Curricula and Syllabi

of

M.E- Communication Systems

Regulations 2022

Choice Based Credit System

Department of Electronics & Communication Engineering

ADHIYAMAAN COLLEGE OF ENGINEERING

[An Autonomous Institution Affiliated to Anna University, Chennai]

[Accredited by NAAC]

Dr. M.G.R NAGAR

HOSUR, KRISHNAGIRI (DT) - 635 130

TAMILNADU, INDIA

ADHIYAMAAN COLLEGE OF ENGINEERING (AUTONOMOUS), HOSUR

(AUTONOMOUS)
AFFILIATED TO ANNA UNIVERSITY
M.E. COMMUNICATION SYSTEMS
REGULATIONS – 2022
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	122COT01	Linear Algebra, Probability and Queuing Theory	FC	3	1	0	4	4
2	122COT02	Advanced Digital Signal Processing	PCC	3	0	0	3	3
3	122COT03	Modern Digital Communication Techniques	PCC	3	0	0	3	3
4	122COT04	Advanced Wireless Communication	PCC	3	0	0	3	3
5	122COT05	Advanced Radiation Systems	PCC	3	0	0	3	3
6	122COT06	Research Methodology & IPR	RMC	3	0	0	3	3
7	122COAXX	Audit Course-1*	AC	2	0	0	2	0
PRACTICAL								
8	122COP07	Advanced Communication Systems Laboratory-I	PCC	0	0	2	2	1
9	122COP08	Advanced Digital Signal Processing Laboratory	PCC	0	0	2	2	1
	Total			20	1	4	25	21

SEMESTER II

S.NO	COxURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	222COT01	RF system design	PCC	3	0	0	3	3
2	222COT02	Photonic and Microwave Integrated Circuits	PCC	3	0	0	3	3
3	222COT03	Advanced Wireless Networks	PCC	3	0	0	3	3
4	222COEXX	Professional Elective I	PEC	3	0	0	3	3
5	222COEXX	Professional Elective II	PEC	3	0	0	3	3
6	222COOXX	Open Elective	OEC	3	0	0	3	3
7	222COAXX	Audit Course-II	AU	2	0	0	2	0
PRACTICAL								
8	222COP07	Advanced Communication Systems Laboratory - II	PCC	0	0	2	2	1
9	222COP08	Term Paper and Seminar	EEC	0	0	2	2	1
Total				20	0	4	24	20

*Audit course is optional

SEMESTER III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	322COT01	Optical and Mobile Communication Networks	PCC	3	0	0	3	3
2	322COT02	Machine Learning	PCC	3	0	0	3	3
3	322COEXX	Professional Elective III	PEC	3	0	0	3	3
4	322COEXX	Professional Elective IV	PEC	3	0	0	3	3
PRACTICAL								
1	322COP05	Project Work Phase – I	EEC	0	0	12	12	6
Total				12	0	12	24	18

SEMESTER IV

S.NO	COURSE CODE	COURSE NAME	CATEGORY	L	T	P	TOTAL CONTACT PERIODS	C
PRACTICAL								
1	422COP01	Project Work Phase – II	EEC	0	0	24	24	12
	Total			0	0	24	24	12

Professional Electives
Semester II, Elective I

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	222COE01	Electromagnetic Interference and Compatibility	PEC	3	0	0	3	3
2	222COE02	WDM Optical Networks	PEC	3	0	0	3	3
3	222COE03	High Speed Switching Architecture	PEC	3	0	0	3	3
4	222COE04	Wavelets and Multi-Resolution Processing	PEC	3	0	0	3	3
5	222COE05	Signal Integrity in High-Speed Design	PEC	3	0	0	3	3
6	222COE06	Advanced Satellite Communication and Navigation systems	PEC	3	0	0	3	3

Semester II, Elective II

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	222COE07	Multimedia Compression Techniques	PEC	3	0	0	3	3
2	222COE08	Cognitive Radio	PEC	3	0	0	3	3
3	222COE09	Speech and Audio Signal Processing	PEC	3	0	0	3	3
4	222COE10	mm Wave Communication	PEC	3	0	0	3	3
5	222COE11	Mixed - Signal Circuit Design	PEC	3	0	0	3	3
6	222COE12	Sensor Networks and IoT	PEC	3	0	0	3	3

Semester III, Elective III

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	322COE01	Smart Antennas	PEC	3	0	0	3	3
2	322COE02	VLSI for Wireless Communication	PEC	3	0	0	3	3
3	322COE03	RF MEMS	PEC	3	0	0	3	3
4	322COE04	Analysis and Design of Planar Transmission Lines	PEC	3	0	0	3	3
5	322COE05	Ultra-Wide band Communications	PEC	3	0	0	3	3
6	322COE06	Software Defined Radio	PEC	3	0	0	3	3

Semester III, Elective IV

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	322COE07	Advanced Digital Image Processing	PEC	3	0	0	3	3
2	322COE08	Embedded Systems for Communication	PEC	3	0	0	3	3
3	322COE09	Detection and Estimation theory	PEC	3	0	0	3	3
4	322COE10	Optical Signal Processing	PEC	3	0	0	3	3
5	322COE11	Ad Hoc Network	PEC	3	0	0	3	3
6	322COE12	Remote Sensing	PEC	3	0	0	3	3

Audit Courses (AC)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	X22COA01	English for Research Paper Writing	AC	2	0	0	2	0
2	X22COA02	Disaster Management	AC	2	0	0	2	0

3	X22COA03	Constitution of India	AC	2	0	0	2	0
4	X22COA04	நற்றமிழ் இலக்கியம்	AC	2	0	0	2	0

Open Electives (OE) from other departments

S.No	Course Code	Course Title	Category	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	222COO01	Energy Auditing and management	OEC	3	0	0	3	3
2	222COO02	HVDC and FACTS Controllers	OEC	3	0	0	3	3
3	222COO03	Power Electronics for Renewable Energy Systems	OEC	3	0	0	3	3
4	222COO04	Design of Hybrid and Electric vehicles	OEC	3	0	0	3	3
5	222COO05	Industry 4.0	OEC	3	0	0	3	3
6	222COO06	Industrial Internet of Things	OEC	3	0	0	3	3

Allocation of Credits:

Semester	I	II	III	IV
Credits	21	20	18	12
Total	71			

SUMMARY

S.No	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL	WEIGHTAGE
		I	II	III	IV		
1.	FC	4				4	5.63%
2.	PCC	14	10	6		30	42.25%
3.	PEC		6	6		12	16.9%
4.	OEC		3			3	4.22%
5.	EEC		1	6	12	19	26.76%
6.	RMC	3				3	4.22%
7.	Non Credit/ Audit Course	✓					
	TOTAL CREDIT	21	20	18	12	71	100%

Foundation Courses (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	122COT01	Linear Algebra, Probability and Queuing Theory	3	1	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S.No.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	122COT02	Advanced Digital Signal Processing	3	1	0	4	I
2	122COT03	Modern Digital Communication Techniques	3	0	0	3	I
3	122COT05	Advanced Radiation Systems	3	0	0	3	I
4	122COT06	Advanced Wireless Communication	3	0	0	3	I
5	122COP01	Communication Systems Laboratory-I	0	0	2	1	I
6	122COP02	Advanced Digital Signal Processing Laboratory	0	0	2	1	I
7	222COT01	RF System Design	3	0	0	3	II
8	222COT02	Photonic and Microwave Integrated Circuits	3	0	0	3	II
9	222COT03	Advanced Wireless Networks	3	0	0	3	II
10	222COP01	Communication Systems Laboratory - II	0	0	2	1	II
11	322COT01	Optical and Mobile Communication Networks	3	0	0	3	III
12	322COT02	Machine Learning	3	0	0	3	III

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1	122COT04	Research Methodology & IPR	3	0	0	3	I

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1	222COP02	Term Paper and Seminar	0	0	2	1	II
2	322COP01	Project Work (Phase – I)	0	0	12	6	III
3	422COP01	Project Work (Phase – II)	0	0	24	12	IV

122COT01 **LINEAR ALGEBRA, PROBABILITY AND QUEUEING THEORY** **L T P C**
3 1 0 4

COURSE OBJECTIVES:

The objective of this course is to enable the student to

- grasp the basic concepts of Probability, Random variables, correlation and regression.
- characterize the phenomena which evolve with respect to time in a probabilistic manner.
- encourage students to develop a working knowledge of the ventral ideas of linear algebra.
- acquire skills in analyzing Queueing Models.
- develop a fundamental understanding of linear programming models and apply the simplex method for solving linear programming problems.

UNIT I **LINEAR ALGEBRA** **12**

Vector spaces – Norms – Inner products – Eigenvalues using QR transformations – QR factorization – Generalized eigenvectors – Jordan Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.

UNIT II **PROBABILITY AND RANDOM VARIABLES** **12**

Probability Concepts – Axioms of probability – Conditional probability – Bayes theorem – Random variables – Probability functions – Two-dimensional random variables – Joint distributions – Marginal and conditional distributions – Correlation – Linear Regression.

UNIT III **RANDOM PROCESSES** **12**

Classification – Stationary random process – Markov process – Markov chain – Poisson process – Gaussian process – Auto correlation – Cross correlation.

UNIT IV **QUEUEING THEORY** **12**

Markovian queues – Single and multi-server models – Little's formula – Steady state analysis – Self-service queue.

UNIT V **LINEAR PROGRAMMING** **12**

Formulation – Graphical solution – Simplex method – Big M method – Variants of Simplex method – Transportation problems – Assignment models.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After the completion of the course, the student will be able to

CO1: apply various methods in Linear Algebra to solve the system of linear equations.
CO2: use two-dimensional random variables, correlations and regression in solving application problem.
CO3: apply the ideas of Random Processes.
CO4: simulate the real life situations into queueing models and analyze and interpret queueing models.
CO5: apply the various methods like simplex method, big M method for solving linear programming problems.

REFERENCES:

1. Miller,S.L. and Childers D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press,2004.
2. Friedberg A.H, Insel A.J. and Spence L, "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
3. Gross, D., Shortie, J.F., Thompson, J.M and Harris, C.M., "Fundamentals of Queueing Theory", 4th Edition, Wiley,2014.
4. T. Veerarajan, "Probability, Statistics and Random Process with Queueing Theory and Queueing Network, Tata McGraw Hill, 4th Edition,2017.
5. Taha H.A., "Operations Research: An Introduction", 9th Edition, Pearson Education Asia, New Delhi,2016.
6. Richard Bronson, "Matrix Operations" Schaum's outline series, McGraw Hill, 2 nd Edition, New York,2011.
7. Oliver C. Ibe, " Fundamentals of Applied Probability and Random Processes", Academic Press, (An Imprint of Elsevier), Boston,2014.

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	1
CO2	3	2	1
CO3	3	2	1
CO4	3	2	1
CO5	3	2	1
AVE	3	2	1

122COT02 ADVANCED DIGITAL SIGNAL PROCESSING **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understand the concept of signals in frequency domain.
- Estimate the signal spectrum by parametric and Non-Parametric approach.
- Design and analysis of filtering functions.
- Understand the concept of Adaptive filters.
- Apply multirate signal processing in various applications.

UNIT I DISCRETE RANDOM SIGNAL PROCESSING **9**

Discrete Random Processes- Ensemble averages, stationary processes, Autocorrelation and Auto covariance matrices. Parseval's Theorem, Wiener-Khintchine Relation- Power Spectral Density-Periodogram, Spectral Factorization, Filtering random processes.Low Pass Filtering of White Noise. Parameter estimation: Bias and consistency.

UNIT II SPECTRUM ESTIMATION **9**

Estimation of spectra from finite duration signals, Non-Parametric Methods-Correlation Method , Periodogram Estimator, Performance Analysis of Estimators -Unbiased, Consistent Estimators-Modified periodogram, Bartlett and Welch methods, Blackman –Tukey method. Parametric Methods - AR, MA, ARMA model based spectral estimation. Parameter Estimation -Yule-Walker equations, solutions using Durbin's algorithm.

UNIT III LINEAR ESTIMATION AND PREDICTION **9**

Linear prediction- Forward and backward predictions, Solutions of the Normal equations- Levinson-Durbin algorithms. Least mean squared error criterion -Wiener filter for filtering and prediction , FIR Wiener filter and Wiener IIR filters ,Discrete Kalman filter

UNIT IV ADAPTIVE FILTERS **9**

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive filters (IIR). RLS adaptive filters-Exponentially weighted RLS-sliding window RLS.

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING **9**

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, Filter implementation for sampling rate conversion- Direct form FIR structures, Polyphase filter structures, time-variant structures. Multistage implementation of multirate system. Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to :

CO1: Analyze the discrete signal parameters in time and frequency domain.

CO2: Estimate statistical parameter of the signal in frequency domain.

CO3: Estimate and predict the different forms of signals.

CO4: Design and develop Adaptive filters.

CO5: Implement Sub-band coding for various Applications.

REFERENCE BOOKS

1. Monson H.Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc.,Singapore, 2002
2. John G.Proakis, DimitrisG.Manolakis, Digital Signal Processing Pearson Education, 2002
3. G.M.REBEIZ, RF MEMS Theory, Design and Technology, John Wiley, 2003.
4. John G.Proakiset.al.,'Algorithms for Statistical Signal Processing', Pearson Education, 2002
5. DimitrisG.Manolakiset.al.,'Statistical and adaptive signal Processing', McGraw Hill, Newyork,2000
6. Rafael C. Gonzalez, Richard E.Woods, 'Digital Image Processing', Pearson Education, Inc., Second Edition, 2004.(For Wavelet Transform Topic)

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	3	1
CO2	3	3	1
CO3	3	3	1
CO4	3	3	1
CO5	3	3	1
AVE	3	3	1

122COT03 MODERN DIGITAL COMMUNICATION TECHNIQUES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- To extend the theory of Constant envelope modulation to M-ary schemes and to familiarize the concept of Spread Spectrum.
- To develop the mathematical and algorithmic foundations of the error detecting and error correcting codes used in modern communications systems.

UNIT I DETECTION AND ESTIMATION 9

Pass band Transmission model - Gram Schmidt orthogonalization procedure, Geometric Interpretation of signals, Response of bank of correlators to a noisy input-Coherent detection of signals in noise, Probability of error - Correlation Receiver - Matched Filter - Detection of signals with unknown phase.

UNIT II EQUALIZATION TECHNIQUES 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals Equalization algorithms– Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.

UNIT III CONVOLUTIONAL CODING 9

Representation of codes using Polynomial - State diagram - Tree diagram - and Trellis diagram, Decoding techniques: Maximum likelihood decoding - Viterbi algorithm- Sequential decoding 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 - Eight state trellis for rectangular QAM signal constellations.

UNIT IV TURBO CODING 9

Introduction - Turbo Encoder -Turbo Decoder-Iterative Turbo Decoding Principles-Modifications of the MAP Algorithm - The Soft-Output Viterbi Algorithm (SOVA) -Turbo Coded BPSK Performance over Gaussian channels -Turbo Coding Performance over Rayleigh Channels.

UNIT V MULTICARRIER AND MULTIUSER COMMUNICATIONS 9

Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems–optimum multiuser receiver, suboptimum detectors,successive interference cancellation.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Apply Digital communication technologies in a variety of engineering applications
CO2: Gain knowledge in equalization techniques
CO3: Implement Error control coding and Digital modulation techniques in MATLAB
CO4: Learn turbo coding and its comparison with Rayleigh channels
CO5: Learn about multicarrier and multiuser communication.

REFERENCE BOOKS

1. Simon Haykin, "Digital Communications", John Wiley and sons, Reprint 2009
2. L. Hanzo, T.H. Liew & B.L. Yeap, "Turbo Coding, Turbo Equalization & Space-Time Coding", Wiley, First Edition, 2002

3. Theodore S.Rappaport, "Wireless Communications", Pearson Education, Second Edition 2002.
4. Stephen G. Wilson, "Digital Modulation and Coding", Pearson Education, First Indian Reprint, 2003.
5. Rodger E. Ziemer, Roger L. Peterson, David E. Borth, "Introduction to Spread Spectrum Communications", Prentice Hall, First Edition, 1995.
6. Lathi B P and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 2011.
7. Richard Van Nee & Ramjee Prasad, "OFDM for Multimedia Communications" Artech House Publication, 2001.
8. Nptel Lecture: http://aicte-stream/

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	2
CO2	3	3	2
CO3	3	2	2
CO4	2	3	3
CO5	3	2	2
AVE	2.8	2.4	2.2

122COT04 ADVANCED WIRELESS COMMUNICATION L T P C
3 0 0 3

Course Objectives

- To learn the concepts of wireless communication.
- To know about the various propagation methods, Channel models, capacity calculations, multiple antennas and multiple user techniques used in the mobile communication.

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, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements, propagation scenarios, METIS channel models, Map-based model, stochastic model.

UNIT II CAPACITY OF WIRELESS CHANNELS 9

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

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.

UNIT IV 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.

UNIT V MULTI USER SYSTEMS 9

Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, MIMO-MUD Application of convex optimization to wireless design

Total: 45 Periods

Course Outcomes

On the successful completion of the course, students will be able to

CO1: Analyze the wireless channel characteristics and identify appropriate channel models

CO2:Understand the mathematics behind the capacity calculation under different channel conditions

CO3: Understand the implication of diversity combining methods and the knowledge of channel

CO4: Understand the concepts in MIMO Communications

CO5: Understand mulitiple access techniques and their use in different multi-user scenarios.

Reference Books

1. David Tse and Pramod Viswanath, *Fundamentals of wireless communications*, Cambridge University Press, First Edition, 2012
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
3. Harry R. Anderson, "Fixed Broadband Wireless System Design", John Wiley, India, 2003.
4. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2006
5. Simon Haykin& Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
6. Rappaport. T.S., "Wireless communications", Pearson Education, 2003.
7. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
8. Upena Dalal, "Wireless Communication", Oxford Higher Education, 2009.

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
AVE	3	3	3

122COT05 ADVANCED RADIATION SYSTEMS **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- Understand the concept of Retarded vector potential with Heuristic and Maxwell's equation approach.
- Describe the concept of Antenna Arrays with different types and their pattern multiplication
- Examine the different Antenna synthesis method
- Design different types of Antennas with their characteristic
- Compare all the special antennas with their applications.

UNIT I ANTENNA FUNDAMENTALS 9

Antenna fundamental parameters, Radiation integrals, Radiation from surface and line current distributions -Introduction to numerical techniques- FEM, FDTD, MoM. 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

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 ANTENNA SYNTHESIS 9

Synthesis problem-Line source based beam synthesis methods - Fourier transform and Woodward-Lawson sampling method – Linear array shaped beam synthesis method – Low side lobe, narrow main beam synthesis methods - discretization of continuous sources. Schelkunoff polynomial method

UNIT IV MODERN ANTENNAS & MEASUREMENT TECHNIQUES 9

Base station antennas, PIFA – Antennas for WBAN – RFID Antennas – Automotive antennas,MIMO Antennas, Diversity techniques – Antenna impedance and radiation pattern measurements

UNIT V RECENT TRENDS IN ANTENNA DESIGN 9

UWB antenna arrays – Vivaldi antenna arrays – Artificial magnetic conductors/High impedance surfaces – Antennas in medicine – Plasma antennas – Antennas for millimeter wave communication - optimization techniques – Numerical methods

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: Calculate the Power radiated in far field and also familiar with Polarization concept.
CO2: Apply Antenna Arrays with N elements for specified Application
CO3: Summarize the Antenna based on their Specification and Performance, for various Applications
CO4: Categorize the micro strip antennas for different applications.
CO5: Understand about Special antennas

REFERENCE BOOKS

1. Balanis, C.A., "Antenna Theory" Wiley,2003
2. Warren L. Stutzman and Gary A. Thiele," Antenna theory and design"John Wiley and sons 1998
3. Jordan, E.C., " Electromagnetic waves and Radiating systems". PHI 2003
4. Krauss, J.D., " Radio Astronomy" McGraw-Hill 1966, for the last unit (reprints available)
5. Krauss, J.D.,, Fleisch,D.A., "Electromagnetics" McGraw-Hill,1999

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	3
CO2	3	3	3
CO3	3	2	3
CO4	2	3	3
CO5	3	2	2
AVE	2.8	2.4	2.8

122COT06	RESEARCH METHODOLOGY & IPR	L T P C 3 0 0 3

UNIT I RESEARCH DESIGN **9**

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES **9**

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods.Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING **9**

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual Property — The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTOin IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS **9**

Patents — objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

Total: 45 Periods

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	3
CO2	3	2	2
CO3	3	1	3
CO4	2	1	3
CO5	3	3	1
AVE	2.8	1.8	2.4

122COP07 **ADVANCED COMMUNICATION SYSTEMS LABORATORY- I** **L T P C**
0 0 2 1

COURSE OBJECTIVES

- Determine and analyse the radiation pattern of the various antenna.
- Explain the design and simulation of the modulation and coding
- Analyse the various applications of the optical communication.
- Create and analyse channel equalizer and OFDM transceivers using MATLAB.

LIST OF EXPERIMENTS

1. Antenna Radiation Pattern measurement.
2. Simulation of Modulation and Coding in a AWGN Communication Channel using Simulation Packages.
3. Implementation of Adaptive Filters, periodogram and multistage multirate system in DSP Processor
4. Performance evaluation of Digital Data Transmission through Fiber Optic Link.
5. Study of Spread Spectrum Techniques.
6. Simulation of QMF using Simulation Packages.
7. Implementation of Video Link using Optical Fiber.
8. Implementation of Linear and Cyclic Codes.
9. OFDM transreceiver design using MATLAB
10. Channel equalizer design using MATLAB

TOTAL:45 PERIODS

COURSE OUTCOMES

CO1: Analyse the radiation pattern of various antenna's in the polar graphs.
CO2: Design the modulation and coding in different applications.
CO3: Discover the video links and digital data transmission using optical fibres.
CO4: Reproduce sim links models of the OFDM and channel equalizer.

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	2	2	2
CO5	3	2	2
AVE	2.8	2	2

122COP08 **ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY** **L T P C**
0 0 2 1

COURSE OBJECTIVES:

- To enable the student to verify the basic principles of random signal processing, spectral estimation methods and additive white Gaussian noise (AWGN) channel characterization
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.

LIST OF EXPERIMENTS

USE APPROPRIATE SIMULATION TOOLS FOR THE FOLLOWING EXPERIMENTS:

1. Generation of Standard discrete time sequences (Unit Impulse, Unit Step, Unit Ramp, Sinusoidal and exponential signals) and carrying out of arithmetic operations and plotthe results
2. Generation of random sequences satisfying the given probability distributions such as Uniform, Gaussian, Rayleigh and Rician.
3. Design of FIR filters for the given specification and plot the frequency response of the designed filter
4. Design of IIR filters for the given specification and plot the frequency response of the designed filter
5. Analysis of finite word length effects of FIR filter coefficients
6. Estimation of power spectrum of the given random sequence using Nonparametric methods (Bartlett, Welch and Blackman Tukey)
7. Estimation of power spectrum of the given random sequence using parametric methods (AR, MA and ARMA)
8. Upsampling the discrete time sequence by L times and plot the spectrum of both thegiven sequence and upsampled sequence
9. Downsampling the discrete time sequence by M times and plot the spectrum of both thegiven sequence and dowsampled sequence
10. Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using LMS Algorithm
11. Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using RLS Algorithm
12. Implementation of Digital Filter Banks for the given specifications

TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: Generate deterministic/Random sequences using simulation tool

CO2: Design and analyze the frequency response of FIR/IIR digital filters for the given specifications

CO3: Estimate power spectrum of the given random sequence using parametric/nonparametric estimation methods

CO4: Implement adaptive filters using LMS/RLS algorithm

CO5: Analyze the discrete time systems at various sampling rates

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	2

CO2	3	-	2
CO3	3	2	2
CO4	2	-	-
CO5	3	2	2
AVE	2.8	2	2

AUDIT COURSES

X22COA01 **ENGLISH FOR RESEARCH PAPER WRITING** **L T P C**
2 0 0 0

Prerequisite: English

Course Objectives

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I **INTRODUCTION TO RESEARCH PAPER WRITING** **6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II **PRESENTATION SKILLS** **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III **TITLE WRITING SKILLS** **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV **RESULT WRITING SKILLS** **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V **VERIFICATION SKILLS** **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good a sit could possibly be the first-time submission

Total: 30 Periods

Course Outcomes

On the successful completion of the course, students will be able to

CO1: Understand that how to improve your writing skills and level of readability
CO2: Learn about what to write in each section
CO3: Understand the skills needed when writing a Title
CO4: Understand the skills needed when writing the Conclusion
CO5: Ensure the good quality of paper at very first-time submission

Reference Books

1 Adrian Wallwork, Englishfor WritingResearchPapers,SpringerNew YorkDordrecht HeidelbergLondon,2011
2 DayR "How to Write and Publish a Scientific Paper", Cambridge University Press2006
3 Goldbort R Writing for Science, Yale University Press (available on Google Books)2006
4 HighmanN,Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	-	2
CO2	3	-	2
CO3	3	-	2
CO4	2	-	1
CO5	3	-	2
AVE	2.8	-	1.8

X22COA02 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

Course Objectives

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I **INTRODUCTION** **6**

Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II **REPERCUSSIONSOFDISASTERSANDHAZARDS** **6**

EconomicDamage,LossofHumanandAnimalLife,DestructionOfEcosystem.NaturalDisasters:Earthquakes,Volcanisms,Cyclones,Tsunamis,Floods,DroughtsAndFamines,Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONEAREAS ININDIA **6**

Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESSAND MANAGEMENT **6**

Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISKASSESSMENT **6**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

Total: 30 Periods

Course Outcomes

On the successful completion of the course, students will be able to

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

Reference Books

1 GoelS.L.,Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt.Ltd., NewDelhi,2009.

2 Nishitha Rai,SinghAK,"Disaster Management in India:Perspectives, issues and strategies"'New Royal book Company,2007.

3 Sahni,PardeepEt.Al.,"Disaster Mitigation Experiences And Reflections",Prentice Hall Of India, NewDelhi,2001.

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	2
CO2	3	2	2
CO3	3	2	2
CO4	2	1	1
CO5	3	2	2

AVE	2.8	1.8	1.8

X22COA03 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

Course Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civilrights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I **HISTORY OF MAKING OF THE INDIAN CONSTITUTION** **5**

History, Drafting Committee, (Composition & Working)

UNIT II **PHILOSOPHYOFTHEINDIANCONSTITUTION** **5**

Preamble, Salient Features

UNIT III **CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES** **5**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV **ORGANS OF GOVERNANCE** **5**

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President,Governor,CouncilofMinisters,Judiciary,AppointmentandTransferofJudges,Qualifications,

Power sand Functions.

UNIT V **LOCAL ADMINISTRATION** **5**

District's Administration head: role and Importance, Municipalities: Introduction , Mayor and Role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI **ELECTION COMMISSION** **5**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners-Institute and Bodies for the welfare of SC/ST/OBC and women.

Total: 30 Periods

Course Outcomes

On the successful completion of the course, students will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before

thearrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the1.6 framework of argument that informed the conceptualization

CO3: of social reforms leading to revolution in India.

CO4: Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of theproposal of direct elections through adult suffrage in the Indian Constitution.

CO5: Discuss the passage of the Hindu Code Bill of 1956.

Reference Books

1 TheConstitution of India,1950(BareAct),GovernmentPublication.

2 Dr.S.N.Busi,Dr.B.R.Ambedkar framing of Indian Constitution,1st Edition,2015.

3 M.P.Jain,Indian Constitution Law, 7th Edn.,LexisNexis,2014.

4 D.D.Basu,Introduction to the Constitution of India,LexisNexis,2015.

CO-PO-PSO MAPPING:

CO	PO 1	PO2	PO3
CO1	3	2	2
CO2	2	1	2
CO3	2	2	2
CO4	2	2	1
CO5	3	2	2
AVE	2.4	1.8	1.8

222COT01 **RF SYSTEM DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Study the behaviour of parameters, components and its applications of radio frequency design.
- Study the filter operation in RF design.
- Study the operational characteristics and applications of Active components on RF networks.
- Understand the basic model, characteristic and configuration of oscillator, mixer and its applications.

UNIT I RF ISSUES **9**

Importance of RF design, Electromagnetic Spectrum, RF behaviour of passive components, Chip components and Circuit Board considerations, Scattering Parameters, Smith Chart and applications.

UNIT II RF FILTER DESIGN **9**

Overview, Basic resonator and filter configuration, Special filter realizations, Filter implementations, Coupled filter.

UNIT III ACTIVE RF COMPONENTS & APPLICATIONS **9**

RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Microstripline matching networks, Amplifier classes of operation and biasing networks.

UNIT IV RF AMPLIFIER DESIGNS **9**

Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, Constant VSWR circles, Low Noise circuits, Broadband , high power and multistage amplifiers.

UNIT V OSCILLATORS, MIXERS & APPLICATIONS **9**

Basic Oscillator model, High frequency oscillator configuration, Basic characteristics of Mixers ; Phase Locked Loops ; RF directional couplers and hybrid couplers ; Detector and demodulator circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Analyze the scattering parameters through the smith chart.

CO2: Design the filter realizations and implementations with knowledge of basic characteristics.

CO3: Analyze the parameters of matching networks using the discrete components.

CO4: Explain the basic definition and to choose the appropriate method for high frequency applications.

CO5: Learn the characteristics of oscillators, mixers and couplers

REFERENCE BOOKS

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.
2. Joseph . J. Carr, Secrets of RF Circuit Design , McGraw Hill Publishers, Third Edition, 2000.
3. Mathew M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002
4. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000
5. Roland E. Best, Phase - Locked Loops : Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3
5	3	3	3
Avg	3	3	3

1 - low, 2 - medium, 3 - high

222COT02 PHOTONIC AND MICROWAVE INTEGRATED CIRCUITS L T P C

3 0 0 3

COURSE OBJECTIVES

- Develop a deep insight into modern photonic devices and circuits through a thorough understanding of the underlying physics
- Learn about photonic Integrated circuits and its applications
- Study about the technologies involved in MICs.
- Learn the types and components of Micro-strip.

UNIT I INTRODUCTION TO PHOTONICS 9

Introduction to photonics-Optical waveguide theory- Photonic crystals, Metamaterials, Plosmonics-Photonic components switch ,couplers etc.

UNIT II PHOTONIC INTEGRATED CIRCUIT 9

Introduction to photonic integrated circuits-Fabrication techniques:Lithography,ion-exchange deposition, diffution process and device characteristics-Photonic Band Gap structure-Applications:Micro-Opto-Electro-Mechanical system(MOEMS).-Bio-Photonics.-VLSI Photonics

UNIT III MICROSTRIP COMPONENTS 9

Component using Microstrips: flat resistors – flat inductors – interdigital capacitors – sandwich capacitors – ferromagnetic substrates for non-reciprocal devices – microstrip circulators – latching circulators – isolators – phase shifters

UNIT IV ANALYSIS OF MICROSTRIP LINE 9

Coupled microstrips – even and odd mode analysis – Microstrip directional couplers – branch line couplers – periodic branch line couplers – synchronous branch line couplers. Losses in microstrip.

UNIT V TECHNOLOGY OF MICS 9

HYBRID MICs: Dielectric substrates - thick film technology and materials - thin film technology and materials – methods of testing – encapsulation of devices for MICs – mounting of active devices.
MONOLITHIC MICs: Processes involved in fabrication – epitaxial growth of semiconductor layer – growth of dielectric layer – diffusion-ion implantation – electron beam technology.

TOTAL HOURS : 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Design the Photonics components.

CO2: Acquire knowledge in the design and fabrication of the Photonic Integrated Circuits

CO3: Design and fabricate the hybrid MIC's in thick and thin film technology.
CO4: Analyse even and odd mode coupled microstrips.
CO5: Implement the different methods for the fabrication of the monolithic MICs.

REFERENCE BOOKS

1. Gupta,K.C, and Amarjitsingh – "Microwave Integrated Circuits" – John Wiley and sons – Wiley Eastern Reprint, 1978
2. Hoffmann, R.K – "Handbook of Microwave Integrated Circuits" – Artech House, 1987.
3. Ari T.Friberg,and Rene Dandliker-"Advances in Information Optics and photonics"-PHI,Eastern Economy Edition
4. "Integrated Photonics "by C.R.Pollack and M.Lipson

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	2	3
2	3	2	3
3	3	2	3
4	3	2	3
5	3	2	3
Avg	3	2	3

1 - low, 2 - medium, 3 - high

222COT03 ADVANCED WIRELESS NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

The students should be made to:

- study about advanced wireless network, LTE, 4G and Evolutions from LTE to LTE.
- study about wireless IP architecture, Packet Data Protocol and LTE network architecture
- study about adaptive link layer, hybrid ARQ and graphs routing protocol.
- study about mobility management, cellular network, and micro cellular networks

UNIT I INTRODUCTION 9

Introduction to 1G/2G/3G/4G Terminology. Evolution of Public Mobile Services -Motivation for IP Based Wireless Networks -Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTE-A - Wireless Standards. Network Model-Network Connectivity-Wireless Network Design with Small World Properties

UNIT II WIRELESS IP NETWORK ARCHITECTURES 9

3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context - Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain —LTE network Architecture - Roaming Architecture- Protocol Architecture- Bearer Establishment Procedure -Inter-Working with other RATs.

UNIT III ADAPTIVE LINK AND NETWORK LAYER 9

Link Layer Capacity of Adaptive Air Interfaces-Adaptive Transmission in *Ad Hoc* Networks- Adaptive Hybrid ARQ Schemes for Wireless Links-Stochastic Learning Link Layer Protocol- Infrared Link Access Protocol-Graphs and Routing Protocols-Graph Theory-Routing with Topology Aggregation-Network and Aggregation Models

UNIT IV MOBILITY MANAGEMENT 9

Cellular Networks-Cellular Systems with Prioritized Handoff-Cell Residing Time Distribution-Mobility Prediction in Pico- and Micro-Cellular Networks

UNIT V QUALITY OF SERVICE 9

QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS Architecture, Management and Classes - QoS Attributes – Management of End-to-End IP QoS – EPS Bearers and QoS in LTEnetworks

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1:know the latest 4G networks and LTE
CO2: Understand about the wireless IP architecture and LTE network architecture.
CO3: know the adaptive link layer and network layer graphs and protocol.
CO4: Understand the mobility management and cellular network.
CO5: Understand the wireless sensor network architecture and its concept.

REFERENCES

1. Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014.
2. Crosspoint Boulevard, "Wireless and Mobile All-IP Networks", Wiley Publication, 2005.
3. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols", John Wiley & Sons, Inc. Publication,2006.
4. Minoru Etoh, "Next Generation Mobile Systems3G and Beyond," Wiley Publications,2005.
5. Savo Glisic," Advanced Wireless Networks-Technology and Business Models", Third Edition, John Wiley & Sons, Ltd, 2016
6. Savo Glisic,"Advanced Wireless Networks-4G Technologies", John Wiley & Sons, Ltd,2006.
7. Stefania Sesia, IssamToufik and Matthew Baker, "LTE – The UMTS Long Term Evolution From Theory to Practice", John Wiley & Sons, Inc. Publication, Second Edition, 2011.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	1	3
2	3	1	3
3	3	1	3
4	3	1	3
5	3	1	3
Avg	3	1	3

1 - low, 2 - medium, 3 - high

222COP07 **ADVANCED COMMUNICATION SYSTEM LABORATORY II** **L T P C**

0 0 2 1

COURSE OBJECTIVES

- Learn the characteristics of the Non-reciprocal components in micro strip lines.
- Perform image, audio and text compressions.
- Analyze the characteristic parameters of the fiber optic components.

LIST OF EXPERIMENTS

1. Characteristics of ring resonator(RING) in micro strip
2. Characteristics of a branch line coupler(BLC) in micro strip
3. Characteristics of power divider in micro strip
4. (a)Characteristics of a transformer fed patch antenna in micro strip
   (b)Characteristics of in inset fed patch antenna micro strip
5. Simulation of EZW / SPIHT Image coding algorithm.
6. Implementation of speech processing using Matlab Simulink and Texas instrument processors
7. Study of OTDR(Optical Time Domain Reflectometer)using source of 1550nm laser diode and PIN TIA photo detector.
8. Measurement of attenuation in fiber optic attenuator
9. Measurement of insertion losses and isolation rate in fiber optic isolator.
10. (i).Measurement of insertion losses and coupling co-efficient in fiber optic coupler.
    (ii). Measurement of insertion losses and coupling co-efficient in fiber optic multiplexer

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1:Acquire knowledge in various characteristics of the Non-reciprocal components in micro strip lines.

CO2: Implement the various compression techniques using MATLAB.

CO3: Measure the losses for the fiber optic components

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	-	3
3	3	1	2
Avg	3	2	2.4

1 - low, 2 - medium, 3 - high

222COE01 ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Understand the EMI/EMC concept in Time and Frequency domain
- Understand the EMI Coupling Concept
- Learn the EMI standards and Measurements
- Learn the EMI control Techniques and to design a PCB for various application

UNIT I EMI ENVIRONMENT **9**

EMI/EMC concepts and definitions, Sources of EMI, conducted and radiated EMI, Transient EMI, Time domain Vs Frequency domain EMI, Units of measurement parameters, Emission and immunity concepts, ESD.

UNIT II EMI COUPLING PRINCIPLES **9**

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply coupling.

UNIT III EMI/EMC STANDARDS AND MEASUREMENTS **9**

Civilian standards - FCC,CISPR,IEC,EN, Military standards - MIL STD 461D/462, EMI Test Instruments /Systems, EMI Shielded Chamber, Open Area Test Site, TEM Cell, Sensors/Injectors/Couplers, Test beds for ESD and EFT, Military Test Method and Procedures (462).

UNIT IV EMI CONTROL TECHNIQUES **9**

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

UNIT V EMC DESIGN OF PCBs **9**

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

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Demonstrate the EMI/EMC concept in Time and Frequency domain
CO2: Demonstrate the EMI Coupling Concept
CO3: Knowledge in EMI standards and Measurements
CO4: Knowledge in EMI Control Techniques
CO5: Design the PCB for various applications

REFERENCE BOOKS

1. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley and Sons, NewYork. 1988
2. C.R.Paul, "Introduction to Electromagnetic Compatibility" , John Wiley and Sons, Inc, 1992
3. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, 1996
4. Bernhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, 3rd Ed, 1986

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	2	3	3
3	3	2	3
4	3	3	2
5	3	2	3
Avg	2.8	2.6	2.8

1 - low, 2 - medium, 3 - high

222COE02 **WDM OPTICAL NETWORKS** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Categorize Optical System Components
- Extrapolate Optical Network Architecture
- Outline the Wavelength Routing Network,
- Develop skills on Packet Switching Network ,Access Networks
- Interpolate about the Network Design and Management Techniques

UNIT I OPTICAL SYSTEM COMPONENTS **9**

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

UNIT II OPTICAL NETWORK ARCHITECTURES **9**

Introduction to Optical Networks; SONET / SDH, Metropoliton-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 **9**

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 HOURS:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Apply the Optical System Components worldwide
CO2: Create Optical Network Architecture for reasoning
CO3: Develop skills on Wavelength Routing Network,
CO4: Integrate on Packet Switching Network, Access Network
CO5: Devise and Manage Optical Network for desired Application

TEXT BOOKS

1. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2004

REFERENCE BOOKS

1. C. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks : Concept,
2. Design and Algorithms", Prentice Hall of India, Ist Edition, 2002
3. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	2
2	3	2	3
3	3	3	3
4	2	1	3
5	2	3	3
Avg	2.6	2.4	2.8

1 - low, 2 - medium, 3 - high

222COE03 **HIGH SPEED SWITCHING ARCHITECTURE** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Learn the switching concept of High Speed Networks
- Learn the concept of ISDN and B-ISDN with the functions, Layers and services
- Learn the ATM Architecture with different networks
- Analyze various Queuing in ATM and IP switching

UNIT I **HIGH SPEED NETWORK** **9**

LAN and WAN network evolution through ISDN to BISDN - Transfer mode and control of BISDN - SDH multiplexing structure - ATM standard; ATM adaptation layers.

UNIT II **LAN SWITCHING TECHNOLOGY** **9**

Switching concepts; Switch forwarding techniques; switch path control - LAN switching; cut through forwarding; store and forward - virtual LANs.

UNIT III **ATM SWITCHING ARCHITECTURE** **9**

Switch models - Blocking networks – basic and enhanced banyan networks - sorting networks – merge sorting - rearrangeable networks - full and partial connection networks - nonblocking networks – recursive network – construction and comparison of non-blocking network.

UNIT IV QUEUES IN ATM SWITCHES 9

Internal queuing – Input, output and shared queuing - multiple queuing networks –combined input, output and shared queuing – performance analysis of queued switches.

UNIT V IP SWITCHING 9

Architectures of Internet Switches and Routers-IP Over ATM address and next hop resolution –IPv6 over ATM - Optical Packet switching - Switching fabric on a chip.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Familiar with switching of High Speed Networks
CO2: Knowledge in ISDN and B-ISDN functions, Layers and services
CO3: Understand ATM architecture with different networks
CO4: Knowledge in Queues.
CO5: Learn concepts of IP switching.

REFERENCE BOOKS

1. Rich Siefert, Jim Edwards, "The All New Switch Book – The Complete Guide to LAN Switching Technology", Wiley Publishing, Inc., Second Edition, 2008
2. Elhanany M. Hamdi, "High Performance Packet Switching architectures", Springer Publications, 2007
3. Christopher Y Metz, Switching protocols & Architectures. McGraw Hill, New York.1998.
4. AchillePatavina, Switching Theory: Architectures and performance in Broadband ATM Networks. John Wiley & Sons Ltd., New York.1998
5. Ranier Handel, Manfred N Huber, Stefan Schrodder. ATM Networks-concepts, protocols, applications, 3rd Edition, Adisson Wesley, New York,1999.
6. JohnA.Chiong: Internetworking ATM for the internet and enterprise networks. McGraw Hill, New York, 1998.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3
5	3	3	3
Avg	3	3	3

1 - low, 2 - medium, 3 - high

222COE04 **WAVELETS AND MULTIRESOLUTION PROCESSING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Study the basics of signal representation and Fourier theory
- Understand Multi Resolution Analysis and Wavelet concepts
- Study the wavelet transform in both continuous and discrete domain
- Understand the design of wavelets using Lifting scheme

UNIT I FUNDAMENTALS **9**

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time Fourier transform, Time-frequency analysis

UNIT II MULTI RESOLUTION ANALYSIS **9**

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

UNIT III CONTINUOUS WAVELET TRANSFORMS **9**

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

UNIT IV DISCRETE WAVELET TRANSFORM **9**

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

UNIT V APPLICATIONS **9**

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

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

CO1: Understand Fourier tools to analyse signals
CO2: Knowledge in MRA and representation using wavelet bases
CO3: Knowledge in various wavelet transforms
CO4: Knowledge in various design wavelet transform
CO5: Apply wavelet transform for various signal & image processing applications

TEXT BOOKS

1. Rao R M and A S Bopardikar, —Wavelet Transforms Introduction to theory and Applications, Pearson Education, Asia, 2000
2. L.Prasad&S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997

REFERENCE BOOKS

1. J. C. Goswami and A. K. Chan, "Fundamentals of wavelets: Theory, Algorithms and Applications" Wiley Interscience Publication, John Wiley & Sons Inc., 1999
2. M. Vetterli, J. Kovacevic, "Wavelets and subband coding" Prentice Hall Inc, 1995
3. Stephen G. Mallat, "A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000
4. Soman K P and Ramachandran K I, —Insight into Wavelets From Theory to practice, Prentice Hall, 2004

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	2	3
3	2	3	3
4	2	1	2
5	3	1	3
Avg	2.6	2	2.8

1 - low, 2 - medium, 3 - high

222COE05 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES

- Study about cross talk in signal integrity
- Study the various parameters of different di-electric material
- Learn the concept of differential signalling and its significance
- Study the physical transmission model

UNIT I FUNDAMENTALS **9**

The importance of signal integrity-new realm of bus design-Electromagnetic fundamentals for signal integrity-maxwell equations common vector operators-wave propagations-Electrostatics magneto statics-Power flow and the poynting vector-Reflections of electromagnetic waves

UNIT II CROSS TALK **9**

Introduction -mutual inductance and capacitance-coupled wave equation-coupled line analysis modal analysis-cross talk minimization signal propagation in unbounded conductive media-classic conductor model for transmission model

UNIT III DI-ELECTRIC MATERIALS **9**

Polarization of Dielectric-Classification of Di electric material-frequency dependent di electric material- Classification of Di electric material fiber-Weave effect-Environmental variation in di electric behaviour Transmission line parameters for loosy dielectric and realistics conductors

UNIT IV DIFFERENTIAL SIGNALING **9**

Removal of common mode noise-Differential Cross talk-Virtual reference plane-propagation ofmodel voltages common terminology-drawbacks of Differential signaling

UNIT V PHYSICAL TRANSMISSION LINE MODEL **9**

Introduction- non ideal return paths-Vias-IO design consideration-Push-pull transmitter-CMOSreceivers-ESSD protection circuits-On chip Termination

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Knowledge in fundamentals of signal integrity
CO2: Knowledge in cross talk in signal integrity
CO3: Knowledge in various parameters of different di-electric material
CO4: Understanding the differential signalling and its drawback in signal integrity
CO5: Knowledge in physical transmission model

REFERENCE BOOKS

1. Advanced Signal Integrity for High-Speed Digital Designs By Stephen H. Hall, Howard
2. L. Heck
3. Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS by James Edgar Buchanan
4. M S Lundstorm, Fundamentals of Carrier Transport, 2nd Ed., Cambrid University Press, Cambridge UK, 2000

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	2
2	3	3	2
3	3	3	2
4	3	3	2
5	3	3	2
Avg	3	3	2

1 - low, 2 - medium, 3 - high

222COE06	ADVANCED SATELLITE COMMUNICATION AND NAVIGATION SYSTEMS	L T P C 3 0 0 3

COURSE OBJECTIVES:

To enable the students to

- Learn M2M developments and satellite applications
- Understand Satellite Communication In Ipv6 Environment

UNIT I OVERVIEW OF SATELLITE COMMUNICATION 9

Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.

UNIT II M2M DEVELOPMENTS AND SATELLITE APPLICATIONS 9

Overview of the Internet of Things and M2M- M2M Applications Examples and Satellite Support- Satellite Roles Context and Applications- Antennas for Satellite M2M Applications- M2M Market Opportunities for Satellite Operators-Ultra HD Video/TV and Satellite Implications-High Throughput Satellites (HTS) and Ka/Ku Spot Beam Technologies-Aeronautical, Maritime and other Mobility Services.

UNIT III SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT 9

Overview of IPv6 and its benefits for Satellite Networks - Migration and Coexistence- Implementation scenarios and support- Preparations for IPv6 in Satellite communication- Satellite specific Protocol issues in IPv6 — Impact of IPv6 on Satellite Network architecture and services- Detailed transitional plan- IPv6 demonstration over satellites - Key results and recommendations.

UNIT IV SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM 9

Over view of Radio and Satellite Navigation, GPS Principles, Signal model and Codes, Satellite Signal Acquisition, Mathematical model of GPS observables, Methods of processing GPS data, GPS Receiver Operation and Differential GPS. IRNSS, GAGAN, GLONASS and Galileo.

UNIT V DEEP SPACE NETWORKS AND INTER PLANETARY MISSIONS 9

Introduction — Functional description - Design procedure and performance criterion-Mars exploration Rover- Mission and space craft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and space craft summary-Telecommunicationsubsystem overview-Ground Subsystem-Telecom subsystem and Link performance.Mangalyaan Mission - Mission and space craft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and Link performance

COURSE OUTCOMES:

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

CO1: Discuss Satellite navigation and global positioning system

CO2: Outline deep space networks and inter planetary missions

CO3: Able to demonstrate an understanding of the different interferences and attenuation mechanisms affecting the satellite link design.

CO4: The student would be able to demonstrate an understanding of the different communication, sensing and navigational applications of satellite.

CO5: Familiar with the implementation aspects of existing satellite based systems.

TOTAL:45 PERIODS

REFERENCES

1. Adimurthy.V,"Concept design and planning of India's first interplanetary mission" Current Science, VOL. 109, NO. 6, 1054 25 SEPTEMBER 2015.
2. Anil K. Maini, Varsha Agrawal, 'Satellite Technology: Principles and Applications', Third Edition, Wiley, 2014.
3. Daniel Minoli' "Innovations in Satellite Communication and SatelliteTechnology" Wiley, 2015
4. Daniel Minoli, "Satellite Systems Engineering in an IPv6 Environment", CRC Press, First Edition, 2009.
5. Hofmann-Wellenhof B., Lichtenegger H., and Elmar Wasle, "Global Navigational Satellite Systems" Springer-Verlag, 2008.
6. Jim Taylor, " Deep Space Communications" John Wiley & Sons, 2016.
7. Louis J. Ippolito, Jr. "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", Second Edition, 2017
8. http://www.isro.gov.in/pslv-c25-mars-orbiter-mission

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	2
2	3	3	2
3	2	2	3
4	3	2	3
5	2	3	3
Avg	2.6	2.6	2.6

1 - low, 2 - medium, 3 - high

222COE07 MULTIMEDIA COMPRESSION TECHNIQUES **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Learn the basic concepts in the multimedia compression techniques.
- Learn the various algorithms and coding techniques of the text compression.
- Learn the audio compression techniques and its applications.
- Understand the predictive techniques and wavelet based image compressions

UNIT I INTRODUCTION **9**

Special features of multimedia – Graphics & Image data representation-Compression techniques-Overview of Source coding-Unique decodable codes, prefix codes, Kraft McMillan inequality-Source modeling –physical model, Probability model, Markov model-Scalar and Vector quantization theory-Evaluation and Error analysis

UNIT II TEXT COMPRESSION **9**

Compaction techniques – Huffmann coding – Adaptive Huffmann Coding – Arithmetic 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 – speech compression techniques – CELP Vocoders.

UNIT IV IMAGE COMPRESSION **9**

Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization– Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders.

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.

TOTAL HOURS : 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Understand the various requirements of the multimedia compression techniques.
CO2: Implement text compression using the LZW algorithms and coding techniques.
CO3: Acquire knowledge in the various audio compression techniques and its applications.
CO4: Design and analyze of images compression using wavelet based compression
CO5: Acquire knowledge in the various video compression techniques and its applications

REFERENCE BOOKS

1. Khalid Sayood:Introduction to Data Compression, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Salomon : Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q.Shi, HuifangSun : Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards, CRC press, 2003.
4. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004
5. Mark Nelson : Data compression, BPB Publishers, New Delhi,1998
6. Mark S.Drew, Ze-NianLi : Fundamentals of Multimedia, PHI, 1st Edition, 2003.
7. Watkinson,J : Compression in Video and Audio, Focal press,London.1995.
8. Jan Vozer : Video Compression for Multimedia, AP Profes, NewYork, 1995

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3
5	3	3	3
Avg	3	3	3

1 - low, 2 - medium, 3 - high

222COE08 **COGNITIVE RADIO** L T P C
3 0 0 3

COURSE OBJECTIVES

- Study the different techniques and computational methods for Cognitive Radio.
- Know the main rules underlying in Cognitive techniques.
- Address the difficulties related to the present day techniques.
- Adopt Cognitive techniques in solving problems in the real world

UNIT I INTRODUCTION TO SOFTWARE DEFINED RADIO 9

Definitions and potential benefits, software radio architecture evolution, technology tradeoffs and architecture implications.

UNIT II SDR ARCHITECTURE 9

Essential functions of the software radio, basic SDR, hardware architecture, Computational processing resources, software architecture, top level component interfaces, interface topologies among plug and play modules.

UNIT III INTRODUCTION TO COGNITIVE RADIOS 9

Marking radio self-aware, cognitive techniques – position awareness, environment awareness in cognitive radios, optimization of radio resources, Artificial Intelligence Techniques.

UNIT IV COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architechture

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

TOTAL HOURS : 45 PERIODS

COURSE OUTCOMES

CO1: Describe the basics of the software defined radios.
CO2: Design the wireless networks based on the cognitive radios.
CO3: Understand the Architecture of cognitive radio
CO4: Explain the concepts behind the wireless networks
CO5: Explain the concepts behind the next generation networks

REFERENCE BOOKS

1. Joseph Mitola III,"Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering", John Wiley & Sons Ltd. 2000
2. Thomas W.Rondeau, Charles W. Bostain, "Artificial Intelligence in Wireless communication", ARTECH
3. Bruce A. Fette, "Cognitive Radio Technology", Elsevier, 2009
4. 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

5. Simon Haykin, "Cognitive Radio: Brain –Empowered Wireless Communications", IEEE Journal on selected areas in communications, Feb 2005

6. Hasari Celebi, Huseyin Arslan, "Enabling Location and Environment Awareness in Cognitive Radios", Elsevier Computer Communications , Jan 2008
7. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
8. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	2	3
2	3	2	3
3	3	2	3
4	3	2	3
5	3	2	3
Avg	3	2	3

1 - low, 2 - medium, 3 - high

222COE09 SPEECH AND AUDIO SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES

- Learn the concept of Speech and Audio
- Implement the time and Frequency domain methods for speech processing
- Develop about Homomorphic Speech Analysis
- Acquire about Linear Predictive Analysis of Speech

UNIT I MECHANICS OF SPEECH 9

Speech production: Mechanism of speech production, Acoustic phonetics - Digital models for speech signals - Representations of speech waveform: Sampling speech signals, basics of quantization, delta modulation, and Differential PCM - Auditory perception: psycho acoustics.

UNIT II TIME DOMAIN METHODS FOR SPEECH PROCESSING 9

Time domain parameters of Speech signal – Methods for extracting the parameters Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function

UNIT III FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING 9

Short Time Fourier analysis – Filter bank analysis – Formant extraction – Pitch Extraction – Analysis by Synthesis- Analysis synthesis systems- Phase vocoder—Channel Vocoder.
Cepstral analysis of Speech – Formant and Pitch Estimation – HomomorphicVocoders.

UNIT IV LINEAR PREDICTIVE ANALYSIS OF SPEECH 9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm

– lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

UNIT V APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING 9

Algorithms: Spectral Estimation, dynamic time warping, Hidden Markov model – Music analysis – Pitch Detection – Feature analysis for recognition – Music synthesis – Automatic Speech Recognition – Feature Extraction for ASR – Deterministic sequence recognition – Statistical Sequence recognition – ASR systems – Speaker identification and verification – Voice response system – Speech Synthesis: Text to speech,voice over IP.

TOTAL HOURS:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Demonstrate the concept of Speech and Audio
CO2: Knowledge of Speech Processing in time and Frequency domains
CO3: Demonstrate the Homomorphic Speech analysis
CO4: Analyze Speech in Linear Predictive Method
CO5: Gain knowledge in speech recognition and detection algorithms

REFERENCE BOOKS

1. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc. , Singapore, 2004.
2. L.R.Rabiner and R.W.Schaffer – Digital Processing of Speech signals – Prentice Hall -1978.
3. Quatieri – Discrete-time Speech Signal Processing – Prentice Hall – 2001.
4. L.R. Rabiner and B. H. Juang, "Fundamentals of speech recognition", Prentice Hall, 1993

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	3	3
3	2	3	1
4	3	3	2
5	3	3	2
Avg	2.8	3	2.2

1 - low, 2 - medium, 3 - high

222COE10 mm WAVE COMMUNICATION L T P C 3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamentals of Millimeter wave devices and circuits.
- To understand the various components of Millimeter wave Communications system.
- To know the antenna design at Millimeter wave frequencies.

UNIT I INTRODUCTION 9

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

UNIT II MM WAVE DEVICES AND CIRCUITS 9

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

UNIT III MM WAVE COMMUNICATION SYSTEMS 9

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

UNIT IV MM WAVE MIMO SYSTEMS 9

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

UNIT V ANTENNAS FOR MM WAVE SYSTEMS 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion the student will be able to

CO1: understand the Millimeter wave characteristics and implementation challenges faced.

CO2: understand Millimeter devices and circuits

CO3: apply his knowledge on the Modulation techniques for millimeter wave communications

CO4: design antenna for Millimeter wave frequencies

CO5: Familiar with Millimeter wave technology

REFERENCES

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

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3

5	3	3	3
Avg	3	3	3

1 - low, 2 - medium, 3 - high

222COE11 **MIXED - SIGNAL CIRCUIT DESIGN** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Know mixed signal circuits like DAC, ADC, PLL etc.
- Gain knowledge on filter design in mixed signal mode.
- Acquire knowledge on design different architectures in mixed signal mode

UNIT I PHASE LOCKED LOOP **9**

Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL - simple PLL, charge-pump PLL, applications of PLL.

UNIT II SAMPLING CIRCUITS **9**

Basic sampling circuits for analog signal sampling, performance metrics of sampling circuits, different types of sampling switches. Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture, current-mode architecture.

UNIT III D/A CONVERTER ARCHITECTURES **9**

Input/output characteristics of an ideal D/A converter, , performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, , switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures

UNIT IV A/D CONVERTER ARCHITECTURES **9**

Input/output characteristics and quantization error of an A/D converter, performance metrics of pipelined architectures, Successive approximation architectures, interleaved architectures.

UNIT V INTEGRATOR BASED FILTERS **9**

Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transferfunction.

TOTAL HOURS : 45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to :

CO1: Acquire knowledge in mixed signal circuits like DAC, ADC, PLL etc.

CO2: Acquire knowledge in filter design in mixed signal mode.

CO3: Design different architectures in mixed signal mode of DAC

CO4: Design different architectures in mixed signal mode of ADC

CO5: Understand about Integrated based filters

REFERENCE BOOKS

1. Razavi, "Design of analog CMOS integrated circuits", McGraw Hill, Edition 2002
2. Razavi, "Principles of data conversion system design", Wiley IEEE Press, 1st Edition, 1994

3. Jacob Baker, "CMOS Mixed-Signal circuit design", IEEE Press, 2009
4. Gregorian, Temes, "Analog MOS Integrated Circuit for signal processing", John Wiley & Sons, 1986
5. Baker, Li, Boyce, "CMOS: Circuit Design, layout and Simulation", PHI, 2000

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	2	3	3
3	2	3	3
4	2	3	3
5	2	3	3
Avg	2.2	3	3

1 - low, 2 - medium, 3 - high

222COE12 SENSOR NETWORKS AND IOT L T P C
3 0 0 3

COURSE OBJECTIVES:

- Computer science, information technology and Electronics & Telecommunication engineeringto understand the interconnection and integration of the physical world with the cyber space and begin designing and developing simple IoT devices.
- Illustrates end-to-end framework for Wireless Sensor Networks in IoT.
- Illustrates the IoT Standards and Protocols, Sensors and Actuators in IoT and IoT in the Cloud

UNIT I EMERGENCE OF IOT **9**

Background and Vision, IoT as a DisruptiveTechnology, Standardization. **Concept of Smart Things / Objects:** Thing in the context of IoT, Needs of an IoT Thing, Commonly usedThings can become smart, Machine to Machine (M2M) Technology

UNIT II WIRELESS SENSOR NETWORKS IN IOT **9**

Introduction, Types of WSN and Their Architecture, Characteristics of Wireless Sensor Network, Network Topologies in Wireless Sensor Network, WSNCommunication Protocols, Security in WSN, Distributed Sensor Network, Wireless Sensor Network Data Aggregation Approaches, RealWorld WSN Applications, Evolution of WSN Towards Internet of Things, Quality of Information in WSN.

UNIT III IOT STANDARDS AND PROTOCOLS **9**

An overview of Internet Principles, IPv6and Its Role in IoT, Low Power Wide Area Network (LPWAN), Wireless Technologies supporting IoT applications.

Sensors and Actuators in IoT: Perception Layer of IoT, UnderstandingVarious Commonly Used Sensors, Environment Measuring Sensors, Medical Sensors, Flow and Fluid Measuring Sensors, Range and MotionCapture Sensors, Actuators, IoT Examples.

UNIT IV Big IoT Data Science **9**

Foundations and Principles of Big Data Science,Concept of a Data Lake/Swamp, Relation between Big

Data and IoT, Big Data Analytics in IoT, Machine Learning and Deep Learning Tools.

UNIT V **IoT in the Cloud** 9

Cloud Computing and IoT: Introduction, IntegratingCloud computing with IoT, Cloud services oriented towards IoT, Selected Cloud Service providers, RESTful Web API design.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of course student should be able to

CO1: Understand various concept of smart things and Internet of Things (IoT)
CO2: Understand the evolution of WSN towards IOT
CO3: Understanding of various IoT standards and measuring sensors.
CO4: Understand the effects in Big data science.
CO5: Understand the effects of Cloud services oriented towards IoT.

Text Books:

1. Internet of Things, by Surya Durbha, Jyoti Joglekar, Oxford University Press
2. Internet of Things, A Hands on Approach, by Arshdeep Bahga & Vijayaudisetti, University Press.

Reference Books

1. The Internet of things: connecting objects to the web, by Hakima Chaouchi,Willey.
2. The Internet of Things, by Michael Millen, Pearson
3. Internet of Things Principles and Paradigms, Rajkumar Buyya and AmirVahid Dastjerdi, Morgan Kaufmann, Elsevier.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	2	3	3
3	2	3	3
4	2	3	3
5	2	3	3
Avg	2.2	3	3

1 - low, 2 - medium, 3 - high

322COT01 OPTICAL COMMUNICATION AND NETWORKING L T P C

3 0 0 3

COURSE OBJECTIVES

- To enable the student to understand the basic principles of operation of optical system components, the different network architectures and issues associated with network design.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.

UNIT I OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN 9

Optical System Components – MZIM, Multiplexers; filters; switches; wavelength converters; optical amplifiers – EDFA, Raman Amplifiers and hybrid; Transmission system Engineering – System Model, Aimer penalty – transmitter, receiver, cross talk, dispersion compensation, wavelength stabilization, FWM.

UNIT II COHERENT SYSTEMS 9

Basic principles of Coherent detections – Practical constraints – Injection laser line width state of polarization, local oscillator power, fiber limitations; Modulation formats – ASK, FSK, PSK, DPSK and polarization shift keying (POL SK); Demodulation schemes – Homodyne, Heterodyne – Synchronous and Non synchronous detection; Comparison; Carrier recovery in Coherent detection.

UNIT III OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; First Generation optical networks –SONET / SDH Network, Second Generation (WDM) Optical Networks, Need for Multilayered Architecture-, Layers and Sublayers, Spectrum partitioning, Optical Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays.

UNIT IV NETWORK CONNECTIONS 9

Connection Management and Control; Static Networks, Wavelength Routed Networks; Linear Light wave networks; Logically Routed Networks; Routing and Wavelength Assignment , Traffic Grooming in Optical Networks.

UNIT V OPTICAL NETWORK SURVIVABILITY 9

Protection and Restoration Objectives, Fault Protection and Restoration Techniques in the Logical Layer – Point-to-Point Systems, SONET Self-Healing Rings, Interconnection Techniques, Architectures with Arbitrary Mesh Topologies, Optical-Layer Protection: Point-to-Point and Ring Architectures, Mesh Architectures.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: Demonstrate an understanding of the differences and challenges involved in the design of optical systems and networks.

CO2: Apply his knowledge for designing a fiber optic system addressing the channel impairments.

CO3: Familiar with the architectures and the protocol stack in use.in optical networks and would be able to identify a suitable backbone infrastructure for our present and future communication needs.

CO4: Understand how connections are managed in the network and the pros and cons of the different approaches

CO5: Appreciate the need for network survivability and the methodologies used.

REFERENCES

1. Max Ming-Kang Liu, "Principles and Applications of Optical Communication", Tata McGraw Hill Education Pvt., Ltd., New Delhi. 2010

2. Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks – Architecture, Design and control ", Cambridge University Press, 2nd Edition, 2009.

3. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2006.

MOOC Links

1. https://nptel.ac.in/courses/117101002
2. https://nptel.ac.in/courses/117101054

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	3	3
2	3	3	3
3	3	3	3
4	3	3	3
5	3	3	3
Avg	3	3	3

1 - low, 2 - medium, 3 - high

322COT02 ***MACHINE LEARNING*** ***L T P C***

3 0 0 3

COURSE OBJECTIVES

- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning To understand the basic concepts of neural networks and deep learning

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9

What is Machine Learning? Need -History - Definitions – Applications-Advantages, Disadvantages & Challenges, Types of Machine Learning Problems- Mathematical Foundations – Linear Algebra & Analytical Geometry - Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

UNIT II SUPERVISED LEARNING **9**

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation - Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines -Kernel Methods -Instance based Methods - K-Nearest Neighbours - Tree based Methods -Decision Trees -ID3 - CART - Ensemble Methods -Random Forest - Evaluation of Classification Algorithms

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING **9**

Introduction - Clustering Algorithms - K-Means - Hierarchical Clustering - Cluster Validity Dimensionality Reduction -Principal Component Analysis - Recommendation Systems -EM algorithm. Reinforcement Learning - Elements -Model based Learning - Temporal Difference Learning

UNIT IV PROBABILISTIC METHODS FOR LEARNING **9**

Introduction -Naive Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks - Probability Density Estimation - Sequence Models - Markov Models - Hidden Markov Models

UNIT V NEURAL NETWORKS AND DEEP LEARNING **9**

Neural Networks - Biological Motivation- Perceptron - Multi-layer Perceptron - Feed Forward Network - Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning- Convolution Neural Networks - Recurrent Neural Networks - Use cases

TOTAL: 45 PERIODS

COURSE OUTCOMES

Students will be able to

CO1: Understand and outline problems for each type of machine learning

CO2: Design a Decision tree and Random Forest for an application

CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.

CO4: Use a tool to implement typical Clustering algorithms for different types of applications.

CO5: Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

SUGGESTED ACTIVITIES:

1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

REFERENCE BOOKS

1. Stephen Mareland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC,2nd Edition, 2014

2. Kevin Murphy, "Machine Learning; A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Shal Shaley Shwartz and Shal Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
6. Aurlien Gron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts,Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

MOOC Link:

1. https://nptel.ac.in/courses/108103192

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	1	2
2	3	1	2
3	3	1	2
4	3	1	2
5	3	1	2
Avg	3	1	2

1 - low, 2 - medium, 3 - high

322COE01 **SMART ANTENNAS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To discuss the various types of Smart Antennas.
- To Study the DOA Estimation Fundamentals.
- To analyze the of Beam Forming Fundamentals.
- To learn the software Integration and Simulation of Smart Antennas.
- To know about Space-Time Processing.

UNIT I SMART ANTENNAS **9**

Introduction, Need for Smart Antennas, Overview, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Basic Principles, Mutual Coupling Effects.

UNIT II DOA ESTIMATION FUNDAMENTALS **9**

Introduction, Array Response Vector, Received Signal Model, Subspace-Based Data Model, Signal Autocovariance, Conventional DOA Estimation Methods, Conventional Beamforming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation, MUSIC Algorithm, ESPRIT Algorithm, Uniqueness of DOA Estimates.

UNIT III BEAM FORMING FUNDAMENTALS 9

Beam Forming Fundamentals: Classical Beam former, Statistically Optimum Beamforming Weight Vectors, Maximum SNR Beam former, Multiple Sidelobe Canceller and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beamforming

UNIT IV INTEGRATION AND SIMULATION OF SMART ANTENNAS 9

Integration and Simulation of Smart Antennas: Overview, Antenna Design, Mutual Coupling, Adaptive Signal Processing Algorithms, DOA, Adaptive Beam forming, Smart Antenna Systems for Mobile Adhoc Networks (MANETs), Protocol, Simulations, Discussion.

UNIT V SPACE-TIME PROCESSING 9

Introduction, Discrete Space-Time Channel and Signal Models, Space- Time Beamforming, Intersymbol and Co-Channel Suppression, Space-Time Processing for DSCDMA, Capacity, and Data Rates in MIMO Systems, Discussion.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Describe various Smart Antennas.

CO2: Learn the concepts of DOA Estimation Fundamentals.

CO3: Understand the concepts of Beam Forming Fundamentals.

CO4: Familiarize the concepts of Integration and Simulation of Smart Antennas.

CO5: Analyze the concepts Space-Time Processing.

REFERENCE BOOKS

1. Constantine A. Balanis & Panayiotis I. Ioannides, "Introduction to Smart Antennas", Morgan & Claypool Publishers' series-2007
2. Joseph C. Liberti Jr ., Theodore S Rappaport, "Smart Antennas for Wireless Communications IS-95 and Third Generation CDMA Applications", PTR – PH publishers, 1st Edition, 1989.
3. T.S Rappaport, Smart Antennas Adaptive Arrays Algorithms and Wireless Position Location", IEEE press 1998, PTR – PH publishers 1999.
4. Lal Chand Godara, "Smart Antennas", CRC Press, LLC-20.

MOOC Link:

1. https://nptel.ac.in/courses/117107035

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	2	2	2
2	3	3	3
3	2	2	2
4	2	2	2
5	2	2	2
Avg	2.2	2.2	2.2

1 - low, 2 - medium, 3 - high

322COE02 **VLSI FOR WIRELESS COMMUNICATION** L T P C

3 0 0 3

COURSE OBJECTIVES

- Understand the basics of Digital Communication.
- Understand the concepts of Receiver architecture.
- Study the principles of ADC and Low noise amplifier.
- Learn the Concepts of VLSI architecture.

UNIT I INTRODUCTION 9

Review of Modulation Schemes - BFSK- BPSK -QPSK - OQPSK - Classical Channel - Additive White Gaussian Noise - Finite Channel Bandwidth - Wireless Channel - Path Environment - Path Loss - Friis Equation - Multipath Fading - Channel Model - Envelope Fading - Frequency Selective Fading - Fast Fading - Comparison of different types of Fading- Review of Spread Spectrum - DSSS - FHSS - Principle of DSSS - Modulation - Demodulation - Performance in the presence of noise - narrowband and wideband interferences.

UNIT II RECEIVER ARCHITECTURE 9

Receiver Front End - Motivations - General Design Philosophy- Heterodyne and Other architectures - Filter Design - Band Selection Filter - Image Rejection Filter - Channel Filter - Non idealities and Design Parameters - Harmonic Distortion - Intermodulation - Cascaded Nonlinear Stages - Gain Compression - Blocking - Noise - Noise Sources - Noise Figure - Design of Front end parameter for DECT

UNIT III LOW NOISE AMPLIFIER 9

Low Noise Amplifier - Matching Networks - Matching for Noise and Stability - Matching for Power - Implementation - Comparison of Narrowband and Wideband LNA - Wideband LNA Design - Narrowband LNA - Impedance matching -Power matching- Salient features of LNA -Core Amplifier Design.

UNIT IV ANALOG TO DIGITAL CONVERTERS & SYNTHESIZER 9

Demodulators - Delta Modulators - Low Pass Sigma Delta Modulators - High Order Modulators - One Bit DAC and ADC -Passive Low Pass Sigma Delta Modulator - Band pass Sigma Delta Modulators - Comparison - PLL based Frequency Synthesizer.

UNIT V VLSI ARCHITECTURE FOR WIRELESS SYSTEMS 9

Implementations: VLSI architecture for Multi-tier Wireless System - Hardware Design Issues for a Next generation CDMA System - Efficient VLSI Architecture for Base Band Signal processing.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Understanding of application of Digital techniques for communication systems.

CO2: Knowledge of various techniques and aspects of Receivers.

CO3: Design a Low noise amplifier.

CO4: Discussion about design and simulation of modulation.

CO5: Learn the technology of next generation wireless in VLSI.

REFERENCE BOOKS

1. Bosco Leung, "VLSI for wireless Communication", Springer, 2nd Edition, 2011.
2. Andreas F.Molisch, "Wideband wireless Digital Communication", Prentice Hall PTR, 2001.
3. Xiaodong Wang and H.Vincent Poor, "Wireless Communication System ,Advanced Techniques for Signal Reception", Pearson Education. 2004.
4. Wolfgang Eberle, "Wireless Transceiver Systems Design", Springer, 2008.

MOOC Links:

1. https://nptel.ac.in/courses/117106149
2. https://nptel.ac.in/courses/117106034

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	2	1	1
2	1		2
3	2		2
4	1		2
5	2		2
Avg	1.6	1	1.8

1 - low, 2 - medium, 3 - high

322COE03 **RF MEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- Learn the various types of analysis in RF MEMS switches.
- Study the DC switches and MEMS release procedure.
- Learn the MEMS SWITCH reliability, power handling and failure mechanisms.
- Study the MEMS phase shifters and various measurements.

UNIT I SWITCHING 9

RF MEMS relays and switches: Switch parameters, Actuation mechanisms, Bistable relays and micro actuators, Dynamics of switching operation.

UNIT II COMPONENTS – I 9

MEMS inductors and capacitors: Micromachined inductor, Effect of inductor layout, Modeling and design issues of planar inductor, Gap tuning and area tuning capacitors, Dielectric tunable capacitors.

UNIT III COMPONENTS - II 9

MEMS phase shifters: Types. Limitations, Switched delay lines, Micromachined transmission lines, coplanar lines, Micromachined directional coupler and mixer.

UNIT IV FILTERS 9

Micromachined RF filters: Modeling of mechanical filters, Electrostatic comb drive, Micromechanical filters using comb drives, Electrostatic coupled beam structures.

UNIT V ANTENNAS 9

Micromachined antennas: Microstrip antennas – design parameters, Micromachining to improve performance, Reconfigurable antennas.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Understand the linear dynamic analysis and switching time calculations.
CO2: Demonstration of the various fabrication technique of the MEMS switch.
CO3: Implementation of the MEMS switches with fault handling mechanisms.
CO4: Designing the various phase shifters for DMTL and wide band distributed switches.
CO5: Insight in how critical modules in wireless systems can be designed and implemented using MEMS technology

REFERENCE BOOKS

1. V.K.Varadan etal, RF MEMS and their Applications, Wiley, 2003
2. H.J.DELOS SANTOS : RF MEMS circuit Design for Wireless Communications, Artech House, 2002.
3. G.M.REBEIZ, RF MEMS Theory, Design and Technology, John Wiley, 2003

MOOC Link:

1. https://nptel.ac.in/courses/117105082

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	1	3
2	2	1	3
3	2	2	3
4	2	1	3
5	3	1	3
Avg	2.4	1.2	3

1 - low, 2 - medium, 3 - high

322COE04 ANALYSIS AND DESIGN OF PLANAR TRANSMISSION LINES L T P C

3 0 0 3

COURSE OBJECTIVES

- Study the different technologies of microwave integrated circuits
- Analyze the planar transmission line.
- Learn about the hybrid mode analysis.
- Know about the Strip line design formulation.

UNIT I ANALYSIS OF PLANAR TRANSMISSION LINES 9

Planar Transmission Lines: Strip line - micro strip line - coplanar waveguide - coplanar strips slot line - fin line and characteristics - properties - design parameters and its applications; Technology of MICs: Monolithic and hybrid substrates - thin and thick film technologies -advantages and applications

UNIT II SPECTRAL DOMAIN METHODS 9

Spectral domain methods. Formulation of quasi-static and dynamic spectral domain analyses. Galekin's method

UNIT III ANALYSIS OF HYBRID MODE 9

Hybrid mode analysis. Formulation. Application in planar transmission lines. Characteristic equation. Evaluation of parameters.

UNIT IV DESIGN OF COPLANAR & SLOT LINES 9

Coplanar lines, quasi-static and full wave analysis. Design equations. Comparison with microstrip and slot lines.

UNIT V MICROSTRIP LINES 9

General analysis of coupled lines. Design considerations for microstrip lines- microstrip losses, power handling capacity, effect of tolerances, effect of dielectric anisotropy, design equations, lumped element of microstrip interconnect, applications of microstrip lines.

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Acquire knowledge about analysis of planar transmission lines.
CO2: Gain knowledge in spectral domain methods.
CO3: Acquire knowledge in analysis of hybrid mode
CO4: Learn about the design consideration of Coplanar lines
CO5: Learn about the design consideration of Microstrip lines and develop applications.

REFERENCE BOOKS

1. Itoh, Numerical Techniques for Microwave and Millimeter Wave Passive Structures, John Wiley & Sons, 1989
2. C.Nguyen, Analysis Methods for RF, Microwave and Planar Transmission Line Structures, Wiley, 2000
3. Ramesh Garg, Inder Bahl, Maurizio Bozzi, Microstrip Lines and Slotlines, Third Edition-2013, Artech house, Boston.
4. Leo G. Maloratsky, "Passive RF & Microwave Integrated Circuits", Elsevier, 2004.

MOOC Link:

1. https://nptel.ac.in/courses/117101057

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	1	3
2	3	1	3
3	3	1	3
4	3	1	3
5	3	1	3
Avg	3	1	3

1 - low, 2 - medium, 3 - high

322COE05 ULTRA-WIDEBAND COMMUNICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES

- Develop a comprehensive overview of UWB system design that spans propagation
- Design transmitter and receiver antenna implementations.
- Adopt Signal processing techniques in solving problems in the real world

UNIT I INTRODUCTION TO UWB 9

History, Definition, FCC Mask, UWB features, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wireless services.

UNIT II UWB TECHNOLOGIES AND CHANNEL MODELS 9

Impulse Radio, Pulsed Multiband, Multiband OFDM, features : Complexity, PowerConsumption, Security and achievable data rate. MIMO Multiband OFDM, Differential multiband OFDM, Performance characterization, Ultra Wide Band Wireless Channels Channel model: Impulse Response Modeling of UWB Wireless Channels, IEEE UWB channel model, Path loss, Delay profiles, Time and frequency modeling.

UNIT III UWB SIGNAL PROCESSING 9

Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver,Transmit-Reference (T-R) Technique, UWB Range- Data Rate Performance, UWBChannel Capacity, UWB Wireless Locationing: Position Locationing Methods, Time ofArrival Estimation, NLOS Location Error , Locationing with OFDM.

UNIT IV UWB ANTENNAS 9

Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broadband antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broad band UWB antennas.

UNIT V UWB APPLICATIONS AND REGULATIONS 9

Wireless Ad hoc Networking, UWB Wireless Sensor, RFID, Consumer Electronics and Personal, Asset Location, Medical applications, UWB Regulation and standards in various countries , UWB Regulation in ITU, IEEE Standardization

TOTAL : 45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1: Understand the basics of IEEE protocol standards.
CO2: The student would be able to understand UWB technologies.
CO3: Ability to assess the performance of UWB channels.
CO4: Understand the construction of UWB antenna.
CO5: The student would be able to design UWB antenna for various applications.

REFERENCE BOOKS

1 Homayoun Nikookar and Ramjee Prasad, "Introduction to Ultra Wideband for Wireless

Communications"1st Edition, Springer Science & Business Media B.V.2010.
2 Thomas Kaiser, Feng Zheng "Ultra Wideband Systems with MIMO", 1st Edition, JohnWiley & Sons Ltd, New York, 2010.
3 W. Pam Siriwong pairat and K. J. Ray Liu, "Ultra-Wideband Communications Systems: Multiband OFDM approach" John Wiley and IEEE press, New York 2008.
4 Huseyin Arslan,Zhi Ning Chen,Maria-Gabriella Di Benedetto "Ultra Wideband Wireless communication" Wiley-Interscience; 1st edition 2006.

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1			2
2	2		2
3			
4			2
5	2		
Avg -	2		2

1 - low, 2 - medium, 3 - high

322COE06 *SOFTWARE DEFINED RADIOS* *L T P C*

3 0 0 3

COURSE OBJECTIVES

- To learn various design principles of software defined radio.
- To understand challenges of receiver design.
- To design smart antennas for SDR.

UNIT I INTRODUCTION TO SOFTWARE RADIO CONCEPTS 9

SDR concepts & history, Benefits of SDR, SDR Forum, Ideal SDR architecture, SDR Based End- to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA. Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems.

UNIT II RADIO FREQUENCY IMPLEMENTATION ISSUES 9

Purpose of RF front - end, Dynamic range, RF receiver front - end topologies, Enhanced flexibility of Transmitter the RF chain architectures with software and their radios, issues, Importance Noise and of the distortion components in the RF to overall chain, performance, ADC & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.

UNIT III MULTIRATE SIGNAL PROCESSING IN SDR 9

Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters.

UNIT IV SMART ANTENNAS 9

Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures, Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio.

UNIT V OBJECT ORIENTED REPRESENTATION OF RADIOS AND NETWORK 9

Networks, Object -oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system. **Case Studies in Software Radio Design**: SPEAKeasy, JTRS, Wireless Information transfer system, SDR-3000 digital transceiver subsystem, Spectrum Ware, Brief introduction to Cognitive Networking. Processing, Recursive Methods for Adaptive Error Processing.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to :

CO1: Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and technologies for its implementation.

CO2: Analyse complex problems critically in the domains of Radio frequency implementation issues,

CO3: Apply multirate signal processing in SDR

CO4: Implement Smart antenna techniques for better spectrum exploitation for conducting research.

CO5: in designing Apply software appropriate defined techniques radios for the development of scientific and technological knowledge.

REFERENCE BOOKS

1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Tony J Rouphael, "RF and DSP for SDR," Elsevier Newnes Press, 2008
3. Travis F. Collins, Robin Getz, Di Pu, and Alexander M. Wyglinski, Software-Defined Radio for Engineers, 2018, ISBN-13: 978-1-63081-457-1.
4. Bard, Kovarik, Software Defined Radio, the Software Communications Architecture, Wiley, 2007

MOOC Link:

1. https://nptel.ac.in/courses/108107107

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3		3
2	3		3
3	3		3
4	3		3
5	3		3
Avg	3		3

1 - low, 2 - medium, 3 - high

322COE07 ADVANCED DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES

- To become familiar with digital image fundamentals.
- To study the image segmentation and representation techniques
- To learn concepts of degradation function and feature extraction techniques
- 3D image visualization is effective for quick representations of objects, and for producing high-quality demonstrations

UNIT I REVIEW OF DIGITAL IMAGE PROCESSING 9

Steps in digital image processing-Elements of visual perception- brightness adaptation, Mach band effect. Image enhancement in spatial and frequency domain, Histogram equalization

UNIT II SEGMENTATION 9

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour models, Texture feature based segmentation, Graph based segmentation, Wavelet based Segmentation - Applications of image segmentation.

UNIT III FEATURE EXTRACTION 9

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

UNIT IV REGISTRATION AND IMAGE FUSION 9

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

UNIT V 3D IMAGE VISUALIZATION 9

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

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon Completion of this course, students will be able to :

CO1: Explain the essentials of digital image processing.
CO2: Describe various segmentation techniques for image analysis.
CO3: Outline the various feature extraction techniques for image analysis.
CO4: Discuss the concepts of image registration and fusion.
CO5: Illustrate 3D image visualization.

REFERENCE BOOKS

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson Education, Inc.,Third Edition, 2016.
2. Mark Nixon, Alberto Aguado, "Feature Extraction and Image Processing", Academic Press,2008.
3. Ardeshir Goshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications",John Wiley and Sons,2005.
4. John C.Russ, "The Image Processing Handbook", CRC Press,2007.

E –BOOKS

1. John C. Russ, F. Brent Neal-The Image Processing Handbook, Seventh Edition, The Kindle edition (2016), CRC Press,Taylor & Francis Group.

MOOC Links:

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/
3. https://nptel.ac.in/courses/105107160

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1			1
2			1
3			2
4	2	2	3
5	3	3	3
Avg	2.6	2.6	1.8

1 - low, 2 - medium, 3 - high

322COE08 **EMBEDDED SYSTEMS FOR COMMUNICATION** **L T P C**

3 0 0 3

COURSE OBJECTIVES

- Understand about Embedded Architecture and to design of hardware and software components
- Study about the embedded processor and computing platform
- Learn the Embedded Networks
- Acquire the Embedded Real time characteristic and System design technique

UNIT I EMBEDDED ARCHITECTURE **9**

Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded System Design, Embedded System Design Process - Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration.

UNIT II EMBEDDED PROCESSOR AND COMPUTING PLATFORM **9**

ARM processor- processor and memory organization, data operations, flow of control, SHARC processor- memory organization, data operations, flow of control, parallelism with instructions, CPU Bus configuration, ARM Bus, SHARC Bus, Memory Devices, Input / Output Devices. Design Example: Alarm Clock.

UNIT III NETWORKS 9

Distributed Embedded Architecture - Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link ports, Ethernet, Myrinet, Internet. Design Example: Elevator Controller.

UNIT IV SCHEDULERS 9

Types of Schedulers, table-driven, Cyclic, EDF, RMA - Process Synchronization - Message queues - Mail boxes - pipes.

UNIT V CASE STUDY 9

Digital camera, Smart card, Flight simulation and control, Automatic Driving Assistance.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Design hardware and software components
CO2: Knowledge in Embedded processor and computing platform
CO3: Knowledge in Embedded Networks
CO4: Design the schedulers for Embedded Systems
CO5: Develop Applications

REFERENCE BOOKS

1. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008
2. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open-Source Tools, CRC press, 2016.
3. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress, 2013
4. Karim Yaghmour, Embedded Android, O'Reilly, 2013.
5. Frank Vahid and Tony Givargi, Embedded System Design: A Unified Hardware/Software Introduction, s, John Wiley & Sons, 2000

MOOC Links:

1. https://nptel.ac.in/courses/106103182
2. https://nptel.ac.in/courses/106105159

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1			3
2	2		1
3		2	2
4	2		3
5	2		1
Avg	2	2	2

1 - low, 2 - medium, 3 - high

322COE09 DETECTION AND ESTIMATION THEORY L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory
- To understand the theory behind various estimation techniques.
- To understand Wiener filter and Kalman filter in detail

UNIT I STATISTICAL DECISION THEORY 9

Bayesian Hypothesis Testing - Likelihood Ratio Tests – Minimax, Hypothesis Testing - Neyman Pearson Hypothesis Testing, Composite Hypothesis Testing - M'ary Hypothesis Testing

UNIT II SINGLE AND MULTIPLE SAMPLE DETECTION 9

Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise, Performance of Binary Receivers in AWGN.

UNIT III PARAMETER ESTIMATION 9

Fundamentals of Estimation Theory - Minimum Variance Unbiased Estimation - Cramer Rao Lower bound - Best Linear Unbiased Estimators - Linear Least Squares Estimation Nonlinear Least Squares Estimation - Maximum Likelihood Estimation

UNIT IV FUNDAMENTALS OF ESTIMATION THEORY 9

Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters.

UNIT V APPLICATIONS 9

Detector Structures in Non-Gaussian Noise, Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: To apply the detection theory for system design and analysis.

CO2: Able to design optimum detector and estimator for AWGN channel

CO3: To apply the various estimation theory for signal and system design and analysis

CO4: Able to design and analyze the various estimators

CO5: Able to design and develop novel receiver structures suitable for modern technology.

REFERENCE BOOKS

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2004.

2. Ludeman, Lonnie C. Random processes: filtering, estimation, and detection. John Wiley &Sons, Inc ., 2003
3. Sergio Verdu " Multi User Detection" Cambridge University Press, 1998
4. Thomas Schonhoff, "Detection and Estimation Theory", Prentice Hall, NewJersy, 2007.

MOOC Link:

1. https://nptel.ac.in/courses/117103018

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	3	1	2
2	3	1	2
3	3	2	2
4	3	2	2
5	3	2	2
Avg	3	1.6	2

1 - low, 2 - medium, 3 - high

322COE10 OPTICAL SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES

- Learn the key aspects of OSP.
- Understand about the components spectrum analysis.
- Understand the features of spatial filtering and its applications
- Acquire knowledge heterodyne system.

UNIT I BASICS OF SIGNAL PROCESSING AND OPTICS 9

Characterization of a General signal, examples of signals, Spatial signal. Basic laws of geometrical optics, Refractions by mirrors, the lens formulas, General Imaging conditions, the optical invariant, Optical Aberrations.

UNIT II PHYSICAL OPTICS 9

The Fresnel Transforms, the Fourier transform, Examples of Fourier transforms, the inverse Fourier transform, Extended Fourier transform analysis, Maximum information capacity and optimum packing density, System coherence.

UNIT III SPECTRUM ANALYSIS AND SPATIAL FILTERING 9

Light sources, spatial light modulators, The detection process in Fourier domain, System performance parameters, Dynamic range. Some fundamentals of signal processing, Spatial Filters

UNIT IV BINARY SPATIAL FILTERS 9

Magnitude Spatial Filters, Phase Spatial Filters, Real valued Spatial Filters, Interferometric techniques for constructing Spatial Filters. Optical signal processor and filter generator, Applications for optical signal processing.

UNIT V ACOUSTO-OPTIC CELL SPATIAL LIGHT MODULATORS 9

Applications of acousto-optic devices. Basic Acousto-optic power spectrum analyzer. Heterodyne systems: Interference between two waves, the optical Radio.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Gain Knowledge in OSP, Transforms, and its resolution criteria
CO2: Develop a OSP system.
CO3: Analyse performance parameters of spectrum analyzer
CO4: Implement the applications of binary spatial filtering
CO5:Model the acousto-optic cell spatial light modulators.

REFERENCE BOOKS

1. 1. Anthony Vanderlugt ,"Optical signal processing" ,Wiley-Interscience, 1st Edition, 2005
2. Hiroshi Ishikawa ,"Ultrafast All-Optical Signal Processing Devices",Wiley, 2008
3. J. Horner ,"Optical Signal Processing ",Academic Press 1988
4. Francis T. S. Yu, Suganda Jutamulia, "Optical Signal Processing, Computing, and Neural Networks", Krieger Publishing Company; 2nd edition, 2000

MOOC Link:

1. https://nptel.ac.in/courses/117101002
2. https://nptel.ac.in/courses/108106161

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1			1
2			1
3			2
4	2	2	3
5	3	3	3
Avg	2.6	2.6	1.8

1 - low, 2 - medium, 3 - high

322COE11 AD HOC NETWORKS L T P C

3 0 0 3

COURSE OBJECTIVES

- To analyse the various design issues and challenges in the layered architecture of Ad hoc wireless networks
- Study various issues in Ad-Hoc Network Routing & TCP

UNIT I BASICS OF AD HOC NETWORKS 9

Cellular and ad hoc wireless networks, Applications of ad hoc wireless networks. Issues in ad hoc wireless networks-medium access scheme, routing, transport layer protocols, security and energy management. Ad hoc wireless internet.

UNIT II MAC PROTOCOLS 9

Design goals of a MAC protocol, Contention based protocols; Contention based protocols with reservation mechanisms and scheduling mechanisms, MAC protocols using directional antennas.

UNIT III TYPES OF AD HOC NETWORK PROTOCOLS 9

Table driven routing protocols, On demand routing protocols, hybrid routing protocols, Hierarchical routing protocols, Power aware routing protocols, Tree based and mesh based multicast routing protocols

UNIT IV ISSUES AND CHALLENGES 9

Network security requirements-Issues and challenges, network security attacks, key management, secure routing protocols

UNIT V ENERGY MANAGEMENT SCHEMES 9

Energy management schemes-Battery management, transmission power management, system power management schemes. Quality of service solutions in ad hoc wireless networks.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Compare the differences between cellular and ad hoc networks and the analyse the challenges at various layers and applications

CO2: Summarize the protocols used at the MAC layer and scheduling mechanisms

CO3: Compare and analyse types of routing protocols used for unicast and multicast routing

CO4: Examine the network security solution and routing mechanism

CO5: Evaluate the energy management schemes and Quality of service solution in ad hoc networks

REFERENCES BOOKS

1. C.Siva ram murthy,B.S. Manoj, "Ad hoc wireless networks-Architectures and protocols" Pearson Education, 2005

2. Stefano Basagni, Marco Conti, "Mobile ad hoc networking", Wielyinterscience 2004

3. Xiuzhen Cheng, Xiao Huang ,Ding Zhu DU ,"Ad hoc wireless networking", Kluwer Academic Publishers,2004

4. George Aggelou,"Mobile ad hoc networks-From wireless LANs to 4G networks, McGraw Hill publishers, 2005

MOOC Link:

1. https://nptel.ac.in/courses/106105160

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1			3
2	3		3
3			3
4	3	2	3
5	3	2	3
Avg	3	2	3

1 - low, 2 - medium, 3 - high

322COE12 ***REMOTE SENSING*** ***L T P C***

3 0 0 3

COURSE OBJECTIVES

- To understand about basics of Remote Sensing and Data Acquisition
- To learn Advanced Photographic Products
- To understand the types of scattering system
- To study about thermal and hyper spectral remote sensing

UNIT I PHYSICS OF REMOTE SENSING **9**

Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types – Absorption -Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned space crafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc.

UNIT II PHOTOGRAPHIC PRODUCTS **9**

B/W, color, color IR film and their characteristics –resolving power of lens and film - Optomechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery - calibration of thermal scanners.

UNIT III SCATTERING SYSTEM **9**

Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT - Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

UNIT IV DATA RECEPTION AND DATA PRODUCTS **9**

Ground segment organization – Data product generation – sources of errors in received data – referencing scheme – data product output medium – Digital products – Super structure, Fast,GeoTIFF, Hierarchical and HDF formats – Indian and International Satellite Data Products – ordering of data.

UNIT V DATA ANALYSIS AND APPLICATIONS **9**

Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics - visual and digital interpretation–Basic principles of data processing – Radiometric correction–Image enhancement–Image classification – Principles of LiDAR, Aerial Laser Terrain Mapping. **Applications:** Mixed and mobile services - Multimedia satellite services - Advanced applications based on satellite platforms, Special services.

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon Completion of this course, students will be able to :

CO1: Familiar with Remote Sensing and Data Acquisition
CO2: Illustrate the concept of advanced photographic Products
CO3: Describe the various types of scattering system
CO4: Gain knowledge about reception, product generation, storage and ordering of satellite data
CO5: Analyze data and interpret accordingly.

REFERENCE BOOKS

1. Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, VI edition of John Wiley & Sons-2015.
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2017.
3. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 5th edition, 2013.
4. George Joseph, Fundamentals of Remote Sensing, Third Edition, Universities Press (India) Pvt Ltd, Hyderabad, 2018

MOOC Links:

1. https://nptel.ac.in/courses/105101206
2. https://nptel.ac.in/courses/105107201

CO's-PO's & PSO's MAPPING

CO	PO1	PO2	PO3
1	2	3	3
2	2	3	3
3	2	3	3
4	3	3	2
5	3	3	3
Avg	2.4	3	2.8

1 - low, 2 - medium, 3 - high