PAAVAI ENGINEERING COLLEGE, NAMAKKAL - 637 018

(AUTONOMOUS)

M.E. COMMUNICATION SYSTEMS

REGULATIONS 2019

CURRICULUM

(CHOICE BASED CREDIT SYSTEM)

SEMESTER I

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PCS19101	Advanced Digital Signal Processing	3	0	0	3
2	PC	PCS19102	Advanced Radiation Systems	3	0	0	3
3	PE	PCS1915*	Programme Elective I	3	0	0	3
4	PE	PCS1925*	Programme Elective II	3	0	0	3
5	PC	PEN19101	Research Methodology and IPR	3	0	0	3
6	AC	PEN19171	English for Research Paper Writing (Audit course I)	2	0	0	0
Practical							
7	PC	PCS19103	Communication System Design Laboratory	0	0	4	2
			TOTAL	**17**	**0**	**4**	**17**

SEMESTER II

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PCS19201	Broadband Wireless Technology	3	0	0	3
2	PC	PCS19202	MIC and RF System Design	3	0	0	3
3	PE	PCS1935*	Programme Elective III	3	0	0	3
4	PE	PCS1945*	Programme Elective IV	3	0	0	3
5	AC	PEN19271	Pedagogy Studies (Audit course II)	2	0	0	0
6	PC	PCS19203	Mini Project	0	0	4	2
Practical							
7	PC	PCS19204	RF and Networks Laboratory	0	0	4	2
			TOTAL	**14**	**0**	**8**	**16**

SEMESTER III

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PCS19301	High Performance Communication Networks	3	0	0	3
2	PE	PCS1955*	Professional Elective V	3	0	0	3
3	OE	********	Open Elective	3	0	0	3
Practical							
4	PC	PCS19302	Dissertation Phase I	0	0	20	10
			TOTAL	**9**	**0**	**20**	**19**

SEMESTER IV

S.No	Category	Course Code	Course Title	L	T	P	C
Practical							
1	PC	PCS19401	Dissertation Phase II	0	0	24	16
			TOTAL	**0**	**0**	**24**	**16**

TOTAL CREDITS: 68

LIST OF ELECTIVES

PROGRAMME ELECTIVE I

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19151	Data Compression Techniques	3	0	0	3
2	PE	PCS19152	Electromagnetic Interference and Compatibility in system design	3	0	0	3
3	PE	PCS19153	Advanced Digital Image Processing	3	0	0	3
4	PE	PCS19154	MEMS and NEMS	3	0	0	3

PROGRAMME ELECTIVE II

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19251	Fiber Optic Networks	3	0	0	3
2	PE	PCS19252	Millimeter Wave Communication	3	0	0	3
3	PE	PCS19253	Pattern Recognition and Machine Learning	3	0	0	3
4	PE	PCS19254	Internet of Things	3	0	0	3

PROGRAMME ELECTIVE III

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19351	Satellite Communication	3	0	0	3
2	PE	PCS19352	Optimization Techniques	3	0	0	3
3	PE	PCS19353	Digital Communication Receivers	3	0	0	3
4	PE	PCS19354	Soft Computing	3	0	0	3

PROGRAMME ELECTIVE IV

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19451	Network Routing Algorithms	3	0	0	3
2	PE	PCS19452	DSP Processor Architecture and Programming	3	0	0	3
3	PE	PCS19453	Mobile Communication Systems and Standards	3	0	0	3
4	PE	PCS19454	Radar Signal Processing	3	0	0	3

PROFESSIONAL ELECTIVE V

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19551	Simulation of Communication Systems and Networks	3	0	0	3
2	PE	PCS19552	Neural Network and Applications	3	0	0	3
3	PE	PCS19553	Cognitive Radio Networks	3	0	0	3
4	PE	PCS19554	Digital Communication Techniques	3	0	0	3

OPEN ELECTIVE

S.No	Category	Course Code	Course Title	L	T	P	C
1	OE	PMA19901	Operations Research	3	0	0	3
2	OE	PSE19901	Cost Management of EngineeringProjects	3	0	0	3
3	OE	PCE19901	Business Analytics	3	0	0	3
4	OE	PED19901	Industrial safety	3	0	0	3
5	OE	PED19902	Composite Materials	3	0	0	3
6	OE	PED19903	Waste to Energy	3	0	0	3

SUMMARY

S. NO.	CATEGORY	CREDITS AS PER SEMESTER				TOTAL CREDITS
		I	II	III	IV	
1	PC	11	10	13	16	**50**
2	PE	06	06	03	-	**15**
3	OE	-	-	03	-	**03**
	TOTAL	**17**	**16**	**19**	**16**	**68**
4	Non Credit	**01**	**01**			

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CURRICULUM

(CHOICE BASED CREDIT SYSTEM)

SEMESTER I

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Theory							
1	PC	PCS19101	Advanced Digital Signal Processing	3	0	0	3
2	PC	PCS19102	Advanced Radiation Systems	3	0	0	3
3	PE	PCS1915*	Programme Elective I	3	0	0	3
4	PE	PCS1925*	Programme Elective II	3	0	0	3
5	PC	PEN19101	Research Methodology and IPR	3	0	0	3
6	AC	PEN19171	English for Research Paper Writing (Audit course I)	2	0	0	0
Practical							
7	PC	PCS19103	Communication System Design Laboratory	0	0	4	2

SEMESTER II

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PCS19201	Broadband Wireless Technology	3	0	0	3
2	PC	PCS19202	MIC and RF System Design	3	0	0	3
3	PE	PCS1935*	Programme Elective III	3	0	0	3
4	PE	PCS1945*	Programme Elective IV	3	0	0	3
5	AC	PEN19271	Pedagogy Studies (Audit course II)	2	0	0	0
6	PC	PCS19203	Mini Project	0	0	4	2
Practical							
7	PC	PCS19204	RF and Networks Laboratory	0	0	4	2

LIST OF ELECTIVES

PROGRAMME ELECTIVE I

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19151	Data Compression Techniques	3	0	0	3
2	PE	PCS19152	Electromagnetic Interference and Compatibility in system design	3	0	0	3
3	PE	PCS19153	Advanced Digital Image Processing	3	0	0	3
4	PE	PCS19154	MEMS and NEMS	3	0	0	3

PROGRAMME ELECTIVE II

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19251	Fiber Optic Networks	3	0	0	3
2	PE	PCS19252	Millimeter Wave Communication	3	0	0	3
3	PE	PCS19253	Pattern Recognition and Machine Learning	3	0	0	3
4	PE	PCS19254	Internet of Things	3	0	0	3

PROGRAMME ELECTIVE III

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19351	Satellite Communication	3	0	0	3
2	PE	PCS19352	Optimization Techniques	3	0	0	3
3	PE	PCS19353	Digital Communication Receivers	3	0	0	3
4	PE	PCS19354	Soft Computing	3	0	0	3

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
APPROVED
BOARD OF STUDIES
Electronics & Communication Engineering
29/4/19
AUTONOMOUS

PROGRAMME ELECTIVE IV

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19451	Network Routing Algorithms	3	0	0	3
2	PE	PCS19452	DSP Processor Architecture and Programming	3	0	0	3
3	PE	PCS19453	Mobile Communication Systems and Standards	3	0	0	3
4	PE	PCS19454	Radar Signal Processing	3	0	0	3

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

PEN19101 RESEARCH METHODOLOGY AND IPR 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the formulation of Research problem
- be familiar with data collection and literature survey process
- know the statistical concepts in experimentation
- acquire knowledge in writing research proposal
- understand about patent rights and its importance

UNIT I RESEARCH PROBLEM FORMULATION **9**

Meaning of research, Objectives of Research, Types of research, Significance of Research, Research process, Selecting the problem, Necessity of defining the problem, Meaning of Research design, Need for research design, features of a good design, Different research designs.

UNIT II LITERATURE SURVEY **9**

Quantitative and Qualitative data, Scaling, Scaling Techniques, Experiments and Surveys, Collection of Primary and secondary data, Data preparation process. Research problems, Effective literature studies approaches, Survey for existing literature, Procedure for reviewing the literature, analysis and assessment

UNIT III DESIGN OF EXPERIMENTS **9**

Strategy of Experimentation - Typical applications of experimental design, Guidelines for designing experiments; Basic statistical concepts - Statistical concepts in experimentation, Regression approach to analysis of variance.

UNIT IV RESEARCH PROPOSAL AND WRITING **9**

Contents of a research proposal, Writing a research report - Research writing in general, Referencing, Writing a bibliography, Presentation and assessment by a review committee, Plagiarism, Research ethics.

UNIT V INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual Property - Definition, WTO, Fundamentals of Patent, Copyright - The rights of the owner, Term of copyright, Register of Trademark, Procedure for trade mark, Term of trademark, New Developments in IPR - Administration of patent system, IPR of Biological Systems, Computer Software.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify research problems
- collect and prepare suitable data for research
- design experiments for different statistical concepts.
- write research proposals and reports
- apply their research work for patent through IPR

REFERENCES

1. C.RKothari and Gaurav Garg, "Research Methodology Methods and Techniques" ,4th Edition, New Age International Publishers, 2019.
2. RanjitKumar, "Research Methodology": A step by Step Guide for beginners,2nd Edition, Pearson Education, 2010.
3. Douglas C. Montgomery, "Design and Analysis of Experiments", 9th edition, Wiley Publishers, 2017.
4. Neeraj Pandey and Khushdeep Dharni,"Intellectual Propertyrights",PHILearning,2014.
5. Dr.R.Radhakrishnan and Dr.S.Balasubramanian,"IntellectualPropertyRights,textandcases",Excel Books, New Delhi.

CO PO MAPPING:

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

AUDIT COURSE I

PEN19171 ENGLISH FOR RESEARCH PAPER WRITING 2 0 0 0

COURSE OBJECTIVES

To enable students to

- understand how to improve the writing skills and level of readability.
- learn about what to write in each section and to understand the skills needed to write a title.
- choose and focus on a topic of interest and to learn how to paraphrase, summarize, using correct attribution and following documentation guidelines.
- craft a research paper in their discipline.
- ensure the good quality of paper at first-time submission.

UNIT 1 PLANNING AND PREPARATION 6

Precision of Words, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Expressing independent thought with grace, clarity and force.

UNIT 2 STRUCTURE OF A PAPER 6

Details of all the parts - Clarifying Who Did What, Highlighting the Findings, Hedging and Criticizing, Skills to identify something we really need to know -some ways to find a topic - to venture out across the swamp of research without losing our bearings - Paraphrasing - Sections of a Paper, Abstract, Introduction. Introduction to Free writing.

UNIT 3 LITERATURE REVIEWS AND CITATIONS 6

Key skills required to - write a title, an abstract, write an introduction, write the review of the literature, conduct a literature review of all current research in their field. Review of the Literature, Methods, Results, Discussion and Conclusions - citing references correctly and avoiding plagiarism.

UNIT 4 EDITING AND ORGANISING SKILLS 6

Skills required to - write the Methods, write the Discussion, write the Results, write Conclusions. - write about what we've learned truthfully so the reader really gets it in thought and expression, demonstrating a clear understanding and execution of the research.

UNIT 5 WRITING STANDARDS 6

Useful phrases, to ensure paper is as good as it could possibly be the first – time submission -first draft, second draft, final draft of research report, journal article, literature review, dissertation chapter, grant proposal, or other relevant document. Avoid -inadequate support of generalizations, slipshod or hurried style, poor attention to detail, straying from directions, mechanical errors, underwritten and/or marred by confused purpose, lack of organization, repetition of ideas, improper use of words, and frequent grammatical, spelling and punctuation errors.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- prepare and write a research paper in their discipline.
- be initially organized and well-versed as a researcher, reviewing in detail general versus specific and problem-solution structures.
- understand the basics of citations, avoiding plagiarism and literature reviews.
- culminate the actual crafting and revising of a research paper.
- use suitable vocabulary, grammar and punctuation to write flawless piece of writing.

REFERENCES

1. Goldbort R (2006) Writing for Science, Yale University Press.
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 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

PCS19103 COMMUNICATION SYSTEM DESIGN LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- learn about signal transmission and reception
- perform simulation and analysis of various systems
- study the digital communication techniques
- know basics of error control
- get experience and knowledge about various communication systems.

LIST OF EXPERIMENTS

1. Design and performance analysis of error control encoder and decoder(CRC, Convolutional Codes)
2. Determination of Maximum bit rate of a digital fiber optic link.
3. Signal transmission and reception using WDM and spectral characterization.
4. Wireless Channel emulation and characterization.
5. Design and analysis of digital communication techniques on an SDR platform.
6. OFDM transceiver design using MATLAB.
7. Channel equalizer design using MATLAB (LMS, RLS)
8. Design and Analysis of Spectrum Estimators (Bartlett, Welch)
9. Simulation of MIMO systems.
10. Simulation of Turbo coding and SOVA.

COURSE OUTCOMES **TOTAL: 60 PERIODS**

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

- analyse characteristics of wireless channel
- understand the design and analysis of spectrum estimators.
- understand the determination of fibre optic link.
- comprehend the generation of OFDM signals and the processing of the signals
- simulate various communication system

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

AUDIT COURSE II

PEN19271 PEDAGOGY STUDIES 2 0 0 0

COURSE OBJECTIVES

The students will be able to

- understand the aims, objectives and educational philosophies of Education
- acquire the knowledge of Instructional objectives of teaching and teaching skills
- apply the knowledge of methods and strategies of teaching in real classroom situation
- utilize the instructional aids and tools for effective classroom teaching
- acquaint with the knowledge of professional development of teachers

Prerequisite: Nil

UNIT I EDUCATION AND ITS PHILOSOPHY 6

Education - Definition, Aims, Objectives, Scope, Educational philosophy of Swami Vivekananda, Mahatma Gandhi, Rabindranath Tagore, Sri Aurobindo and J.Krishnamoorthy, Montessori,Jean-Jacques Rousseau, Friedrich Froebel and John Dewey. Current trends and issues in Education-Educational reforms and National policy on Education-1968 and 1986-its objectives and features

UNIT II INSTRUCTIONAL OBJECTIVES AND DESIGN 6

Instructional Objectives- Taxonomy of Educational objectives- Writing of general and specific objectives. Instructional design- Planning and designing the lesson, Writing of lesson plan- meaning, its need and importance, format of lesson plan and Types of lesson plan Skills of teaching - various ways of introducing lessons, explaining skills, problem solving skills, illustrative skills, scaffolding skills, integrating ICT skills, questioning skills, Reinforcement skills, skill of probing questions, skill of stimulus variation and computation skills.

UNIT III INSTRUCTIONAL METHODS AND STRATEGIES 6

Instruction strategies – Lecture, demonstration, laboratory, Inductive method, Deductive method, Inquiry method, seminar, panel discussion, symposium, problem solving, project based learning (PBL), Learning by doing, workshop, role- play(socio-drama), Recent trends- Constructivist learning - Problem-based learning - Brain-based learning – Collaborative learning - Flipped learning - Blended learning - e-Learning trends - Video conferencing

UNIT IV INSTRUCTIONAL MEDIA 6

Key concepts in the selection and use of media in education, Developing learning resource material using different media, Instructional aids – types, uses, selection, preparation, utilization. Dale cone of Experience, Teacher's role in procuring and managing instructional Aids – Projected and non-projected aids, multimedia, video-teleconferencing etc.

UNIT V TEACHER PREPARATION 6

Teacher – roles and responsibilities, functions, characteristics, competencies, qualities,

Preparation of professional teacher, Organizing professional aspects of teacher preparation programs, Professional development of teachers-In-service training, Refresher programmes, workshop and higher studies.

TOTAL PERIODS 30

Practicum:

Writing of three lesson plans

Practice teaching for 15 days

Preparation of one teaching aid

A seminar on one educational philosophy

Assignment on any of these five units

COURSE OUTCOMES

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

- explain the educational philosophies of Education
- write instructional and specific objectives in lesson plan
- utilize the teaching skills and methods effectively
- use instructional media efficiently
- update themselves in the area of professional development

REFERENCES

1. T.V. Somashekar, G Viswanathappa and Anice James (2014), Methods of Teaching Mathematics, Hyderabad, Neelkamal publications Pvt Ltd
2. National Policy on Education 1968 and 1986- National Policy on Education 1986-Programme of Action 1992.
3. Batra, P. (2010). Social science learning in schools: Perspectives and challenges. New Delhi: Sage publications India.
4. Benjamin S., Bloom et al. (1987). Taxonomy of educational objectives. Longman Group.
5. Encyclopaedia of Modern Methods of Teaching and Learning (Vol. 1-5).
6. Karthikeyan, C. (2004). A Text book on instructional technology, RBSA
7. Siddiqui, MujibulHasan (2005). Techniques of classroom teaching A.P.H
8. Dhamija, N. (1993). Multimedia approaches in teaching social studies. New Delhi: Harman Publishing House
9. Jeffrey Bennett (2014). On Teaching Science: Principles and Strategies That Every Educator Should Know. Big Kid Science: Boulder,CO
10. Kulbir Singh. (2010). Teaching of mathematics. New Delhi: Sterling Publishers.
11. Bawa, M.S. &Nagpal, B.M. (2010). Developing teaching competencies. New Delhi: Viva Book House
12. Sharma, R.A. (2008). Technological foundation of education. Meerut: Lall Books Depot.

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

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