about Broadband network technology
- To gain in-sight into reliable transport protocol and applications
- To know about multimedia communication standards
- To learn about multimedia communication across networks

UNIT I MULTIMEDIA NETWORKING **9**

Digital Sound, Video and Graphics - Basic Multimedia Networking - Multimedia Characteristics –Evolution of Internet Services Model - Network Requirements for Audio/ Video Transform - Multimedia Coding and Compression for Text, Image Audio And Video.

UNIT II BROADBAND NETWORK TECHNOLOGY **9**

Broadband Services – ATM and IP, IPV6, High Speed Switching – Resource Reservation, Buffer Management – Traffic Shaping – Caching – Scheduling and Policing, Throughput, Delay and Jitter Performance – Storage and Media Services – Voice and Video Over IP – MPEG–2 over ATM/IP – Indexing Synchronization of Requests – Recording and Remote Control .

UNIT III RELIABLE TRANSPORT PROTOCOL AND APPLICATIONS **9**

Multicast over Shared Media Network – Multicast Routing and Addressing – Scaling Multicast and NBMA Networks – Reliable Transport Protocols – TCP Adaptation Algorithm – RTP, RTCP – MIME – Peer–to Peer Computing – Shared Application – Video Conferencing, Centralized and Distributed Conference Control – .Distributed Virtual Reality – Light Weight Session Philosophy.

UNIT IV MULTIMEDIA COMMUNICATION STANDARDS **9**

Objective of MPEG – 7 Standard – Functionalities and Systems of MPEG–7, MPEG–21 Multimedia Framework Architecture – Content Representation – Content Management and usage – Intellectual Property Management – Audio Visual System – H322 : Guaranteed QOS LAN Systems – MPEG-4 Video Transport Across Internet.

UNIT V MULTIMEDIA COMMUNICATION ACROSS NETWORKS **9**

Packet Audio/Video in The Network Environment –Video Transport across Generic Networks – Layered Video Coding– Error Resilient Video Coding Techniques – Scalable Rate Control – Streaming Video Across Internet – Multimedia Transport Across ATM Networks and IP Network – Multimedia Across Wireless Networks

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Gain knowledge about multimedia networking
- Evaluate about broadband network technology
- Gain in-sight into reliable transport protocol and applications
- Analyze about multimedia communication standards

- Explain about multimedia communication across networks

REFERENCES

1. B O Szuprowicz, “Multimedia Networking”, McGraw Hill, Newyork, 1995.
2. K R Rao, Zoran S, Bojkovic and Dragorad A, Milovanovic, “Multimedia communication systems”, PHI, 2003.
3. JonCrowcroft, Mark Handley, Ian Wakeman “Internetworking Multimedia” Harcourt, Singapore, 1998.
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3. www.nptel.ac.in/courses/106105080/pdf/M6L3.pd
4. www.nptel.ac.in/syllabus/117105083
5. nptel.ac.in/courses/106105082/37

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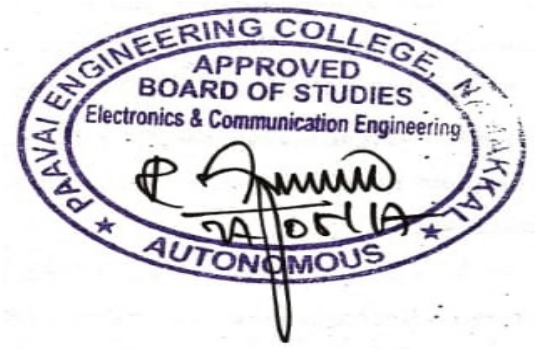

PCS16654 VLSI FOR WIRELESS COMMUNICATION 3 0 0 3

COURSE OBJECTIVES

- To understand the basics of wireless communication.
- To understand the concepts of transceiver architectures.
- To Know about the students the low power design techniques of VLSI circuits.
- To learn the design and implementation of various VLSI circuits for wireless communication systems.

UNIT I WIRELESS COMMUNICATION 9

Digital communication systems- minimum bandwidth requirement, the Shannon limit- overview of modulation schemes- classical channel- Characteristics of wireless channel – path loss- multipath fading- basics ofspread spectrum and spread spectrum techniques.

UNIT II TRANSCEIVER ARCHITECTURE 9

Transceiver design constraints- baseband subsystem design- RF subsystem design- Super heterodyne receiver and direct conversion receiver- Receiver front-end- filter design- non-idealities and design parameters.

UNIT III LOW POWER DESIGN TECHNIQUES 9

Source of power dissipation- estimation of power dissipation- reducing power dissipation at device and circuit levels- low voltage and low power operation- reducing power dissipation at architecture and algorithm levels.

UNIT IV WIRELESS CIRCUITS 9

VLSI Design of LNA-wideband and narrow band-impedance matching-Automatic Gain Control (AGC) amplifier Active mixer-analysis, conversion gain, distortion analysis- low frequency and high frequency case, noise – Passive mixer- sampling mixer and switching mixer- analysis of distortion, conversion gain and noise in these mixers.

UNIT V FREQUENCY SYNTHESIZERS 9

VLSI design of Frequency Synthesizers (FS) – Parameters of FS - PLL based frequency synthesizer, VCO- Phase Detector – Analog Phase Detectors – Digital Phase Detectors, LC oscillators- ring oscillator- phase noise, design approaches(DECT application).

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Analyze the application of VLSI circuits in wireless communication.
- Gain knowledge of various architectures used in implementing wireless systems.
- Know about design and simulation of low power techniques using software
- Evaluate the VLSI design of wireless circuits.
- Determine the frequency synthesizer

REFERENCES

1. Bosco Leung, “VLSI for Wireless Communication”, Springer, 2011.
2. Elmad N Farag and Mohamed I Elmasry, “Mixed Signal VLSI Wireless Design-Circuits and Systems”, Kluwer Academic Publishers, 2002.
3. DavidTsee, PramodViswanath,” Fundamentals of Wireless Communication”, Cambridge Univ Press.

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1. nptel.ac.in/video.php?subjectId=117102062
2. http://nptel.ac.in/courses/117102012/
3. https://www.youtube.com/watch?v=7xVSL93ZZq8
4. https://www.youtube.com/watch?v=CRgrQAgLVKc
5. nptel.ac.in/courses/106105034

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CO4	-	-	3	-	3	-	-	-	-	-	-	-	3	3
CO5	-	-	3	-	3	-	-	-	-	-	-	-	3	3