SETHU INSTITUTE OF TECHNOLOGY

PULLOOR, KARIAPATTI – 626 115.

(AN AUTONOMOUS INSTITUTION)

REGULATION – 2015

M.E COMMUNICATION SYSTEMS

CHOICE BASED CREDIT SYSTEM

CURRICULUM & SYLLABI

CHAIRMAN

ACADEMIC COUNCIL

SETHU INSTITUTE OF TECHNOLOGY

PULLOOR, KARIAPATTI – 626 115.

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Approved in the Academic Council Meeting held on 06.10.2016

Chairman
Board of Studies

Chairman
Academic Council

SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti – 626 115

M.E. Degree Programme

CURRICULUM

Regulation 2015

Master of Engineering in COMMUNICATION SYSTEMS

OVERALL COURSE STRUCTURE

Category	TOTAL No. of Courses	Credits	Percentage
BASIC SCIENCE	01	04	5.71%
PROGRAM CORE	11	30	42.86%
PROGRAM ELECTIVE	05	15	21.43%
OPEN ELECTIVE	01	03	4.29%
PROJECT WORK	02	18	25.71%
TOTAL	20	70	100%

COURSE CREDITS – SEMESTER WISE

Branch	I	II	III	IV	TOTAL
COMMUNICATION SYSTEMS	19	18	18	15	70

SUMMER/ WINTER COURSES

Winter Courses									
Sl.No	**Subject Code**	**Subject Name**	**Sem**	**L**	**T**	**P**	**C**	**Summer/ Winter**	**Category**
1.	15PMA122	Applied Mathematics for Communication Engineers	I	3	2	0	4	Winter	Basic Science
2.	15PCM101	Adaptive Signal Processing	I	4	0	0	4	Winter	Program Core
3.	15PCM102	Advanced Radi Systems	I	3	0	0	3	Winter	Program Core
4.	15PCM103	Modulation and Coding Techniques	I	3	0	0	3	Winter	Program Core
5.	-	Elective I	I	3	0	0	3	Winter	Program Elective
6.	15PCM104	Communication System Design Laboratory	I	0	0	4	2	Winter	Program Core
7.	15PCM301	Wireless Communication Engineering	III	3	0	0	3	Winter	Program Core
8.	15PCM302	Telecommunicati on Switching and Management	III	3	0	0	3	Winter	Program Core
9.	-	Elective IV	III	3	0	0	3	Winter	Program Elective
10.	-	Elective V	III	3	0	0	3	Winter	Program Elective
11.	-	Open Elective	III	3	0	0	3	Winter	Open Elective
12.	15PCM303	Project Work (Phase I)	III	0	0	6	3	Winter	Project Work

Summer Courses									
13.	15PCM201	Satellite Communication	II	3	0	0	3	Summer	Program Core
14.	15PCM202	Optical Networks	II	3	0	0	3	Summer	Program Core
15.	15PCM203	Microwave Integrated Circuits	II	3	0	0	3	Summer	Program Core
16.	-	Elective II	II	3	0	0	3	Summer	Program Elective
17.	-	Elective III	II	3	0	0	3	Summer	Program Elective
18.	15PCM204	Microwave and Networks Laboratory	II	0	0	4	2	Summer	Program Core
19.	15PCM205	Internship/ Industrial Training	II	0	0	2	1	Summer	Program Core
20.	15PCM401	Project Work (Phase II)	IV	0	0	30	15	Summer	Project Work

COURSE CATEGORY: PROGRAM ELECTIVES

S.No	Course Code	Course Title	L	T	P	C
1.	15PCM501	CDMA Systems	3	0	0	3
2.	15PCM502	Wireless Ad-hoc Networks	3	0	0	3
3.	15PCM503	Global Positioning Systems	3	0	0	3
4.	15PCM504	High Performance Communication Networks	3	0	0	3
5.	15PCM505	Data Compression	3	0	0	3
6.	15PCM506	Adaptive Antennas	3	0	0	3
7.	15PCM507	DSP Processor Architecture and Programming	3	0	0	3
8.	15PCM508	RF MEMS	3	0	0	3
9.	15PCM509	Communication Network Security	3	0	0	3
10.	15PCM510	Wireless Networks	3	0	0	3
11.	15PCM511	Mobile Communication Networks	3	0	0	3
12.	15PCM512	Numerical Techniques in Electromagnetics	3	0	0	3
13.	15PCM513	Network Routing Algorithms	3	0	0	3
14.	15PCM514	Medical Imaging Techniques	3	0	0	3
15.	15PCM515	MIMO Communication Systems	3	0	0	3
16.	15PCM516	Beamforming in Wireless Communication	3	0	0	3
17.	15PCM517	Network Management System	3	0	0	3
18.	15PCM518	Communication Protocol Engineering	3	0	0	3
19.	15PCM519	Cognitive Radio Networks	3	0	0	3
20.	15PCM520	Communication Network Design	3	0	0	3
21.	15PCM521	Digital Communication Receivers	3	0	0	3
22.	15PCM522	Sensor Networks	3	0	0	3
23.	15PCM523	Ultra Wideband Communication	3	0	0	3
24.	15PCM524	Wireless Body Area Network	3	0	0	3

COURSE CATEGORY: OPEN ELECTIVE

S.No	Course Code	Course Title	L	T	P	C
1.	**15PSE601**	Research Methodology	**3**	**0**	**0**	**3**
2.	**15PEN602**	Pedagogy	**3**	**0**	**0**	**3**
3.	**15PEN603**	Professional and Communication Skill	**3**	**0**	**0**	**3**
4.	**15PPE604**	Soft Computing	**3**	**0**	**0**	**3**
5.	**15PCD605**	Industrial Safety	**3**	**0**	**0**	**3**
6.	**15PCD606**	Business Management and Leadership	**3**	**0**	**0**	**3**
7.	**15PCS607**	Management Information System	**3**	**0**	**0**	**3**

COURSE CATEGORY: ELECTIVES FOR Ph.D SCHOLARS

S.No	Course Code	Course Title	L	T	P	C
1.	**15PCM525**	Green Radio Networks	**3**	**0**	**0**	**3**
2.	**15PCM526**	Application of DSP Techniques in Communication Systems	**3**	**0**	**0**	**3**
3.	**15PCM527**	EM Band Gap Structures for Antenna	**3**	**0**	**0**	**3**
4.	**15PCM528**	Modern Planar Antennas	**3**	**0**	**0**	**3**
5.	**15PCM529**	Pattern Recognition	**3**	**0**	**0**	**3**

REGULATION – 2015

(Applicable to the students admitted from the Academic Year 2015 – 2016 onwards)

CURRICULUM I TO IV SEMESTERS (FULL TIME)

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PMA122**	Applied Mathematics for Communication Engineers	**3**	**2**	**0**	**4**
2.	**15PCM101**	Adaptive Signal Processing	**4**	**0**	**0**	**4**
3.	**15PCM102**	Advanced Radiation Systems	**3**	**0**	**0**	**3**
4.	**15PCM103**	Modulation and Coding Techniques	**3**	**0**	**0**	**3**
5.	-	Elective I	**3**	**0**	**0**	**3**
PRACTICAL						
6.	**15PCM104**	Communication System Design Laboratory	**0**	**0**	**4**	**2**
Total			**16**	**2**	**4**	**19**
Total Number of Credits: 19						

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM201**	Satellite Communication	**3**	**0**	**0**	**3**
2.	**15PCM202**	Optical Networks	**3**	**0**	**0**	**3**
3.	**15PCM203**	Microwave Integrated Circuits	**3**	**0**	**0**	**3**
4.	-	Elective II	**3**	**0**	**0**	**3**
5.	-	Elective III	**3**	**0**	**0**	**3**
PRACTICAL						
6.	**15PCM204**	Microwave and Networks Laboratory	**0**	**0**	**4**	**2**
7.	**15PCM205**	Internship/ Industrial Training	**0**	**0**	**2**	**1**
Total			**15**	**0**	**6**	**18**
Total Number of Credits: 18						

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM301**	Wireless Communication Engineering	**3**	**0**	**0**	**3**
2.	**15PCM302**	Telecommunication Switching and Management	**3**	**0**	**0**	**3**
3.	-	Elective IV	**3**	**0**	**0**	**3**
4.	-	Elective V	**3**	**0**	**0**	**3**
5.	-	Open Elective	**3**	**0**	**0**	**3**
PRACTICAL						
6.	**15PCM303**	Project Work (Phase I)	**0**	**0**	**6**	**3**
Total			**15**	**0**	**6**	**18**
Total Number of Credits: 18						

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	**15PCM401**	Project Work (Phase II)	**0**	**0**	**30**	**15**
Total			**0**	**0**	**30**	**15**
Total Number of Credits: 15						

TOTAL NO. OF CREDITS: 70

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M.E. Degree Programme

CURRICULUM

Regulation 2015

Master of Engineering in COMMUNICATION SYSTEMS(PART TIME)

OVERALL COURSE STRUCTURE

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PROGRAM ELECTIVE	05	15	21.43%
OPEN ELECTIVE	01	03	4.29%
PROJECT WORK	02	18	25.71%
TOTAL	20	70	100%

COURSE CREDITS – SEMESTER WISE

Branch	I	II	III	IV	V	VI	TOTAL
COMMUNICATION SYSTEMS	13	11	9	10	12	15	70

M.E COMMUNICATION SYSTEMS

REGULATION – 2015

(Applicable to the students admitted from the Academic Year 2015 – 2016 onwards)

CURRICULUM I TO VI SEMESTERS (PART TIME)

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PMA122**	Applied Mathematics for Communication Engineers	**3**	**2**	**0**	**4**
2.	**15PCM101**	Adaptive Signal Processing	**4**	**0**	**0**	**4**
3.	**15PCM102**	Advanced Radiation Systems	**3**	**0**	**0**	**3**
PRACTICAL						
4.	**15PCM104**	Communication System Design Laboratory	**0**	**0**	**4**	**2**
Total			**10**	**2**	**4**	**13**
Total Number of Credits: 13						

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM201**	Satellite Communication	**3**	**0**	**0**	**3**
2.	**15PCM202**	Optical Networks	**3**	**0**	**0**	**3**
3.	**15PCM203**	Microwave Integrated Circuits	**3**	**0**	**0**	**3**
PRACTICAL						
4.	**15PCM204**	Microwave and Networks Laboratory	**0**	**0**	**4**	**2**
Total			**9**	**0**	**4**	**11**
Total Number of Credits: 11						

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM103**	Modulation and Coding Techniques	**3**	**0**	**0**	**3**
2.	**15PCM301**	Wireless Communication Engineering	**3**	**0**	**0**	**3**
3.	**-**	Elective I	**3**	**0**	**0**	**3**
Total			**9**	**0**	**0**	**9**
Total Number of Credits: 9						

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM302**	Telecommunication Switching and Management	**3**	**0**	**0**	**3**
2.	**-**	Elective II	**3**	**0**	**0**	**3**
3.	**-**	Elective III	**3**	**0**	**0**	**3**
PRACTICAL						
4.	**15PCM205**	Internship/ Industrial Training	**0**	**0**	**2**	**1**
Total			**9**	**0**	**0**	**10**
Total Number of Credits: 10						

SEMESTER V

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	-	Elective IV	**3**	**0**	**0**	**3**
2.	-	Elective V	**3**	**0**	**0**	**3**
3.	-	Open Elective	**3**	**0**	**0**	**3**
PRACTICAL						
4.	**15PCM303**	Project Work (Phase I)	**0**	**0**	**6**	**3**
Total			**9**	**0**	**6**	**12**
Total Number of Credits: 12						

SEMESTER VI

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	**15PCM401**	Project Work (Phase II)	**0**	**0**	**30**	**15**
Total			**0**	**0**	**30**	**15**
Total Number of Credits: 15						

TOTAL NO. OF CREDITS: 70

SEMESTER I

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PMA122**	Applied Mathematics for Communication Engineers	**3**	**2**	**0**	**4**
2.	**15PCM101**	Adaptive Signal Processing	**4**	**0**	**0**	**4**
3.	**15PCM102**	Advanced Radiation Systems	**3**	**0**	**0**	**3**
4.	**15PCM103**	Modulation and Coding Techniques	**3**	**0**	**0**	**3**
5.	-	Elective I	**3**	**0**	**0**	**3**
PRACTICAL						
6.	**15PCM104**	Communication System Design Laboratory	**0**	**0**	**4**	**2**
Total			**16**	**2**	**4**	**19**
Total Number of Credits: 19						

SYLLABUS

15PMA122	APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS	L	T	P	C
		3	2	0	4

OBJECTIVE:

- To develop an understanding of the basic concepts of Queueing Theory.
- To familiarize the students with the fundamental concepts of Special Functions.
- To formulate and construct a mathematical model for a linear programming problem in real life situation.

UNIT I SPECIAL FUNCTIONS 9+6

Bessel's equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion.

UNIT II LINEAR ALGEBRA 9+6

Vector spaces – Norms - Inner Products – Eigen values using QR transformations – QR factorization – Generalized eigenvectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations - Toeplitz matrices and some applications.

UNIT III WAVE EQUATION 9+6

Solution of initial and boundary value problems - D'Alembert's Solution - Significance of characteristic curves - Laplace transform solutions for displacement in a long string - A long string under its weight - A bar with prescribed force on one end - Free vibrations of a string.

UNIT IV LINEAR PROGRAMMING 9+6

Formulation – Graphical solution – Simplex method – Two phase method – Transportation and Assignment Models.

UNIT V QUEUEING MODELS 9+6

Poisson Process – Markovian queues – Single and Multi-server Models – Little's formula - Machine Interference Model – Steady State analysis – Self Service queue - Open and Closed Jackson networks.

TOTAL: 45(L) + 30(T) = 75 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Analyze analog and digital communication systems performance and design subsystems and circuits.
- Acquire knowledge on matrix decompositions and factorizations which is used in image processing and signal processing.
- Formulate and construct a mathematical model for a linear programming problem in real life situation.
- Apply the principles of queuing models in software related projects.
- Apply basic knowledge of linear programming problems.

REFERENCES:

1. RICHARD BRONSON, GABRIEL B. COSTA, “Linear Algebra ”, Academic Press, 2nd Edition, California, 2007.
2. TAHA, H.A, “ Operations Research, An introduction ”, Pearson Education, 9th Edition, New Delhi, 2012.
3. DONALD GROSS and CARL M. HARRIS, “ Fundamentals of Queueing theory ”, John Wiley and Sons, 2nd Edition, New York, 1985.
4. MOON, T.K., STERLING, W.C, “ Mathematical methods and algorithms for signal processing ”, Prentice Hall of India, New Delhi, 2nd Edition, (2000).
5. SANKARA RAO.K, “ Introduction to Partial Differential Equation ”, Prentice Hall of India, New Delhi, 3rd Edition, (2011).
6. ANDREWS, L.A., “ Special Functions Of Mathematics For Engineers ”, Spie Optical Engineering Press, Washington USA, 2nd Edition, (1998).

15PCM101	ADAPTIVE SIGNAL PROCESSING	L	T	P	C
		4	0	0	4

OBJECTIVE:

- To impart the fundamental concepts of discrete random signal processing and spectrum estimation.
- To explain linear estimation, prediction and adaptive filters.
- To give an outline about multirate digital signal processing.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 12

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

UNIT II SPECTRAL ESTIMATION 12

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

UNIT III LINEAR ESTIMATION AND PREDICTION 12

Linear prediction – Forward and Backward prediction, Solution of Prony's normal equations, Least mean-squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters, Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 12

FIR adaptive filters – adaptive filter based on steepest descent method Widrow-Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 12

Mathematical description of change of sampling rate – Interpolation and Decimation, Decimation by an integer factor, Interpolation by an integer factor, Sampling rate conversion by a rational factor, Polyphase filter structures, Multistage implementation of multi rate system, Application to sub band coding – Wavelet transform.

TOTAL: 60 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Characterize a random process in terms of its ensemble averages.
- Estimate the power spectrum of a random process using non-parametric and parametric methods.
- Determine the filter coefficients of forward and backward prediction filters.
- Design an adaptive filter for the given application.
- Apply multi rate processing for sub band coding.

REFERENCES:

1. Monson H, Hayes, " Statistical Digital Signal Processing and Modeling ", John Wiley and Sons, Inc, Singapore, 2002.
2. John J. Proakis, Dimitris G. Manolakis, " Digital Signal Processing ", Pearson Education, 2002.
3. Farhang-Boroujeny, " Adaptive Filters Theory and Application ", 1998.
4. Haykins S, " Adaptive Filter Theory ", Prentice-Hall, USA, 1996.

15PCM102	ADVANCED RADIATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an idea about radiation from different current distributions and radiation field of different types of apertures.
- To summarize the performance characteristics of various antenna arrays, microstrip antennas and its radiation analysis.
- To review horn, microstrip, reflector antennas and various measuring parameters of EMC antenna.

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 MICROSTRIP ANTENNA 9

Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of microstrip array antenna.

UNIT V EMC ANTENNA AND ANTENNA MEASUREMENTS 9

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

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain the working principles of antennas and design any type of antenna.
- Evaluate the performance of various aperture antennas.
- Describe various array antennas and synthesis techniques.
- Analyze and design microstrip patch antennas and EMC antennas and perform the various EMC antenna measurements.
- Gain knowledge about EMC antennas and perform various EMC antenna measurements.

REFERENCES:

1. Balanis.A, " Antenna Theory Analysis and Design ", John Wiley and Sons, New York, 1982.
2. Krauss.J.D, " Antennas ", John Wiley and sons, II edition, New York, 1997.
3. Bahl.I.J, Bhartia.P, " Microstrip Antennas ", Artech House Inc, 1980..
4. Stutzman.W.L,Thiele.G.A, " Antenna Theory and Design ", John Wiley& Sons Inc, 2nd edition, 1998.

15PCM103 MODULATION AND CODING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVE:

- To give an overview of band limited digital modulations and OFDM.
- To impart the knowledge on advanced coding techniques in communication systems
- To introduce high data rate modulation.

UNIT I MODULATION TECHNIQUES WITH MEMORY 9

Linear modulation with memory, Non Linear modulation with memory : CPFSK, CPM and MSK, Power spectra of CPFSK, CPM and MSK , Power spectra of linear modulation with memory.

UNIT II ADAPTIVE EQUALIZER 9

Adaptive Equalizer ; zero forcing algorithm, LMS algorithm, Convergence properties of LMS algorithm. Adaptive decision feedback equalizer, Adaptive equalization of Trellis coded signals. Recursive least square algorithms for adaptive equalization : Kalman algorithm, Linear predictor. Blind equalization : blind equalization based on maximum likelihood criteria.

UNIT III CHANNEL CAPACITY AND CODING 9

Introduction to Coding and its role in a communication system: overview and objectives, Motivation and Background Channel models: Binary symmetric channel (BSC),Constellation-constrained AWGN channel, AWGN channel Achievable performance: Channel capacity, Modulation constrained information rate, Sphere packing and random coding bounds.

UNIT IV TRELLIS CODED MODULATION 9

Coded modulation for bandwidth-constrained channels-Trellis coded modulation; Set Partitioning, Four –state Trellis-coded modulation with 8-PSK signal constellation, Eight-state Trellis code for coded 8-PSK modulation.

UNIT V TURBO CODING 9

Introduction-Turbo Encoder, Turbo Decoder, Iterative Turbo Decoding Principles; Modifications of the MAP Algorithm-The Soft-Output Viterbi Algorithm(SOVA); Turbo Coding for AWGN channels, Turbo Coding for Rayleigh Channels, LDPC Codes.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Analyze CPFSK, CPM and MSK with respect to the relevant parameters.
- Compare the various algorithms used for adaptive equalization with respect to different parameters
- Understand different channel models.
- Build the trellis diagram for the given TCM encoder specification.
- Discuss the concepts of turbo codes.

REFERENCES:

1. Bernard Sklar, " Digital Communications' ", Pearson Education, second edition, 2001.
2. John G. Proakis, " Digital Communication ", Mc Graw Hill Publication, 4th edition, 2001.
3. Richard Van Nee & Ramjee Prasad., " OFDM for Multimedia Communications ", Artech House Publication, 2001.
4. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital Communication Receivers ", Vol I & Vol II John Wiley, New York, 1997.
5. L.Hanzo, T.H.Liew, B.L.Yeap, " Turbo coding, Turbo equalization and Space time coding ", John Wiley & Sons Pvt Ltd,.

15PCM104 COMMUNICATION SYSTEM DESIGN LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

- To impart the knowledge on various simulation tools used in communication engineering.

1. Simulation of Microstrip Antennas.
2. Simulation of MIMO systems.
3. Design of Adaptive filters .
4. Antenna Radiation Pattern measurement.
5. Performance Evaluation of digital modulation schemes.
6. OFDM transceiver design using MATLAB/SIMULINK.
7. Design and Analysis of Spectrum Estimators (Bartlett , Welch).
8. Design and performance analysis of error control encoder and decoder (Block and Convolutional Codes).
9. Simulation of Turbo coding.
10. Wireless Channel simulation and characterization.
11. Study of GPS.

TOTAL: 60 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Analyze the BER characteristics of various modulation techniques on different wireless channels using Matlab/Simulink.
- Construct different channel codes(Block codes, Convolutional and Turbo codes).
- Measure various parameters of Antenna Radiation Pattern.
- Describe the principle of GPS operation system.

Sl. No.	Name of the equipment	Quantity required
1	Simulation software	13 user License
2	Antenna Trainer Kit	1 Nos.
3	Personal computers	13 Nos.
4	GPS Trainer Kit	2 Nos.

SEMESTER II

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM201**	Satellite Communication	**3**	**0**	**0**	**3**
2.	**15PCM202**	Optical Networks	**3**	**0**	**0**	**3**
3.	**15PCM203**	Microwave Integrated Circuits	**3**	**0**	**0**	**3**
4.	-	Elective II	**3**	**0**	**0**	**3**
5.	-	Elective III	**3**	**0**	**0**	**3**
PRACTICAL						
6.	**15PCM204**	Microwave and Networks Laboratory	**0**	**0**	**4**	**2**
7.	**15PCM205**	Internship/ Industrial Training	**0**	**0**	**2**	**1**
Total			**15**	**0**	**6**	**18**
Total Number of Credits: 18						

15PCM201	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce about the elements of satellite Communication.
- To explain the modulation and multiple access schemes.
- To summarize about satellites and its applications

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 – description of different Communication subsystems, Bandwidth allocation.

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

Phased arrays for satellite communications, satellite laser communications, Features of RF and optical space communication systems, wireless standards in satellite networking, Tracking and Data Relay Satellite K (TDRS-K) , Multiple Access Techniques – DMA, TDMA, CDMA, and DAMA.

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 SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 9

Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS.

UNIT V APPLICATIONS 9

Satellite Packet Communications , Intelsat series – INSAT series –VSAT, mobile satellite services, IMMERSAT, Satellite and Cable Television, DBS (DTH), VSAT, Satellite Phones, Application of satellites in navigation, weather earth observation.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Distinguish the elements of satellite.
- Compare the various multiplexing and modulation techniques involved in satellite communication.
- Analyze the design methods of satellite link.
- Describe about satellite navigation and global positioning system.
- Explain the applications of satellite communication.

REFERENCES:

1. Wilbur Pritchard.L,Suyderhoud.H.D,Robert Nelson.A, " Satellite Communication Systems Engineering ", Prentice Hall, New Jersey, 2006.
2. Timothy Pratt, Charles Bostain.W, " Satellite Communications ", John Wiley and Sons, 2003.
3. Roddy.D, " Satellite Communication ", McGrawHill, 2006.
4. Tri T Ha, " Digital Satellite Communication ", Mc Graw Hill, 1990.

15PCM202	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on optical system components and optical network architectures.
- To give an idea about the wavelength routing networks and packet switching and access networks**.**
- To familiarize the students on the network design and management.

UNIT I OPTICAL SYSTEM COMPONENTS 9

Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORK ARCHITECTURES 8

Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Test beds for Broadcast & Select WDM; Wavelength Routing Architecture.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing and wavelength assignment, Virtual topology design, Wavelength Routing Test beds, Architectural variations.

UNIT IV PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

UNIT V NETWORK DESIGN AND MANAGEMENT 10

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

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Explain the concepts of optical system components.
- Infer knowledge on SONET / SDH and optical network architectures.
- Design routing networks and virtual topology.
- Explain the various packet switching techniques and compare different network management methods.
- Analyze the Fault Management and Optical safety.

REFERENCES:

1. Rajiv Ramaswami , Kumar, Sivarajan .N, " Optical Networks : A Practical Perspective ", Harcourt Asia Pte Ltd, Second Edition, 2004.
2. Siva Ram Moorthy , Mohan Gurusamy, " WDM Optical Networks : Concept, Design and Algorithms ", Prentice Hall of India, 1st Edition, 2002.
3. Green P.E, Jr, " Fiber Optic Networks ", Prentice Hall, NJ, 1993.
4. Biswajit Mukherjee, " Optical Communication Networks ", TMG, 1998.

15PCM203	MICROWAVE INTEGRATED CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce about microwave integrated circuits basics and their technologies.
- To explain the fabrication techniques of passive components.
- To impart knowledge on microwave amplifier and oscillator design techniques.

UNIT I INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS 9

MMIC- technology, advantages and applications, Active device technologies, design approaches, multichip module technology.

UNIT II TECHNOLOGY OF HYBRID MICs 9

Dielectric substrates - thick film technology and materials - thin film technology and materials – methods of testing – encapsulation of devices for MICs – mounting of active devices.

UNIT III TECHNOLOGY OF MONOLITHIC MICs 9

Processes involved in fabrication – epitaxial growth of semiconductor layer – growth of dielectric layer – diffusion – ion implantation – electron beam technology .

UNIT IV PASSIVE COMPONENTS 9

Inductors, capacitors, resistors, microstrip components, coplanar circuits, multilayer techniques, micro machined passive components, switches & attenuators.

UNIT V AMPLIFIERS & OSCILLATORS *9

Amplifiers - Stability & gain analysis, matching techniques, reactively matched amplifier design, LNA, Oscillators **-** Design principles, active device CAD techniques for large signal oscillators design, phase noise, MMIC VCO, mixers.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Explain the basic MIC technology and their applications.
- Describe about hybrid MIC technologies.
- Describe about monolithic MIC technologies.
- Explain the fabrication techniques of passive components.
- Design microwave amplifiers and oscillators.

REFERENCES:

1. I.D.Robertson and S.Lucyszyn, " RFIC and MMIC Design and Technology ", IET Circuits, Devices and Systems Series13 .
2. Gupta K.C and Amarjit Singh, " Microwave Integrated Circuits ", John Wiley and sons – Wiley Eastern Reprint, 1978.
3. Hoffmann R.K, " Handbook of Microwave Integrated Circuits ", Artech House, 1998..

4. “ Monolithic Microwave Integrated Circuits: Modeling and Design Technologies ”, (Premier Reference source), 2011.

15PCM204 MICROWAVE AND NETWORKS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVE:

- To demonstrate the s-parameter estimation of various microwave devices.
- To implement the channel equalizer techniques using simulation software.

1. S-parameter estimation of microwave devices.
2. Characteristics of λ/4 filters.
3. Measurement of Transmission line Parameters
4. Fiber optic communication using analog and digital link
5. Design and testing of a Microstrip coupler.
6. Simulation and performance evaluation of MAC protocols for wireless Networks
7. Simulation and performance evaluation of Routing protocols for wireless networks.
8. Simulation and performance evaluation of Wireless Sensor Network technologies in terms of Throughput and Energy Efficiency
9. Channel equalizer design using MATLAB.
10. Design of Digital Receiver in AWGN and Fading channels.

TOTAL: 60 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain about S-parameters for microwave passive components .
- Obtain the measurement techniques for transmission line parameters.
- Analyze the performance of microwave components in terms of scattering parameters.
- Analyze the performance of MAC protocols and routing protocols.

Sl. No.	Name of the equipment	Quantity required
1	Microstrip couplers	2 Nos.
2	Personal Computers	13 Nos.
3	Network Analyzer	2 Nos.
4	Digital Fiber Optics Link Trainer Kit	2 Nos.
5	Microwave Devices for measurement	2 Nos.
6	Simulation Software	13 user License
7	Network Simulator	Open Source

15PCM205	INTERNSHIP/INDUSTRIAL TRAINING	L	T	P	C
		0	0	2	1

OBJECTIVE:

- To provide hands on training in an industry or a research institution or an academic institution
- To provide knowledge on practical applications for the theoretical concepts studied

A candidate has to undergo practical training for two weeks in an approved organization related to their branch of study during the vacation period of first semester or should be accommodated in the UG programme laboratory during the second semester. After successful completion of the training the student shall submit the report.

EVALUATION PROCESS

The evaluation is based on the successful completion of the Industrial Training/ Internship, report submitted by the candidate and a viva-voce examination done by a three member panel. The evaluation is done for 100 marks.

COURSE OUTCOME:

After successful completion of this course the students will be able to:

- Develop analytical/hardware/software/experimental skills
- Prepare and present technical reports
- Apply practical knowledge to their project work

SEMESTER III

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**15PCM301**	Wireless Communication Engineering	**3**	**0**	**0**	**3**
2.	**15PCM302**	Telecommunication Switching and Management	**3**	**0**	**0**	**3**
3.	-	Elective IV	**3**	**0**	**0**	**3**
4.	-	Elective V	**3**	**0**	**0**	**3**
5.	-	Open Elective	**3**	**0**	**0**	**3**
PRACTICAL						
6.	**15PCM303**	Project Work (Phase I)	**0**	**0**	**6**	**3**
Total			**15**	**0**	**6**	**18**
Total Number of Credits: 18						

15PCM301	WIRELESS COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Give knowledge on wireless channels and capacity of fading channels.
- To explain diversity and combining scheme and multicarrier modulation techniques
- To give an idea about the basics of MIMO communication channels.

UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL 9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-free space, two ray. Small scale fading- channel classification- channel models – COST -231 Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading – shadowing Distributions, Link power budget Analysis.

UNIT II CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels.

UNIT III DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter, The Alamouti scheme

UNIT IV MULTICARRIER MODULATION 9

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset – Case study IEEE 802.11a.

UNIT V MIMO COMMUNICATIONS 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Compare the different types of wireless channel models.
- Relate the capacity of various fading channels.
- Apply the concept of diversity and combining in various transmitter channels.
- Discuss the multicarrier modulation techniques.
- Summarize the concepts of MIMO communication.

REFERENCES:

1. Andrea Goldsmith, " Wireless Communications, Cambridge University Press ", 2007.
2. Harry r. Anderson, " Fixed Broadband Wireless System Design ", John Wiley, India, 2003.
3. Andreas F. Molisch, " Wireless Communications ", John Wiley, India, 2006.
4. Simon Haykin & Michael Moher, " Modern Wireless Communications ", Pearson Education, 2007.

15PCM302	TELECOMMUNICATION SWITCHING AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an overview of evolution of telecommunication system.
- To introduce to switching systems.
- To impart knowledge on telecommunication Networks.

UNIT I INTRODUCTION TO SWITCHING SYSTEMS 9

Evolution of Tele communication, Simple Telephone Communication, Basics of a Switching System, Manual Switching System, Major Telecommunication Networks, Strowger Switching Components-, Rotary Dial Telephone, Signaling Tones, Strowger Switching Components, Step by Step Switching, Design Parameters, 100 line Switching Systems, Crossbar Switching- Principles of Common Control, Touch Tone Dial Telephone, Principles of Crossbar Switching.

UNIT II SPACE AND TIME DIVISION SWITCHING 9

Stored Program Control, Centralized SPC, Distributed SPC, Software Architecture, Application Software, Enhanced Services, Two Stage Networks, Basic Time Division Space Switching, Basic Time Division Time Switching, Time Multiplexed Space Switching, Time Multiplexed Time Switching.

UNIT III TELEPHONE NETWORKS 9

Subscriber loop Systems, Switching Hierarchy and Routing , Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan ,Signaling Techniques in Channel Signaling, Common Channel Signaling, Cellular Mobile Telephony.

UNIT IV INTEGRATED SERVICES DIGITAL NETWORKS 9

Motivation for ISDN, New Services, Network and Protocol Architecture, Transmission Channels, User Network Interfaces, Signaling ,Numbering and Addressing, Service Characterization, Interworking, ISDN Standards, Expert Systems in ISDN, Broadband ISDN.

UNIT V TELECOMMUNICATION NETWORK MANAGEMENT AND TRAFFIC ENGINEERING 9

TMN Framework, The TMN Functional Model, TMN Standard Interfaces, TMN Logical Model, TMN Solutions, Network Traffic Load and Parameters, Grade of Services and Blocking Probability, Modelling Switching Systems.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Illustrate the call processing procedures in different switching schemes used in digital exchange
- Summarize the working principle of centralized and distributed stored program control.
- Compare different two stage networks in terms of the design parameters.
- Compute the grade of Service and blocking Probability of a two stage network .
- Differentiate operating principles of telephone network and ISDN.

REFERENCES:

1. Viswanathan. T, “ Telecommunication Switching System and Networks ”, Prentice Hall of India Ltd, 1994.
2. Web Proforum Tutorials, “ http://www.iec.org,The International Engineering Consortium Telecommunications Management Network ”.
3. Achille Patavina, “ Theory: Architectures and performance in Broadband ATM ”, John Wiley & Sons Ltd, New York, 1998.
4. Christopher Y Metz, “ Switching protocols & Architectures ”, McGraw Hill, New York, 1998.

15PCM303	PROJECT WORK(PHASE I)	L	T	P	C
		0	0	6	3

Every candidate shall be permitted to undertake a research based project work of his/her choice related to his/her discipline in consultation with the Head of the Department. The project shall be supervised by faculty members of the department in which the candidate registered a course.

In case of a project work at Industrial/research organization, the project work shall be jointly supervised by the faculty supervisor and an expert from the organization.

He/she shall be required to undergo three reviews in a semester to assess the progress of the project work. The project work shall be evaluated based on the project report submitted by the candidate and viva-voce examination conducted by a committee consisting of an external examiner, internal examiner and the supervisor of the candidate.

SEMESTER IV

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	**15PCM401**	Project Work (Phase II)	**0**	**0**	**30**	**15**
Total			**0**	**0**	**30**	**15**
Total Number of Credits: 15						

15PCM401	PROJECT WORK(PHASE II)	L	T	P	C
		0	0	30	15

Every candidate shall be permitted to undertake a research based project work of his/her choice related to his/her discipline in consultation with the Head of the Department. The project shall be supervised by faculty members of the department in which the candidate registered a course.

In case of a project work at Industrial/research organization, the project work shall be jointly supervised by the faculty supervisor and an expert from the organization.

He/she shall be required to undergo three reviews in a semester to assess the progress of the project work. The project work shall be evaluated based on the project report submitted by the candidate and viva-voce examination conducted by a committee consisting of an external examiner, internal examiner and the supervisor of the candidate.

LIST OF PROGRAM ELECTIVES

S.No	Course Code	Course Title	L	T	P	C
1.	15PCM501	CDMA Systems	3	0	0	3
2.	15PCM502	Wireless Ad-hoc Networks	3	0	0	3
3.	15PCM503	Global Positioning Systems	3	0	0	3
4.	15PCM504	High Performance Communication Networks	3	0	0	3
5.	15PCM505	Data Compression	3	0	0	3
6.	15PCM506	Adaptive Antennas	3	0	0	3
7.	15PCM507	DSP Processor Architecture and Programming	3	0	0	3
8.	15PCM508	RF MEMS	3	0	0	3
9.	15PCM509	Communication Network Security	3	0	0	3
10.	15PCM510	Wireless Networks	3	0	0	3
11.	15PCM511	Mobile Communication Networks	3	0	0	3
12.	15PCM512	Numerical Techniques in Electromagnetics	3	0	0	3
13.	15PCM513	Network Routing Algorithms	3	0	0	3
14.	15PCM514	Medical Imaging Techniques	3	0	0	3
15.	15PCM515	MIMO Communication Systems	3	0	0	3
16.	15PCM516	Beamforming in Wireless Communication	3	0	0	3
17.	15PCM517	Network Management System	3	0	0	3
18.	15PCM518	Communication Protocol Engineering	3	0	0	3
19.	15PCM519	Cognitive Radio Networks	3	0	0	3
20.	15PCM520	Communication Network Design	3	0	0	3
21.	15PCM521	Digital Communication Receivers	3	0	0	3
22.	15PCM522	Sensor Networks	3	0	0	3
23.	15PCM523	Ultra Wideband Communication	3	0	0	3
24.	15PCM524	Wireless Body Area Network	3	0	0	3

15PCM501	CDMA SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Give clear knowledge on CDMA and CDMA Techniques.
- To explain the WCDMA / CDMA 2000**.**
- To impart knowledge on multicarrier CDMA and optical CDMA**.**

UNIT I BASIC CONCEPTS OF CDMA 9

Spread spectrum communication techniques (DS-CDMA, FH-CDMA), Synchronization in CDMA system, Detection and False alarm probabilities, Early Late gate measurement statistics, Information capacity of Spread Spectrum Systems.

UNIT II IS-95 CDMA TECHNIQUES 9

Spreading Codes, Power control, Handover techniques, Physical and logical channels and processing (Forward and reverse links).

UNIT III WCDMA 9

History-system overview, FDD/WCDMA, TDD/WCDMA-System attributes, Radio channel spreading, Scrambling& modulation, Multisystem operation, Physical radio carriers ,Transport channels, Mapping, Frequency reuse, Packet data, Speech coding, Sleep mode, IS handover, RF power control-Basic operation ,Access, Paging, Packet access, Handover.

UNIT IV MULTICARRIER CDMA SYSTEMS 9

Multicarrier CDMA, System design , Performance parameters – BER lower bound, Down & Up link BER Performance- Handoff and Power control in 3G Systems.

UNIT V OPTICAL CDMA 9

Prime Codes and it's properties, Generalized and Extended Prime Codes, Experimental demonstration of Optical CDMA, Synchronization of Optical CDMA networks, Multi wavelength Optical CDMA networks.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Discuss the fundamental parameters relevant to CDMA systems.
- Analyze the basics of IS-95 CDMA.
- Distinguish the various WCDMA channels and their attributes.
- Discuss various multicarrier CDMA systems
- Compare the concept of Synchronization in CDMA system and performance of optical CDMA networks.

REFERENCES:

1. John G.Proakis, " Digital Communications ", McGraw Hill International Ltd, 4th edition, Singapore, 2000.
2. Andrew J. Viterbi, " CDMA: Principles of Spread Spectrum Communication", Addison-Wesley, 1995.
3. Kaveh Pahlavan.K, Prashanth Krishnamuorthy," Principles of Wireless Networks ", Prentice Hall of India, 2006.
4. Richard Van Nee, Ramjee Prasad, " OFDM for Wireless Multimedia Communication ", Artech House Boston, Londo,, 2000.
5. L.Hatre, R.Levine, R.Kikta, " 3G Wireless Demystified ", McGraw Hill International Ltd, 2002.
6. Guu-Chang Yang, " Prime Codes with Application to Optical and Wireless Networks ", Artech House Inc, 2002.

15PCM502	WIRELESS ADHOC NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on the major issues associated with ad-hoc networks
- To explain the concepts of Adhoc networks and medium access protocols.
- To give an idea about current technologies by researching key areas such as algorithms, protocols and cross layer design.

UNIT I INTRODUCTION **9**

Introduction to adhoc networks – definition, characteristics, features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: Indoor and outdoor models.

UNIT II MEDIUM ACCESS PROTOCOLS **9**

MAC Protocols: design issues, goals and classification. Contention based protocols- with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards:802.11a,802.11b,802.11g,802.15.HIPERLAN.

UNIT III NETWORK PROTOCOLS **9**

Routing Protocols: Design issues, goals and classification. Proactive Vs Reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Energy aware routing algorithm.

UNIT IV END-END DELIVERY AND SECURITY **9**

Transport layer: Issues in designing- Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.

UNIT V CROSS LAYER DESIGN AND INTEGRATION OF ADHOC FOR 4G **9**

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective. Integration of adhoc with Mobile IP networks.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Describe the unique issues and current technology trends for the implementation and deployment of wireless ad-hoc networks.
- Discuss the challenges in designing MAC protocol for wireless adhoc networks.
- Explain the routing and transport protocols for wireless adhoc networks
- Infer knowledge on network security attacks.
- Develop an attitude to propose solutions with comparisons for problems related to Adhoc networks computing through investigation of different protocols for future application.

REFERENCES

1. Siva Ram Murthy.C, and Manoj.B.S, " Ad hoc Wireless Networks Architectures and protocols ", Pearson Education, 2nd Edition, 2007.
2. Charles E. Perkins, " Ad hoc Networking ", Addison – Wesley, , 2000.
3. Stefano Basagni, Marco Conti, Silvia Giordano, and Ivan stojmenovic, " Mobilead hoc networking ", Wiley-IEEE press, 2004.
4. Mohammad Ilyas, " The handbook of adhoc wireless networks ", CRC press, 2002.

15PCM503	GLOBAL POSITIONING SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the concepts GPS and GPS co-ordination system .
- To give an idea about the GPS communication and its propagation models.
- To outline the applications of GPS.

UNIT I INTRODUCTION **9**

History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems – GPS Constellation – Space Segment – Control Segment – User Segment –Single and Dual Frequency – Point – Relative – Differential GPS – Static and Kinematic Positioning – 2D and 3D – reporting Anti Spoofing (AS); Selective Availability (SA) –DOP Factors.

UNIT II GPS CO-ORDINATION SYSTEM **9**

Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference System – Orbit Description – Keplerian Orbit – Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion –Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System– Atomic Time – GPS Time – Need for Coordination – Link to Earth Rotation – Time and Earth Motion Services.

UNIT III GPS COMMUNICATION **9**

C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages and Formats – Undifferenced and Differenced Range Models – Delta Ranges – Signal Processing and Processing Techniques – Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity.

UNIT IV PROPAGATION MODELS **9**

Propagation Media – Multipath – Antenna Phase Centre – Atmosphere in brief –Elements of Wave Propagation – Ionospheric Effects on GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias –Blunders – Tropospheric Effects on GPS Oberservables – Multipath Effect – Antenna Phase Centre Problems and Correction.

UNIT V APPLICATION **9**

Inter Disciplinary Applications – Crystal Dynamics – Gravity Field Mapping –Atmospheric Occulation – Surveying – Geophysics – Air borne GPS – Ground Transportation – Space borne GPS – Metrological and Climate Research using GPS. GPS Technologies in sports field.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain the basic concepts of GPS constellation and different segments.
- Identify the need for coordination in GPS.
- Relate the various codes and range models in GPS communication. .
- Analyze various propagation models and multipath effects.
- Explain the various applications of GPS.

REFERENCES:

1. Hoffman.B, Wellenhof, Lichtenegger.H and Collins.J, " GPS: Theory and Practice ", Springer, Wein, 4th revised edition, New York, 1997.
2. Leick.A, " GPS Satellites Surveying ", John Wiley & Sons, 2nd edition, NewYork, 1995.
3. Parkinson.B, Spilker.J, " GPS: Theory and Applications ", Vol.I & Vol.II, AIAA,370 L'Enfant Promenade SW, Washington, DC 20024, 1996.
4. A.Kleusberg and P.Teunisen(Eds), " GPS for Geodesy ", Springer-Verla,, Berlin, 1996.
5. Adams.L, " The GPS - A Shared National Asset ", Chair, National Academy Press, Washington DC , 1995.

15PCM504	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give knowledge on communication networks and multimedia networking applications.
- To give an idea about the advanced networks concepts and various traffic modeling.
- To summarize the basics of network security and management.

UNIT I INTRODUCTION **9**

Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN,ATM.

UNIT II MULTIMEDIA NETWORKING APPLICATIONS **9**

Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism –integrated services – RSVP- differentiated services.

UNIT III ADVANCED NETWORKS CONCEPTS **9**

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

UNIT IV TRAFFIC MODELLING **8**

Little's theorem, Need for modeling , Poisson modeling and its failure, Non- poisson models, Network performance evaluation.

UNIT V NETWORK SECURITY AND MANAGEMENT **10**

Key distribution and certification, Securing Email – Securing TCP connections – Network Layer Security – Securing Wireless LANs Operational Security - security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Define the OSI layers and various modes of communication and switching.
- Summarize protocols, scheduling and polling mechanism.
- Discuss about advanced network concepts.
- Measure various models and its failure.
- Explain various network security methods.

REFERENCES:

1. Kurose. J.F, & Ross. K.W, " Computer Networking- A top down approach featuring the internet ", Pearson, 2nd edition, 2003.
2. Nader F.Mir, " Computer and Communication Networks ", first edition.
3. Walrand .J, Varatya, " Performance Communication Network ", Morgan Kauffman – Harcourt Asia Pvt. Ltd, 2nd Edition, 2000.
4. Leon-Garcia, Widjaja, " Communication Networks ", TMH seventh reprint, 2002.

15PCM505	DATA COMPRESSION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To explain the concepts of multimedia and compression techniques.
- Give knowledge on text compression and audio compression.
- To impart the concepts of image and video compression techniques.

UNIT I INTRODUCTION **9**

Special features of Multimedia - Graphics and Image Data Representations -Fundamental Concepts in Video and Digital Audio-Storage requirements for multimedia applications -Need for Compression - Taxonomy of compression techniques – Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies.

UNIT II TEXT COMPRESSION **9**

Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmatic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III AUDIO COMPRESSION **9**

Audio compression techniques - μ- Law and A- Law companding. Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders

UNIT IV IMAGE COMPRESSION **9**

Contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards - JBIG, JBIG2 standards.

UNIT V VIDEO COMPRESSION **9**

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 – MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.

TOTAL: 45 Periods

COUURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Describe the various data representations of multimedia, quantization and compression techniques.
- Analyze the different types of coding in text compression.
- Explain the concepts of various coding and compression techniques in audio compression.
- Describe the concepts of image compression.
- Compare the different types of MPEG video coding and compression techniques.

REFERENCES:

1. Khalid Sayood, “ Introduction to Data Compression ”, Morgan Kauffman Harcourt India, 3rd Edition, 2011.
2. David Salomon, “ Data Compression – The Complete Reference ”, Springer Verlag, 4th Edition, New York, 2011.
3. Yun Q.Shi, Huifang Sun, “ Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards ”, CRC press, 2003.
4. Mark S.Drew, Ze-Nian Li, “ Fundamentals of Multimedia ”, PHI, 1st Edition, 2004.

15PCM506	ADAPTIVE ANTENNAS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the concepts of array antennas and adaptive array antenna.
- To explain the vector and matrix techniques for adaptive arrays
- To impart knowledge on optimal antennas and adaptive solutions of optimal antennas.

UNIT I INTRODUCTION TO ARRAY ANTENNAS 9

Basic array characteristics, linear arrays- patterns, beamwidth, sidelobes, grating lobes, bandwidth, planar arrays- array coordinates, beamwidth, grating lobes.

UNIT II ADAPTIVE ARRAY FUNDAMENTALS 9

Antenna Null Rotation, Electronic Null Steering ,Constrained Power minimization, Weak Signal Adaptation, Side lobe canceller, the Davies Beamformer, Multiple Null Formation.

UNIT III VECTOR AND MATRIX TECHNIQUES FOR ADAPTIVE ARRAYS 9

Narrow Band Signals, Vector Inner Products, Angles between Vectors, Orthogonality achieved by projections, output powers, covariance Matrices, Quadratic Forms.

UNIT IV OPTIMAL ANTENNAS 9

Meaning of optimality, Eigen value, Solution for maximum SNIR, Least Mean Square (LMS) Error Criterion, Maximization of Probability of Detection, Direct maximization of SNR, Optimization of power pattern.

UNIT V ADAPTIVE SOLUTIONS OF OPTIMAL ANTENNAS 9

Meaning of Adaptivity, Gradient Methods, Real Time Least Mean square Error Algorithm.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Explain the parameters of array antenna.
- Explain the fundamentals of adaptive arrays.
- Describe the concepts of vector inner products and covariance matrices.
- Estimate the Least Mean Square (LMS) error criterion for optimal antennas.
- Explain the meaning of adaptivity and solutions for optimal antennas.

REFERENCES:

1. Hudson. J.E, " Adaptive Array Principles ", Peter Peregrinus Ltd On Behalf of Institution of Electrical Engineers, London New York.
2. Compton. R.T, JR, " Adaptive Antennas, Concepts and Performance ", Prentice Hall, New Jersey.
3. Eli Brookner, " Practical Phased Array Antenna Systems ", Editor Artech House, Boston , London.
4. Hansen.R.C, Wiley, " Phased Array Antennas ", Series in Microwave and optical Engg, John Wiley & Sons Inc, Wiley- Interscience Publication.,

15PCM507	DSP PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an over view of TMS320C5X processor.
- To impart knowledge on programming techniques of TMS320C3X processor and ADSP processors**.**
- To give an over view of advanced Motorola DSP processor.

UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs 9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in P-DSPs – Multiple access memory – Multi-port 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 - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III TMS 320C6474 MULTICORE DIGITAL SIGNAL PROCESSOR 9

Functional Block Diagram-Device overview-Device configuration-System interconnect-C64x$^+$ mega module-Peripherals-Mapping an Application to a Multi core Processor-Inter process Communication-Data transfer Engines-DSP code and Data images-Memory Management-Simple Programs using TMS 320C6474.

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: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain the architectural features of programmable DSPs.
- Demonstrate the power of TMS320C5X processor compared to PIC microcontroller by programming some application of their choice.
- Explain the architectural features of Multicore processors.
- Implement Filters and FFT using ADSP processors.
- Compare the architecture and programming features ofTMS320C54X and TMS320C6X.

REFERENCES:

1. Venkataramani.B, Bhaskar.M, " Digital Signal Processors – Architecture, Programming and Applications ", Hill Publishing Company Limited, 2003.
2. " http://www.fixya.com/support/t5478826-user_guides_texas_instrumentation_analog,Analog Devices ", Motorola.
3. "http://www.analog.com/en/processors-dsp/ADSP-1x/products/mals/resources/index.html ", Using the ADSP-2100 Family volume 1(Rev 1.0,1990).
4. " TMS320C6474 Multicore Digital Signal Processor-Technical Reference ", Texas Instruments, Revised Edition, 2011.

15PCM508	RF MEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on MEMS based wireless appliances and enabled circuit .
- To familiarize the students about resonators, enabled circuit and reconfigurable circuit elements.
- To make the students to study the filters and oscillators.

UNIT I INTRODUCTION 9

Introduction and origin of MEMS, driving force for MEMS development, fabrication process. MEMS fabrication technologies: Conventional IC fabrication processes. wireless standards, systems and architectures, Spheres of wireless activities, wireless standards, conceptual wireless systems, wireless transceiver architectures, power and bandwidth-efficient wireless systems & challenges, MEMS based wireless appliances enable ubiquitous connectivity. Physical aspects of RF circuit design, skin effect, transmission lines on thin substrates, self-resonance frequency, quality factor packaging, practical aspects of RF circuit design, dc biasing, impedance mismatch effects in RF MEMS.

UNIT II ENABLED CIRCUIT ELEMENTS 9

RF/Microwave substrate properties, Micro machined – enhanced elements – capacitors, inductors, varactors, MEM switches – shunt MEM switch, low voltage hinged MEM switch approaches, push-pull series switch, folded – beam – springs suspension series switch.

UNIT III RESONATORS & ENABLED CIRCUITS 9

Transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustic wave resonators, MEMS modeling – mechanical modeling, electromagnetic modeling. Enabled circuits –reconfigurable circuits – the resonant MEMS switch, Capacitors, inductors, tunable CPW resonator, MEMS microswitch arrays.

UNIT IV RECONFIGURABLE CIRCUITS 9

Double – stud tuner, Nth – stub tuner, filters, resonator tuning system, massively parallel switchable RF front ends, true time-delay digital phase shifters, Reconfigurable antennas – tunable dipole antennas, tunable microstrip patch-array antenna. Phase shifters- fundamentals, X-Band RF MEMS Phase shifter for phased array applications, Ka-Band RF MEMS Phase shifter for radar systems applications.

UNIT V FILTERS & OSCILLATORS 9

Film bulk acoustic wave filters – FBAR filter fundamentals, FBAR filter for PCS applications, RF MEMS filters – A Ka-Band millimeter-wave Micromachined tunable filter, A High-Q 8-MHz MEM Resonator filter, RF MEMS Oscillators – fundamentals, A 14-GHz MEM Oscillator, A Ka- Band Micromachined cavity oscillator, A 2.4 GHz MEMS based voltage controlled oscillator.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain various structure and techniques of MEMS.
- Explain various enabled circuit elements.
- Describe the modeling and applications of MEMS in different circuits.
- Explain the concept of reconfigurable circuits and its applications.
- Describe various MEMS based filters and oscillators.

REFERENCES:

1. Hector J. De Los Santos," RF MEMS Circuit Design for Wireless Communications ", Artech House, 2002.
2. Vijay K.Varadan, Vinoy.K.J, Jose.K.A," RF MEMS and their Applications ", John Wiley and sons, LTD, 2002.
3. Gabriel M. Rebeiz, " RF MEMS Theory, Design & Technology ", Wiley Interscience, 2002.
4. Reinhold Ludwig, " RF circuit design, theory and applications ", Pearson Asia Education. , Pavel Bretchko, 2001.

15PCM509	COMMUNICATION NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the concept of security and explain symmetric and asymmetric key algorithms.
- To impart knowledge on integrity, authentication and key management.
- To outline the concept of network security and wireless network security .

UNIT I INTRODUCTION ON SECURITY 9

Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability. Security services and mechanisms, Techniques: Cryptography, Steganography , Revision on Mathematics for Cryptography.

UNIT II SYMMETRIC & ASYMMETRIC KEY ALGORITHMS 9

Substitutional Ciphers, Transposition Ciphers, Stream and Block Ciphers, Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem .

UNIT III INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT 9

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

UNIT IV NETWORK SECURITY , FIREWALLS AND WEB SECURITY 9

Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall. IP Security Overview, IP security Architecture, authentication Header, Security payload, security associations, Key Management. Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature .

UNIT V WIRELESS NETWORK SECURITY 9

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network .

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain the attacks, security services and mechanisms.
- Explain symmetric and asymmetric key algorithms.
- Summarize the concepts of Digital Signature, Authentication and key management techniques.
- Identify IP security, web security requirement and secure electronic transaction.
- Discuss about wireless networks security.

REFERENCES:

1. Behrouz Fourcuzan.A , “ Cryptography and Network security ”, Tata McGraw- Hill, 2008.
2. William Stallings, “ Cryptography and Network security: principles and practice ”, Prentice Hall of India, 2ndEdition, New Delhi, 2002.
3. Atul Kahate, “ Cryptography and Network security ”, Tata McGraw- Hill , 2nd Edition, 2008.
4. Yang.H, “ Security in Mobile Ad Hoc Networks: Challenges and Solution ”, IEEE Wireless Communications, 2004.

15PCM510	WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To summarize the fundamentals of wireless communication, wireless networking, wireless LAN & PAN. .
- To give an idea about the ad-hoc wireless networks and wireless sensor networks**.**
- To impart knowledge on the recent advances in wireless networks.

UNIT I INTRODUCTION 9

Fundamentals of Wireless Communication - Transmission fundamentals - Wireless Communication Technology, Modulation Techniques- Signal Encoding Techniques, Coding and Error Control.

UNIT II WIRELESS NETWORKING, WIRELESS LANS & PANS 9

Wireless Networking – Cellular Wireless Networks, Wide Area Networks – GSM, IS95, CDMA 2000, Wireless LANs -Wireless LAN Technology, IEEE 802.11 Wireless LAN Standards, Bluetooth, HIPERLAN Standard, Home RF.

UNIT III AD-HOC WIRELESS NETWORKS 9

Introduction - Issues in Ad Hoc Wireless Networks - MAC Protocols-Introduction, Issues, classification of MAC protocol-FAMA,CATA,DWOP,PCM,ICSMA - Routing Protocols-Introduction, Issues, Classification of routing protocols-WRP,CGSR,AODV,Qos of AODV- Transport Layer Protocols-Introduction, Issues, Classification - Energy Management Schemes -Introduction, Need for energy management, classification-Transmission power management scheme.

UNIT IV WIRELESS SENSOR NETWORKS 9

Introduction - Sensor Network Architecture - Data Dissemination - Data Gathering - MAC Protocols for Sensor Networks - Location Discovery - Quality of a Sensor Network - Evolving Standards - Other Issues.

UNIT V RECENT ADVANCES IN WIRELESS NETWORKS 9

Ultra-Wide-Band Radio Communication - Wireless Fidelity Systems – Optical Wireless Networks - The Multimode 802.11 -IEEE 802.11a/b/g - The Meghadoot Architecture - Next-Generation Hybrid Wireless Architectures-MCN,HWN architecture, Open issues in the next generation hybrid architecture, power control schemes.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Describe the fundamentals of wireless communication & networks.
- Analyze the wireless standards and protocols.
- Discuss the importance of adhoc technology in wireless communication.
- Conclude the knowledge about the wireless sensor network and wireless network standards.
- Discriminate the hybrid wireless architectures.

REFERENCES:

1. William Stallings, " Wireless Communications and Networking ", Pearson Education, 2nd Edition, 2005.
2. Siva Ram Murthy C, Manoj B.S, " Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall, 2004.
3. Kaveh Pahlavan, Prashant Krishnamurthy, " Principles of Wireless Networks ", Pearson Education.
4. Rappaport T.S, " Wireless Communications: Principles and Practice ", Prentice Hall, 2nd Edition.

15PCM511	MOBILE COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the knowledge of PCS and GSM.
- To introduce the knowledge of General Packet Radio Services.
- To explain the wireless application protocols and medium access protocols.

UNIT I PERSONAL COMMUNICATION SERVICES 9

Introduction to Personal Communication Services (PCS): PCS architecture, Mobility management, Hand off management: Detection and assignment, Radio link transfer, Networks signaling.

UNIT II GLOBAL SYSTEM FOR MOBILE COMMUNICATION 9

Global system for Mobile Communication (GSM) system overview: GSM Architecture, Mobility Management, Network signaling, GSM short message services.

UNIT III PACKET RADIO SERVICES 9

General Packet Radio Services (GPRS): GPRS architecture, GPRS Network nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, HIPERLAN, Mobile IP.

UNIT IV WIRELESS COMMUNICATION PROTOCOLS OF STANDARDS 9

Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, Wireless Markup Languages (WML)Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

UNIT V MEDIUM ACCESS PROTOCOLS 9

MAC Protocols: design issues, goals and classification. Contention based protocols, reservation based protocols, scheduling algorithms.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain the PCS architecture and mobility management.
- Explain the GSM Architecture and Mobility management.
- Explain GPRS architecture and services
- Categorize the different types of wireless communication protocols.
- Compare Medium access protocols

REFERENCES:

1. Yi-Bang Lin, Imrich Chlamtac, " Wireless and mobile Networks Architecture ", John Wiley & Sons, 2001.
2. Raj Pandya, " Mobile and Personal Communication Systems and Services ", John Wiley & Sons, 2001.
3. Jochen Schiller, " Mobile communications ", Pearson Education Pvt. Ltd, 2002.
4. C.Siva Ram Murthy and B.S.Manoj, " Ad Hoc Wireless Networks Architectures and Protocols ", Prentice Hall, 2004.
5. Ivan Stojmenovic, " Handbook Of Wireless Networks And Mobile Computing ", John Wiley & Sons.

15PCM512	NUMERICAL TECHNIQUES IN ELECTROMAGNETICS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To review the EM theory.
- To introduce the various numerical techniques for electromagnetics.
- To give an idea about optimization techniques.

UNIT I REVIEW OF EM THEORY 8

Electrostatic fields, magnetoststic fields ,Time varying fields , boundary conditions , wave equations, Classification of EM problems.

UNIT II ANALYTICAL METHODS 8

Separation of variables in Cartesian,cylindrical,spherical coordinates-Laplace equation and wave equation.Series expansion-Practical application.

UNIT III FINITE DIFFERENCE METHOD 9

Finite difference schemeas, Finite differenceing of parabolic, hyperbolic and elliptic PDE's. Accuracy and stability of FD solutions, Applications

UNIT IV VARIATIONAL METHODS 10

Construction of functional from PDE's, Weighted residual method, Eigen value problems, applications, Deterministic numerical techniques-method of moments, FEM, FDTD-Applications and numerical examples. Non Deterministic numerical techniques-Montecarlo method-Simulation of EMC behavior-Computational models.

UNIT V OPTIMIZATION 10

Problem Statement , Line Searches ,Newton's Method , Equality Constraints and Lagrange Multipliers,Particle swarm optimization.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Review EM theory.
- Explain analytical methods for Electromagnetics.
- Describe about finite difference method for Electromagnetics.
- Describe variational methods for Electromagnetics.
- Explain about optimization techniques.

REFERENCES:

1. Mathew.N.O.Sadiku, " Numerical Techniques in Electromagnetics ", CRC press, second edition , 2001.
2. Thomas Weise, " Global Optimization Algorithms– Theory and Application ", second edition, 2009.
3. *General Editor:*P.G. Ciarlet, " Handbook of Numerical Analysis ", Elsevier, 2005.
4. Christopher j. Zarowski, " An Introduction to Numerical Analysis for Electrical and Computer Engineers ", John Wiley and Sons, 2005.

15PCM513	NETWORK ROUTING ALGORITHMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To explain the concepts of routing in network and various routing protocols.
- Give knowledge on optical and mobile IP networks.
- To summarize the various routing in mobile Ad-HOC networks.

UNIT I INTRODUCTION **9**

ISO, OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Nonhierarchical 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 Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol(DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing.

UNIT III ROUTING IN OPTICAL WDM NETWORKS **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).

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Compare the various routing techniques.
- Summarize the concepts of internet routing.
- Discuss the benefits and issues of routing in optical networks.
- Explain the various mobile IP protocols**.**
- Analyze the various routing techniques in mobile adhoc networks.

REFERENCES:

1. William Stallings, " High speed networks and Internets Performance and Quality of Service ", Pearson Education Asia, IInd Edition, Reprint India, 2002.
2. M. Steen Strub, " Routing in Communication network ", Prentice –Hall International, Newyork, 1995.
3. S. Keshav, " An engineering approach to computer networking ", Addison Wesley, 1999.
4. William Stallings, " High speed Networks TCP/IP and ATM Design Principles ", Prentice-Hall, New York, 1995.
5. C.E Perkins, " Ad Hoc Networking ", Addison – Wesley, 2001.

15PCM514	MEDICAL IMAGING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVE:

- Explain the principles of the gamma camera, SPET and PET
- Understand how Doppler and echo information can be combined in an ultrasound image
- Describe what a pulse sequence consists of in magnetic resonance imaging
- Understand the distinction between anatomical functional imaging

UNIT I ULTRASONIC IMAGING 9

Ultra Sound In Medicine - Introduction, production of ultra sound - properties principles of image formation,Capture and display - principles of A -mode, B-mode and M-mode display - Doppler Ultra sound and Colour flow mapping - Applications of diagnostic ultra sound.

UNIT II CT IMAGING 9

X-Ray computed tomography - Principles of sectional imaging - scanner configuration - data acquisition system -image formation principles - conversion of x-ray data in to scan image - 2D image reconstruction techniques -Iteration and Fourier methods. Types of CT scanners.

UNIT III MAGNETIC RESONANCE IMAGING 9

Magnetic Resonance Imaging - Principles of MRI pulse sequence- image acquisition and reconstruction techniques MRI instrumentation magnets gradient system RF coils - receiver system Functional MRI - Application of MRI.

UNIT IV NUCLEAR MEDICINE IMAGING 9

Radio isotope imaging - Rectilinear scanners, linear scanners - SPECT - PET Gamma Camera Radio nuclides for imaging, Emission Computed Tomography.

UNIT V OPTICAL AND THERMAL IMAGING 9

Infra-red Imaging - Physics of thermography - Imaging systems - Pyroelectric vidicon camera clinical thermography- liquid crystal thermography.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Discuss physics of how signals, from which images are formed, are obtained
- Discriminate characteristics of different medical imaging modalities
- Compare the effect of different imaging modalities on the human body
- Explain the principles of the gamma camera, SPET and PET
- Interpret various parameters of medical images for measurement and analysis

REFERENCES:

1. S Webb, Adam Highler, Bristol, " The Physics of Medical Imaging ", IEEE Press New York, 1998.
2. A C Kak, " Principle of Computed Tomography ", IEEE Press New York.
3. G A Hay, " Medical Image Formation Perception and Measurement" .

15PCM515	MIMO COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge about MIMO Channel modeling and system architecture.
- To introduce space time block codes and space time trellis codes.
- To explain the practical applications of MIMO systems.

UNIT I SPATIAL MULTIPLEXING AND CHANNEL MODELING 9

Review of SISO fading communication channels, Multiplexing capability of deterministic MIMO channels, Physical modeling of MIMO Channels, Modelling of MIMO fading channels

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UNIT II CAPACITY AND MULTIPLEXING ARCHITECTURES 9

The V-BLAST architecture, Fast fading MIMO channel, Receiver architectures, Slow fading MIMO channel, D-BLAST: an outage-optimal architecture.

UNIT III DIVERSITY–MULTIPLEXING TRADEOFF AND SPACE TIME BLOCK CODES 9

Diversity–multiplexing tradeoff, Space time block codes on real and complex orthogonal designs, Code design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Orthogonal designs, Generalized orthogonal designs, Quasi-orthogonal designs and Performance analysis.

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UNIT IV SPACE TIME TRELLIS CODES 9

Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.

UNIT V MULTIUSER COMMUNICATION 9

Uplink with multiple receive antennas, MIMO uplink, Downlink with multiple transmit antennas, MIMO downlink, MIMO in 4G (LTE, LTE-Advanced and WiMAX) and beyond.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Develop mathematical models for MIMO Channels
- Explain MIMO architecture
- Design space time block codes
- Design space time trellis codes
- Explain the applications of MIMO systems

REFERENCES:

1. Nei David Tse and Pramod Viswanath , " Fundamentals of Wireless Communication ", Cambridge University Press 2005, Press 2005.
2. Hamid Jafarkhani, , " Space-Time Coding: Theory and Practice ", Cambridge University, Press 2005.
3. Paulraj, R. Nabar and D. Gore, " Introduction to Space-Time Wireless Communications ", Cambridge University, Press 2005.
4. E.G. Larsson and P. Stoica, " Space-Time Block Coding for Wireless Communications ", Cambridge University, Press 2008.
5. M. Janakiraman, "Space-time codes and MIMO systems ", Artech House, 2004.
6. Ezio Biglieri , Robert Calderbank et al, " MIMO Wireless Communications ", Cambridge University, Press 2007.
7. B. Clerckx and C. Oestges, "MIMO Wireless Networks: Channels, Techniques and Standards for Multi-Antenna, Multi-User and Multi-Cell Systems", Academic Press (Elsevier), Oxford, UK, Jan 2013.

15PCM516	BEAMFORMING IN WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the basics of Beamforming.
- To explain the concepts of adaptive beamforming and subband adaptive beamforming.
- To introduce to the students the design techniques of beamformers and the effects of error in DBF.

UNIT I INTRODUCTION TO BEAMFORMING **9**

Array signal processing- narrowband Beamforming-wideband Beamforming- wideband beamsteering- multiple access- digital Beamforming- fundamentals of digital Beamforming- introduction to antenna arrays, analog Beamforming, phased arrays, element-space Beamforming, beam-space Beamforming, two dimensional Beamforming.

UNIT II ADAPTIVE BEAMFORMING **9**

Basic concepts- criteria for optimal weights- adaptive algorithms- LMS algorithm, direct sample covariance matrix inversion, RLS algorithm, neural networks. Partial adaptivity- Reference signal based beamformer-linearly constrained minimum variance Beamforming- constraints in LCMV Beamforming- generalized side lobe canceller- soft constrained minimum variance beamformer- correlation constrained minimum variance beamformer-robust Beamforming.

UNIT III SUBBAND ADAPTIVE BEAMFORMING **9**

Fundamentals of filter banks- Subband adaptive filtering- generalized Subband adaptive Beamforming- Generalized Subband Canceller (GSC)- Subband adaptive GSC- emporally/spatially Subband selective Beamforming- frequency domain adaptive Beamforming- transform domain adaptive Beamforming.

UNIT IV DIGITAL BEAMFORMING **9**

Iterative optimization- least squares approach- Eigen filter approach- digital Beamforming networks- element-space and beam-space networks- DBF with multiple access schemes- DBF with TDMA, DBF with FDMA and DBF with CDMA.

UNIT V ERROR EFFECTS IN DBF **9**

Error sources in DBF antenna arrays- random errors and nonlinearities in receivers- quantization errors in DBF arrays- complex signal quantization error and quantization noise in Beamforming- random errors in DBF arraysbeam pattern, fractional loss in main beam gain, pointing error, side lobes and effect of element failurenonlinearities in DBF arrays- modeling of nonlinearities, receiver nonlinearity effects on fixed Beamforming and receiver nonlinearity effects on adaptive Beamforming.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Illustrate the applications of beamforming.
- Explain the various adaptive beamforming techniques.
- Explain the various subband adaptive beamforming techniques.
- Discuss about the design and simulation of various beamformers.
- Explain the effects of error in DBF and methods of reducing it.

REFERENCES:

1. Wei Liu and Stephen Weiss, " Wideband Beamforming-concepts and techniques ", John Wiley and Sons. 2010.
2. John Litva and Titus Kwok-Yeung Lo, " Digital Beamforming in Wireless Communication ", Artech House1996.
3. By Yikun. Yu, Petrus Gerardus Maria Baltus, Arthur H. M. Van, " Roermund Integrated 60GHz RF ", Springer, 2011.

15PCM517	NETWORK MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on computer network technology.
- To give an overview of OSI Network Management and the applications of network management.
- To explain the internet management (SNMP) and the broadband network management.

UNIT I FUNDAMENTALS OF COMPUTER NETWORK TECHNOLOGY 9

Network Topology, LAN, Network node components- Hubs, Bridges, Routers, Gateways, Switches, WAN, ISDN Transmission Technology, Communications protocols and standards

UNIT II OSI NETWORK MANAGEMENT 9

OSI Network management model-Organizational model-Information model, communication model. Abstract Syntax Notation - Encoding structure, Macros Functional model CMIP/CMIS.

UNIT III INTERNET MANAGEMENT (SNMP) 9

SNMP-Organizational model-System Overview, The information model, communication model-Functional model, SNMP proxy server, Management information, protocol remote monitoring. RMON SMI and MIB, RMON1, RMON2 – A case study of Internet traffic using RMON.

UNIT IV BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology-VP,VC,ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN. ATM Network Management-ATM Network reference model, integrated local management Interface. ATM Management Information base, Role of SNMD and ILMI in ATM Management, M1, M2, M3, M4 Interface. ATM Digital Exchange Interface Management.

UNIT V NETWORK MANAGEMENT APPLICATIONS 9

Configuration management, Fault management, performance management, Event Correlation Techniques, security Management, Accounting management, Report Management, Policy Based Management, Service Level Management

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Describe the network topologies and its components used in computer networks.
- Relate SNMP model with OSI model.
- Show how to apply network management standards to manage practical networks.
- Compare internet management and broad band network management.
- Explain various management methods of a network.

REFERENCES:

1. Mani Subramanian, " Management Principles and practice ", Addison Wesly, New York, 2000.
2. Salah Aiidarous, Thomas Plevayk, " Telecommunications Network Management Technologies and Implementations ", IEEE press, Eastern Economy Edition, New Delhi, 1998.
3. Rajiv Ramaswami , Kumar N. Sivarajan, " Optical Networks : A Practical Perspective ", Harcourt Asia Pte Ltd., Second Edition, 2004.
4. Behrouz A.Forouzan, " Data Communications and Networking ", Tata McGraw Hill, 2nd Edition, 2003.

15PCM518	COMMUNICATION PROTOCOL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge on network reference model and protocol specifications.
- To explain the various protocol verification and validation approaches
- Give knowledge on protocol conformance, performance testing and their implementation and synthesis.

UNIT I NETWORK REFERENCE MODEL 9

Communication model-software, subsystems, protocol, protocol development methods,Protocol engineering process, Layered architecture, Network services and Interfaces, Protocol functions, OSI model ,TCP/IP protocol suite.

UNIT II PROTOCOL SPECIFICATIONS 9

Components of protocol, Specifications of Communication service, Protocol entity ,Interface, Interactions, Multimedia protocol, Internet protocol, SDL, SDL based protocol other protocol specification languages.

UNIT III PROTOCOL VERIFICATION/VALIDATION 9

Protocol verification, Verification of a protocol using finite state machines, Protocol validation, protocol design errors, Protocol validation approaches, SDL based protocol verification and validation.

UNIT IV PROTOCOL CONFORMANCE/PERFORMANCE TESTING 9

Conformance testing methodology and frame work, Conformance test architectures, Test sequence generation methods, Distributed architecture by local methods, Conformance testing with TTCN, systems with semi controllable interfaces - RIP,SDL based tools for conformance testing, SDL based conformance testing of MPLS Performance testing, SDL based performance testing of TCP and OSPF, Interoperability testing, SDL based interoperability testing of CSMA/CD and CSMA/CA protocol using Bridge, Scalability testing.

UNIT V PROTOCOL SYNTHESIS AND IMPLEMENTATION 9

Protocol synthesis, Interactive synthesis algorithm, Automatic synthesis algorithm, Automatic synthesis of SDL from MSC, Protocol Re-synthesis; Requirements of protocol implementation, Object based approach to protocol implementation, Protocol compilers, Tool for protocol engineering.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Describe the various network models .
- Analyze the protocol specifications and SDL based protocol.
- Relate the different protocol validation and verification.
- Explain the types of testing in protocol performance and conformance.
- Explain various protocol synthesis and implementation.

REFERENCES:

1. Pallapa Venkataram and Sunilkumar S.Manvi, " Communication protocol Engineering ", Eastern Economy edition, 2004.
2. Richard Lai and Jirachief pattana, " Communication Protocol Specification and Verification ", Kluwer Publishers, Boston, 1998.
3. Tarnay. K, " Protocol Specification and Testing ", Plenum, New York, 1991.
4. Mohamed G. Gouda, " Elements of Network Protocol Design ", John Wiley & Sons, Inc, New York, USA, 1998.

15PCM519	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
- To give an idea about the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.
- To give an idea about the evolving next generation wireless networks and their associated challenges.

UNIT I INTRODUCTION TO SDR 9

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

UNIT II SDR ARCHITECTURE 9

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

UNIT III INTRODUCTION TO COGNITIVE RADIOS 9

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

UNIT IV COGNITIVE RADIO ARCHITECTURE 9

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

UNIT V NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design, White Space Radio.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Describe the fundamentals of SDR .
- Explain the essential functions of SDR architecture.
- Analyze the various cognitive radio communication strategies.
- Apply the new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
- Develop the solutions in future wireless network design.

REFERENCES:

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

15PCM520	COMMUNICATION NETWORK DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an idea about the functional elements and evolution of networking, multiplexing,
- Give knowledge on switching and routing.
- To review the various aspects of a protocol and implement it using a network simulation tool.

UNIT I INTRODUCTION **9**

Importance of Quantitative Modeling in Engineering of Telecommunication Networks, The Functional Elements of Networking, Evolution of Networking in the Wired and Wireless Domain.

UNIT II MULTIPLEXING **9**

Performance Measures and Engineering Issues Network performance and source characterization, Circuit multiplexed Networks, packet Multiplexing over wireless networks, Events and processes in packet multiplexer models, Deterministic traffic Models and network calculus, stochastic traffic models, LRD traffic, Link Scheduling and network capacity in wireless networks.

UNIT III SWITCHING **9**

Performance Measures of packet switches and circuit switches, queuing in packet switches, delay Analysis in Output Queued Switch, Input Queued Switch and CIOQ Switch with Parallelism, Blocking in Switching Networks, Closed Networks.

UNIT IV ROUTING **9**

Algorithms for Shortest Path Routing - Dijkstra's Algorithm, Bellman Ford Algorithm, Generalized Dijkstra's Algorithm, Optimal Routing, Routing Protocols-Distance Vector, Link State and Exterior gateway protocols, Formulations of the Routing Problem-minimum interference Routing, MPLS, QoS Routing, Non additive and Additive metrics.

UNIT V CASE STUDIES **9**

Design of a wireless network and a wired network, prototype implementation to be simulated in a network simulator. A routing algorithm for mixed wired and wireless networks – ADV static(ADVS) Routing algorithm.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Review the importance of functional elements and network evolution.
- Analyze the different multiplexing and deterministic traffic models.
- Explain the performance of various switches and analyze the input/output queued switches.
- Describe the basic types of routing techniques.
- Infer the knowledge in various prototype implementations.

REFERENCES:

1. Anurag Kumar, D. Manjunath and Joy, " Communication Networking ", Morgan Kaufan Publishers, 2005.
2. A.Lean Garica and Indra Widjaja, " Communications Networks ", Tata Mc Graw Hill, 2004.

3. Thomas G.Robertazzi, “ Computer Networks and Systems ”, Springer, Third Edition, 2006.
4. Keshav.S, “ An Engineering Approach to Computer Networking ”, Addison – Wesley, 1991.

15PCM521	DIGITAL COMMUNICATION RECEIVERS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To introduce the various Demodulation and Synchronization Techniques.
- To impart knowledge about parameter synchronization and receiver structure for fading channels**.**
- To familiarize the students with various channel equalization techniques.

UNIT I DEMODULATION 9

Gaussian basics, Hypothesis testing basics, Signal space concepts - Geometrical representation of signals, Receiver structure and sufficient statistics, Decision region, Optimal reception in AWGN, Performance analysis of ML reception, Link budget analysis.

UNIT II SYNCHRONIZATION 9

Receiver design requirements, Parameter estimation basics, Parameter estimation for synchronization, Carrier phase estimation, Symbol timing estimation, Joint carrier phase and symbol timing estimation.

UNIT III PARAMETER SYNCHRONIZATION FOR FADING CHANNELS 9

Data aided and non data aided flat fading channel estimation and detection, Data aided and non data aided selective fading channel estimation and detection.

UNIT IV RECEIVER STRUCTURE FOR FADING CHANNELS 9

Outer and inner receiver for fading channels, Inner receiver for frequency selective and flat fading channels, Rake receivers, Non-coherent communication – Hypothesis testing, Optimal demodulation, Differential modulation and demodulation, Performance.

UNIT V CHANNEL EQUALIZATION 9

The channel model, Receiver front end, Eye Diagrams, Maximum likelihood sequence estimation, Geometrical model for suboptimal equalizer design, Linear equalization, Decision feedback equalization, Performance analysis of MLSE, Adaptive equalization.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Explain the signal space concepts of different digital modulation schemes.
- Estimate carrier phase and symbol timing of the received signal.
- Describe channel estimation of flat fading and selective fading channels.
- Analyze the receiver structures of different fading channels.
- Compare the various channel equalization techniques .

REFERENCES:

1. Upamanyu Madhow, " Fundamentals of Digital Communication ", Cambridge University press, 2008.
2. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication Receivers ", Vol I & Vol II, John Wiley, New York, 1997.

3. John G. Proakis and Masoud Salehi, “ Digital Communications ”, McGraw-Hill International Editions, 4th Edition, 2008.
4. Andrea Goldsmith, “ Wireless Communications ”, Cambridge university press, 2005.
5. Theodore S Rappaport, “ Wireless Communications – Principles and practice ”, Pearson Education, 2nd Edition, 2012.

15PCM522	SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give knowledge on sensor networks and their localization and positioning.
- To explain the concepts of routing protocols and topology control.
- To outline the concepts of sensor networks security.

UNIT I INTRODUCTION 9

Wireless Sensor Networks - Characteristics requirements- -Unique Constraints and Challenges – Difference between Mobile adhoc and Sensor Networks- Advantages of sensor networks - Sensor Node Architecture - Sensor Network Architecture - Sensor Networks Applications-Enabling technologies for Wireless Sensor Network.

UNIT II LOCALIZATION AND POSITIONING 9

Properties of localization and positioning procedures, Possible approaches, Mathematical basics for the lateration problem, Single-hop localization, Positioning in multi hop environments, Impact of anchor placement.

UNIT III ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORKS 9

Introduction, Background, Data Dissemination and Gathering, Routing Challenges and Design Issues in WSN. Network Scale and Time-Varying Characteristics, Resource Constraints, Data Models, Routing Strategies in WSN, WSN Routing Techniques, Flooding and its Variants, Sensor Protocols for Information via Negotiation, Low Energy Adaptive Clustering Hierarchy, Power Efficient Gathering in Sensor Information Systems Directed Diffusion, Geographical Routing.

UNIT IV TOPOLOGY CONTROL 9

Motivation and basic ideas, Controlling topology in flat networks – Power control, Hierarchical networks by dominating sets, Hierarchical networks by dominating sets, Combining hierarchical topologies and power control, Adaptive node activity.

UNIT V SENSOR NETWORK SECURITY 9

Introduction, Attacks on Sensor Networks , Security Objectives for Sensor Networks ,Key Management in Sensor Networks, Secure Routing in Sensor Networks, Security Protocols for Wireless Sensor Networks ,Introduction ,Security Protocols in Sensor Networks ,Sensor Network Security Requirements.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Summarize the advantages and applications of sensor networks.
- Discuss the different methods of localization and positioning methods.
- Analyze the various routing protocols in sensor networks.
- Distinguish the flat and hierarchical network topology control.
- Explain the security concepts of wireless sensor networks.

REFERENCES:

1. Holger Karl And Andreas Willig, " Protocols and Architectures for Wireless Sensor Networks ", John Wiley & Sons, 2005.
2. Kazem Sohraby, Daniel Minoli, & Taieb Znati, " Wireless Sensor Networks-s Technology, Protocols, And Applications ", John Wiley, 2007.
3. Anna Hac, " Wireless Sensor Network Designs ", John Wiley, 2003.
4. Yingshu Li, My T. Thai,Weili Wu, " Wireless Sensor Networks and Applications ", Springer, 2008.

15PCM523	ULTRA WIDE BAND (UWB) COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart the overview of ultra wideband systems.
- To summarize the performance characteristics of UWB communication systems
- To give an idea about UWB system design

UNIT I INTRODUCTION TO UWB SYSTEMS 9

Overview of UWB - UWB Concept - UWB Signals: Impulse(I) and Multi-Carrier(MC) Signals, Uniqueness of UWB Systems; I-UWB System Model; MC-UWB System Model. Advantages of UWB Systems - Challenges in UWB Systems - Single Band Vs Multi Band - Applications of UWB Systems - Regulatory, Legal & Other Controversial Issues.

UNIT II UWB TRANSMITTER DESIGN 9

IUWB Signal Generators: Avalanche Pulse Generators, Step Recovery Diode Pulse

Generators, Tunnel Diode Pulsers, Pulse Circuits Suitable for Integrated Circuits. Modulators. I-UWB Transmitters: TH-PPM and TH(A-PAM) UWB Signals, OOC-PPM UWB Signals, DSUWB Signals, TR UWB System. MC-UWB Transmitters: CI-UWB Signals, FH-UWB Systems, OFDM-UWB Systems. Spectral Encoded UWB Communication System.

UNIT III IUWB RECEIVER DESIGN 9

System Model, Threshold/Leading Edge Detection, Correlation Detection (CD) Receivers, RAKE Receivers, Multi-User Detection (MUD) UWB Receivers, Hybrid RAKEIMUD Receivers, Auto Correlation TR UWB Receivers, Synchronization and Timing Issues, Digital I-UWB Implementation.

UNIT IV MC - UWB RECEIVER DESIGN 9

Icarrier Interferrometry(CI) UWB Receivers, Frequency Hopped(FH) UWB Receivers, OFDM - UWB Receivers, Spectral Encoded UWB Communication System. Methods of Improving Range of UWB using RAKE Receivers. Overview of UWB Simulation techniques.

UNIT V INTERFERENCE, COEXISTENCE & UWB ANTENNAS 9

Interference of UWB on NB: UWB Pulse Model, Effect of NB Receive Filter, BER Analysis, Time-Hopped Case. Aggregate of UWB Interference Modeling: Received Power, Asymptotic PDF of Aggregate Noise, Amplitudes: Aggregated PDF, Bernoulli and Poisson Models. Interference Analysis: NB on UWB, UWB on UWB. Basic Properties of UWB Antennas.

TOTAL: 45 Periods

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to:

- Explain the concepts of UWB system.
- Design and analysis UWB transmitter section
- Design and analysis UWB receiver section
- Describe the MC – UWB receiver section
- Evaluate the UWB system Performance

REFERENCES:

1. Jeffrey H. Reed, “ An Introduction to UWB Communication Systems ”, Prentice Hall, 2005.
2. Robert Aiello and Anuj Batra, “ UWB Systems: Technologies and Applications ”, Newnes-Elsevier, 2006.
3. Faranak Nekoogar, “ UWB Communications: Fundamentals and Applications ”, Prentice Hall, 2005.

15PCM524	WIRELESS BODY AREA NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an overview of wireless sensor networks and their applications in Healthcare and issues related specific to Healthcare applications.
- To explain the fundamentals and principles of wireless Body Area Networks.
- To introduce the standards related to Wireless Body Area Networks.

UNIT I OVERVIEW OF WIRELESS SENSOR NETWORKS 9

Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Enabling Technologies for Wireless Sensor Networks – Operating Systems – Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.

UNIT II FREQUENCY REGULATIONS 9

Frequency regulations on candidate frequency bands in different countries and regions, Ultra wideband (UWB), industrial, scientific, and medical (ISM), medical implant communication service (MICS), and wireless medical telemetry system (WMTS).

UNIT III WIRELESS SENSOR NETWORKS FOR HEALTHCARE APPLICATIONS 9

General approach to WSN in Healthcare – Key Principles, Methodology – Architecting WSN solutions for Healthcare – Hardware, Firmware and Software Choices.

UNIT IV ANTENNA, PROPAGATION AND CHANNEL MODELING 9

Antenna, propagation, and channel modeling related to WBAN – Effects of radio frequency on tissues and organs and effects of human tissues on RF propagations.

UNIT V NETWORKING OF SENSORS 9

Physical (PHY) layer technologies – Narrow band and UWB – Medium access control (MAC) technologies for WBAN – Unified MAC design independent of underlying PHY technologies; Standardization with IEEE802.15.6, IEEE 11073, and ETSI eHealth Project.

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TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Explain the overview of WBAN.
- Explain about frequency regulations for various systems.
- Describe about WSN for healthcare applications.
- Model WBAN antenna and evaluate the effect of RF signal on human tissues.
- Describe about the technologies and standards for WBAN systems.

REFERENCES:

1. Kaveh Pahlavan, Prasanth Krishnamoorthy, " Principles of Wireless Networks ", Pearson Education, First Edition, 2003.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, " Principles of Mobile Computing ", Springer, 2003.
3. C.K. Toh, " AdHoc Mobile Wireless Networks ", Pearson Education, First Edition, 2002.
4. Burkhardt, " Pervasive Computing ", Pearson Education, First Edition, 2003.
5. Terrance J. Dishongh and Michael Mcgrath, " Wireless Sensor Networks for Healthcare Applications ", Artech House, First edition, October 30, 2009, ISBN – 978-1596933057.
6. Huan-Bang Li, Kamya Yekeh Yazdandoost, and Bin Zhen, " Wireless Body Area Network ", River Publishers' Series in Information Science and Technology, Oct 29, 2010, ISBN : 978-87-92329-46-2. .

LIST OF ELECTIVES

(For Ph.D Scholars)

LIST OF ELECTIVES (For Ph.D.Scholars)

S.No	Course Code	Course Title	L	T	P	C
1.	**15PCM525**	Green Radio Networks	**3**	**0**	**0**	**3**
2.	**15PCM526**	Application of DSP Techniques in Communication Systems	**3**	**0**	**0**	**3**
3.	**15PCM527**	EM Band Gap Structures for Antenna	**3**	**0**	**0**	**3**
4.	**15PCM528**	Modern Planar Antennas	**3**	**0**	**0**	**3**
5.	**15PCM529**	Pattern Recognition	**3**	**0**	**0**	**3**

15PCM525	GREEN RADIO NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart the students to understand the evolving paradigm of cooperative and green wireless communication concepts and the challenges and trade-offs involved in such networks.
- To explain the different power saving strategies, energy efficient signal, system and network design.
- To give an idea about the energy saving techniques adopted in existing wireless components, protocols and networks and the evolution of green future wireless communication technologies.

UNIT I COOPERATIVE COMMUNICATIONS AND GREEN CONCEPTS 9

Network architectures and research issues in cooperative cellular wireless networks ; Cooperative Communications in OFDM and MIMO cellular relay networks: issues and approaches; Fundamental trade-offs on the design of green radio networks, Green modulation and coding schemes, operative techniques for energy efficiency.

UNIT II COOPERATIVE BASE STATION TECHNIQUES 9

Cooperative base station techniques for cellular wireless networks; Turbo base stations ; Antenna architectures for cooperation; Cooperative communications in 3GPP LTE-Advanced,Partial information relaying and Coordinated multi-point transmission in LTE-Advanced.

UNIT III RELAY-BASED COOPERATIVE CELLULAR NETWORKS 9

Distributed space-time block codes ; Collaborative relaying in downlink cellular systems ; Radio resource optimization; Adaptive resource allocation ; Cross-layer scheduling design for cooperative wireless two-way relay networks ; Network coding in relay-based networks

UNIT IV GREEN RADIO NETWORKS 9

Base Station Power-Management Techniques- Opportunistic spectrum and load management, Energy-saving techniques in cellular wireless base stations , Power-management for base stations in smart grid environment , Cooperative multicell processing techniques for energy-efficient cellular wireless communications , Green communications in cellular networks with fixed relay nodes.

UNIT V ACCESS TECHNIQUES FOR GREEN RADIO NETWORKS 9

Cross-layer design of adaptive packet scheduling for green radio networks; Energy-efficient relaying for cooperative cellular wireless networks ; Energy performance in TDD-CDMA multihop cellular networks ; Resource allocation for green communication in relay-based cellular networks ; Green Radio Test-Beds and Standardization Activities.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Discuss the necessity and the design aspects of cooperative and green wireless communication.
- Summarize the cooperative base station techniques for cellular wireless network.
- Design the network coding in relay based networks.
- Explain the power management techniques in green radio networks.
- Outline the resource allocation for green communication in relay based cellular networks.

REFERENCES:

1. Ekram Hossain, Dong In Kim, Vijay K. Bhargava, “ Cooperative Cellular Wireless Networks ”, Cambridge University Press, 2011.
2. Ekram Hossain, Vijay K. Bhargava(Editor), Gerhard P. Fettweis (Editor), “ Green Radio Communication Networks ”, Cambridge University Press, 2012.
3. Shafiullah Khan, Jaime Lloret Mauri, “ Green Networking And Communications: Ict For Sustainability ”, CRC Press, 2013.
4. Francine Krief, “ Green Networking ”, Wiley-ISTE, 2012.

15PCM526	APPLICATION OF DSP TECHNIQUES IN COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge of DSP in basic communication techniques.
- To give an overview of SAR image processing.
- To explain about channel simulator.

UNIT I DSP FOR COMMUNICATION SYSTEMS 9

Applications of DSP in telecommunications: echo cancellation, trans multiplexers, voice-compression, and waveform generation.

UNIT II CHANNEL CHARACTERIZATION 9

Radio Channel Measurement Using a Hybrid Simulation Approach, VHF Troposcatter Communication Channels, Implementation of a Digital Frequency Selective Fading Simulator, Development of a Real Time Wide Band Channel Simulator for LEO Satellite Channels Portable Channel Characterization Sounder. A Flexible DSP-Based System for Propagation Path Characterization.

UNIT III DSP SIGNAL DETECTION 9

Non-Stationary, Narrowband Gaussian Signal Discrimination in Time-Frequency Space, Adaptive CFAR Tests for Detection of a Signal in Noise and Deflection Criterion Adaptive Signal Equalisation for Frequency Discriminator Output Signal in a Mobile Channel, Combination of a Viterbi Decoder with an Adaptive Neural Equaliser over a Rician Fading Channel, Tracking Behaviour of Lattice Filters for Linear and Quadratic FM Signals.

UNIT IV DSP SYSTEM DESIGN AND IMPLEMENTATION 9

High performance DSP Implementation with FPGA, DSP Based Diversity Modem for FDMA and TDMA Mobile Satellite Applications, Scare-State-Transition Viterbi Decoding of Punctured Convolutional Codes for VLSI Implementation, DSP principles and signal characteristics in both analog and digital domains, advanced signal sampling, and interpolation techniques

UNIT V DSP APPLICATIONS IN RADAR IMAGE PROCESSING 9

System Model and Data Acquisition of SAR image: System model of Range Radar imaging- System model of Cross-Range Radar imaging-Data Acquisition, sampling and power spectrum of Radar image- Range-Doppler processing on SAR images-stolt interpolation processing on SAR images: Wave number Domain processing of SAR data-Direct interpolation from unevenly spaced samples-Reconstruction of satellite radar image data-comparision between Range-Doppler and stolt interpolation on SAR data processing

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to:

- Explain the applications of DSP in communication system.
- Discuss the implementation of Real Time Wide Band Channel Simulator for LEO Satellite Channels.
- Design simple convolutional codes using VLSI technique.
- Design a data acquisition system for SAR images.
- Compare the data processing of SAR images using range Doppler and interpolation methods.

REFERENCES:

1. Wysocki, Tadeusz, Razavi, Hashem, Honary, Bahram, " Digital Signal Processing for Communication Systems ", The Springer International Series in Engineering and Computer Science Vol. 403, 1997.
2. Kishan Shenoi, " Digital Signal Processing In Telecommunications ", Telecom Solutions,Inc., Prentice Hall, San Jose California, 1995.
3. Bu chin wang, " Digital Signal Processing Techniques and Applications in RAD Image Processing ", Wiley, First Edition, 2008.
4. Marvin Frerking, "Digital Signal Processing in Communications Systems", Springer, 2004.

15PCM527	EM BANDGAP STRUCTURES FOR ANTENNAS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart knowledge about the mathematical tool for electromagnetic.
- To give an idea about the Band Gap structure and its applications.
- To introduce the knowledge of photonic crystals.

UNIT I MATHEMATICAL TOOLS FOR EM 9

Finite difference method – Finite element method – Moment method – Transmission line matrix method - Finite difference time domain method.

UNIT II MATERIALS AND APPLICATIONS 9

EBG & PBG materials – uses in EMC – uses in micro strip antennas – uses in wave guides – limitations of EBG & PBG - applications of EBG & PBG .

UNIT III BANDGAP STRUCTURES AND CLASSIFICATIONS 10

Introduction of electromagnetic band gap structures –configuration – photonic band gap structures – configuration – Band gap characterization – classifications of EBG & PBG.

UNIT IV PHOTONIC CRYSTALS 10

The traditional multilayer film - A one dimensional photonic crystal – physical origin of photonic band gaps – evanesant modes – off axis propagation – localized modes of defects – surface states.

UNIT V DESIGN OF PHOTONIC CRYSTALS 7

Design of photonic crystals for various applications – a reflecting dielectric – a resonant cavity – a wave guide.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Explain various numeric methods for electromagnetic
- Evaluate various EBG materials and its usage
- Describe band gap structure and its classifications
- Describe photonic crystal structure
- Design photonic crystals for antenna applications.

REFERENCES:

1. Mathew N. O. Sadiku, " Numerical Techniques in Electromagnetics ", CRC Press,IInd Edition, 2001.
2. Fanyang & Yahya Rahmat- Samii, " Electromagnetic Band gap structures in Antenna Engineering", (The Cambridge RF & microwave Engineering series).
3. Joannopoulos .J, Meade .R.D and Winn .J.N, " Photonic crystals: molding the flow of lights ", Princeton Univ. press. 1995.
4. Inoue, Ohtaka, " Photonic crystals: Physics, fabrication & application ", (Springer series in optical sciences).

15PCM528	MODERN PLANAR ANTENNAS	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To give an idea about planar antennas.
- To introduce various modern mobile antennas.
- To make knowledge about dielectric resonator antennas.

UNIT I MOBILE ANTENNAS 9

Introduction, Dual frequency PIFA, Triple frequency PIFA, PIFA with an L shaped ground, stacked PIFA , Ground plane effect on impedance bandwidth of the PIFA.

UNIT II BASE STATION ANTENNAS 9

Introduction, Antenna for single band operation, Antenna for dual band and multiband operation , Antenna for dual polarized operation using two same feed, Antenna for dual polarized operation using hybrid feeds, Antenna for dual band dual polarized operation.

UNIT III LOW PROFILE MONOPOLE ANTENNA 9

Introduction , Branch line planar monopole , Branch patch planar monopole, Branch patch planar monopole in a wrapped structure – planar monopole with slits, rectangular spiral planar monopole , Dual band monopole chip antenna, Folded planar monopole – Inverted L wire monopole, Printed L wire monopole, shorted monopole with reduced backward radiation.

UNIT IV ANTENNAS FOR WLAN APPLICATIONS 9

Introduction, WLAN access point antennas, surface mountable antennas, Printed monopole antenna for dual band operation, Printed dipole antenna for dual band operation, PIFA for dual WLAN (or) ISM bands, Low cost compact dual polarized microstrip antenna for WLAN operation.

UNIT V DIELECTRIC RESONATOR ANTENNAS 9

Introduction, Single feed single element circularly polarized DR antenna, two element circularly polarized DR antenna, Integration of antennas for different operation bands: Introduction, Integration of two separate DCS and WLAN antennas, Integration of two separate DCS and GPS.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Categorize Planar mobile antennas.
- Describe the principles of base station antennas for various bands.
- Explain about the operation of monopole antennas.
- Explain about planar antennas for WLAN applications.
- Elaborate the operations of different dielectric resonator antennas

REFERENCES:

1. Kin-Ln-Wong, " Planar antenna for Wireless Communication ", John- Wiley, 2002.
2. Krauss.J.D, " Antennas ", John Wiley and sons, II edition, New York, 1997.

15PCM529	PATTERN RECOGNITION	L	T	P	C
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OBJECTIVE:

- To Introduce the statistical theory in pattern recognition .
- To give knowledge on parametric and nonparametric models.
- To explain the various clustering algorithms in Pattern Recognition.

UNIT I INTRODUCTION **9**

Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis

UNIT II STATISTICAL PATTERN RECOGNITION **9**

Statistical Patten Recognition: Bayesian Decision Theory – Classifiers – Normal density and discriminant functions.

UNIT III MODELS **9**

Parameter estimation methods: Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear Discriminant analysis – Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models.

UNIT IV NON PARAMETRIC TECHNIQUES **9**

Nonparametric Techniques: Density Estimation – Parzen Windows – K-Nearest Neighbor Estimation – Nearest Neighbor Rule – Fuzzy classification.

UNIT V CLUSTERING TECHNIQUES **9**

Unsupervised Learning and Clustering: Criterion functions for clustering – Clustering Techniques: Iterative square – Error partitional clustering – K-Means – agglomerative hierarchical clustering – Cluster validation.

TOTAL: 45 Periods

COURSE OUTCOMES:

After successful completion of this course the students will be able to :

- Outline the basic principles and application of Linear algebra in pattern recognition
- Introduce various pattern recognition methods using Statistical theory.
- List the Parameter estimation and Dimension reduction methods
- Categorize the various non parametric techniques in Pattern Recognition.
- Summarize the various clustering Techniques used in Pattern Recognition.

REFERENCES:

1. Richard O. Duda, Peter E. Hart, David G. Stork, " Pattern Classification ", John Wiley, 2nd Edition, 2006.

2. Bishop Christopher M, " Pattern Recognition and Machine Learning ", Springer, 1st Edition, 2009.
3. Theodoridis S, Koutroumbas K, " Pattern Recognition ", Academic Press, 4th Edition, 2009.
4. Keinosuke Fukunaga, " Introduction to Statistical Pattern Recognition ", Academic Press, 2nd Edition, 2003.
5. Sergios Thedoridis, Konstantinos Koutroumbas, " Pattern Recognition ", Academic Press, 4th Edition, 2009.