M.KUMARASAMY
COLLEGE OF ENGINEERING
NAAC Accredited Autonomous Institution
Approved by AICTE & Affiliated to Anna University
ISO 9001:2015 Certified Institution
Thalavapalayam, Karur, Tamilnadu.

REGULATION 2019

M.E.,COMMUNICATION SYSTEMS

CURRICULUM AND SYLLABUS

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NAAC Accredited Autonomous Institution
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Thalavapalayam, Karur, Tamilnadu.

CURRICULUM AND SYLLABUS

REGULATION 2019

Programme: M.E. Communication Systems

Vision of the Department:

To empower the Electronics and Communication Engineering students with emerging technologies, professionalism, innovative research and social responsibility.

Mission of the Department:

M1: Attain the academic excellence through innovative teaching learning process, research areas & laboratories and Consultancy projects.

M2: Inculcate the students in problem solving and lifelong learning ability.

M3: Provide entrepreneurial skills and leadership qualities.

M4: Render the technical knowledge and industrial skills of faculties.

Programme Educational Objectives (PEOs):

PEO1: Graduates will be capable to develop their skills and provide optimal solutions to subsystems in the areas of Communication Systems

PEO2: Graduates will be capable of carrying out scientific research in the areas of Communication Systems

PEO3: Graduates will be able to analyze societal problem and can provide technological solutions.

Programme Outcomes (POs):

PO1: An ability to independently carryout research/investigation and development work to solve practical problems

PO2: An ability to write and present a substantial report/document

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO4: An ability to independently carry out research to deliver solutions for complex problems in Communication systems.

PO5: Able to communicate effectively in written and oral formats.

PO6: Ability to continuously engage in life-long learning with enhanced knowledge and competence.

CURRICULUM AND SYLLABUS

REGULATION 2019

Programme: M.E. –Communication Systems

Structure of Curriculum

Sl.No.	Category	Credits
1	Basic Science courses (B)	4
2	Professional core courses (C)	12
3	Professional Elective courses relevant to chosen specialization/branch (E)	15
4	Project work, Practical, Minor project, seminar and internship in industry or elsewhere (P)	32
5	Mandatory Courses (M)	2
	Total Credits	68

*Minor variation is allowed as per need of the respective disciplines.

1. Basic Science courses (B)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCMB101T	Applied Mathematics for Communication Engineers	3	1	0	4
				Total Credits	4

T-Lecture T-Lecture+ Tutorial L-Practical, Project, J- Lecture+ project

2. Professional Core courses (C)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCMC101T	Advanced Communication Networks	3	0	0	3
19PCMC102T	Wireless and Mobile Communication	3	0	0	3
19PCMC103T	Antennas and Radiating Systems	3	0	0	3
19PCMC104T	Advanced Digital Signal Processing	3	0	0	3
				Total Credits	12

T-Lecture T-Lecture+ Tutorial L-Practical, Project, J- Lecture+ project

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3. Professional Elective courses relevant to chosen specialization/branch (E)

Course Code	Course Name	Hours / Week			C
		L	T	P	
Professional Elective for I Semester					
19PCME001T	Wireless Sensor Networks	3	0	0	3
19PCME002T	Optical Networks	3	0	0	3
19PCME003T	Modern Digital Communication Techniques	3	0	0	3
19PCME004T	Cognitive Radio	3	0	0	3
19PCME005T	RF and Microwave Circuit Design	3	0	0	3
19PCME006T	DSP Architecture	3	0	0	3
19PCME007T	Communication Network Security	3	0	0	3
19PCME008T	Network Routing Algorithms	3	0	0	3
Professional Elective for II Semester					
19PCME009T	Satellite Communication and Navigation Systems	3	0	0	3
19PCME010T	Modern Internet of Things	3	0	0	3
19PCME011T	Voice and Data networks	3	0	0	3
19PCME012T	MIMO System	3	0	0	3
19PCME013T	Programmable Networks SDN NFV	3	0	0	3
Professional Elective for III Semester					
19PCME014T/ 19PVLE019T	Wireless Embedded Systems	3	0	0	3
19PCME015T	Remote Sensing	3	0	0	3
19PCME016T	PCB Design Technology	3	0	0	3
19PCME017T	Communication Interfaces	3	0	0	3
				Total Credits	**15**

T-Lecture T-Lecture+Tutorial L-Practical, Project, J- Lecture+ project

4. Project work, minor project, seminar and internship in industry or elsewhere(P)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PCMP101L	Communication Systems Laboratory I	0	0	4	2
19PCMP102L	Communication Systems Laboratory II	0	0	4	2
19PCMP103L	Minor Project I	0	0	4	2
19PCMP104L	Project work Phase I	0	0	20	10
19PCMP105L	Project work Phase II	0	0	32	16
				Total Credits	**32**

T-Lecture T-Lecture+Tutorial L-Practical, Project, J- Lecture+project

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5. Mandatory Courses (M)

Course Code	Course Name	Hours / Week			C
		L	T	P	
19PATM101	Research Methodology and IPR	2	0	0	2
19PATM102	English for Research Paper Writing	1	0	0	0
19PATM103	Pedagogy Studies	1	0	0	0
				Total Credits	**2**

T-Lecture T-Lecture+ Tutorial L-Practical, Project, J- Lecture+ project

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SEMESTER I						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	19PCMB101T	Applied Mathematics for Communication Engineers	3	1	0	4
C	19PCMC101T	Advanced Communication Networks	3	0	0	3
C	19PCMC102T	Wireless and Mobile Communication	3	0	0	3
E		Professional Elective I	3	0	0	3
E		Professional Elective II	3	0	0	3
P	19PCMP101L	Communication Systems Laboratory I	0	0	4	2
M	19PATM101	Research Methodology and IPR	2	0	0	2
M	19PATM102	English for Research Paper Writing	1	0	0	0
					Total Credits	20

SEMESTER II						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCMC103T	Antennas and Radiating Systems	3	0	0	3
C	19PCMC104T	Advanced Digital Signal Processing	3	0	0	3
E		Professional Elective III	3	0	0	3
E		Professional Elective IV	3	0	0	3
P	19PCMP102L	Communication Systems Laboratory II	0	0	4	2
P	19PCMP103L	Minor Project I	0	0	4	2
M	19PATM103	Pedagogy Studies	1	0	0	0
					Total Credits	16

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SEMESTER III						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E		Professional Elective V	3	0	0	3
E		Professional Elective VI	3	0	0	3
P	19PCMP104L	Project Work Phase I	0	0	20	10
					Total Credits	16

SEMESTER IV						
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
P	19PCMP105L	Project Work Phase II	0	0	32	16
					Total Credits	16

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Category / Semester	I	II	III	IV	Category wise Total Credits
Basic Science Course(B)	4	-	-	-	4
Professional Core(C)	6	6	-	-	12
Professional Elective(E)	6	6	6	-	18
Practical / Lab (P)	2	2	-	-	4
Project Work(P)	-	2	10	16	28
Mandatory Course(M)	2	-	-	-	2
Semester Wise Total Credits	**20**	**16**	**16**	**16**	**68**

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Regulation 2019		Semester I	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
B	19PCMB101T	APPLIED MATHEMATICS FOR COMMUNICATION ENGINEERS	3	1	0	4

Course Objective (s):The purpose of learning this course is to:

1	Demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in Electronics Engineering.
2	Identify, formulate, abstract, and solve problems in Electrical Engineering using mathematical tools from a variety of mathematical areas, including special functions, matrix theory, probability, dynamic programming and queuing theory.

Course Outcome (s) (Cos):At the end of this course, learners will be able to:

CO1	Understand the concepts ofspecial functions, knowledge representation using Bessel's equation, Bessel function, Recurrence relationsand Generating function and orthogonal property.
CO2	Develop the ability to apply the matrix concept of matrix theory in communication engineering problems
CO3	Compute probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
CO4	Find the application of marginal, conditional distributions,correlation and regression analysis in various aspects.
CO5	Expose the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

UNIT I	SPECIAL FUNCTIONS	12

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

UNIT II	MATRIX THEORY	12

Some important matrix factorizations – The Cholesky decomposition – QR factorization – Least square method – Singular value decomposition - Toeplitz matrices and some applications.

UNIT III	ONE DIMENSIONAL RANDOM VARIABLES	12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Functions of a Random Variable.

UNIT IV	TWO DIMENSIONAL RANDOM VARIABLES	12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT V	QUEUEING MODELS	12

Poisson process – Markovian queues – Single and Multi server Models – Little"s formula - Machine Interference Model – Steady state analysis – Self service queue.

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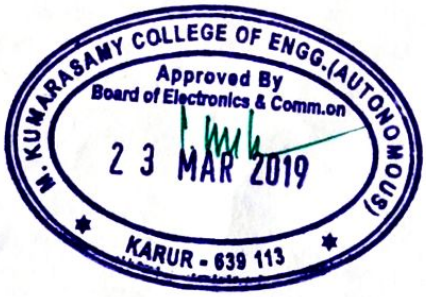
Reference (s)	
1	Grewal, B.S., "Numerical Methods in Engineering and Science", 40th edition, Khanna Publishers, 2007.
2	Moon, T.K., Sterling, W.C., "Mathematical Methods and Algorithms for Signal Processing", Pearson Education, 2000.
3	Richard Johnson, Miller & Freund, "Probability and Statistics for Engineers", 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).
4	Taha, H.A., "Operations Research, An Introduction", 7th edition, Pearson education editions, Asia, New Delhi, 2002.
5	Donald Gross and Carl M. Harris, "Fundamentals of Queueing Theory", 2nd edition, John Wiley and Sons, New York (1985).



Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCMC101T	ADVANCED COMMUNICATION NETWORKS	3	0	0	3

Prerequisite Course (s)

Computer Networks

Course Objective (s): The purpose of learning this course is to:

1	Understand the protocol layering and physical level communication.
2	Analyze the performance of a network.
3	Understand the various components required to build different networks.
4	Learn the functions of network layer and the various routing protocols.
5	Familiarize the functions and protocols of the Internet servers.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the basic layers and its functions in Communication networks.
CO2	Design and develop protocols for Communication Networks.
CO3	Understand the basics mechanisms in Quality of Service in networking.
CO4	Analyze and design routing algorithms.
CO5	Design protocols for various functions in the network.

UNIT I	OVERVIEW OF INTERNET	9

Overview of Internet-Concepts, challenges and history. Overview of -ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

UNIT II	REAL TIME COMMUNICATIONS OVER INTERNET	9

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP.;Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties

UNIT III	PACKET SCHEDULING ALGORITHMS	9

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

UNIT IV	IP ADDRESS LOOKUP-CHALLENGES	9

IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producting and controlled prefix expansion algorithms.

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UNIT V	ADMISSION CONTROL IN INTERNET	9

Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.IPV4, IPV6, IP tunnelling, IPswitching and MPLS. Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

Text Book (s)

1	Jean Wairand and Pravin Varaiya, "High Performance Communications Networks", 2nd edition, 2000.
2	Jean Le Boudec and Patrick Thiran, "Network Calculus A Theory of Deterministic Queueing Systems for the Internet", Springer Veriag, 2001.

Reference (s)

1	Zhang Wang, "Internet QoS", Morgan Kaufman, 2001.
2	Anurag Kumar, D. Manjunath and Joy Kuri, "Communication Networking: An Analytical Approach" . Morgan Kaufman Publishers, 2004.
3	George Kesidis, "ATM Network Performance", Kluwer Academic, Research Papers, 2005

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Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCM102T	WIRELESS AND MOBILE COMMUNICATION	3	0	0	3

Prerequisite Course (s)

Signals and Systems

Course Objective (s):The purpose of learning this course is to:

1	Understand the various mobile communication systems.
2	Analyse the interefernce and frequency reuse concept
3	Understand the various techniques for mobile communication
4	Analyse the path loss and interference of mobile communication system
5	Analyze and design CDMA system functioning with knowledge of forward and reverse channel

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Design appropriate mobile communication systems.
CO2	Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
CO3	Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
CO4	Analyze path loss and interference for wireless telephony and their influences on a mobile communication system's performance.
CO5	Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology

UNIT I	CELLULAR COMMUNICATION FUNDAMENTALS	9

Cellular Communication Fundamentals:Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reductiontechniques and methods to improve cell coverage, Frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

UNIT II	MULTIPLE ACCESS TECHNOLOGIES	9

Spectral efficiency analysis based on calculations for Multiple access technologies:TDMA, FDMA and CDMA,Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.Wireless network planning (Link budget and power spectrum calculations

UNIT III	MOBILE RADIO PROPAGATION	9

Mobile Radio Propagation:Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale

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Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

UNIT IV	EQUALIZATION DIVERSITY	9

Equalization, Diversity:Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

UNIT V	CODE DIVISION MULTIPLE ACCESS	9

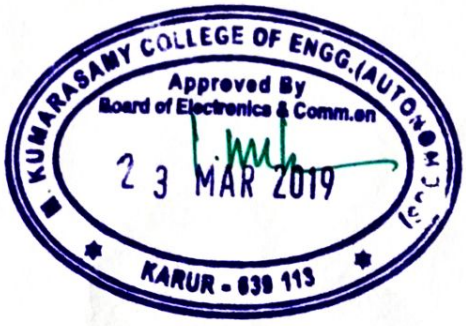
Code Division Multiple Access:Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels. Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

Text Book (s)

1.	William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
2.	Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten London,1997.

Reference (s)

1	V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2	V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3	T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI,2002.



Regulation 2019		SEMESTER I	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
P	19PCMP101L	COMMUNICATION SYSTEMS LABORATORY I	0	0	4	2

Prerequisite Course (s)
Nil

Course Objective (s): The purpose of learning this course is to:	
1	Practice the compression techniques available in audio,video and image
2	Implement the various digital signal processing techniques

Course Outcome (s) (COs): At the end of this course, learners will be able to:	
CO1	Understand the various scompression techniques
CO2	Analyse the various transmission line parameters using network analyzer
CO3	Analyse the various coding and digital modulation techniques

LIST OF EXPERIMENTS		9
1	Channel equalizer design using MATLAB (LMS, RLS)	
2	Transform based compression techniques.	
3	Antenna Radiation Pattern measurement.	
4	Transmission line parameters – Measurement using Network Analyzer	
5	Performance Evaluation of digital modulation schemes	
6	Implementation of Linear and Cyclic Codes	
7	OFDM transceiver design using MATLAB Performance evaluation of Digital Data Transmission through Fiber Optic Link	

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Regulation 2019		Semester I	Total Hours			30
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	19PATM101	Research Methodology and IPR	2	0	0	2

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

1	Understand and analyse the fundamental of research problem
2	Understand the Research Ethics
3	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
4	Understand Intellectual Property Rights
5	Understand Patents Rights

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Understand research problem formulation
CO2	Analyze research related information
CO3	Follow research ethics
CO4	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular
CO5	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits

UNIT I	INTRODUCTION	6

Meaning of research problem- Sources of research problem-Criteria Characteristics of a good research problem- Errors in selecting a research problem- Scope and objectives of research problem.

UNIT II	ANALYSIS OF REARCH	6

Approaches of investigation of solutions for research problem- data collection- analysis-interpretation- Necessary instrumentations Effective literature studies approaches- analysis Plagiarism,- Research ethics.

UNIT III	RESEACRH PRPOSAL AND TECHNICAL WRITING	6

Effective technical writing - how to write report-Paper Developing a Research Proposal- Format of research proposal- a presentation and assessment by a review committee.

UNIT IV	INTELLECTUAL PROPERTY	6

Nature of Intellectual Property: Patents –Designs - Trade and Copyright- Process of Patenting and

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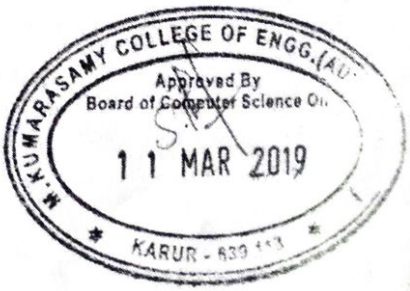
Development: technological research- innovation- patenting- And development. International Scenario: International cooperation on Intellectual Property- Procedure for grants of patents- Patenting under PCT.		
UNIT V	**PATENTS RIGHTS**	**6**
Patent Rights: Scope of Patent Rights- Licensing and transfer of technology -Patent information and databases- Geographical Indications.		
Text Book (s)		
1	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".	
2	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007	
Reference (s)		
1	Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"	
2	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008	
3	Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.	
4	Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"	



Regulation 2019		Semester I	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	19PATM102	English For Research Paper Writing	1	0	0	0

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

1	Understand that how to improve your writing skills and level of readability
2	Learn about what to write in each section
3	Understand the skills needed when writing a Title

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Understand the basics of writing skills
CO2	Illustrate the level of readability
CO3	Explain about what to write in each section
CO4	Summarize the skills needed to form a title

UNIT I	3

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

UNIT II	3

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

UNIT III	3

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV	3

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

UNIT V	3

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, Useful Phrases, How to ensure paper is as good as it could possibly be the first- Time Submission.

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11 MAR 2019

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

Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			
			L	T	P	C
E	19PCME001T	WIRELESS SENSOR NETWORKS	3	0	0	3

Prerequisite Course (s)

Analog Communication

Course Objective (s):The purpose of learning this course is to:

1	Know the fundamental concepts in the WSN
2	Understand the various hardware devices support
3	Analyse radio standards and communication protocols to be used for wireless sensor network
4	Understand the operating systems and programming languages for wireless sensor nodes
5	Analyse issues in sensors like energy conservation and security challenges.

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Design wireless sensor network system for different applications under consideration.
CO2	Understand the hardware details of different types of sensors and select right type of sensor for various applications.
CO3	Understand radio standards and communication protocols to be used for wireless sensor network based systems and application
CO4	Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
CO5	Handle special issues related to sensors like energy conservation and security challenges.

UNIT I	SENSOR NETWORK ARCHITECTURE	9

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

UNIT II	HARDWARE	9

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

UNIT III	PROGRAMMING TOOLS	9

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

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UNIT IV	OVERVIEW OF SENSOR NETWORK PROTOCOLS	9
Overview of sensor network protocols (details of atleast 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.		

UNIT V	DATA DISSEMINATION AND PROCESSING	9
Data dissemination and processing; differences compared with other database management systems, data storage; query processing. Specialized features: Energy preservation and efficiency; security challenges; faulttolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.		

Text Book (s)	
1	H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
2	C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
Reference (s)	
1	F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
2	YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

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Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME002T	OPTICAL NETWORKS	3	0	0	3

Prerequisite Course (s)

Fiber Optic Communication

Course Objective (s): The purpose of learning this course is to:

1	Understand the optical network and WDM network design
2	Understand the optical network multiplexer architectures
3	Analyse the network management techniques
4	Analyse the network protection techniques
5	Analyse the network multiplexer design techniques

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Contribute in the areas of optical network and WDM network design.
CO2	Implement simple optical network and understand further technology developments for future enhanced network.
CO3	Implement the fault management and network management techniques
CO4	Implement the network protection techniques
CO5	Implement simple optical network with multiplexing

UNIT I	SONET/SDH	9

Optical transport network, IP, routing and forwarding, multiprotocol label switching.

UNIT II	WDM NETWORK ELEMENTS	9

Optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

UNIT III	CONTROL AND MANAGEMENT	9

Network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

UNIT IV	NETWORK SURVIVABILITY	9

Protection in SONET/SDH & client layer, optical layer protection schemes

UNIT V	WDM NETWORK DESIGN	9

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical

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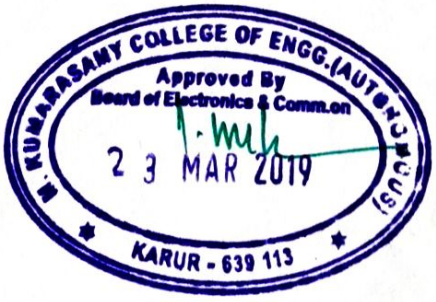
dimensioning models. Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.	
Text Book (s)	
1.	C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.
Reference (s)	
1	Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.



Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME003T	MODERN DIGITAL COMMUNICATION TECHNIQUES	3	0	0	3

Prerequisite Course (s)

Digital Communication

Course Objective (s):The purpose of learning this course is to:

1	Understand the Constant envelope modulation
2	Understand the orthogonal frequency division multiplexing
3	Analyse the block coded digital communication
4	Analyse the convolutional coded digital communication
5	Analyse the equalization techniques

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Understand the modern digital communication techniques
CO2	Summarize the OFDM and PAP reduction techniques
CO3	Analyse the various block codes for digital communication
CO4	Analyse the various convolution codes for digital communication
CO5	Understand the equalization techniques .

UNIT I	CONSTANT ENVELOPE MODULATION	9

Constant envelope modulation; Advantages of Constant Envelope Modulation; Binary Frequency Shift Keying-Coherent and Non-coherent Detection of BFSK; Minimum Shift Keying; Gaussian Minimum Shift Keying; M-ary Phase Shift Keying; M-ary Quadrature Amplitude Modulation; M-ary Frequency Shift keying.

UNIT II	OFDM	9

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes- Clipping, Filtering, Coding and Scrambling.

UNIT III	BLOCK CODED DIGITAL COMMUNICATION	9

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon"s channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators – Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed – Solomon 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.

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UNIT V	EQUALIZATION TECHNIQUES .	9
Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signalsEqualization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms		
Text Book (s)		
1.	M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995	
2.	Simon Haykin, Digital communications, John Wiley and sons, 1998	
3.	Bernard Sklar.,Digital Communications", second edition, Pearson Education, 2001.	
4	John G. Proakis.,Digital Communication",4 th edition, Mc Graw Hill Publication, 2001.	
Reference (s)		
1.	Stephen G. Wilson.,Digital Modulation and Coding", First Indian Reprint Pearson Education, 2003	
2.	Richard Van Nee & Ramjee Prasad., „OFDM for Multimedia Communications" Artech House Publication, 2001.	

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Regulation 2019		SEMESTER-I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME004T	COGNITIVE RADIO	3	0	0	3

Prerequisite Course (s)

Analog Communication

Course Objective (s): The purpose of learning this course is to:

1	Know the basics of the software definedradios.
2	Learn the SDR architecture
3	Learn the basics of the cognitive radio
4	Learn the Cognitive radio architecture
5	Understand the concepts of wireless networks and next generation networks.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Describe the basics of the software definedradios
CO2	Discuss about the SDR architecture
CO3	Design the wireless networks based on the cognitiveradios
CO4	Describe in detail about the architecture of cognitive radios
CO5	Explain the concepts behind the wireless networks and next generation networks

UNIT I	INTRODUCTION TO COGNITIVE RADIOS	9

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

UNIT II	SPECTRUM SENSING	9

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

UNIT III	OPTIMIZATION TECHNIQUES OF DYNAMIC SPECTRUM ALLOCATION	9

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming

UNIT IV	DYNAMIC SPECTRUM ACCESS AND MANAGEMENT	9

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

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UNIT V	SPECTRUM TRADING AND RESEARCH CHALLENGES IN COGNITIVE RADIO	9

Spectrum Trading: 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). Research Challenges in Cognitive Radio: Network layer and transport layer issues, crosslayer design for cognitive radio networks.

Text Book (s)

1.	Alexander M. Wyglinski, Maziar Nekovee, and Y. Thomas Hou, "Cognitive Radio Communications and Networks - Principles And Practice", Elsevier Inc. 2010
2.	"E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, Principles of Cognitive Radio", Cambridge University Press, 2013.
3.	Kwang-Cheng Chen and Ramjee Prasad," Cognitive Radio Networks" , John Wiley & Sons, Ltd, 2009.
4.	Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks – From Theory to Practice", Springer Series: Analog Circuits and Signal Processing, 2009.

Reference (s)

1	Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.
2	Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, " NeXt generation /dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks, May 2006.
3	5. J. Mitola, " Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.

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Regulation 2019		SEMESTER-I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME005T	RF AND MICROWAVE CIRCUIT DESIGN	3	0	0	3

Prerequisite Course (s)

Microwave Engineering

Course Objective (s): The purpose of learning this course is to:

1	Know the transmission line theory
2	Learn the different properties of transmission lines
3	Learn the operation of microwave devices
4	Learn the properties of microwave devices
5	Know the Microwave Semiconductor Devices And Modeling

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the transmission Line Theory
CO2	Understand the admittance matrix,scattering matrix and signal flow graph
CO3	Analyse the operation of microwave devices
CO4	Analyse the functionality of Microwave devices
CO5	Understand the Microwave Semiconductor Devices And Modeling

UNIT I	TRANSMISSION LINE THEORY	9

Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedancematching and tuning.

UNIT II	MICROWAVE NETWORK ANALYSIS	9

Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph

UNIT III	MICROWAVE DEVICES	9

Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

UNIT IV	PROPERTIES OF MICROWAVE DEVICES	9

Nonlinearity And Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.

UNIT V	MICROWAVE SEMICONDUCTOR DEVICES AND MODELING	9

PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT. Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low

noise, high power and broadband amplifier, oscillators, Mixers design	
Text Book (s)	
1	J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd Edition.
2	Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, 2nd Edition.
Reference (s)	
1	BehzadRazavi , "Design of Analog CMOS Integrated Circuits", TMH, 2007.
2	Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 3rd Edition.
3	R J Baker, "CMOS circuit Design, Layout and Simulation", IEEE Inc., 2008.
4	Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design",TMH, 3rd Edition.
5	Pucknell, D.A. and Eshraghian, K., "Basic VLSI Design", PHI, 3rd Edition.

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Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME006T	DSP ARCHITECTURE	3	0	0	3

Prerequisite Course (s)

Embedded Systems

Course Objective (s): The purpose of learning this course is to:

1	Learn the Processing Architectures
2	Learn the Structural and Architectural Considerations
3	Know the VLIW Architecture
4	Understand the functioning of Multi-core DSPs
5	Understand the functioning of FPGA based DSP Systems

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the Processing Architectures and its algorithms
CO2	Analyse the Structural and Architectural Considerations
CO3	Analyse the VLIW Architecture
CO4	Analyse the Multi-core DSPs and architecture
CO5	Understand the FPGA based DSP Systems and High Performance Computing

UNIT I	PROGRAMMABLE DSP HARDWARE	9

Processing Architectures (von Neumann, Harvard), DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed and Floating Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

UNIT II	STRUCTURAL AND ARCHITECTURAL CONSIDERATIONS	9

Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

UNIT III	VLIW ARCHITECTURE	9

Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.

UNIT IV	MULTI-CORE DSPs	9

Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel

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programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).		
UNIT V	**FPGA BASED DSP SYSTEMS AND HIGH PERFORMANCE COMPUTING USING P-DSP**	**9**
Limitations of P-DSPs, Requirements of Signal processing for Cognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor. Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.		

Text Book (s)	
1	M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
2	Fayez Gebali, "Algorithms and Parallel Computing",1st Edition, John Wiley & Sons, 2011
Reference (s)	
1	Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
2	Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
3	E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007
4	Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010

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Regulation 2019		SEMESTER I	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME007T	COMMUNICATION NETWORK SECURITY	3	0	0	3

Prerequisite Course (s)

Computer Networks

Course Objective (s):The purpose of learning this course is to:

1	Learn the fundamentals of the information and network security
2	Know the different types of ciphers and key development algoritms
3	Understand about integrity and authentication techniques
4	Know about the firewalls and web security
5	Understand about fundamentals of wireless security

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Understand the fundamentals of the information security and network security
CO2	Analyse the different types of ciphers and key development algoritms
CO3	Underatand the key management techniques
CO4	Underatand the concept of firewalls and web security
CO5	Analyse the wireless network security techniques

UNIT I	INTRODUCTION ON SECURITY	9

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

UNIT II	SYMMETRIC & ASYMMETRIC KEY ALGORITHMS	9

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

UNIT III	INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT	9

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

UNIT IV	NETWORK SECURITY, FIREWALLS AND WEB SECURITY	9

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

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UNIT V	WIRELESS NETWORK SECURITY	9
Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network		

Text Book (s)	
1.	Behrouz A. Forouzan ," Cryptography and Network security" Tata McGraw- Hill, 2008
2.	William Stallings, "Cryptography and Network security: principles and practice",2nd Edition,Prentice Hall of India, New Delhi,2002.
3.	Atul Kahate ," Cryptography and Network security", 2nd Edition, Tata McGraw- Hill, 2008.
Reference (s)	
1	R.K.Nichols and P.C. Lekkas ," Wireless Security",2008
2	H. Yang et al., Security in Mobile Ad Hoc Networks: Challenges and Solution, IEEE Wireless Communications, Feb. 2004.
3	"Security of Wireless Ad Hoc Networks," http://www.cs.umd.edu/~aram/wireless/survey.pdf.

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Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME008T	NETWORK ROUTING ALGORITHMS	3	0	0	3

Prerequisite Course (s)

Computer Networks

Course Objective (s): The purpose of learning this course is to:

1	Learn about the various types of routing techniques in telephone networks
2	Understatnd the different types of internet routing
3	Understatnd the various the optical WDM routing techniques
4	Learn about the routing protocols avail in Mobile - IP networks
5	Understand the routing scheme for Mobile Ad-hoc networks

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Understand the fundamentals of the routing techniques for telephone networks
CO2	Analyse the different types of internet routing
CO3	Understand the various the optical WDM routing techniques
CO4	Understand the routing protocols avail in Mobile - IP networks
CO5	Analyse the the routing scheme for Mobile Ad-hoc networks

UNIT I	INTRODUCTION	9

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Dynamic Alternative Routing, Bellman Ford Distance Vector Routing, Link state routing, Hierarchical routing.

UNIT II	INTERNET ROUTING	9

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

UNIT III	ROUTING IN OPTICAL WDM NETWORKS	9

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

UNIT IV	MOBILE - IP NETWORKS	9

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based : Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).Mobile Network Architecture-Mobility and Routing in Cellular Digital Packet Data(CDPD) Network-Packet Radio Routing.

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UNIT V	MOBILE AD –HOC NETWORKS	9

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

Text Book (s)

1. William Stallings,High speed networks and Internets Performance and Quality of Service", IInd Edition, Pearson Education Asia.
2. M. Steen Strub,Routing in Communication network, Prentice –Hall International, Newyork, 1995

Reference (s)

1. S. Keshav,An engineering approach to computer networking" Addison Wesley 1999.
2. C.E Perkins, Ad Hoc Networking", Addison – Wesley, 2001.

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Regulation 2019		SEMESTER II	Total Hours			45
			Hours / Week			C
Category	Course Code	Course Name	L	T	P	
C	19PCMC103T	ANTENNAS AND RADIATING SYSTEMS	3	0	0	3

Prerequisite Course (s)

Antenna and Wave Propagation

Course Objective (s):The purpose of learning this course is to:

1	Enhance the students knowledge in the area of various antenna design
2	Impart knowledge about the state of art in antenna technology.
3	Study the antenna arrays
4	Understand the concepts of aperture antennas
5	Design the patch antennas

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Compute the far field distance, radiation pattern and gain of an antenna
CO2	Explain about linear wire antennas
CO3	Compute the array factor for an array of identical antennas
CO4	Describe the characteristics of aperture antenna
CO5	Design the Microstrip patch antennas

UNIT I	TYPES OF ANTENNAS	9

Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

UNIT II	LINEAR WIRE ANTENNAS	9

Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

UNIT III	LINEARARRAYS	9

Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

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UNIT IV	APERTURE ANTENNAS	9
Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.		
UNIT V	**MICROSTRIP ANTENNAS**	**9**
Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch. Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.		

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

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Regulation 2019		SEMESTER II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
C	19PCMC104T	ADVANCED DIGITAL SIGNAL PROCESSING	3	0	0	3

Prerequisite Course (s)

Digital Signal Processing

Course Objective (s):The purpose of learning this course is to:

1	Impart the knowledge of FIR/IIR filters
2	Understand the coneept behind multirate signal processing
3	Study the linear prediction filter characteristics
4	Know the estimation of spectrum
5	Study the applications of digital signal processing

Course Outcome (s) (COs):At the end of this course, learners will be able to:

CO1	Understand theory of different filters and algorithms.
CO2	Summarize the theory of multirate DSP, solve numerical problems and write algorithms
CO3	Explain prediction and solution of normal equations
CO4	Compute the power spectrum estimation
CO5	Understand applications of DSP at block level.

UNIT I	FIR/IIR FILTERS	9

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

UNIT II	MULTIRATE SIGNAL PROCESSING	9

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

UNIT III	LINEAR PREDICTION FILTERS	9

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

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UNIT IV	SPECTRUM ESTIMATION	9
Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation		
UNIT V	**APPLICATIONS OF SIGNAL PROCESSING**	**9**
Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications		

Text Book (s)	
1	Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons,Inc, Singapore, 2002.
2	John J. Proakis, Dimitris G. Manolakis, „Digital Signal Processing", Pearson Education, 2002.
Reference (s)	
3	Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Pearson Education, Second Edition, 2004 (For Wavelet Transform Topic).

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Regulation 2019		SEMESTER II	Total Hours			60
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
P	19PCMP102L	COMMUNICATION SYSTEMS LABORATORY II	0	0	4	2

Prerequisite Course (s)

Nil

Course Objective (s): The purpose of learning this course is to:

1	Study the basic principles, configurations and practical limitations of op-amp.
2	Understand the operation of timer, PLL, basic D/A and A/D converter types.
3	Understand the special functions if IC's.
4	Identify the working concept of Feedback amplifiers.
5	Understand the various Tuned amplifier and Multivibrators circuits.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Illustrate the op-amp's basic construction, characteristics, parameter limitations, various configurations and few applications of op-amp.
CO2	Analyze the timer circuits, PLL and Analog to digital and Digital to Analog Convertors.
CO3	Analyze the special functions of IC's.
CO4	Summarize the concept of concept of Feedback amplifiers.
CO5	Review the concepts of Wave shaping circuits and tuned amplifier.

LIST OF EXPERIMENTS

1	Simulation of Audio and speech compression algorithms.
2	Simulation of EZW / SPIHT Image coding algorithm.
3	Simulation of Microstrip Antennas.
4	S-parameter estimation of Microwave devices
5	Study of Global Positioning System
6	Performance evaluation of simulated CDMA System.
7	Design and testing of a Microstrip coupler.
8	Characteristics of $\lambda/4$ and $\lambda/2$ transmission lines.

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Regulation 2019		Semester II	Total Hours			15
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
M	19PATM103	Pedagogy Studies	1	0	0	0

Prerequisite Course (s)

Nil

Course Objective (s):

The purpose of learning this course is to:

1	Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2	Identify critical evidence gaps to guide the development.

Course Outcome (s) (COs):

At the end of this course, learners will be able to:

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	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.
CO4	Discuss the passage of the Hindu Code Bill of 1956.

UNIT I	INTRODUCTION AND METHODOLOGY	3

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and Searching

UNIT II	THEMATIC OVERVIEW	3

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education

UNIT III	PEDAGOGIC STRATEGIES	3

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the school,curriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogical practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and Pedagogic strategies

UNIT IV	PROFESSIONAL DEVELOPMENT	3

Alignment with classroom practices and follow-up support ,Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes

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UNIT V	RESEARCH GAPS AND FUTURE DIRECTIONS	3
Research design , Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact		

Text Book (s)

1	Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2	Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

Reference (s)

1	Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
2	Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
3.	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

Regulation 2019		SEMESTER II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME009T	SATELLITE COMMUNICATION AND NAVIGATION SYSTEMS	3	0	0	3

Prerequisite Course (s)

Analog Communication

Course Objective (s): The purpose of learning this course is to:

1	Gain knowledge of architecture of satellite systems
2	Understand the orbital analysis
3	Study about satellite sub-systems
4	Know the typical Phenomena in Satellite Communication
5	Compute the link budget design of satellite

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Visualize the architecture of satellite systems as a means of high speed, high range communication system.
CO2	State various aspects related to satellite systems such as orbital equations
CO3	Explain the satellite sub-systems
CO4	Descibe typical Phenomena in Satellite Communication
CO5	Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions

UNIT I	ARCHITECTURE OF SATELLITE COMMUNICATION	9

Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

UNIT II	ORBITAL ANALYSIS	9

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

UNIT III	SATELLITE SUB-SYSTEMS	9

Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

UNIT IV	PHENOMENA IN SATELLITE COMMUNICATION	9
Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.		
UNIT V	**SATELLITE LINK BUDGET**	**9**
Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.Modulation and Multiple Access Schemes used in satellite communication.Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ISRO. GPS.		

Text Book (s)	
1	Tri T Ha, Digital Satellite Communication, McGrawHill, 1990.
2	B.N.Agarwal, Design of Geosynchronous Spacecraft, Prentice Hall, 1993.
Reference (s)	
1	Wilbur L. Pritchard, H.G. Suyderhoud Robert A.Nelson, Satellite Communication Systems Engineering, Prentice Hall, New Jersey, 2006.
2	Timothy Pratt and Charles W.Bostain, Satellite Communications, John Wiley and Sons, 2003.
3	D.Roddy, Satellite Communication, McGrawHill, 2006.

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Regulation 2019		SEMESTER II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME010T	MODERN INTERNET OF THINGS	3	0	0	3

Prerequisite Course (s)

Microprocessors and Networks

Course Objective (s):The purpose of learning this course is to:

1	Underatand the need of IoT evolved from IT
2	Study the Software Defined Networks for modern IoT
3	Gain the knowledge about protocols used in Wireless sensor networks
4	Know the available Open source platforms
5	Understand the Operating systems requirement modern IoT

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the IoT revolution from IT
CO2	Explain about Software Defined Networks for IoT
CO3	Summarize the protocols used in Wireless sensor networks
CO4	State the Open source platforms used in software
CO5	Analyze the Operating systems requirement for modern IoT

UNIT I	IoT REVOLUTION	9

Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.

UNIT II	SOFTWARE DEFINED NETWORKS	9

Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog.

UNIT III	WIRELESS SENSOR NETWORKS	9

Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.

UNIT IV	OPEN SOURCE PLATFORMS	9

Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts.

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UNIT V	OPERATING SYSTEMS REQUIREMENT	9
Operating systems requirement of IoT environment, study of mbed, RIoT, andContiki operating systems, Introductory concepts of big data for IoT applications. Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation.		

Text Book (s)	
1	A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", VPT publisher, 2014.
2	Samuel Greenguard, "Internet of things", MIT Press, 2015.
Reference (s)	
1	CunoPfister, "Getting started with Internet of Things", Maker Media, 1st edition, 2011.
2	A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.

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Regulation 2019		SEMESTER II	Total Hours			
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME011T	VOICE AND DATA NETWORKS	3	0	0	3

Prerequisite Course (s)

Computer Networks

Course Objective (s): The purpose of learning this course is to:

1	Underatand the need of Network Terminology
2	Study the Cross layer design of networks
3	Gain the knowledge about Link layer design
4	Understand the Queuing Models of Networks
5	Know the available protocols for Inter-networking

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the Network Terminologies
CO2	Explain the Cross layer design of voice networks
CO3	Describe the Link layer design of data networks
CO4	Analyze the Queuing Models of Networks
CO5	Understand the protocols used for Inter-networking

UNIT I	NETWORK TERMINOLOGY	9

Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.

UNIT II	CROSS LAYER DESIGN	9

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, Statistical Multiplexing

UNIT III	LINK LAYER DESIGN	9

Data Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

UNIT IV	QUEUING MODELS OF NETWORKS	9

Queuing Models of Networks , Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing , Examples of Local area networks,

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UNIT V	INTER-NETWORKING	9
Inter-networking, Bridging, Global Internet , IP protocol and addressing , Sub netting , Classless Inter domain Routing (CIDR) , IP address lookup , Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control , Additive Increase/Multiplicative Decrease , Slow Start, Fast Retransmit/ Fast Recovery, Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.		

Text Book (s)	
1	L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition, Morgan Kaufman, 2011.
2	Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
Reference (s)	
1	D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992. 1st Edition, Morgan Kaufman, 2004.
2	Walrand, "Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002

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Regulation 2019		SEMESTER II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME012T	MIMO SYSTEM	3	0	0	3

Prerequisite Course (s)
NIL

Course Objective (s):The purpose of learning this course is to:	
1	Underatand the need of Multi-antenna Systems
2	Study the Diversity Techniques
3	Know the available MIMO systems
4	Understand the Beamforming principles
5	Gain the knowledge about MIMO channel

Course Outcome (s) (COs):At the end of this course, learners will be able to:	
CO1	Understand the Multi-antenna Systems
CO2	Explain the Diversity Techniques
CO3	Describe the Mathematical modelling and analysis of MIMO systems.
CO4	Analyze the Beamforming principles
CO5	Understand the MIMO channel

UNIT I	MULTI-ANTENNA SYSTEMS	9

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

UNIT II	DIVERSITY TECHNIQUES	9

Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation.

UNIT III	MIMO SYSTEMS	9

The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Pre-distortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of pre- coding and combining, Channel state information.

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UNIT IV	BEAMFORMING PRINCIPLES	9

Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer

UNIT V	MIMO CHANNEL	9

MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel model.Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

Text Book (s)

1	Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design",Academic Press, 1st edition, 2010.
2	Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.

Regulation 2019		SEMESTER II	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19PCME013T	PROGRAMMABLE NETWORKS SDN NFV	3	0	0	3

Prerequisite Course (s)

Advanced Communication Networks

Course Objective (s): The purpose of learning this course is to:

1	Gain the knowledge about Software Defined Networking
2	Study the Control and Data Plane
3	Understand the Network Virtualization
4	Know the available Customization of Control Plane
5	Underatand the need of Programming SDNs

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand advanced concepts in Programmable Networks.
CO2	Understand Software Defined Networking, an emerging Internet architectural framework.
CO3	Analyze the Network Virtualization in SDN's
CO4	Explain the Customization of Control Plane
CO5	Implement the main concepts, architectures, algorithms, protocols and applications in SDN and NFV.

UNIT I	SOFTWARE DEFINED NETWORKING	9

Introduction to Programmable Networks, History and Evolution of Software Defined Networking (SDN), Fundamental Characteristics of SDN, Separation of Control Plane and Data Plane, Active Networking.

UNIT II	CONTROL AND DATA PLANE	9

Control and Data Plane Separation: Concepts, Advantages and Disadvantages, the basics of Open Flow protocol.

UNIT III	NETWORK VIRTUALIZATION	9

Network Virtualization: Concepts, Applications, Existing Network Virtualization Framework, Mininet A simulation environment for SDN.

UNIT IV	CUSTOMIZATION OF CONTROL PLANE	9

Control Plane: Overview, Existing SDN Controllers including Floodlight and Open Daylight projects.

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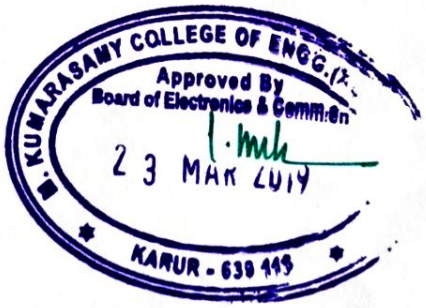
Customization of Control Plane: Switching and Firewall Implementation using SDN Concepts. Data Plane: Software-based and Hadrware-based; Programmable Network Hardware.		
UNIT V	**PROGRAMMING SDNS**	**9**
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs. Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.Data Center Networks: Packet, Optical and Wireless Architectures, Network Topologies.Use Cases of SDNs: Data Centers, Internet Exchange Points, Backbone Networks, HomeNetworks.		

Text Book (s)	
1	Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", O'Reilly Media, August 2013.
2	Paul Goransson, Chuck Black, Timothy Culver. "Software Defined Networks: A Comprehensive Approach", Morgan Kaufmann Publishers, 2016

Reference (s)	
1	Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", CRC Press, 2014.
2	Vivek Tiwari, "SDN and OpenFlow for Beginners", Amazon Digital Services, Inc., ASIN: , 2013
3	Nick Feamster, Jennifer Rexford and Ellen Zegura, "The Road to SDN: An Intellectual History of Programmable Networks" ACM CCR April 2014



Regulation 2018		Semester III	Total Hours			45
Category	Course Code	Course Name	Hours / Week			C
			L	T	P	
E	19CME014T/ 19PVLE019T	WIRELESS EMBEDDED SYSTEMS	3	0	0	3

Prerequisite Course (s)

Wirleless and Mobile Communication

Course Objective (s): The purpose of learning this course is to:

1	Describe about the generation of wireless systems.
2	Impart concepts of security in wireless system.
3	Understand the network requirement and about the network management of CAN message.
4	Familiarizing the students in embedded concepts and programming.
5	Understand the techniques essential to the design and implementation of real-time embedded system

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Understand the different generation of wireless systems.
CO2	Understand the concepts of security in wireless system.
CO3	Know about requirement of Embedded network
CO4	Develop advanced programs in Embedded
CO5	Understand the Embedded Real Time software that is needed to run embedded systems

UNIT I	AN OVERVIEW OF WIRELESS SYSTEMS	9

Introduction-First and Second Generation Cellular Systems-Cellular Communications from 1G to 3G-Road Map for higher Data Rate Capability in 3G-Wireless 4G Systems-Future Wireless Network-Standardization Activites for Cellular Systems

UNIT II	SECURITY IN WIRELESS SYSTEMS	9

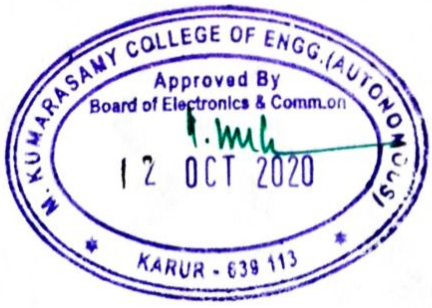
Introduction-Purpose of security-Privacy Requirements-Required Features for a secured Wireless Communications System-Methods of Providing Privacy and Security Wireless Systems-Wireless security and Standards-IEEE 802.11 Security-Security in North American Cellular/PCS Systems-Security in GSM,GPRS, and UMTS.

UNIT III	EMBEDDED NETWORK REQUIREMENTS	9

Embedded networking Communication in the Automation Pyramid-Terminology used in Embedded

Networking-Code Requirements for Embedded Systems-Communication Requirements for Embedded Networking-Introduction to CANopen from the Application Level-The Object Dictionary Concept-Electronic Data Sheets		
UNIT IV	**EMBEDDED PROGRAMMING**	**9**
Embedded OS Fundamentals (Linux) Introduction: Operating System Fundamentals, General Linux Architecture, Linux Kernel, Linux file systems, ROOTFS, Sysfs and Procfs, Embedded Linux: Booting Process in Linux, boot loaders, U-boot, Kernel Images, Linux File systems. GNU Tools: gcc, gdb, gprof, Makefiles		
UNIT V	**EMBEDDED OS & RTOS**	**9**
Embedded OS Internals, Overview of POSIX APIs, Kernel, Linux Device Drivers, Basics of RTOS, Scheduling Systems, Inter-process communication, Performance Matric in scheduling models, Realtime scheduling, Task Creation, Intertask Communication, I/O Systems, Cross compilers, debugging Techniques, Creation of binaries & porting stages for Embedded Development board.		

Text Book (s)	
1	Vijay Garg, "Wireless Communication and networking",FirstEdition,Elsevier 2007.
2	GlafP.Feiffer,AndrewAyre and Christian Keyold, "Embedded networking with CAN and CANopen",Embedded System Academy 2005.
Reference (s)	
1	William Stallings, "Wireless communication and Networking" Second edition Prentice Hall,India 2007.
2	Jon W Mark,WeihuaZhuang "Wireless communication and Networking" Prentice Hall India 2003.



Regulation 2019		Semester III	Total Hours				45
Category	Course Code	Course Name	Hours / Week				C
			L	T	P	J	
E	19PCME015T	REMOTE SENSING	3	0	0	0	3

Prerequisite Course (s)

NiL

Course Objective (s): The purpose of learning this course is to:

1	Understand the basics fundamental of remote sensing.
2	Know the platform and sensors used for remote sensing.
3	Understand digital cataography of mapping
4	Know the photogrammetry, surveying and GPS.
5	Understand the remote sesing application in ResourseManagement .

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Illustrate Basics of Printed circuit board design engineering
CO2	Knowledge on PCB design process, rules, routing
CO3	Know the digital cataography of mapping
CO4	Understand photogrammetry, surveying and GPS
CO5	Knowledge on remote sensing of Resourse Management

UNIT I	FUNDAMENTALS OF REMOTE SENSING	9

Concept and Scope of Remote Sensing: Definitions, Process and Characteristics of Remote Sensing System, Advantages and limitations. Concept of Electromagnetic Radiation (EMR): Wavelength-frequency-energy relationship of EMR, EMR Spectrum and its properties, EMR wavelength regions and their applications, Atmospheric windows, Interaction of EMR with matter, Spectral signatures. Fundamental laws governing the science: Sources of Energy, Radiation laws: StefanBoltzman law, Wien's law, Kirchhoff's law etc., Black body and Real body, Radiant temperature & Kinetic temperature (Numerical problems of all above) Energy Interaction.

UNIT II	REMOTE SENSING PLATFORMS AND SENSORS	9

Introduction: Sensor materials, Sensor System - Framing and Scanning System, Whiskbroom scanners, Push-broom scanners, Side Looking scanner. Types and Characteristics of Sensor: Imaging and non-imaging sensors, Active and passive sensors, Resolution of Sensors - Spectral, Spatial, Radiometric & Temporal, Scale, Mapping unit, Multi-band concepts and False Colour Composites Remote Sensor Platforms : Ground, Airborne and Space borne Platforms.

UNIT III	DIGITAL CARTOGRAPHY	9

GIS and Digital Cartography: Concept of Digital Cartography, Advantages and Disadvantages of Digital Cartography ii. Concept of Map Scales: Defining Map, Projection Systems, Categories of maps, Map Scales iii. Measurement of Geographic Variables: Nominal, Ordinal, Interval and Ratio Scales, Qualitative vs. Quantitative data, Discrete vs. Continuous data iv. Digital Mapping: Cartographic Design Issues, Concept of Visual Variables, Map Lettering, Map Compilation, Generalization, Map Composition, Multivariate and Dynamic Mapping, Map Production v. Visualization of geospatial data-2D and 3D visualization.

UNIT IV	PHOTOGRAMMETRY, SURVEYING AND GPS	9

Introduction: Historical Development and Fundamentals of aerial photography, Vertical and Oblique aerial photography, Classification of Aerial Film Cameras, Digital cameras Components of aerial Cameras, Camera Calibration, Photogrammetric Applications and Products . Scale, Geometry and Ground Coverage of Aerial Photographs, Area calculation & Flight Planning. Binocular and Stereoscopic vision, Conditions for Stereovision, Photographic overlap Image Parallax, Height determination from stereo pairs - Parallax Equation, Ground Control. Co-ordinate Systems used in Photogrammetry, Relief distortion and Tilt distortions, Rectification, Ortho Rectification, Height determination from single photograph, Planimetric map compilation, Digital Elevation Model (DEM), Digital orthophotos.

UNIT V	APPLICATION OF REMOTE SENSING AND GIS IN RESOURCE MANAGEMENT	9

Bio-Resources: Remote sensing application in agriculture, forest resources and wildlife habitat assessment. Water Resources: Remote sensing application in surface and sub surface water resources evaluation, water mining and pollution, issues in water resources management. Energy Resources: Coal, oil and nuclear energy, non conventional energy resources, future potential and requirement of energy resources. GIS in energy resources management.

Text Book (s)

1	Panda, B. C., 2008. Remote Sensing: Principles and Applications, Viva Books Private Limited, India
2	C.P.Lo and Albert K.W.Yeung 2005 "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India,New Delhi.

Reference (s)

1	Joseph, George, (2003), Fundamental of Remote Sensing, University Press (India) Pvt. Ltd, Orient Longman Pte. Ltd., Hyderabad, India
2	Jensen J.R. (2005) Digital Image Processing: A Remote Sensing Perspective, 3rd ed., Prentice Hall.

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Regulation 2019		Semester III	Total Hours				45
Category	Course Code	Course Name	Hours / Week				C
			L	T	P	J	
E	19PCME016T	PCB DESIGN TECHNOLOGY	3	0	0	0	3

Prerequisite Course (s)

NIL

Course Objective (s): The purpose of learning this course is to:

1	Understand the basics requirement of PCB types, electronic packages and flow of PCB design.
2	Construct the layout design and assemble the components as per IPC standard.
3	Design in CAE and CAD Tools.
4	Calculate the current calculations in design to improve the performance.
5	Understand the manufacturing & Advanced Techniques in PCB.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Illustrate Basics of Printed circuit board design engineering
CO2	Knowledge on PCB design process, rules, routing
CO3	Design PCB design parameters using CAE tools
CO4	Design the electrical parameters and design
CO5	Knowledge on Manufacturing and advanced PCB techniques

UNIT I	BASIS OF PRINTED CIRCUIT BOARD DESIGN ENGINEERING	9

Printed Circuit Boards history & evolution- Technology trends- Physical characteristics of the PCB-vias concept Classes of PCB designs- Types of Printed Circuit Boards- Types of packages For electronic circuits- Concepts of Printed Circuit Board Design & Manufacturing- System specification- System block diagram- Partitioning system into PCBs- Determining PCB size- Building component libraries.

UNIT II	PCB DESIGN PROCESS	9

Creating the schematic- Mechanical design parameters and enclosures- Mechanical aspects- Stack up build- Design flow formulation- Placing components on PCBs- Constraints set up-Power rules- Mixed Signal design rules- High-Speed rules- Consideration on timing & transmission lines effects- Routing PCB- Checkingrouted results - Generating manufacturing files – archiving design.

UNIT III	DESIGN TOOLS AND DESIGN PARAMETERS	9

Setting up the PCB design process in CAE tools- Library, Schematic – CAD tools - Mechanical, Placement, Setting Constraint, Auto Routing, Manual Routing, Post Root Task, Output Generation. Design Rules Setting to compliance with Design & Manufacturability- Physical Rules, Spacing Rules, Electrical Rules. EDA tools.

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UNIT IV	DESIGN PERFORMANCE	9
Electrical Design Parameters- Current Calculations, Voltage Calculation, Impedance Calculations. Electrical Design Performance-Signal Integrity, Power Integrity, Thermal Management.		
UNIT V	**MANUFACTURING AND ADVANCED PCB TECHNIQUES**	**9**
Manufacturing related documentation- Planning for Fabrication & Assembly- Fabrication process- Assembly process Hand Soldering process, Wave soldering, Reflow soldering - Bare Board testing methods - Introductionto New Technologies-HDI technology, Flexi Rigid Boards, Embedded Actives and Passives.		

Text Book (s)

1	Clyde F. Coombs, "Printed Circuits Handbook", Sixth Edition, The McGraw-Hill Companies, 2008.
2	Sd Mehta, "Electronic Product Design Vol 1 Basic Of PCB Design", S Chand & Company Pvt Ltd, 2011.

Reference (s)

1	John H. Lau, "Microvias: For Low Cost, High Density Interconnects: Conventional Printed Circuit Board Technologies", McGraw-Hill Professional, 2001.
2	R. Khandpur, "Printed Circuit Boards: Design, Fabrication, and Assembly", McGraw-Hill Electronic Engineering, August 2005.

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Regulation 2019		Semester III	Total Hours				45
			Hours / Week				C
Category	Course Code	Course Name	L	T	P	J	
E	19PCME017T	COMMUNICATION INTERFACES	3	0	0	0	3

Prerequisite Course (s)

Computer Networks ,Embedded Systems

Course Objective (s): The purpose of learning this course is to:

1	Study the concepts of serial busses.
2	Understand the concepts of CAN.
3	Study the concepts of PCI.
4	Understand the concepts of USB.
5	Study the concepts of Data Streaming Serial Communication Protocol.

Course Outcome (s) (COs): At the end of this course, learners will be able to:

CO1	Review the concepts of serial busses.
CO2	Summarize the concepts of CAN.
CO3	Review the concepts of PCIe.
CO4	Summarize the concepts of USB.
CO5	Analyse the Data Streaming Serial Communication Protocol.

UNIT I	SERIAL BUSSES	9

Physical interface, Data and Control signals, features.

UNIT II	COMMUNICATION PROTOCOLA	9

Limitations and applications of RS232, RS485, I2 C, SPI.Architecture, data transmission, layers, frame formats, applications, Ethernet, SCSI

UNIT III	PCI	9

Revisions, Configuration space, Hardware protocols, applications.

UNIT IV	USB	9

Transfer types, enumeration, Descriptor types and contents, Device driver.

UNIT V	DATA STREAMING SERIAL COMMUNICATION PROTOCOL	9

Serial Front Panel Data Port (SFPDP) using fiber optic and copper cable.

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Text Book (s)	
1	JanAxelson,-SerialPortComplete- COMPorts, USB VirtualComPorts, and Ports for Embedded Systems , Lakeview Research, 2nd Edition.
2	JanAxelson,-USBComplete,PenramPublications.
Reference (s)	
1	MikeJackson,RaviBudruk,-PCI ExpressTechnologyl,Mindshare Press.
2	Wilfried Voss, -A Comprehensible Guide to Controller Area Networkl, Copperhill Media Corporation, 2nd Edition, 2005.

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