ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. COMMUNICATION AND NETWORKING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. Acquire core competence and excel in communication and networking based industries.
II. Serve in research establishments and contribute towards the development of sophisticated signal processing systems.
III. Provide consultancy and offer networking solutions for establishments.
IV. Work towards doctoral and post-doctoral degrees in the area of Data Centre Networking and 5G Networks
V. Become entrepreneurs and contribute towards indigenous product development which could compete in global market.

2. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Communication and Networking programme, students will have the following programme specific outcomes.

I. Foundation of communication and signal processing systems: Ability to understand the basics principles of Networking, communication, signal processing, Security Network and understand their implementation issues.
II. Foundation of networking systems: Ability to understand the various technologies behind the recent communication standards like 5G Communication Techniques, Wireless Broadband Networks and work towards improved solutions.
III. Foundations of Mathematical concepts: Ability to apply mathematical knowledge to solve complex signal processing algorithms and networking issues.
IV. Applications of Communication and networking and Research ability: Ability to use knowledge in various Domains to identify research gaps and provide innovative solutions.

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CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI
SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4156	Linear Algebra, Probability and Queueing Theory	FC	3	1	0	4	4
2.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
3.	DS4152	Statistical Signal Processing	PCC	3	0	0	3	3
4.	CU4151	Advanced Wireless Communication	PCC	3	0	0	3	3
5.	EL4151	Modern Digital Communication Systems	PCC	3	0	0	3	3
6.	NC4101	High Performance Networks	PCC	3	0	0	3	3
7.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
8.	NC4111	Communication Networks Laboratory	PCC	0	0	3	3	1.5
9.	CU4161	Advanced Digital Signal Processing Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**19**	**1**	**6**	**26**	**21**

*Audit course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	NC4251	Cognitive Radio Networks	PCC	3	0	0	3	3
2.	NC4201	Internet of Things and Cloud	PCC	3	0	2	5	4
3.	NC4202	RF System and Antenna Design	PCC	3	0	0	3	3
4.	CP4252	Machine Learning	PCC	3	0	2	5	4
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Audit Course – II*	AC	2	0	0	2	0
PRACTICALS								
8.	NC4211	Internet of Things Laboratory	PCC	0	0	4	4	2
9.	NC4212	Term Paper and seminar	EEC	0	0	2	2	1
			TOTAL	**20**	**0**	**10**	**30**	**23**

*Audit course is optional

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	NC4301	Data Centre Networking	PCC	3	0	0	3	3
2.		Professional Elective III	PEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	2	5	4
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	NC4311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	NC4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES

SEMESTER II, ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	DS4251	Multimedia Compression Techniques	PEC	3	0	0	3	3
2.	NC4001	Network Analytics	PEC	3	0	0	3	3
3.	CU4071	Advanced Satellite Communication and Navigation Systems	PEC	3	0	0	3	3
4.	AP4078	Signal Integrity in High Speed Design	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	NC4002	Server Architecture	PEC	3	0	0	3	3
2.	CU4072	High Speed Switching and Networking	PEC	3	0	0	3	3
3.	EL4351	Optical Networks	PEC	3	0	0	3	3
4.	CU4076	Speech Processing	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CU4074	Ultra Wide Band Communications	PEC	3	0	0	3	3
2.	NC4003	Broadband Networks	PEC	3	0	0	3	3
3.	NC4004	Virtual Private Networks	PEC	3	0	0	3	3
4.	NC4005	Telecommunication Switching System Modeling	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CU4073	Image Processing and Video Analytics	PEC	3	0	2	5	4
2.	DS4071	Radar Signal Processing	PEC	3	0	2	5	4
3.	NC4006	Network Protocols and Programming	PEC	3	0	2	5	4
4.	EL4072	Signal Detection and Estimation	PEC	3	0	2	5	4

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4156	Linear Algebra, Probability and Queueing Theory	3	1	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	DS4152	Statistical Signal Processing	3	0	0	3	I
2.	CU4151	Advanced Wireless Communication	3	0	0	3	I
3.	EL4151	Modern Digital Communication	3	0	0	3	I
4.	NC4101	High Performance Networks	3	0	0	3	I
5.	NC4111	Communication Networks Laboratory	0	0	3	1.5	I
6.	CU4161	Advanced Digital Signal Processing Laboratory	0	0	3	1.5	I
7.	NC4251	Cognitive Radio Networks	3	0	0	3	I
8.	NC4201	Internet of Things and Cloud	3	0	2	4	I
9.	NC4202	RF System and Antenna Design	3	0	0	3	I
10.	CP4252	Machine Learning	3	0	2	4	I
11.	NC4211	Internet of Things Laboratory	0	0	4	2	I
12.	NC4301	Data Centre Networking	3	0	0	3	I

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	NC4212	Term Paper and seminar	0	0	2	1	III
2.	NC4311	Project Work I	0	0	12	6	III
3.	NC4411	Project Work II	0	0	24	12	IV

SUMMARY

Sl. No.	Name of the Programme: M.E. COMMUNICATION AND NETWORKING					
	SUBJECT AREA	**CREDITS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1.	FC	04	00	00	00	04
2.	PCC	15	16	03	00	34
3.	PEC	00	06	07	00	13
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	01	06	12	19
7.	Non Credit/Audit Course	✓	✓	00	00	
8.	**TOTAL CREDIT**	**21**	**23**	**19**	**12**	**75**

MA4156 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

- grasap 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 ROANDOM VARIABLES 12

Probability Concepts – Axioms of probability – Conditional probability – Baye's 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

- apply various methods in Linear Algebra to solve the system of linear equations.
- use two-dimensional random variables, correlations and regression in solving application problem.
- apply the ideas of Random Processes.
- understand the basic characteristic features of a queueing system and acquire skills in analyzing queueing models.
- apply the Simplex 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, 2nd Edition, New York,2011.
7. Oliver C. Ibe, “ Fundamentals of Applied Probability and Random Processes”, Academic Press, (An Imprint of Elsevier), Boston,2014.

RM4151 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

UNIT I RESEARCH DESIGN 6

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 6

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

UNIT III DATA ANALYSIS AND REPORTING 6

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 6

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 WTO in 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 6

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 : 30 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.

DS4152 STATISTICAL SIGNAL PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basics of random signal processing
- To learn the concept of estimation and signal modeling
- To know about optimum filters and adaptive filtering and its applications

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Auto covariance and Cross covariance- Properties – White noise process – Wiener Khintchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

UNIT II PARAMETER ESTIMATION THEORY 9

Principle of estimation and applications-Properties of estimates-unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE)-Cramer Rao bound- Efficient estimators; Criteria of estimation: Methods of maximum likelihood and its properties ; Bayesian estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation

UNIT III SPECTRUM ESTIMATION 9

Estimation of spectra from finite duration signals, Bias and Consistency of estimators - Non-Parametric methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric Methods: AR, MA and ARMA spectrum estimation - Detection of Harmonic signals - Performance analysis of estimators. MUSIC and ESPRIT algorithms

UNIT IV SIGNAL MODELING AND OPTIMUM FILTERS 9

Introduction- Least square method – Pade approximation – Prony's method – Levinson Recursion – Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIR Wiener Filter -– MSE – State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

UNIT V ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echo canceller, Adaptive Recursive Filters: RLS adaptive algorithm, Exponentially weighted RLS-sliding window RLS. Matrix inversion Lemma, Initialization, tracking of nonstationarity.

COURSE OUTCOMES:

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

CO1: Analyze discrete time random processes
CO2: Apply appropriate model for estimation and signal modeling for the given problem
CO3: Analyze non-parametric and parametric methods for spectral estimation
CO4: Design optimum filter for the given problem
CO5: Design adaptive filters for different applications

TOTAL PERIODS:45

REFERENCES:

1. Monson. H. Hayes, Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996 (Reprint 2008)
2. Simon Haykin, Adaptive Filter Theory, Pearson Prentice Hall, 5th edition, 2014
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, Statistical and Adaptive SignalProcessing, Artech House Publishers, 2005.
4. Steven. M. Kay, Modern Spectral Estimation, Theory and Application, Pearson India, 2009
5. A.Veloni, N I. Miridakis, E Boukouvala, Digital and Statistical SignalProcessing, CRC Press, 2019
6. S Nandi, D Kundu, Statistical Signal Processing- Frequency Estimation, Springer Nature Singapore, 2nd edition , 2020
7. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Statistical Signal Processing with Applications, PHI, 1996.

CU4151	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 OUTCOME:

At the end of the course, the student 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.

REFERENCES:

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. 4. 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.

EL4151 MODERN DIGITAL COMMUNICATION SYSTEMS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand the coherent and non coherent receivers and their performance under AWGN channel conditions
- To understand the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI
- To understand different channel models, channel capacity and different block coding techniques
- To understand the principle of convolutional coding and different decoding techniques
- To understand the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

UNIT I COHERENT AND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK-BER Performance Analysis. Carrier Synchronization Bit synchronization.

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 BLOCK CODED DIGITAL COMMUNICATION 9

Architecture and performance – Binary block codes; – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

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

UNIT V 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.

COURSE OUTCOMES

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

CO1: Differentiate coherent and non coherent receivers and analyse their performance under AWGN channel conditions

CO2: Illustrate the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI

CO3: Determine the channel capacity and design various block coding techniques to combat channel errors

CO4: Construct convolutional coders and analyze the performance of different decoding techniques.

CO5: Describe the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

TOTAL:45 PERIODS

REFERENCES:

1. John G. Proakis and Masoud Salehi "Digital Communication", Fifth Edition, Mc Graw Hill Publication, 2014.
2. Simon Haykin, "Digital communication Systems", John Wiley and sons, 2014.
3. Bernard Sklar and Pabitra Kumar Ray, "Digital Communications Fundamentals & Applications ", second edition, Pearson Education, 2009.
4. Lathi B P and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 2011.
5. Richard Van Nee & Ramjee Prasad, "OFDM for Multimedia Communications" Artech House Publication, 2001.
6. Theodore S.Rappaport, 'Wireless Communications", 2nd edition, Pearson Education, 2002.

NC4101 **HIGH PERFORMANCE NETWORKS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientists, national, international policies with a futuristic vision along with social-economic impact and issues.
- To introduce the layered communication architectures of high performance network.
- To understand various layer protocols and security issues.

UNIT I INTRODUCTION 9

Review of OSI, TCP/IP, Multiplexing, Modes of communication, Switching, Routing, SONET-DWDM-DSL-ISDN-BISDN, ATM-Features, Addressing signaling & Routing, Header structure, ATM adaptation layer, Management control, Interworking with ATM.

UNIT II MULTIMEDIA NETWORKING APPLICATIONS 9

Streaming stored audio and video-Best effort service,-protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism integrated services, RSVP, differentiated services.

UNIT III ADVANCED NETWORKS CONCEPTS 9

Architecture and performance, binary block codes, orthogonal, Biorthogonal, VPN-remote access VPN, site-to-site VPN, tunneling to PPP, security in VPN, MPLS-operation, routing, tunneling and use of FEC, traffic engineering, MPLS based VPN, overlay networks, P2P connections.

UNIT IV TRAFFIC MODELLING 9

Little's theorem, Need for modeling, Poisson modeling and its failure, Non-poisson models, Network performance evaluation, Non-Markovian –Pollaczek-Khinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues- Burke's theorem and Jackson theorem.

UNIT V NETWORK SECURITY AND MANAGEMENT 9

Network Architecture, SNMP basics, SNMP naming and OIDs, MIBs, SNMPv1 data types, SNMP operations, Authentication applications- Kerberos, X.509 authentication service, Electronic mail security-Pretty Good Privacy, IP Security-IP security overview, Firewalls- Firewall design principles.

TOTAL:45 PERIODS

COURSE OUTCOMES:

- Students will be able to differentiate concepts of ATM, SONET and ISDN.
- Students will have an understanding of various multimedia networking applications and services.
- Students will have an exposure to the advanced networks concepts.
- Students will be able to model the traffic based on the various models and theorems.
- Students Will have an understanding of the various networks security issues and management concepts.

REFERENCES:

1. J.F.Kurose & K.W. Ross, "Computer Networking-A Top Down Approach Featuring the Internet", Pearson, 6th Edition, 2012.

2. Walrand. J. Varatya, “High Performance Communication Networks”, Morgan Kaufman publishers, 2nd edition, 2000.
3. Fred Halsall and Lingana Gouda Kulkami, “Computer Networking and the Internet”, Fifth Edition, Pearson Education, 2012.
4. Behrouz A. Forouzan, “Cryptography & Network Security”, Fourth Edition.

NC4111 COMMUNICATION NETWORKS LABORATORY L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientists, national/international policies with a futuristic vision along with socio-economic impact and issues.
- To understand various protocols of physical, MAC and routing layers.
- To understand the security issues in wired and wireless network and implement the security algorithms.

LISTOF EXPERIMENTS:

Simulation and performance evaluation using
(QUALNET/GLOMOSIM/NS2/ MATLAB/PYTHON/ Equivalent) of:

1 MAC protocols for wired and wireless networks – CSMA – CD/CA, 802.11, ALOHA,ect.,
2 LLC Protocols for wired and wireless networks - STOP & WAIT, SLIDING WINDOW, GO BACK – N, SELECTIVE REPEAT, ETC.,
3 Routing protocols for wired and wireless networks – AODV, DSR,OSPF,ETC.,
4 Scheduling policies and queuing method on the network performance – FIFO, ROUND – PRIORITY BASED, etc.,
5 Cellular network modeling and performance analysis in terms of blocking probability and Spectral Efficiency – GSM,LTE,etc.,
6 Wireless Sensor Network implementation and analysis in terms of through put and Energy Efficiency
7 Throughput, End-End delay comparison study of 802.11a,b,802.16
8 Analyze the low power communication standards - WSN, 6 LOWPAN, LORA.
9 Simulation analysis of Cooperative communication – Relay, Amplify & Forward, Decode & Forward, Network Coding, etc.,
10 Analyze block ciphers, Data Encryption Standard (DES), Advanced Encryption Standard (AES) and RSA.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Students will be able to design and analyze the performance of physical and MAC layer protocols for wired and wireless networks.
- Students will understand the need for various routing, scheduling and queuing algorithms for the wired and wireless networks.
- Students can be able to design and analyze the cellular an wireless sensor network architectures.
- Students will be able to analyze the performance of understand the performance analysis of existing wireless technologies.

- Students will have an exposure to the various issues and the algorithms to protect the networks.

CU4161 ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY L T P C
0 0 3 1.5

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 plot the 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 the given sequence and upsampled sequence
9. Downsampling the discrete time sequence by M times and plot the spectrum of both the given sequence and downsampled 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

- Generate deterministic/Random sequences using simulation tool
- Design and analyze the frequency response of FIR/IIR digital filters for the given specifications
- Estimate power spectrum of the given random sequence using parametric/nonparametric estimation methods
- Implement adaptive filters using LMS/RLS algorithm
- Analyze the discrete time systems at various sampling rates

NC4251 **COGNITIVE RADIO NETWORKS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understand the fundamental concepts of cognitive radio networks.
- Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
- Understand the functions of MAC layer and Network layer and its various protocols
- Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading
- Interpret the basics of security management and the various attacks & its countermeasures

UNIT I INTRODUCTION TO COGNITIVE RADIO 9

Cognitive Radio : Techniques and signal processing History and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclo stationary and wavelet based sensing- problem formulation and performance analysis based on probability of detection Vs SNR. Cooperative sensing: different fusion rules, wideband spectrum

UNIT II SPECTRUM SENSING AND TRADING 9

Introduction –Spectrum Sensing – Multiband Spectrum Sensing – Sensing Techniques – Other algorithms – Comparison – Performance Measure & Design Trade-Offs : Receiver operating characteristics – Throughput Performance measure –Fundamental limits and trade-off. Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential)

UNIT III MAC PROTOCOLS AND NETWORK LAYER DESIGN 9

Functionality of MAC protocol in spectrum access –classification –Interframe spacing and MAC challenges – QOS – Spectrum sharing in CRAHN –CRAHN models – CSMA/CA based MAC protocols for CRAHN – Routing in CRN– Centralized and Distributed protocols – Geographical Protocol

UNIT IV DYNAMIC SPECTRUM ACCESS AND MANAGEMENT 9

Spectrum broker, Dynamic spectrum access architecture- centralized dynamic spectrum access, distributed dynamic spectrum access, Inter- and intra-RAN dynamic spectrum allocation, Spectrum management, Spectrum sharing, Spectrum mobility issues

UNIT V TRUSTED COGNITIVE RADIO NETWORKS AND RESEARCH CHALLENGES 9

Trust for CRN :Fundamentals – Models – Effects of Trust Management –Security properties in CRN – Route Disruption attacks –Jamming attacks –PU Emulation attacks. Network layer and transport layer issues, cross layer design for cognitive radio networks.

OUTCOMES:

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

CO1: Understand the fundamental concepts of cognitive radio networks.
CO2: Interpret the basics of various spectrum sensing techniques and algorithms
CO3: Understand the functions of MAC layer and Network layer and its various protocols
CO4: Recognize the concepts of cooperative spectrum sensing and handoff process

CO5: Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation.

TOTAL PERIODS:45

REFERENCES

1. Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Hüseyin Arslan, Springer, ISBN 978-1-4020-5541-6 (HB), 2007.
2. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.
3. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
4. Cognitive Radio Technology", by Bruce A. Fette, Elsevier, ISBN 10: 0-7506-7952-2, 2006.
5. Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, "Cognitive Radio Communications and Networks - Principles and Practice", Elsevier Inc., 2010.

NC4201 **INTERNET OF THINGS (IOT) AND CLOUD** **L T P C 3 0 2 4**

COURSE OBJECTIVES:

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I FUNDAMENTALS OF IoT 9

Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU. A Case study with any one of the boards and data acquisition from sensors.

UNIT II PROTOCOLS FOR IoT 9

Infrastructure protocol (IPV4/V6/RPL), Identification (URIs), Transport (Wifi, Lifi, BLE), Discovery, Data Protocols, Device Management Protocols. – A Case Study with MQTT/CoAP usage-IoT privacy, security and vulnerability solutions.

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS 9

Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION 9

Introduction to Cloud Computing - Service Model – Deployment Model- Virtualization Concepts – Cloud Platforms – Amazon AWS – Microsoft Azure – Google APIs.

UNIT V IoT AND CLOUD 9

IoT and the Cloud - Role of Cloud Computing in IoT - AWS Components - S3 – Lambda - AWS IoT

Core -Connecting a web application to AWS IoT using MQTT- AWS IoT Examples. Security Concerns, Risk Issues, and Legal Aspects of Cloud Computing- Cloud Data Security

OUTCOMES:

At the end of the course, the student will be able to:

CO1: Understand the various concept of the IoT and their technologies..
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

TOTAL PERIODS:45

REFERENCES

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press, 2017
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.
3. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.
4. Simon Walkowiak, “Big Data Analytics with R” PackT Publishers, 2016
5. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, 2015.

NC4202 **RF SYSTEM AND ANTENNA DESIGN** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To model high frequency circuit using scattering matrices
- To acquire knowledge on the RF filter design
- To design microwave amplifier
- To get familiar with design of RF oscillator
- To learn about the high frequency antennas

UNIT I NETWORKS AND MATRICES 9

Scattering and chain scattering matrices, Generalized scattering matrix, Analysis of two port networks, Interconnection of networks. Positive real concepts, scattering matrix, representation of microwave components (directional coupler, circulators, hybrids and isolators).

UNIT II HIGH FREQUENCY CIRCUIT DESIGN 9

Tuned Circuits, Filter design- Butterworth filter, Chebyshev filter, impedance matching. High frequency amplifier, BJT and MOSFET amplifier, Broadband Amplifiers RF Oscillators, Colpitts, Hartley Oscillators, PLL. High Frequency Integrated Circuits.

UNIT III MICROWAVE AMPLIFIER DESIGN 9

Types of amplifiers, Power gain equations. Introduction to narrow band amplifiers basic concepts, Maximum gain design, Low noise design. High power design, Negative resistance, reflection amplifiers – various kinds – stability considerations, Microwave transistor amplifier design – input and output matching networks – constant noise figure circuits.

UNIT IV MICROWAVE TRANSISTOR OSCILLATOR DESIGN 9

One port and two port negative resistance oscillators. Oscillator configurations, Oscillator design

using large signal measurements, Introduction to Microwave CAD packages, Microwave integrated circuits, MIC design for lumped elements.

UNIT V RF AND MICROWAVE ANTENNAS 9

Radiation from surface current and line current distribution, Basic Antenna parameters, Feeding structure-Patch Antenna, Ring Antenna, Micro strip dipole, Micro strip arrays, Traveling wave Antenna, Antenna System for Mobile Radio-Antenna Measurements and Instrumentation. Propagation characteristics of RF and Microwave signals, Introduction to EBG structures.

45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Apply scattering parameters in RF circuit and systems
CO2:Develop filters for high frequency applications
CO3: Design amplifiers for RF transceivers
CO4: Understand the RF oscillator design techniques
CO5: Develop antennas for high frequency applications.

REFERENCES

1. Matthew M.Radmanesh, "RF and Microwave Design Essentials", Author House, Bloomington, 2007.
2. Reinhold Ludwig and Gene Bogdanov, "RF Circuit Design – Theory and Applications", 2nd Edition, Pearson, 2012.
3. E.da Silva, "High Frequency and Microwave Engineering", Butterworth Heinmann Publications, Oxford, 2001.
4. David.M.Pozar, "Microwave Engineering", John Wiley and Sons, Fourth Edition, 2012.
5. Kraus.J.D, Marhefka.R.J. Khan.A.S. "Antennas and Wave Propagation", Fifth edition, Tata Mc Graw Hill, New Delhi, 2017

CP4252 MACHINE LEARNING L T P C

3 0 2 4

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 -Naïve 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

45 PERIODS

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

PRACTICAL EXERCISES: 30 PERIODS

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbours. In this question, you will use the scikit-learn's KNN classifer to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.

a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
d. You must properly provide references to any work that is not your own in the write-up.
e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.
List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

COURSE OUTCOMES:

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.
C06: Identify applications suitable for different types of Machine Learning with suitable justification.

TOTAL PERIODS:75

REFERENCES

1. Stephen Marsland, “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. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2015
7. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
8. Hal Daumé III, “A Course in Machine Learning”, 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

	PO					
	1	2	3	4	5	6
C01	1	2	1	3	1	1
C02	2	3	1	2	1	2
C03	1	1	2	1		2
C04	2	2				3
C05	3	3	1	1	1	3
AVG	1.80	2.20	1.25	1.75	1.00	2.20

NC4211 **IOT LABORATORY** **L T P C**
0 0 4 2

COURSE OBJECTIVES:

- To implement the concepts of IoT.
- To interface different platforms like Arduino and Raspberry pi
- To design and implement the related applications .
- To learn how to analysis the data in IoT.

LIST OF EXPERIMENT:

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform.
10. Design an IoT based system

TOTAL: 60 PERIODS

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

CO1: Use microcontroller based embedded platforms in IoT
CO2:Use microprocessor based embedded platforms in IoT
CO3:Use wireless peripherals for exchange of data.
CO4:Make use of Cloud platform to upload and analyse any sensor data
CO5:Use of Devices, Gateways and Data Management in IoT.
CO6:Use the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis.

NC4212 **TERM PAPER WRITING AND SEMINAR** **L T P C**
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of	4th week	**6%** (the list of standard papers and reason for selection)

	them, • Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions

			about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

TOTAL: 30 PERIODS

NC4301 **DATA CENTER NETWORKING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understanding of Network Infrastructure management
- Understanding of Server Management and troubleshooting
- Understanding of system Resource Management
- Understanding of Information Security

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UNIT I DATA CENTER ARCHITECTURE 9

Data center Architecture, Data center prerequisites Data center Requirements, Required Physical Area for Equipment and Unoccupied Space, Required power to run all the devices, Required cooling and HVAC Required weight, Required Network bandwidth Budget Constraints

UNIT II DATA CENTER SAFETY 9

Selecting a Geographic Location Safety from Natural hazards, Safe from Manmade disaster, Availability of local Technical talent, Abundant and Inexpensive Utilities, Selecting an Existing building.

UNIT III DATA CENTER DESIGN 9

Data Center design, Characteristics of an Outstanding Design, Guidelines for Planning a Data Center Data Center structures, Raised Floor Design and Deployment, Design and Plan against Vandalism, Data center design case study, Modular Cabling Design, Points of Distribution, Data center servers, Sever Capacity Planning

UNIT IV DATA CENTER NETWORK MAINTENANCE 9

ISP Network Infrastructure, ISP WAN Links, Data Center Maintenance, Network Operations Center, Network Monitoring, Datacenter physical security, Data center Logical security, Data center Consolidation,Reasons for data center Consolidation, Consolidation opportunity, Server consolidation, Storage Consolidation, Network Consolidation, Service Consolidation, Process Consolidation, Staff Consolidation, Data Consolidation phases

UNIT V DATA CENTER SECURITY AND ADMINISTRATION 9

System Management Best Practices, Server Cluster Best Practices, Data Storage Best Practices, Network Management Best Practices, Documentation Best Practices, Security Guidelines Internet security, Source Security Issues, Best Practices for System Administration, System Administration Work Automation, Device Naming, Naming Practices, NIS, DNS, LDAP, Load balancing, Terminology, Advantages, Types of load balancing, Implementing a Network with Load-Balancing Switches

COURSE OUTCOMES:

Upon completion of the course, students will be able to

CO1: Manage Server Systems and Data Centres Infrastructure Management
CO2:Utilize the Storage, Bandwidth, Efficiency of systems and other resources for Data centre.
CO3:Monitor the Networks and Resources.
CO4:Plan for Flexible resource allocation.
CO5: To understand how the natural disaster plays role in Data Networking

TOTAL PERIODS:45

REFERENCES

1. Administering Data Centers: Servers, Storage and Voice over IP, Kailash Jayaswal, John

Wiley & Sons, Oct 28, 2005

2. Data center fundamentals, Mauricio Arregoces, Maurizio Portol, Cisco Press, 2003

DS4251 MULTIMEDIA COMPRESSION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics about compression algorithms related to multimedia components such as text, speech, audio, image and video.
- To understand the principles, standards, and their applications with an emphasis on underlying technologies, algorithms, and performance.
- To understand the importance of compression in multimedia processing applications.
- To understand and implement compression standards

UNIT I ESSENTIALS OF COMPRESSION 9

Introduction to multimedia system- Elements, Categories, Features, Applications, and Stages of multimedia Application Development- Graphics, Image and Video representations – Fundamental concepts of video, digital audio–Storage Requirements Of Multimedia Applications–Need For Compression-Taxonomy of compression Algorithms

UNIT II TEXT COMPRESSION TECHNIQUES 9

Elements of Information Theory-Entropy coding: Run length coding -Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Analysis/Synthesis Schemes - Dictionary techniques – LZW family algorithms.

UNIT III IMAGE COMPRESSION TECHNIQUES 9

Image Compression: Fundamentals –– Compression Standards – Still image coding JPEG Standard – Sub-band coding – Wavelet transform for image coding– Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards- Non-standardized still image coding.

UNIT IV AUDIO COMPRESSION TECHNIQUES 9

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

UNIT V VIDEO COMPRESSION TECHNIQUES 9

Video compression: Fundamentals, techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Content-Based Video Coding. ITU-T Video Coding Standards H.261 and H.263. Video Coding Standard--H.264/AVC. A New Video Coding Standard--HEVC/H.265. Internet Video Coding Standard--IVC. MPEG Media Transport-DVI technology – DVI real time compression – Current Trends in Compression standards.

45 PERIODS

COURSE OUTCOMES:

CO1: Implement basic compression algorithms familiar with the use of MATLAB and its equivalent open source environments

CO2: Design and analyse text compression techniques

CO3:Design and implement image and audio compression techniques

CO4: Develop basic audio compression standards

CO5: Critically analyze different approaches of compression algorithms in multimedia related mini projects.

REFERENCES

1. Khalid Sayood: Introduction to Data Compression", Morgan Kauffman Harcourt India, Fifth Edition,2017.
2. David Solomon, "Data Compression – The Complete Reference", Fourth Edition, Springer Verlag, New York, 2011.
3. Thomas m. Cover Joy a. Thomas, "Elements Of Information Theory", Wiley Second edition 2013.
4. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering: Fundamentals, Algorithms, and Standards, Third Edition", CRC Press,2019.
5. Mark S. Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, Springer Nature; 2nd ed. 2014.
6. Mohammed Ghanbari, Standard Codecs: Image compression to Advanced Video Coding, Telecommunication Series, IET, 3rd edition, 2011.
7. Peter Symes, Digital Video Compression, McGraw Hill, 2004
8. Iain E.G. Richardson, H.264 and MPEG-4, Video Compression: Video Coding for Next generation Multimedia, John Wiley, 2003.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	✔	✔	✔			✔
CO2	✔	✔	✔	✔	✔	✔
CO3	✔	✔	✔	✔	✔	✔
CO4	✔	✔	✔	✔	✔	✔
CO5	✔	✔	✔	✔	✔	✔

NC4001 **NETWORK ANALYTICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

After the completion of the course the student will be able

- To provide students with the mathematical tools and computational training to understand large-scale networks in the current era of Big Data.
- To introduce basic network models and structural descriptors, network dynamics
- To mine the users in the social network.
- To understand the evolution of the social network.

- To know the applications in real time systems.

UNIT I INTRODUCTION 9

Overview: Social network data-Formal methods- Paths and Connectivity-Graphs to represent social relations-Working with network data- Network Datasets-Strong and weak ties - Closure, Structural Holes, and Social Capital.

.

UNIT II SOCIAL INFLUENCE 9

Homophily: Mechanisms Underlying Homophily, Selection and Social Influence, Affiliation,Tracking Link Formation in OnLine Data, Spatial Model of Segregation - Positive and Negative Relationships - Structural Balance - Applications of Structural Balance, Weaker Form of Structural Balance.

UNIT III INFORMATION NETWORKS AND THE WORLD WIDE WEB 9

The Structure of the Web- World Wide Web- Information Networks, Hypertext, and Associative Memory- Web as a Directed Graph, Bow-Tie Structure of the Web- Link Analysis and Web Search Searching the Web: Ranking, Link Analysis using Hubs and Authorities- Page Rank- Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and Web Search.

UNIT IV SOCIAL NETWORK MINING 9

Clustering of Social Network graphs: Betweenness, Girvan newman algorithm-Discovery of communities- Cliques and Bipartite graphs-Graph partitioning methods-Matrices-Eigen valuesSimrank.

UNIT V NETWORK DYNAMICS 9

Cascading Behavior in Networks: Diffusion in Networks, Modeling Diffusion - Cascades and Cluster, Thresholds, Extensions of the Basic Cascade Model- Six Degrees of Separation-Structure and Randomness, Decentralized Search- Empirical Analysis and Generalized Models- Analysis of Decentralized Search.

COURSE OUTCOMES:

At the end of the course student will be able to

CO1: understand the underpinnings of search engines and webpage ranking

CO2: make sense of large graphs, ranging from social networks to the smart power grid

CO3: have a good understanding of prediction of processes evolving on graphs, modern algorithms for topology inference, community and anomaly detection, as well as fundamentals of social network analysis

CO4: Analyze the network flow data

CO5: Estimate the size of the Internet

TOTAL PERIODS:45

REFERENCES

1. Easley and Kleinberg, “Networks, Crowds, and Markets: Reasoning about a highly connected world”, Cambridge Univ. Press, 2010.
2. Robert A. Hanneman and Mark Riddle, “Introduction to social network methods”, University of California, 2005.
3. Jure Leskovec,Stanford Univ.Anand Rajaraman,Milliway Labs, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2 edition, 2014.
4. Wasserman, S., & Faust, K, “Social Network Analysis: Methods and Applications”, Cambridge University Press, 2009.
5. Borgatti, S. P., Everett, M. G., & Johnson, J. C., “Analyzing social networks”, SAGE

Publications Ltd; 1 edition, 2013.
6. John Scott , “Social Network Analysis: A Handbook” , SAGE Publications, 2nd edition, 2000.

CU4071 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-Telecommunication subsystem 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 PERIODS:45

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 Satellite Technology" 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

AP4078 SIGNAL INTEGRITY FOR HIGH SPEED DESIGN L T P C

3 0 0 3

COURSE OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution, wave *vs*. circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion.

UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9

Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossless models.

UNIT III NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses – Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors.

UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO , DC power bus design , layer stack up, SMT decoupling ,, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic ,SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components , Eye diagrams , jitter , inter-symbol interference Bit-error rate ,Timing analysis.

UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: identify sources affecting the speed of digital circuits.

CO2:identify methods to improve the signal transmission characteristics

REFERENCES

1. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
2. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR , 2003.
3. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handboo of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.
4. Eric Bogatin , Signal Integrity – Simplified , Prentice Hall PTR, 2003.

TOOLS REQUIRED

1. SPICE, source - http://www-cad.eecs.berkeley.edu/Software/software.html

2. HSPICE from synopsis, www.synopsys.com/products/ mixedsignal/hspice/hspice.html

3. SPECCTRAQUEST from Cadence, http://www.specctraquest.com

NC4002 **SERVER ARCHITECTURES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand fundamentals of DBMS.
- To understand various concept of Database and its working.
- To acquaint the students with Client Server Architecture and PL/SQL programming

UNIT I DATABASE COMPUTING MODEL 9

Client Server Computing: Functions of client, server,middleware components, Advantages and limitations of client server computing

Three Tier Architecture: Overview of thin client, application server, web server, Overview of Distributed Database, Overview of Real Application Clusters, Overview of High Performance Database Computing, Overview of Data Warehousing and Data Mining

UNIT II OVERVIEW OF ORACLE DATABASE SERVER ARCHITECTURE 9

Architecture of Oracle Database and Oracle Instance, Overview of Physical and Logical Structures, Dedicated and Shared Server Configuration, Oracle Server Startup and Shutdown, Creating Database

UNIT III ORACLE TOOLS AND UTILITIES 9

SQL - Pl/SQL Procedural Extension, Overview, PL/SQL data types & Control Structures, Cursors, Stored Procedures & Functions, Database Triggers, Package Creation, Dynamic SQL Collections

UNIT IV DATABASE ADMINISTRATION 9

Objects Managing Users, User Configuration Setup, Resource Management, Working with user database account , Backup & Recovery, Database Security, Export & Import Tools, Overview of Grid Based Database

UNIT V DATA STORAGE 9

Magnetic disk, magnetic tape, CD-ROM, WORM, Optical disk, mirrored disk, fault tolerance, RAID, RAID-Disk network interface cards. Network protection devices, Power Protection Devices, UPS, Surge protectors. Client Server Systems Development: Services and Support, system administration, Availability, Reliability, Serviceability, Software Distribution, Performance, Network management, Help Disk, Remote Systems Management Security, LAN and Network Management issues.

COURSE OUTCOMES:

After completing the course, students will be able to:

CO1: Understand how DBMS works and the importance of various concepts of DBMS.
CO2: Understand oracle architecture and its tools.
CO3: Apply ORACLE in DBMS administration
CO4: Familiarize with the various storage devices.
CO5: Establish a Secure connectivity for a network to any environment.
CO6: Analyse the convergence between the Database and the User environment.

TOTAL PERIODS:45

REFERENCES

1. Patrick Smith & Steave Guengerich, “Client / Server Computing”, PHI, 2nd edition, 2011.

2. Dawna Travis Dewire, “Client/Server Computing”, TMH, July 2003

3. Korth, Silberchatz, Sudarshan, “Database Concepts”, McGraw Hill,2005

4. Elmasri, Navathe, S.B, “Fundamentals of Data Base System”, Addison Wesley, 6th Edition, 2010.

CU4072 **HIGH SPEED SWITCHING AND NETWORKING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To explore the various space division switches
- To enable the various network performance analysis
- To get the clear idea about the various multimedia application
- To get a clear idea about the traffic and Queuing systems.
- Interpret the basics of security management and the various attacks & its countermeasures

UNIT I SWITCHING ARCHITECTURES 9

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks – Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches

UNIT II NETWORK PERFORMANCE ANALYSIS 9

Objectives and requirements for Quality of Service (QoS) in high performance networks. Architecture of high performance networks (HPN), design issues, protocols for HPN, VHF backbone networks, virtual interface architectures, virtual interface for networking, High-speed switching and routing - internet and PSTN IP switching techniques, SRP protocols, SRP authentication, and key exchange, comparison of TCP/IP, FTP, TELNET, queuing systems, network modeling as a graph

UNIT III MULTIMEDIA NETWORKING APPLICATIONS 9

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

UNIT IV PACKET QUEUES AND DELAY ANALYSIS 9

Littles theorem, Birth and Death process, queueing discipline- Control & stability -, Markovian FIFO queueing system, Non-markovian - PollaczekKhinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues – Burkes theorem and Jackson Theorem.

UNIT V NETWORK SECURITY AND MANAGEMENT 9

Principles of cryptography – Elliptic-AES Authentication – integrity – key distribution and certification– Access control and: fire walls – DoS-attacks and counter measures – security in many layers.Infrastructure for network management – The internet standard management

framework – SMI, MIB,SNMP, Security and administration – ASN.1.

COURSE OUTCOMES:

Upon completion the students will be able to

CO1: Understand the fundamental concepts of the switching architecture involved in various switching types

CO2: Interpret the basics of various protocols and QOS in the network performance

CO3: Understand the various types of multimedia networking application

CO4: Recognize the concepts of various analysis method involved in the processing

CO5: Understand fundamental issues involved in providing the security as well as the management.

TOTAL PERIODS:45

REFERENCES

1. Achille Pattavina, "Switching Theory Architectures and performance in Broadband ATM networks", John wiley & sons Ltd. New York, 2007.
2. Elhanany, Itamar, Hamdi and Mounir, ―High Performance Packet Switching Architectures‖, Springer 2007
3. Walrand .J. Varatya, "High Performance Communication Network", Morgan Kaufmann – Harcourt Asia Pvt. Ltd., 2nd Edition, 2000.
4. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", Fifth Edition, Pearson Education, 2012.
5. Nader F.Mir, "Computer and Communication Networks", Pearson Education, 2009.

EL4351 **OPTICAL NETWORKS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Understand the concepts of optical components and networks.
- To gain an understanding of various issues in designing a high speed, and huge bandwidth optical network.
- To acquire knowledge of architecture and standards of optical networks.
- Thorough knowledge about the routing and access mechanism in optical networks.
- Thorough understanding of the scientific and engineering principles underlying the photonics technology.

UNIT I OPTICAL SYSTEM COMPONENTS 9

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

UNIT II OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks**;** WDM networks , SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks- Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture. WOBAN and OTDM networks. Introduction to ASON.

UNIT III WAVELENGTH ROUTING NETWORKS 9

The Optical layer, Node Designs, Optical layer cost tradeoff, Routing and Wavelength Assignment algorithms, Virtual Topology design, 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.

UNIT V NETWORK DESIGN AND MANAGEMENT 9

Transmission system Engineering-system model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, wavelength stabilization; overall design consideration; Control and Management-Network management functions, Configuration management, Performance management, Fault management. Optical safety, Service interface.

COURSE OUTCOMES:

On completion of the course the student will be

CO1:able to design state-of-the-art optical networks.

CO2: able to implement optical network protocols.

CO3: able to design high speed networks using optical fibers

CO4: able to simulate access network

CO5: able to design the optical network infrastructure and network management methods.

TOTAL: 45 PERIODS

REFERENCES

1. Rajiv Ramaswami and Kumar N.Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pvt Ltd., Second Edition 2004.
2. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, PHI, 1st Edition, 2002.
3. P.E.Green, jr., "Fiber Optical Networks", Prentice Hall, New Jersey, 1993.
4. Optical Networks: Third Generation Transport Systems, Prentice Hall, 2002.
5. Martin Maier, "Optical Switching Networks", Cambridge India, 2014.

CU4076 **SPEECH PROCESSING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce speech production and related parameters of speech.
- To illustrate the concepts of speech signal representations and coding.
- To understand different speech modeling procedures such Markov and their implementation issues.
- To gain knowledge about text analysis and speech synthesis.

UNIT I FUNDAMENTALS OF SPEECH PROCESSING 9

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

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

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

UNIT III **SPEECH RECOGNITION** **9**

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

UNIT IV **TEXT ANALYSIS** **9**

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

UNIT V **SPEECH SYNTHESIS** **9**

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

COURSE OUTCOMES:

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

CO1: Model speech production system and describe the fundamentals of speech.
CO2: Extract and compare different speech parameters.
CO3: Choose an appropriate statistical speech model for a given application.
CO4: Design a speech recognition system.
CO5: Use different text analysis and speech synthesis techniques.

TOTAL PERIODS:45

REFERENCES

1. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2006
2. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
3. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education, 2002.
4. Frederick Jelinek, “Statistical Methods of Speech Recognition”, MIT Press, 1997. 5. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
5. Steven W. Smith, “The Scientist and Engineer‟s Guide to Digital Signal Processing”, California Technical Publishing, 1997.
6. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, 2004.

CU4074 **ULTRA WIDEBAND COMMUNICATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To give fundamental concepts related to Ultra wide band
- To understand the channel model and signal processing for UWB.
- To acquire knowledge about UWB antennas and regulations.

UNIT I INTRODUCTION TO UWB 9

History, Definition, FCC Mask, UWB features, Benefits and challenges, 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, Power Consumption, 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, UWB Channel Capacity, UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS Location Error , Locationing with OFDM

UNIT IV UWB ANTENNAS 9

Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad band 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

Ultra wideband receiver architecture, 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

COURSE OUTCOMES:

Upon completion the students will be able to

CO1: understand the basic concepts of UWB ..
CO2: understand the basic concepts of UWB technologies.
CO3: Ability to assess the performance of UWB channels.
CO4: ability to apply the UWB signal processing
CO5: to design UWB antenna for various applications.

TOTAL PERIODS:45

REFERENCES

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, John Wiley & Sons Ltd, New York, 2010.

3. W. Pam Siriwongpairat 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.

NC4003 BROADBAND NETWORKS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know about uses, applications, disadvantages of broadband networks
- To Understand the Protocols involved in Broadband Networks
- To Know the various evolutions of network
- To elaborate on the Layer level functions

UNIT I EVOLUTION OF WIRELESS NETWORKS 9

Review of cellular standards, migration and advancement of GSM architecture and CDMA architecture, WLAN – IEEE 802.11and HIPERLAN, Bluetooth.

UNIT II WIRELESS PROTOCOLS . 9

Mobile network layer- Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing - DHCP, Mobile transport layer-Traditional TCP, congestion control, slow start, fast recovery/fast retransmission, classical TCP improvements. Indirect TCP, snooping TCP, Mobile TCP

UNIT III 3G EVOLUTIONS 9

IMT-2000 - W-CDMA, CDMA 2000 – radio & network components, network structure, packet-data transport process flow, Channel Allocation, core network, interference-mitigation techniques, UMTS-services, air interface, network architecture of 3GPP, UTRAN – architecture, High Speed Packet Data-HSDPA,HSUPA.

UNIT IV 4G AND BEYOND 9

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT V LAYER-LEVEL FUNCTIONS 9

Characteristics of wireless channels - downlink physical layer, uplink physical layer, MAC scheme - frame structure, resource structure, mapping, synchronization, reference signals and channel estimation, SC-FDMA, interference cancellation –CoMP, Carrier aggregation, Services - multimedia broadcast/multicast, location-based services.

COURSE OUTCOMES:

At the end of the course, student will be able to

CO1: design routing mechanism meeting the desired QoS in NGN.

CO2:compare various methods of providing connection-oriented services over a NGN.

CO3:compare various NGN virtual network services with reference to VPNs, VLANs, pseudo wires, VPLS and typical applications

CO4: analyse the traditional networking structure
CO5: understand the Uplink and downlink layers

TOTAL PERIODS:45

REFERENCES

1. Kaveh Pahlavan, “Principles of wireless networks”, Prentice-Hall of India, 2008.
2. Vijay K.Garg, “Wireless Network Evolution- 2G & 3G” Pearson, 2013.
3. Clint Smith,P.E, Dannel Collins, “3G Wireless Networks” 2nd edition, Tata McGraw-Hill, 2008..
4. Jochen H.Schiller, “Mobile Communications”, 2/e, Pearson, 2014
5. Sassan Ahmadi, “LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies”, Elsevier, 2014.

NC4004	**VIRTUAL PRIVATE NETWORKS**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

To facilitate the students

- To Understand the purpose and operation of Virtual Private Network
- To identify the business and personal uses of VPN’s.
- To differentiate between a Transport mode VPN and Tunnel mode VPN
- To understand how to manage and maintain the VPN

UNIT I INTRODUCTION AND BASICS VPN TECHNOLOGIES 9

Security Risks of the Internet , VPNs and Internet Security Issues, VPN Solutions, A Note on IP Address and Domain Name Conventions, Firewall Deployment, Encryption and Authentication , VPN Protocols, Methodologies for Compromising VPNs, Patents and Legal Ramifications

UNIT II IMPLEMENTING, CONFIGURING AND TESTING LAYER 2 CONNECTIONS 9

General WAN, RAS, and VPN Concepts, VPN Versus WAN, VPN Versus RAS, Differences Between PPTP, L2F, and L2TP, How PPTP Works, Features of PPTP, Installing and Configuring PPTP on a Windows NT RAS Server, Configuring PPTP for Dialup Networking on a Windows NT Client, Using PPTP with Other Security Measures

UNIT III IMPLEMENTING THE ALTA VISTA TUNNEL 98 9

Advantages of the AltaVista Tunnel System, AltaVista Tunnel Limitations , working of AltaVista Tunnel Works, VPNs and AltaVista , Installing the AltaVista Tunnel, Configuring the AltaVista Tunnel Extranet and Telecommuter Server, Configuring the AltaVista Telecommuter Client, Troubleshooting Problems

UNIT IV CREATING A VPN AND THE CISCO PIX FIREWALL 9

The SSH Software, Building and Installing SSH , SSH Components , Creating a VPN with PPP and SSH, Troubleshooting Problems , A Performance Evaluation , The Cisco PIX Firewall, The PIX in Action , Configuring the PIX as a Gateway, Configuring the Other VPN Capabilities

UNIT V MANAGING AND MAINTAINING VPN AND ITS SCENARIO 9

Choosing an ISP, Solving VPN Problems , Delivering Quality of Service , Security Suggestions , Keeping Yourself Up-to-Date, A VPN Scenario: The Topology , Central Office Large Branch Office, Small Branch Offices, Remote Access Users.

COURSE OUTCOMES:

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

CO1: Identify the importance of Encryption, Authentication and Authorization.

CO2: Configure a site to site Internet Protocol Security VPN

CO3: Configure a Remote Access VPN.

CO4: To establish IPSEC VPN on a Cisco device

CO5: To know how to stay safe in online cyber ghost

TOTAL PERIODS:45

REFERENCES

1. Virtual Private Networks, Charlie Scott, Paul Wolfe and Mike Erwin , O'Reilly Publisher, Second Edition January1999

NC4005 TELECOMMUNICATION SWITCHING SYSTEM MODELING AND SIMULATION L T P C 3 0 0 3

COURSE OBJECTIVES:

- To enable the student to understand the various aspects of simulation methodology and performance, appreciate the significance of selecting sampling frequency and modelling different types of signals and processing them.
- To expose the student to the different simulation techniques, their pros and cons and enable him to understand and interpret results using case studies.

UNIT I SIMULATION METHODOLOGY 9

Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time-varying systems, Post processing – Basic graphical techniques and estimations

UNIT II RANDOM SIGNAL GENERATION & PROCESSING 9

Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.

UNIT III MONTE CARLO SIMULATION 9

Fundamental concepts, Application to communication systems, Monte Carlo integration, Semianalytic techniques, Case study: Performance estimation of a wireless system

UNIT IV ADVANCED MODELS & SIMULATION TECHNIQUES 9

Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modelling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory.

UNIT V EFFICIENT SIMULATION TECHNIQUES 9

Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.

COURSE OUTCOMES:

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

CO1: Understand the different signal generation and processing methods

CO2: Mathematically model a physical phenomena

CO3: Simulate a phenomena so as to depict the characteristics that may be observed in a real experiment.

CO4: Apply knowledge of the different simulation techniques for designing a communication system or channel

CO5: Validate a simulated system performance so as to match a realistic scenario

TOTAL PERIODS:45

REFERENCES

1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004.
2. 2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001.
3. 3. Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 2000.
4. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2007.

CU4073 IMAGE PROCESSING AND VIDEO ANALYTICS L T P C

3 0 2 4

COURSE OBJECTIVES:

- To comprehend the relation between human visual system and machine perception and processing of digital images
- To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression.
- To also explore the integration principles of communication system working with different sampling rates.
- To analysis the fundamentals of digital image processing, image and video analysis
- To present the mathematics and algorithms that underlie image analysis techniques.

UNIT I INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS 9

Introduction: Introduction & Applications, Elements of visual perception, Image sensing and acquisition, simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to colour image – RGB and HSI Models.

Image enhancement in Spatial domain: Introduction to image enhancement, basic grey level transforms, Histogram, Histogram-processing equalization, Matching & colour histogram, Enhancement using arithmetic/logic operations, spatial filtering, Smoothing spatial filtering, Sharpening spatial filtering.

UNIT II IMAGE PROCESSING TECHNIQUES 9

Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation

UNIT III VIDEO PROCESSING AND MOTION ESTIMATION 9

Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding.

UNIT IV INTRODUCTION: VIDEO ANALYTICS 9

Computer Vision: Challenges- Spatial Domain Processing – Frequency Domain Processing-Background Modeling-Shadow Detection-Eigen Faces - Object Detection -Local Features-Mean Shift: Clustering, Tracking - Object Tracking using Active Contours – Tracking & Video Analysis-Kalman filters, condensation, particle, Bayesian filters, hidden Markov models, change detection and model based tracking

UNIT V MOTION UNDERSTANDING 9

Motion estimation and Compensation-Block Matching Method, Motion Segmentation -Thresholding for Change Detection, Estimation of Model parameters - Optical Flow Segmentation-Modified Hough Transform Method- Segmentation for Layered Video Representation-Bayesian Segmentation -Simultaneous Estimation and Segmentation-Motion Field Model - Action Recognition - Low Level Image Processing for Action Recognition

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

COURSE OUTCOMES:

Upon completion, the students will be able to

CO1: Exploration of the limitations of the computational methods on digital images.

CO2: Expected to implement the spatial and frequency domain image transforms on enhancement and restoration of images

CO3: Expected to define the need for compression and evaluate the basic compression algorithms

CO4: Studying the techniques to recover the desired signal parameters and information from the signal corrupted by noisy channel

CO5: Understand the algorithms available for performing analysis on video data and address the challenges

CO6: Understand the approaches for identifying and tracking objects and person with motion based algorithms.

TOTAL PERIODS:45

REFERENCES

1. Digital Image Processing – Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008
2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson Education, 2002.
3. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools – Scotte Umbaugh, 2nd Ed, CRC Press, 2011
4. John C. Russ, F. Brent Neal-The Image Processing Handbook, Seventh Edition, The Kindle edition (2016), CRC Press,Taylor & Francis Group.
5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.
6. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
7. Yao Wang, JornOstermann and Ya-Qin Zhang, "Video Processing and Communications", Prentice Hall, 2001.

DS4071 RADAR SIGNAL PROCESSING L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understand the Radar Signal acquisition and sampling in multiple domains
- To provide clear instruction in radar DSP basics
- To equip the skills needed in both design and analysis of common radar algorithms
- To understand the basics of synthetic aperture imaging and adaptive array processing
- To illustrate how theoretical results are derived and applied in practice

UNIT I INTRODUCTION TO RADAR SYSTEMS 9

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

UNIT II SIGNAL MODELS 9

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

UNIT III SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS 9

Domains and criteria for sampling radar signals, Sampling in the fast time dimension,Sampling in slow time: selecting the pulse repetition interval,sampling the dopplerspectrum,Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.

UNIT IV RADAR WAVEFORMS 9

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

UNIT V DOPPLER PROCESSING **9**

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

PRACTICAL EXERCISES: 30 PERIODS

1.Matched filtering operation
2.Modeling the Propagation of Radar Signals
3.Modeling of radar targets
4. Density-based algorithm for clustering data.
5.MTI radar design, target detection in noise
6.Estimation of bearing angle in noise, clutter modelling
7.Frequency modulated radar signal generation
8.Doppler shift Signal strength
9.SNR loss measurement in pulse compression
10.detection performance of a radar system

75 PERIODS

COURSE OUTCOMES:

CO1: perform radar signal acquisition and sampling
CO2: perform algorithm on radar processing
CO3 design basic radar algorithm
CO4: design on aperture imaging and array processing
CO5: Illustrate theoretical results are derived and applied in practice

REFERENCES

1. Michael O Kolawole, "Radar systems, Peak Detection and Tracking", Elseveir. 2003
2. Introduction To Radar Systems 3/E, Skolnik, McGraw Hill. 2017
3. Radar Principles, Peyton Z. Peebles, Wiley India 2009
4. And Marvin N. Cohen, Fred E. Nathanson, Radar Design Principles-Signal Processing and the environment PHI, 2nd edition, 2006.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	✔	✔	✔	✔	✔	✔
CO2	✔	✔	✔	✔	✔	✔
CO3	✔	✔	✔	✔	✔	✔
CO4	✔	✔	✔	✔	✔	✔
CO5	✔	✔	✔	✔	✔	✔

NC4006 **NETWORK PROTOCOLS AND PROGRAMMING** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- Define and explain the concept of a networking protocol
- To understand the requirements of a Protocol and design it.
- To Validate the designed protocols

UNIT I INTRODUCTION 9

Communication Model, Software, Subsystems, Protocol, Communication protocol development methods, Protocol Engineering Process, Layered Architecture, Network services and interfaces, Protocol functions, OSI, TCP/IP, Wireless Protocol Challenges, Application Protocols.

UNIT II PROTOCOL SPECIFICATION 9

Components, Services, Protocol Entity, Interface, Interactions, Multimedia, Internet. Protocol Specification Languages, SDL, SPIN, Estelle, E-Lotus, CPN, Uppal, UML.

UNIT III PROTOCOL VERIFICATION AND VALIDATION 9

Finite State Machines, Design Errors, Approaches, SDL based, Communication Protocol Conformance Test Principle, Test Execution, Methodology and Framework, Architectures, Generation Methods

UNIT IV PROTOCOL PERFORMANCE TESTING 9

Protocol Performance Testing, SDL based TCP and OSPF, Interoperability, SDL based CSMA/CD and CSMA/CA, Scalability, Protocol Synthesis, Interactive and Automatic, SDL from MSC, Re-synthesis

UNIT V IMPLEMENTATION 9

Protocol implementation, requirement, Object based, compilers, Tool for Protocol Engineering

LIST OF EXPERIMENTS

1. AODV/DSR routing
2. Design and setup a network and configure different network protocols.
3. Implement client-server communication using socket programming and TCP & UDP as transport layer protocol
4. Security algorithms in wired network
5. MAC protocols Wired and wireless
6. Configuration of LAN & Configuration of VLAN- Tunneling
7. Configuration of WLAN
8. Design and configure a network with multiple subnets with wired and wireless LANs using

required network devices. Configure commonly used services in the network.

COURSE OUTCOMES:

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

CO1:Compare the communication protocol development methods.

CO2 Apply protocol specification languages for the given problems.

CO3 Validate and verify using methods.

CO4 Perform protocol verification and validation testing.

CO5 Implement tools for protocol engineering.

TOTAL PERIODS:45

REFERENCES

1. Elements of network Protocol Design: Mohamed G. Gouda (Wiley Publications), 2006.
2. Pallapa Venkataram, Sunil Kumar S Manvi, B. Sathish Babu " Communication Protocol Engineering, PHI, Learning, 2014.
3. Mohammed G. Gouda: Elements of Protocol Design, Wiley Student Edition, 2004.

EL4072	SIGNAL DETECTION AND ESTIMATION	L T P C 3 0 2 4

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 REVEIW OF PROBABILITY AND STOCHASTIC PROCESS 9

Conditional Probability, Bayes' Theorem , Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete Time Stochastic Processes, Spatial Stochastic Processes, Random Signals, Relationship of Power Spectral Density and Autocorrelation Function.

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 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 IV WIENER AND KALMAN FILTERS 9

Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, Least Squares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous

Kalman Filter, Extended Kalman Filter.

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.

PRACTICALS: Period – 30 hrs

Software Requirement: Matlab / Python / Equivalent

1. Power Spectrum Estimation of a Random Signal
2. Maximum Likelihood Estimation
3. Design of optimum receiver in AWGN channel
4. Wiener Filter Design
5. Adaptive Filter Design using LMS algorithm
6. Minimum Variance Estimation

COURSE OUTCOMES:

CO1: Able to understand the importance of probability and stochastic process concepts in detection and estimation.
CO2: Able to design optimum detector and estimator for AWGN channel
CO3: Able to design and analyze the various estimators.
CO4: Able to design Wiener and Kalman filters to solve linear estimation problems.
CO5: Able to design and develop novel receiver structures suitable for modern technology.

TOTAL PERIODS:75

REFERENCES

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. Steven M. Kay, "Fundamentals of Statistical Processing, Volume I: Estimation Theory", Prentice Hall Signal Processing Series, Prentice Hall, PTR, NewJersy, 1993.
5. Thomas Schonhoff, "Detection and Estimation Theory", Prentice Hall, NewJersy, 2007.

AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

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 as it could possibly be the first- time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX4092 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 REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, 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 PRONE AREAS IN INDIA 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 PREPAREDNESS AND 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 RISK ASSESSMENT 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:

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

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX4093 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

COURSE OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights 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

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

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

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:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.

- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
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., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX4094 **நற்றமிழ் இலக்கியம்** **L T P C**
2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)

- இயமம் நியமம் விதிகள்

4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V நவீன தமிழ் இலக்கியம் 6

1. உரைநடைத் தமிழ்,
   - தமிழின் முதல் புதினம்,
   - தமிழின் முதல் சிறுகதை,
   - கட்டுரை இலக்கியம்,
   - பயண இலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL : 30 PERIODS

<u>தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்</u>

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
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