Sl. No.	Category of subjects	Semester				Total Credits allotted
		1	2	3	4	
1.	Humanities and Social Sciences (HS);	0	0	4	0	4
2.	Basic Sciences(BS);	4	0	0	0	4
3.	Professional Subjects-Core (PC);	16	14	0	0	30
4.	Professional Subjects – Electives (PE);	4	8	4	0	16
5.	Project Work, Seminar and/or Internship in Industry or elsewhere.	1	5	14	24	44
		25	27	22	24	98

SEMESTER I

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	MCE101	COMPULSORY:ADVANCED ENGINEERING MATHEMATICS	3	1	0	4	4
2	MCE102	COMPULSORY: ADVANCED DIGITAL COMMUNICATION	4	0	0	4	4
3	MCE103	COMPULSORY: ADVANCED DIGITAL SIGNAL PROCESSING	4	0	0	4	4
4	MCE104	COMPULSORY: ADVANCED RADIO PROPAGATION AND REMOTE SENSING	4	0	0	4	4
5	MCE105	ELECT-I (a) COMPUTER COMMUNICATION & NETWORKING (b) ADVANCED MICROWAVE (c) COMMUNICATION ENGINEERING	4	0	0	4	4
PRACTICAL							
6	MCE191	ADVANCED COMMUNICATION LAB	0	0	3	3	2
7	MCE192	DESIGN AND SIMULATION LAB	0	0	3	3	2
SESSIONAL							
8	MCE183	SEMINAR 1	0	2	0	2	1
			Total			28	25

SEMESTER II

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	MCE201	COMPULSORY: MOBILE COMPUTING	4	0	0	4	4
2	MCE202	COMPULSORY: ERROR CONTROL AND CHANNEL CODING	4	0	0	4	4
3	MCE203	COMPULSORY: MOBILE INTERNET	4	0	0	4	4
4	MCE204	ELECT- II: (a) CRYPTOGRAPHY & NETWORK SECURITY (b) J2ME FOR MOBILE PROGRAMMING (c) SATELLITE COMMUNICATION (d) Microwave measurement Techniques	4	0	0	4	4
5	MCE205	ELECT- III: (a) Baseband Processor (b) Multimedia for Mobile Devices (c) Image processing & pattern recognition (d) Advanced Antenna Engineering	4	0	0	4	4
PRACTICAL							
6	MCE291	COMMUNICATION SYSTEMS LAB	0	0	3	3	2
SESSIONAL							
7	MCE281	TERM PAPER LEADING TO THESIS					1
8	MCE282	COMPREHENSIVE VIVA-VOSE					4
			Total			23	27

SEMESTER III

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
1	MCE301	COMPULSORY: MANAGEMENT OF TECHNOLOGY	4	0	0	4	4
2	MCE302	ELCT- 4 (a)MOBILE ADHOC NETWORKING (b)BROADBAND COMMUNICATION NETWORK (c)DIGITAL WIRLESS COMM.SYSTAM DESIGN	4	0	0	4	4
3	MCE381	DISSERTATION (PART-1)					6
4	MCE382	DEFENCE OF DISSERTATION (PART-1)					8
			Total			8	22

SEMESTER IV

Sl. No.	Field	Subject	Contact Hours/ Week				
			L	T	P	Total	Credit points
SESSIONAL							
1	MCE481	DISSERTATION (COMPLETION)					6
	MCE482	POST- SUBMISSION DEFENSE OF DISSERTATION					18
			Total				24

Total Credit = 98

SEMESTER I

Advanced Engineering Mathematics
Code: MCE 101
Contacts: 3-1-0
Credits: 4

Part – A

Optimization Technique: calculus of several variables, implicit funtion theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus of variation, constrained optimization, lagrange multipliers gradient method, dynamic programming.

Probability and statistics: Definition and postulates of probability, field of probability Mutually exclusive events bayes' theorem independence, bernoulli trail, discrete distributions, continuouse

Part – B

Complex Variable: Elements of set theory, set notations, applications of set theory, open & closed set. Review of complex variable, conformal mapping and transformations, functions of complex variable, integration with respect to complex argument,residues and basic theorems on residues.
Numerical Analysis : Introduction, Interpolation formulae, differnce equations roots of equations, solutions of simultaneous linear and non linear equations, solution techniques for ODE and PDE , Introduction to stability, Matrix eigen value and eigen vector problems.

Reference Books:

1. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill
2. Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.
3. Halmos, T. R.-NaÃ¨ve Set Theory, Van Nostrand
4. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press
5. Cone, S. D.-Elementary Numerical Analysis, Mc. Graw Hill.
6. Mukhopadhyay ,P.-Mathematical Statistics ,New Central Book Agency
7. Kapoor, V. K and Gupta, S.C.-Fundamental of Mathematical Statistics, Sultan Chand and Sons.
8. Uspensky, J. V.-Introduction to Mathematical Probability, Tata Mc. Graw Hill
9. Dreyfus, S. E.-The Art and Theory of Dynamic Programming –Theory and Applications, Academic Press.
10. Rao, S. S.-Optimisation Theory and Application, Wiley Eastern Ltd., New Delhi

Advanced digital communication
Code: MCE 102
Contacts: 3-1-0
Credits: 4

Prerequisite: Digital Communication, Field Theory, Signal and Systems

Objective

1. Understanding of the main concepts and techniques used in the analysis and design of digital communication systems.

2. Help students to design complex circuits in digital communication.

Outcome

On completing this subject the student should be able to:

- Qualitatively and quantitatively analyse and evaluate digital communication systems;
- Use software tools to analyse, design and evaluate digital communication systems

Module 1 :

Fourier Expansion, Fourier transform, Normalized power spectrum, Power spectral density, Effect of transfer function on output power spectral density, Perseval's theorem. Autocorrelation & cross correlation between periodic signals, cross correlation power. Relation between power spectral density of a signal, its autocorrelation function and its spectrum. Distinction between a random variable and a random process. Probability, sample space, Venn diagram, joint probability, bay's theorem, cumulative probability distribution function, probability density function, joint cumulative probability distribution function, joint probability density function. Mean/average/expectation of a random variable and of sum of random variables. Standard deviation, variance, moments of random variables, explanation with reference to common signals. Tchebycheff's inequality. Gaussian probability density function – error function & Q function Central limit theorem.

Spectral analysis of signals:

Orthogonal & orthonormal signals. Gram-Schmidt procedure to represent a set of arbitrary signalsby a set of orthonormal components; - numerical examples. The concept of signal-space coordinate system, representing a signal vector by its ortho-normal components, measure of distinguishability of signals.

Line codes: UPNRZ, PNRZ, UPRZ, PRZ, AMI, Manchester etc. Calculation of their power spectral densities. Bandwidths and probabilities of error (P_e) for different line codes.

Revision of digital modulation: Principle, transmitter, receiver, signal vectors, their distinguish ability (d) and signal band width for BPSK, QPSK, M-ARY PSK, QASK, MSK, BFSK, M-ARY FSK.

Module 2

Spread spectrum modulation: Principle of DSSS, processing gain, jamming margin, single tone interference, principle of CDMA.

Multiplexing & multiple access: TDM/TDMA, FDM/FDMA, Space DMA, Polarization DMA, OFDM, ALOHA, Slotted ALOHA, Reservation ALOHA, CSMA-CD, CSMA-CA – basic techniques and comparative performances e.g. signal bandwidth, delay, probability of error etc.

Module 3

Base band signal receiver and probabilities of bit error: Peak signal to RMS noise output ration, probability of error. Optimum filter, it's transfer function. Matched filter, it's probability of error. Probability of error in PSK, effect of imperfect phase synchronization or imperfect bit synchronization. Probability of error in FSK, QPSK. Signal space vector approach to calculate

probability of error in BPSK, BFSK, QPSK. Relation between bit error rate and symbol error rate. Comparison of various digital modulation techniques vis-Ã -vis band width requirement and probabilities of bit error.

Characteristics of random variables and random processes:
Common probability density functions, - Gaussian, Rayleigh, Poisson, binomial, Rice, Laplacian, log-normal, etc. Probability of error in Gaussian Binary symmetric channel. Random processes – time average, ensemble average, covariance, autocorrelation, cross correlation, stationary process, ergodic process, wide sense stationary process. Power spectral density and autocorrelation, power spectral density of a random binary signal. Linear mean square estimation methods.

Revision of source coding: Sampling theorem, instantaneous/ flat top/ natural sampling, band width of PAM signal, quantization, quantization noise, principle of pulse code modulation, delta modulation & adaptive delta modulation. Parametric coding/ hybrid coding/ sub band coding: APC, LPC, Pitch predictive, ADPCM, voice excited vocoder, vocal synthesizer.

Module 4

Noise: Representation of noise in frequency domain. Effect of filtering on the power spectral density of noise – Low pass filter, band pass filter, differentiating filter, integrating filter. Quadrature component of noise, their power spectral densities and probability density functions. Representation of noise in orthogonal components.

Text Books:
1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.
2. Principle of Communication Systems – Taub, Schilling, TMH
3. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.
4. Principles of Digital Communication – Haykin
5. Digital Communication – Zeimer, Tranter.
6. Principle of Digital communication - J. Das, S. K. Mallick, P. K Chakraborty, New Age Int.
7. Communication Systems, 4th ed. – A. Bruce Carlson, Paul B. Crilly, Janet C. Rutledge, MGH International edition.
8. Digital Communications, 2nd ed. – Bernard Sklar, Pearson Education.
9. Electronic Communications, 4th ed. – Dennis Roddy, John Coolen, PHI

PEO Mapping

a	b	c	d	e	f	g	h	i	j	k	l
√	√	√									

Engineering knowledge: Apply knowledge of circuit and field theory

Problem analysis: Analyse performance of a large communication system

Design/development of solutions: Conducting experiments in communication systems

Advanced Digital Signal Processing
MCE103

Contacts: 4-0-0
Credits: 4
Prerequisites: Signals and systems

Program Objectives:
The purpose of this course is to provide in-depth treatment on methods and techniques in discrete-time signal transforms, digital filter design, optimal filtering, power spectrum estimation, multi-rate digital signal processing, DSP architectures, which are of importance in the areas of signal processing, and communications. Applications of these methods and techniques are also presented. The intended audiences are research students and industry professionals working in the above-mentioned areas and related technical fields.

Course Content:

Module 1: Discrete time signals and systems: 6L
Review of Discreet Time domain and frequency domain, Comparative study on different transform technique, Convolution and frequency response. Discrete time Fourier, Laplace and Ztransforms, discrete time processing of continuous time signals, LTI,SISO,MIMO, BIBO systems Analysis. Parametric analysis of different type of Signal, Comprehensive coverage of advanced digital signal processing towards industry.

Module 2: Computation on Discrete Domain Transform & Analysis Technique: 7L

Computation of DFT and IDFT with its properties, Computation of FFT, FFT and DFT Algorithms with comparison, Deterministic and Nondeterministic approach on advanced DSP, Wavelet transforms. Industrial application on Transform Technique with specific Mobile based example.

Module 3: Digital Filter Design: 8L

Comparative approach of Analog and Digital filter. Impulse invariance.Bilinear transformation, finite difference, window design technique, frequency sampling optimization algorithms, IIR - Direct, parallel and cascaded realizations. FIR – Direct and cascaded realizations, Kalman Filters, Filter Adaptation Technique. Industry based approach on design of digital filter to improve Mobile communication.

Module 4: Power Spectrum 7L

Estimation of Power Spectrum and Correlation, Non-parametric and Parametric methods, Minimum Variation Estimation methods, Eigen Analysis algorithm, Power Spectrum analysis using DFT, Maximum Entropy Spectral Estimation, Model-Based Power Spectral Estimation.

Module 5: Application based Digital Signal Processing: 8L

Analysis and analytical technique on Audio signal, Video signal , Bio-signal processing, A/D conversion and quantization, D/A conversion, Signal Processor IC chip based introduction, MATLAB computation technique on several DSP industrial applications mainly based on mobile communication system.

PEO:
The topics covered in this course provide solid and comprehensive foundation for other more specialized areas in signal processing to support communications system. At the end of the course, students would be able to apply fundamental principles, methodologies and techniques of the course to analyse and design various problems encountered in both academic research and industry R&D practice.

paper code	a	b	c	d	e	f	g	h	i	j	k	l
	√	√	√	√		√	√	√	√	√		

Text and Reference Books :
1. Applied Digital Signal Processing: Theory and Practice By Dimitris G. Manolakis, Vinay K. Ingle Cambridge University Press
2. E.C. Ifeachor and B.W. Jervis, Digital Signal Processing –A practical approach, Second Edition,Prentice-Hall, 2002.
3. Wireless digital signal processors -- Authors: Ingrid Verbauwhede and MihranTouriguian Affiliation: UCLA, ATMEL Corporation.
4. M. Hayes, Statistical Digital Signal Processing and Modeling, Wiley, 1996.
5. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice-Hall, 1993.

Advanced Radio propagation and Remote Sensing
MCE104
Contacts:4-0-0
Credits:4

Prerequisites: EM Theory

Program Objectives:
1. To know fundamental mechanism of Radio propagation Advancement in Remote Sensing.
2. To understand model analysis in the subject area.

Module I
Basic Radio propagation mechanism: Short distance & long distance propagation cases. Free space propagation models. Diffraction, Reflection and Scattering. 4L
Module II
Radio propagation models: Two ray reflection model, Fresnel zones, knife edge model; 6L
Module III
Link budget analysis, Outdoor propagation models. 6L
Module IV
Multipath & Small-Scale Fading, Types Large scale fading, small scale fading, delay speed effect doppler shift, doppler power spectrum. Flat fading channel modelling, frequency selective fading, Fading effects on device. 6L
Module V
Concept of Remote Sensing: Remote Sensing, Data, Sources of Energy, Interaction with Atmosphere and Target, Recording of Energy, Application of Remote Sensing, Types of Remote Sensing, Sensor Resolution. 6L
Module VI

Digital Imaging: Digital Image, Sensors, Detectors, Imaging by Scanning, Active Remote Sensors. Microwave Remote Sensing 5L

Module VII

Radar Imaging GPS: Requirement of Ground Truth Data, Parameters of Ground Truthing-Atmospheric Condition, Suface Water, Factors of Special Measurement—Sun Angle, Aerosol, Haze Water Vapour. 6L

Text and Reference Books:

1. Wireless Communication, Upena Dalal
2. Wireless Communication, Basudeb Acharya
3. Satellite Communication, D. C. Agarwal, Khanna publisher

Learning Outcome: Student should be able to

1) Gain knowledge and understanding of radio propagation.
2) Have knowledge of remote sensing mechanism.

PO Table

Paper Code	A	B	C	d	e	F	G	H	i	j	k	L
MCE104	√	√	√									√

PO Statement

1. Engineering knowledge: Apply the knowledge of basic microwave engineering, and an engineering specialization to the solution of various related measurements.
2. Problem analysis: Analyze and synthesize performance of various channel characteristics.
3. Design/development of solutions: be able to design low loss path in radio propagation.
4. Lifelong learning: proceed to further research work according to the need based analysis.

Elective – I

Computer communication &Networking

Code: MCE 105A

Prerequisite: Digital Communication

Objective:

1. An understanding of how devices like Hub, Switch, Router and Bridge are used in network.
2. An understanding of how securely data can be transmitted from one place to remotely place using various protocols.

Outcome:

After the course, student will be able to

1. Analyze various protocols used in data communication
2. Design networking structure in data communication.
3. Transmit data securely from one place to another.
4. Analyze the performance of various protocols.

Module no.	Topic	No. of Lectures
1	Introduction - Motivation, goals, applications and classification of computer networks, common networks and standard organizations Network Structure and Architecture- Network structure-concept of subnet, backbone and local access, Channel sharing techniques- FDM, TDM. Circuit and packet switching. Topological Design of a network. Network architecture layering concept, OSI Reference Model, OSI Services and protocols Physical layer - bit communication between DTE and DCE, RS232, transmission media, modems.	10
2	Data link layer - error detection and correction, retransmission strategies, stop and wait protocol, sliding window protocols, pure Aloha protocols, slotted Aloha protocol, CSMA protocols, CSMA / CD and CSMA / CA protocol, HDLC. LANs and their Interconnection - Basic concepts and IEEE standards, Architecture, protocol, management and performance of Ethernet, token ring and token bus LANs, WLAN, Bluetooth, LAN interconnection - repeaters and bridges, Transparent and source routing bridges and their relative advantages and disadvantages.	10
3	Network layer - basic design issues, network layer services, connection oriented and connection less services, routing – static, dynamic, stochastic, flow based routing, optimal routing, Quality of service, congestion control, Leaky Bucket Algorithm Transport layer- process to process delivery, TCP, UDP. Internetworking- motivation, goals and strategies, Routers and gateways, TCP / IP model, IP addressing, important features of Ipv6.	10
4	Application layer – DNS, SMTP, FTP, HTTP, WWW Network security -Cryptographic principle, DES, AES, RSA, Digital signature, Security in internet, VPN, Firewalls. Network management system – SNMP. Advance Protocol-RTP, SIP.	10

Text and Reference Books :

1. B. A. Forouzan, Data Communication and Networking, Tata Mc-Graw Hill.
2. W. Stallings, Data and Computer Communication, 5th Ed. PHI, 1998.
3. A. S. Tanenbaum, Computer Networks, Prentice-Hall India.
4. Miller, Data Communication and Networks, Vikas.

5. A. Leon-Garcia, Communication networks, Tata Mc-Graw Hill.
6. G. E. Keiser: Local Area Network, McGraw Hill. 1989.
7. D. Bertsekas and R. Gallagher: Data Networks, 2nd Ed. PHI, 1992.

PEO Mapping

a	b	c	d	e	f	g	h	i	j	k	l
√	√	√	√	√							

Engineering knowledge: Apply knowledge of digital communication
Problem analysis: Analyse performance of a large network system, checking no of packets transmitted and received
Design/development of solutions: Conducting experiments in network setup
Individual and team work: Setup network among different departments and provides security
Modern tool usage: Share knowledge regarding up gradation of computer network.

Advanced microwave communication engineering
Code: MCE 105B
Contacts: 4-0-0
Credits: 4

Prerequisite:
One semester in basic microwave engineering, propagation of microwave.
Program Objectives:
1.Advance Microwave Engineering introduces the student to microwave and millimetre wave solid state devices.
2.Scattering parameters are defined and used to characterize devices and system behaviour.
3.Describe the principles and working of various antennas.
4. Passive and active devices commonly utilized in microwave subsystems are analyzed and studied.
5.Design procedures are presented along with methods to evaluate device performance.
6.Basic radiowaves propagation mechanism will be dealt with.

Prerequisites:`
• One semester course in electromagnetic engineering, microwave and antenna fundamentals.

Microwave and millimeter wave devices: 10L

• Overview of microwave and millimeter wave vacuum tube devices, limitations of microwave vacuum tubes, gyratron vacuum tube devices.
• Advances in microwave and millimeter wave solid state devices, Gunn devices, oscillator using Gunn diode, and injection locked oscillators, IMPATT devices, and microwave and mm wave performance of IMPATT.
• Other solid state devices like Tunnel diode, BARITT and TRAPAT.

Microwave and mm wave circuits: 10L

• Review of scattering matrix concept in the light of vector network analyzer, impedance matching network, couplers, power dividers, resonators and filters.
• Detectors, mixers, attenuators, phase shifters, amplifier and oscillator
• Ferrite based circuits.

Antennas: 10L

• Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: Du0Hamel principle, log spiral and log periodic dipole antenna array.
• Babinet principle, waveguide slot antenna, microstrip antenna, horn antenna, parabolic reflector.
• Antenna arrays and phased array antenna. Antenna measurement.

Microwave and mm wave propagation. 10L

Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, troposcatter systems, ionosphere propagation, duct propagation, microwave radio link and calculation of link budget.
• Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth's magnetic field.

Learning Outcome: Student should be able to
1) Gain knowledge and understanding of microwave and millimetre wave solid state devices.
2) Be able to apply analysis methods to determine circuit properties of microwave devices.
3) Know how to model and determine the performance characteristics of a microwave circuit or system.
4) Have knowledge of radio waves propagation mechanism.
5) Have knowledge of few basic antennas and principles.
6) Know to how perform antenna measurements.
7) Solve microwave design problems:

PO Table

Paper Code	a	B	c	d	e	F	G	H	i	j	k	l
MCE104	√	√	√									√

PO Statement

1. Engineering knowledge: Apply the knowledge of basic microwave engineering s, and an engineering specialization to the solution of various microwave and millimetre wave related measurements and problems.

2. Problem analysis: Analyze and synthesize performance of various GUNN and IMPATT devices.

3. Design/development of solutions: be able to design antennas.

12. Lifelong learning: Performance measure of solid state devices of millimetre wave and microwave
and how to design antennas can be applied to further research work.

Books

• P Bhartia & I J Bahl, Millimeter wave engineering and Applications, John Wiley & Sons
• David M Pozar, Microwave Engineering, John Wiley & Sons
• R E Collin, Antenna & Radio wave Propagation, McGraw Hill Book Co.

• Jordan & Balman, Electromagnetic waves & Radiating System
• R E Collin, Microwave Engineering, McGraw Hill CO.

Advanced communication Lab
Code: MCE 191
Contacts: 0-0-3
Credits: 2

Purpose:
Experiments on hardware/ kits in order to acquire sufficient knowledge and understand practical limitations/ implications of various communication techniques.
Program Objectives:

- To introduce the basic principles, methods, and applications of various advanced communication systems.
- To learn measurement and synchronization with ambient changes.

Learning outcomes:

1. Learn to represent real world signals in digital format to representation of the signals;
2. Learn to apply the knowledge for proper data recovery.
3. Learn the basic blocks of communication systems.

Experiments:

1. QPSK – signal bandwidth, distinguish ability, effect of noise etc.
2. Sampling, quantization, coding – sampling rate, quantization error, signal bandwidth etc.
3. Bit synchronization technique
4. Error control coding techniques
5. Sampling and reconstruction data transmission scheme for
   a. External sampling signal
   b. Audio signal
6. Modulation (Spreading) of DSSS signal.
7. De-modulation (De-spreading) of DSSS signal.

Lab II: Design and Simulation Lab
Code: MCE 192
Contacts: 0-0-3
Credits: 2

Program Objective: Practical concept of Design and Simulation is being necessary for the PG level ECE based students. Designing graphical user interfaced models of various communication systems/ subsystems with the help of suitable advanced software e.g. MATLAB/ LABVIEW/ NS/ PUFF/ IE3D/ ANSOFT/ HFSS/ CST/ QUALNET/ MICROWAVE OFFICE etc. for detail study of their operating principle and their performance vis-Ã -vis practical limitations like, channel bandwidth, noise, attenuation etc.

Learning outcomes:

4. Learn to represent real world signals in digital format using software.
5. Learn to apply the linear systems approach to signal processing problems using high-level programming language;

paper code	a	b	c	d	e	f	g	h	i	j	k	l
	√	√	√	√	√	√	√			√		

Experiments:

1. M-ary Quadrature Amplitude Modulation (MQAM)
2. Characteristic of Digital Filter
3. poles and zeros of Digital Filter
4. characterization of Microstrip antennas
5. Optimum filters for receiving base band random binary data – Pe vs. S/N.
6. Signal bandwidth and Pe vs. S/N in different modes of line coding
7. Error rates in error control for different types of error control coding
8. DSSS – error rate due to different types of chip code
9. Cellular architecture, WiFi using QUALNET.
10. Simulation using QUALNET

Mobile Computing
MCE201
Contacts:4-0-0
Credits:4

Aim of the course:

Aim of the course is to provide students advanced level of theoretical knowledge on mobile computing. The knowledge from the mobile computing architecture to database for mobile computing and data synchronization analysis will make students enrich enough to work in mobile computing area either in research field or in industry.

Course Objective:

After completion of this course students will be able to

- ✓ State advantages and limitations of mobile computing
- ✓ Describe Mobile Computing architecture and environment
- ✓ Describe Mobile Computing application architecture
- ✓ Explain Mobile computing databases
- ✓ Describe synchronization techniques for mobile data

PEO:

Outcome of this course is:

Students will be able to apply the knowledge of mobile computing to design , implement new mobile computing architecture and to configure and write programs for mobile computing as well as suggest databases, synchronization techniques for mobile computing. Having a strong foundation on the theoretical knowledge of mobile computing will help them to analyze, synthesize and design & propose new mobile computing architecture which may have good social impact in form of

products in recent communication era.
PEO(in tabular form)

	a	b	c	d	e	f	g	h	i	j	k	l
EC60*	√	√						√				

Introduction to mobile computing,Novel applications of mobile computing,Limitations of mobile computing.
Mobile computing architecture and environment:
Programming languages,Operating system functions,Functions of middleware for mobile systems,Mobile computing architectural layers.

Mobile computing application architecture:
Reconfigurable Access module for MObile computiNg applications (RAMON).Functional atchitecture of RAMON,Algorithm description,control parameters and user plane interaction,mobilty management algorithm,handover decition and execution,session control and error control algorithm,Radio resource control algorithm,radio resource sharing,simulative approach,performance issues.
Databases for moile computing: Data organization,Database transaction models,Query processing,Data recovery process,Data caching.

Data synchronization:
Synchronization in mobile computing systems,conflict resolution strategies,overview of synchronization softwares for mobile devices.Synchronization protocls,SyncML programming model for mobile computing,SyncML protocol, SMIL.

Text and Reference Books :

1. Architectures and protocols for mobile
computing applications: a reconfigurable approach

Carla-Fabiana Chiasserini a, Francesca Cuomo b,*, Leonardo Piacentini c,
Michele Rossi d, Ilenia Tinirello e, Francesco Vacirca b-- b a
Polytechnic of Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
Dip. INFOCOM, University of Roma ‘‘La Sapienza’’, Via Eudossiana 18, 00184 Roma, Italy
University of Perugia, Via G. Duranti 93, 06125 Perugia, Italy d
University of Ferrara, Via Saragat 1, 44100 Ferrara, Italye
University of Palermo, Viale delle Scienze, 90128 Palermo, Italy
2. HANDBOOK OF
WIRELESS NETWORKS
AND MOBILE COMPUTING
A WILEY-INTERSCIENCE PUBLICATION--
JOHN WILEY & SONS, INC.

Error control & channel coding
Code: MCE 202
Contacts: 4-0-0

Credits: 4

Prerequisites: Digital electronics

Program Objective:

Error control techniques for digital data are widely used in application in our everyday life. They are used in digital transmission system to eliminate transmission errors and in magnetic, optical and semiconductor storage devices. To provide an introduction to traditional and modern coding theory. Topics covered include linear block codes, cyclic codes (BCH and RS codes), convolutional codes and low-density parity-check (LDPC) codes.

Module 1 Introduction : Brief description of a digital communication system, Cause of errors and need for error control coding, broad classes of error and classes of error correcting codes, general expression of the probability of error in a binary symmetric Gaussian channel, Principle of maximum likelihood decoding. L4

Module 2 Linear algebra:

Groups- definition, order of a group, modulo-m addition and multiplication tables, modulo-m subtraction and division. Fields- Definition, binary field, Galois field. Polynomials- The concept of polynomial expression, addition/subtraction/multiplication/division of polynomials over GF(2). Irreducible polynomials, primitive polynomials. Vector space, sub space, dual space – their properties and interrelations. Numerical exercises with manual computation and by using MATLAB. L6

Module 3 Linear block code:

Definition of linear block code. Generator matrix, properties of generator matrix. Parity check matrix and its properties. Encoding circuit- operating principle. Syndrome- definition, most likelihood principle of error detection. Syndrome circuit- operating principle. Hamming distance, minimum distance, minimum weight, error detecting & error correcting capabilities. Standard array construction, error detection with syndrome. Decoder-operating principle. L7

Module 4 Hamming code:

Construction, error detection and correction capabilities. L2

Module 5 Error detection/ correction performance of block codes

Distance properties of block codes and their dual codes, concept of distance space and decoding sphere. Effect of code rate on random bit error probability. Probability of undetected word error, uncorrected word error and residual bit error. Simulation test of above for data transmission through Gaussian binary symmetric channel. L6

Module 6 Cyclic code:

Definition, generator polynomial, properties of cyclic code and generator polynomial. Generator matrix, parity check matrix, their properties and interrelations. Design and operation of encoder. Design and operation of syndrome circuit. Design & operation of Meggitt decoder. Simulation test of above for data transmission through Gaussian binary symmetric channel. Cyclic Hamming code. L7

Module 7 BCH code:
Construction of Galois field GF(2m)- power representation, polynomial representation, n-tupple representation. Properties of GF(2m), conjugate roots, minimal polynomial, determining minimal polynomials. Description of BCH code, encoding, parity check matrix, error trapping and decoding. L4

Module 8 Reed-Solomon code: Brief qualitative discussion. L1

Module 9 Convolutional code:
Definition, encoder, generator sequences, generator matrix, principle of constructing code words, numerical examples, code rate, constraint length, fractional rate loss. Finite state machine analysis of coder, state diagramme, code tree, Trellis. Principle of maximum likelihood decoding of convolutional code, Viterbi algorithm, Numerical examples of decoding and error detection/correction using Trellis, numerical examples using Trellis by MATLAB. Simulation test of above for data transmission through Gaussian binary symmetric channel. Distance properties of convolutional codes. L7

Module 10 Multiple error/ Burst error correcting codes:
Shortened cyclic code, Hadamard code, Golay code, brief qualitative description of Kasami decoder. L2

Module 11 Application:
Brief qualitative discussion of practical application of error control in processors, data storage, data exchange between CPU and peripherals, in CDMA etc. L2

PEO:

- **(i)** Students understand the theoretical framework upon which error-control codes are built.
- **(ii)** Students implement some of error control codes discussed in this contained for research purpose.
- **(iii)** Student successfully contribute the gained acquaintance of error control coding technique in some industry based application fields.

paper code	a	b	c	d	e	f	g	h	i	j	k	l
	√		√	√	√			√				

Text & Reference Books:

1. Error Control Coding Fundamentals and Applications. – Shu Lin, Daniel J. Costello, Jr. - Prentice Hall.
2. Information Theory Coding and Cryptography. – Ranjan Bose, - TMH.
3. Fundamentals of Convolutional Coding. - Roft Johannesson and K. S. Zigangirov. - OUP.
4. Information and Coding Theory. – gareth A. Jones & J. Mary Jones. - Springer.
5. Error Correcting Codes. - Paterson, W. W. and Weldon, Jr. E. J. - Prentice Hall.
6. Applied Coding and Information Theory for Engineers. – Richard B. W
7. Introduction to Error Control Codes. – Salvatore Gravano. – Oxford.

Mobile Internet

MCE203
Contacts:4-0-0
Credits:4

Aim of the course: Aim of the course is to provide the students advanced level theoretical knowledge on mobile internet technologies. From GPRS to broadband through EDGE for mobile will make them enough equipped to enter in the field mobile internet either as a research scientist or as a protocol analyzer/designer.
Course Objective:
After completion of this course students will be able to

- ✓ State mobile internet protocols
- ✓ Describe GPRS architecture, services, interfaces
- ✓ Describe EDGE modulation & coding schemes
- ✓ State transmission techniques for EDGE & GPRS
- ✓ Describe terminology, standard & deployment of mobile broadband

PEO
Outcome of this course is:
Students will be able to apply the knowledge by involving themselves in the research area of new protocol design for the internet. Having a good foundation on the different types of protocols available for mobile internet (GPRS, EDGE to broadband), they will be able to analyze, synthesize, design products related to mobile internet.
PEO (in tabular form)

	a	b	c	d	e	f	g	h	i	j	k	l
EC203	√	√						√				

Module-1:Mobile internet protocol:
Mobile IP, agent discovery protocol, ICMP router discovery protocol, registration mechanism, mobility binding, route mechanism& optimization, smooth handoff, mobile IP TCP & ACTs interaction and performance issues.

Module-2:GPRS:
Network architecture for GPRS, PCU, data packet routing, SGSN,GGSN, border gateway, charging gateway, GPRS interfaces, packet transfer between GSNs, Roaming, IP addressing i GPRS,GPRS handset classes, Qos for GPRS,VLR &HLR in GPRS context, GPRS tuning protocol, GPRS services.

Module-3:EDGE:
Introduction to EDGE and EGPRS,EDGE modulation and coding schemes, comparison of transmission techniques for EDGE and GPRS.

Module-4:Mobile Broadband:
Terminology and standards, deployment, integration with IP based network, spectral

allocation, efficiency, limitations etc for WiMax.

Text and Reference Books :

1. GPRS/UMTS -- IAB Workshop February 29 - March 2, 2000 Jonne Soininen Nokia
2. GPRS a Mobile Internet Architecture -- Stas Khiman CTO,Narus Inc.Stask@narus.com.
3. System Architecture of GPRS -- Group R1: Xiong Guangyu, Nik A. Salleh
4. FULL SERVICE BROADBAND ARCHITECTURE ----- Gives users convenient access to any broadband service, from any device, anywhere. It gives operators new cost-effective growth opportunities, based on open-standard solutions.

Cryptography & network security
Code: MCE 204A
Contacts: 4-0-0
Credits: 4

Prerequisites: Computer networking
Program Objective: The key objective of this subject is to provide a thorough understanding of technologies and methodologies with which computer networks can be protected. Course is designed with the view of this main three objectives; Understand basic cryptography theory, including some well-known algorithms for symmetric and public key encryption, digital signatures, key management, etc. ; Understand how crypto can be used as an effective tools in providing assurances concerning privacy and integrity of information, non-repudiation, etc.; Understand the principles of computer and network security. Appreciate the issues involved in creating secure systems (robust software, security in depth, policy, attack mitigation, etc.)

Module 1 Introduction : Principles of security, Overview of network security and cryptography, OSI Security architecture, model for network security, classification of attacks (Reply, Reflection, Man – in – the – middle), Virus, Worm, Trojan Horse,
Spam etc.

Module 2 Symmetric ciphers : Algorithm types and modes, classical encryption techniques, block ciphers and Data Encryption Standard (DES), Advanced Encryption Standard (AES), Contemporary Symmetric Ciphers, and confidentiality using symmetric encryption.

Module 3 Public Key Cryptography : Public key Infrastructure (PKI), RSA, key management, Diffe-Hellman key exchange, elliptic curve arithmetic, elliptic curve
cryptography.

Module 4 Message Authentication and Hash Functions : Authentication requirements, authentication
functions, message authentication codes, Hash functions, security of Hash functions and MACs.

Module 5 Hash Algorithms : MD5 Message Digest Algorithm, Secure Hash Algorithm, Digital

Signature Algorithm, Digital Signature Standard.

Module 6 Network Security Applications : Authentication Applications (Kerberos), Electronic Mail Security (SMIME), IP Security (IPSec), Web Security (SSL and TLS), E – cash and Secure Electronic Transaction (SET), System security using Firewalls and VPNs.

Module 7 Advance Applications of Network Security : Smart cards and security, Enterprise Application Security, Biometric Authentication, Database Access Control, Security and Privacy Issues in RFIDs.

PEO:

i. Students understand the theory of fundamental cryptography, encryption, and decryption algorithms and others also apply it in research purpose.
ii. Learn threats to computer networks and protection mechanisms and methods need to thwart these threats with knowledgeable support.
iii. Students build simple cryptosystems by applying encryption algorithms, comprehend secure identity management (authentication), message authentication, and digital signature techniques accelerate for industry purpose.

paper code	a	b	c	d	e	f	g	h	i	j	k	l
	√	√	√	√				√		√		

Text and Reference Books:

1. William Stallings, Cryptography and Network Security—Principles and Applications, Pearson Edu.
2. Atul Kahate, Cryptography and Network Security, Tata McGraw Hill.
3. Trappe & Washington, Introduction to Cryptography with Coding theory, Pearson Education.
4. William Stallings, Network Security Essentials, Pearson Education.
5. Kaufman, Perlman & Speciner, Network Security, Pearson Education.
6. Behrouz A. Forouzan, , Cryptography and Network Security, McGraw – Hill Education.

Elective II:

J2ME for mobile programming
MCE 204B
Contacts:4-0-0
Credits:4

Program Objectives: Mobile phones have been so popular and found a fated market inarguably because of its software features. Java Platform, Micro Edition (Java ME) provides a robust, flexible environment for applications running on embedded and mobile devices in the Internet of Things: micro-controllers, sensors, gateways, mobile phones, personal digital assistants (PDAs), TV set-top boxes, printers and more. Java ME includes flexible user interfaces, robust security, built-in

network protocols, and support for networked and offline applications that can be downloaded dynamically. Applications based on Java ME are portable across many devices, yet leverage each device's native capabilities. The Java ME Software Development Kit (SDK) provides device emulation, a standalone development environment and a set of utilities for rapid development of Java ME applications.

Module 1

Introduction to Java ME: Getting Started with Wireless Tool Kit, writing your first J2ME Application, setting up *WTK* with Eclipse and using Netbeans Mobility pack. **3L**

Module 2

MIDlet and UI Elements:MIDlet as a unit of a JME Application, MID let life cycle concepts and simulation, *Display* class; Command Buttons, *Alert* Class, Form, *Choice Group, Date Field, Gauge, String Item, TextField , ImageItem, List, TextBox, Ticker*; Event handling concepts and listener **5L**

Module 3Application data, persistence and RMS: Concept & Need of Persistent Storage with detailed coverage, JME Record Management Store (RMS), Record Store, how to use it for saving application data, Reading from and Writing to a record store, Writing and reading : String, primitive data type, *Serializable* type, any object, use of java.io. Byte Array Output Stream, java. io. Byte Array Input Stream, java.io. Object Output Stream, java.io.ObjectInput Stream., Iterating over a record set data. **5L**

Module 4 Generic Connection Framework (GCF):

Connecting to a Server over TCP/IP, UDP/IP and HTTP, *Connector* class, *HttpConnection, StreamConnection, FileConnection,* Writing request to and reading response from a HTTP server. Uploading a dummy Form to the Web. Concept of multi-threading in Network and IO operations and replication of Network and IO blockage. Using GCF in a non-UI thread. **4L**

Module 5 Mobile Media API (JSR-135): Capturing Video, Audio, Different formats:

Using Multimedia devices on your phone, to render or play stored media (images, audio, and video). Taking still snap using phone camera, recording audio and video and saving it on phone file system, including SD card. *Canavs* class, Video Control elements. Troubleshooting and overcoming non-JSR-135 compliant native device dependencies. **4L**

Module 6 Wireless Messaging API (JSR-205): Sending and receiving SMS and MMS from your program. **2L**

Module 7 Bluetooth API-JSR 82: Programming Java ME devices and Windows OS Java apps to communicate over Bluetooth. Getting device information, Finding devices, services, *LocalDevice, RemoteDevice, DiscoveryAgent, DiscoveyListener, UUID, StreamConnection.* Bluetooth Serial Port Profile ,Connecting to standard Bluetooth (IEEE 802.15.x) profiles: DUN, HEADSET, OBEX, concept of AT commands in GSM devices. Using Bluetooth to programmatically connect to a GSM phone and extract information, auto-answer, dial a number. **6L**

PEO:

- **(i)** Students can develop Java ME software and make and distribute essential applications for themselves and their friends which grows interest in engineering as a whole.
- **(ii)** They can sell products from different application Stores, maybe, for free initially, but they can earn good revenue by incorporating *AdSense* to even their free applications
- **(iii)** They get a ready-to-explore career in Mobile Application Development and can pick up other technologies like Android, iOS, RIM etc. very fast
- **(iv)**They can have good professional offers

(v) They can earn from home even if they are not directly in software industryor can be self-employed if they wish or till they get a suitable opening.

paper code	a	b	c	d	e	f	g	h	i	j	k	l
MCE 204B	√	√	√	√		√	√	√	√	√		

Text & Reference Books:

1. **J2ME Complete Reference by J. Keogh (TMG)**
2. **J2ME from Novice to Professional by Sing Li , Knudsen (Apress)**
3. **Oracle Developers Network**
4. **IBM dW**
5. http://sohamsironline.weebly.com

Satellite Communication
Code: MCE 204C
Contacts: 4-0-0
Credits: 4

Prerequisites: Digital Communication

Program Objective:
The main objective of this course is to provide in-depth study on advanced Satellite Communication Systems to provide vital and economical fixed and mobile communication services over very large coverage areas of land, sea and air. In this course, Students will learn the fundamentals and the techniques for the design and analysis of satellite communication systems. Topics include Satellite Orbital Mechanism, Satellite Subsystems, Earth Station, Satellite transponder, Satellite Link Design, Multiple Access Techniques, Time division Multiple Access, Propagation effects, Mobile satellite network, Introduction to VSAT systems and the basics of Satellite Networking.

Module 1:
Introduction: A brief history of satellite communication, future scope satellite communication. Orbital Mechanism: Orbits, look angle, orbital period and velocity, azimuth and orbital inclination, coverage angle slant range, orbital perturbation, placement of satellite in geostationary orbit.

Module 2:
Satellite Subsystems: Communication, telemetry, ranging & command, power, altitude control, tracking, antenna subsystems. Earth Station : Earth station antenna, gain, pointing loss, G/T variation and it's measurement, antenna tracking, power amplifier, low noise amplifier, up converter, down converter, transponder hopping, polarization hopping, redundancy configuration.
Satellite transponder : transponder model, transponder channelization, frequency plans, processing transponders. Satellite Link Design : Basic link analysis, interference analysis, attenuation due to rain, link with and without frequency reuse.

Module 3:

Multiple Access Techniques: Frequency Division Multiple Access: SPADE, FDM-FM-FDMA, Companded FDM-FM-FDMA and SSB-AM-FDMA, intermodulation products in FDMA, optimized carrier-to-intermodulation plus noise ratio. Time division Multiple Access: Principle, TDMA frame structure, TDMA Burst structure, TDMA Superframe structure, Frame acquisition and synchronization. Satellite position determination. TDMA timing. Demand Assignment Multiple Access and Digital Speech interpolation. ERLANG B Formula. Type of demand assignment, DAMA characteristics, Real time frame reconfiguration, DAMA interfaces, SCPC-DAMA, Digital Speech interpolation. Satellite packet communication.

Module 4:
Propagation effects : Propagation effects and their impact on satellite earth link. Introduction to VSAT systems : low earth orbit and non-geostationary satellite systems. Direct broadcast Television and Radio. Satellite Navigation and the global positioning system. Network configuration, multiaccess and networking, network error control poling VSAT network. Mobile satellite network : Operating environment. MSAT network concept, CDMA MSAT relink. Worldwide timing by satellite relay.

Program Outcome:

At the end of the course, students would be able to apply fundamental principles, methodologies and techniques of the course to analyse and design various problems encountered in both academic research and communication industry R&D practice.

paper code	a	b	c	d	e	f	g	h	i	j	k	l
	√		√	√	√			√				

Text and Reference Books:

1.Tri T. Ha, Digital Satellite Communication, TMH.
2. Timothy Pratt, Charles Bostian, Teremy Allnutt, Satellite Communication, John Wiley & Sons.
3.J. J. Spilker, Jr., Digital Communication by Satellite, Prentice Hall.
4. Bruce R. Elbert, Satellite Communication Applications Hand Book, Artech House.

Microwave measurement Techniques
Code: MCE 204D
Contacts: 4-0-0
Credits: 4

Prerequisite: RF & Microwave Engineering

Program Educational Objectives:
1. To understand the various concepts of Microwave measurement techniques.
2. To understand how to achieve optimization with minute variations.
3. To understand the merits of various measurement devices.
4. To understand the domain based measurements and comparisons.

Learning Outcome:
Outcome 1: Solve measurement related problems.
Outcome 2: Calculate the parametric value to achieve better measurement.

Module-I
Introduction to Radio Frequency & Microwave Measurements- Introduction Radio Frequency Band, microwave and millimeter wave. Power Measurement- High Power Measurement, calorimeter technique, Low power Measurement, bolometer technique, Very Low Power Measurement.
Module-II
Frequency Measurement - Different Technique to measure frequency, Slotted Line Technique, maxima & minima, wavelength & frequency measurement. Impedance Measurement- Measurement of unknown load impedance of a transmission line, Slotted Line Technique to measure unknown impedance.
Module-III
Distortion & Frequency Translation Measurement- Different types of distortion occurred at microwave frequencies, Procedures for frequency translation. Detectors& Sensors: Definition of Detectors; Different type of microwave detectors functions and applications, Sensors Definition & working principle, applications.
Module-IV
Vector Network Analyzer (VNA): Concept of vector network analyzer, measurement of scattering parameters, Basic block diagram of vector network analyzer (VNA), Application of vector network analyzers. Scalar Network Analyzer (SNA): Definition of network analyzer, Difference between SNA&VNA, Basic block diagram Scalar Network Analyzer.
Module-V
Spectrum Analyzer: Basic block diagram of a spectrum analyzer, functions & applications of a spectrum analyzer. Time Domain Electrometer (TDR) & IC Technology: Introduction to Electrometer, Measurement of reflection coefficient using electrometer technique, Basic block diagram of a time domain electrometer.

Recommended Books:
1. G.H.Bryant- Principles of Microwave Measurements- Peter Peregrinus Ltd.
2. D.Pozar- Microwave Engineering, 2nd Ed, John Wiley
3. T.S.Laverghetta- Hand book on Microwave Testing
4. S.F.Adam- Microwave Theory & Application- Prentice Hall, Inc
5. HP Application Notes
6. A.E. Bailey, Ed. Microwave Measurements- Peter Peregrinus Ltd
7. M. Engelson-Moder Spectrum Analyser: Theory & Applications Artech Hous

Elective III

Baseband Processor
Code: MCE 205A
Contacts: 4-0-0
Credits: 4

Prerequisites: Signals and systems, Microprocessor

Aim of the course:

Aim of the course is to provide students advanced level of theoretical knowledge on baseband processor. The knowledge from the baseband processor architecture to power & throughput analysis will make students enrich enough to design and debug baseband processor related areas either in reaserch filed or in industry.

Course Objective:

After completion of this course students will be able to

- ✓ Identify digital baseband operations
- ✓ State characteristics of Parallelizable computation kernels
- ✓ State SIMD and scalar architecture
- ✓ Write macro instruction .
- ✓ Describe macro piping
- ✓ State main processing element and computation units in baseband processor
- ✓ Describe programming model for baseband processor

PEO:

Outcome of this course is :

Students will be able to apply the knowledge of baseband processor to design ,new baseband architecture and to configure and write programs for the baseband processor. Having a strong foundation on the theoretical knowledge of baseband processor will help then to analyze, synthesize and design baseband processors & also to configure and propose new baseband architecture which may have good social impact in form of products in recent communication era.

PEO(in tabular form)

	a	b	c	d	e	f	g	h	i	j	k	l
EC60*	√	√						√				

Module-1:Introduction

Digital baseband operations,major computation kernels,workload,characteristic of parallelizable computation kernels.

Module-2:Architecture of baseband processor:

Chip multiprtocessor,coarse gain PE,Homogeneous PE,Low speech bus,Memory hierarchi,SIMD & scalar architecture.

Module-3:Processing element archtecture:

SODA architecture,macro instruction,macro pipeling,staggered execution of computation units, high level architecture of main processing element,computaion units,vector reduction unit, address generators, programming model.

Module-4:Power and throughput analysis:

Component level evaluation environment,Kernel levlel evaluation environment,system level

evaluation environment,kernel level analysis,system level analysis,optimal active mode operation frequency,idle mode,comparison with SODA.

Text and Reference Books :

1. A Low Area and Low Power Programmable Baseband Processor Architecture .-- Eric Tell, Anders Nilsson, and Dake Liu Dept. of Electrical Engineering Linköping University S-581 83 Linköping, Sweden {erite,andni,dake}@isy.liu.se

2. Design of Programmable Baseband Processors -- Department of Electrical Engineering Linköping University SE-581 83 Linköping, Sweden Linköping 2005 ISBN 91-85457-20-ISSN 0345-7524

3. A BASEBAND PROCESSOR FOR SOFTWARE DEFINED RADIO TERMINALS
-- A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy (Electrical Engineering and Computer Science) in The University of Michigan 2007 Doctoral Committee: Professor Trevor N. Mudge, Chair Professor Chaitali Chakrabarti, Arizona State University Associate Professor Scott Mahlke Professor Marios C. Papaefthymiou Professor Wayne E. Stark.

ELECTIVE III

Multimedia for Mobile

MCE 205B

Contacts: 4-0-0

Credits: 4

The objectives of this course are to:

1.Provide knowledge of mobile multimedia application and its properties.
2.Provide knowledge of mobile multimedia telephony
3.Provide knowledge of mobile multimedia streaming
4.Provide knowledge of audio codecs and voice codecs.
5.Provide knowledge of video telephony.
6.Provide knowledge of various services as voice mail,media service.

Module 1:

Introduction to multimedia for mobile :

Mobile multimedia application properties, Mobile multimedia telephony, mobile multimedia streaming. **4L**

The PSS standrad, media traffic characteristics,content,creation and distribution Media content and rate controls, speach streaming traffic,video streaming traffic. **8L**

Module 2:

Audio for mobile and standrad : 6L

Brief introduction of audio codecs. MP3,AAC,WMA formats Synthetic polyphonic sound format, DLS Voice codecs.

Videos for mobile and standrad : 6L

Video telephony, video straming, MMS, video compression (H.263,MPEG – 4, H. 264, 3gp) brief inoduction of video codecs.

Module 3: 8L

Multimedia services :
Multimedia messaging service, voice mail, video caller ID, video portal for mobile, mobile TV,components for delevering multimedia service, gateways, media service, multimedia end points.
Module 4:
Qos issues fir mobile multimedia : 8L
Bandwidth, error rates, delivery order,delay, jitter, segmentation issues,frame based Qos issues,PSNR based Qos metrics, Delay based Qos metrics,call control based Qos metrics.
Course Learning Outcomes
At the end of the course, students should be able to:
1.describe the importance of multimedia in mobile.
2.understand the process of video telephony
3.understand how concept of MP3,AAC,WMA audio codecs.
4.understand some issues related to bandwidth,error rates,delivery order,call control based issues.
5.understand some trafficking as speech and video streaming.
PO Table

Paper Code	a	b	c	d	e	F	g	h	i	j	k	l
MCE205B	√		√		√							

PO Statement
1. Engineering knowledge: Apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of AdHoc Networking problems.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
Text and Reference Books:
1. Tampereen teknillinen yliopisto. Julkaisu 973 tampere University of Technology. Publication 973 igor danilo diego curcio QoS Aspects of mobile multimedia Application.
2. Multimedia in mobile phones – the ongoing revolution jim rasmussion,fredrik dahlgren,harald gustafsson and tord nilsson
3. Quality of Experiance in digital mobile multimedia service shendrik Ole knoche A dissertation submitted in partial fulfillment of the requirements for the degree of doctor of philosophy of university college london.

Image processing & pattern recognition
Code: MCE 205C
Contacts: 4-0-0
Credits: 4

Objective: Students will have an idea about basic image processing in spatial domain/ image space, extraction of pixel-patterns from an image and construction of different feature spaces, application of pattern clustering and classification techniques to analyse/ recognize an image. Some hints on advance and more recent research topics like change detection in remotely sensed imagery, Eigen face recognition, image miming, content based image retrieval will also be provided.

Prerequisite: Basic concept of vectors and matrices (relation between a column matrix and vector), inner product of two vectors, matrix multiplication, inversion, extracting Eigenvectors and Eigen values of a matrix, covariance matrix. Perception of dimensionality and hyper plane. Distance measures in Euclidean space between two points (e.g. Euclidean distance) and a point with a group of points (Mahalanobis distance). Knowledge about statistical distributions (e.g. Normal/ Gaussian), statistical independence, probability distribution function, condition probability, the law of total probability and Bayes rule.

Part – A:

Image Processing Basics: Image definition, a simple image formation model, basic concepts of image sampling and quantization, representing a digital image, concept of pixel/ pel, spatial and gray level resolution, some basic relationships between pixels : Neighbors of a pixel, Adjacency, Connectivity, Path, Connected component, Connected component labeling. Distance measures: the three essential properties, Euclidean, City-Block and Chess-Board distance, concept of image operations on a pixel basis. 6 L

Popular image processing methodologies: Spatial domain technique : contrast stretching, basic point processing, thresholding function, concept of mask/ sub image, mask processing/ filtering, gray-level slicing, bit-plane slicing. Basics of spatial filtering : convolution mask/kernel, concept of sliding mask throughout the image-space, smoothing(averaging) filter/ low pass filter. Image segmentation by global and local gray level thresholding, region growing, region splitting and merging techniques. Morphological algorithms: thinning, thickening, skeletons. 8 L

Color image processing: Perception of color: color fundamentals. Two popular color models: RGB & HSI, concept of RGB & HSI space and their conceptual relationships, mathematical conversion from RGB to HSI space and vice versa. 2 L

Part – B :

Pattern Recognition Basics of pattern recognition: Concept of a pattern: feature, feature vectors and classifiers. Importance of pattern recognition. Basic concept of fuzzy pattern recognition, linearly separable and inseparable classes, classes with some overlapping regions, convex and non-convex paradigm in this aspect. 2 L

Clustering: Basic concept of cluster analysis.Similarity (Proximity) metrics (indices) and clustering criteria.Partitional clustering: Extraction of natural groups that are inherent in some data set by hard c-means (k-means), fuzzy cmeans. Concept of getting stuck to a local optimum (in objective functional space) by k-means and fuzzy c-means due to their initiation/ starting point. Fuzzy cluster validity index: Xie-Beni index. 8 L

Classification and prediction: Definition of classification and prediction. Basic task of a classifier.Concept of training & testing data and overfitting. Bayes classification: Bayes' Theorem, Naïve Bayesian classification. Classification by Backpropagation: Multilayer Perceptron (MLP) neural network and Backpropagation algorithm. 6 L

Global optimization techniques: Genetic Algorithms (Gas): Cycle of genetic algorithms, selection (Roulette wheel and Tourment) crossover, mutation, evaluation of fitness function, incorporation of elitism in GAs. Multi-objective optimization using GAs. Simulated Annealing (SA): Analogy with physical annealing process, concept of energy and mechanism of energy minimization using SA, Necessity of an uphill movement during the process. Hybridization with partitional clustering techniques. 4 L

Part – C : Image analysis

Image clustering applications: Mechanism of extracting pixel-patterns from a gray-scale image in various ways: e.g. forming feature space (like a two column matrix) treating the gray-value of center-pixel (of a local window) as the first feature and averaged value over a square-shaped local window (3x3 or 5x5 or like that) as the second feature, construction of high-dimensional feature space: e.g. treating all the pixel-gray-values of a local window as features (i.e. for 3x3 window 9-dimensional feature space will result). Application of partitionalclusterings in the above mentioned feature-space to recognize the objects in the concerned image. 2 L

Applications in multispectral and multitemporal remotely sensed imagery: Identification of different land cover types from multispectral remote image data using supervised/ unsupervised classification: Clustering by Histogram peak selection & and its limitation in this context (i.e. remote image analysis). Unsupervised Change Detection using squared-error clustering methodologies: The algorithm, process, key challenges, error estimations like missed alarms,false alarms and overall error, need of ground truth. 2 L

Image mining: Need, Image search and retrieval. Bottleneck of Text based image mining/ retrieval, Visual feature based image mining: Content-based image retrieval (CBIR). 2 L

Image based face recognition: Basic technique for Eigen face generation & recognition. Intended outcomes: After completion of the course students will be able to analyze about the spatial image processing (in image space) and superiority of image pattern recognition. They will also get the idea about how to deal in an environment with high vagueness and/or ill-fashioned classes (or objects in some image) using fuzzy concept (fuzzy pattern recognition), function of basic and multilayer perceptron model to classify a data set. Some optimization processes (e.g. GA) to enhance the chance to reach a global optimum. Research and development kind of analyses should be realized by them concerning the recent trends in this aspect. 2 L

Text and Reference Books:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, Pearson Education Asia, 2004
2. S.K. Pal, A.Ghosh, and M.K. Kundu, Soft Computing for Image Processing, Physica
3. Verlag, (Springer), Heidelberg,1999.
4. R. O. Duda, P.E. Hart and D. G. Stork, Pattern Classification, John Wiley & Sons (Low Priced Edition).
5. Anil K. Jain and R.C.Dubes, Algorithms for Clustering Data, Prentice Hall.
6. S. Theodoridis and K. Koutroumbus, Pattern Recognition, Elsevier.
7. A. Ghosh, S. Dehuri, and S. Ghosh (editors). Multi-Objective Evolutionary
8. Algorithms for Knowledge Discovery from Databases. Springer, Berlin,
9. 2008.
10. Anil K. Jain, Fundamentals of Digital Picture Processing, Prentice Hall.
11. D. E. Goldberg, Genetic Algorithms in search, Optimization & Machine Learning, Pearson
12. Education.
13. 9. Remote Sensing Digital Image Analysis : An Introduction by J.A Richards and X. Jia. Springer.
14. Data Clustering: A Review by Anil K. Jain, ACM Comput. Surv., Vol. 31, No. 3. (September 1999), pp. 264-323.
15. Pattern Recognition: The Journal of the Pattern Recognition Society.
16. IEEE Transactions on (i) Pattern Analysis and Machine Intelligence (TPAMI), (ii) on Neural Networks, (iii) on Fuzzy Systems.

PEO Mapping

a	b	c	d	e	f	g	h	i	j	k	l
√		√		√							

Engineering knowledge: Applyknowledge of mathematics, field theory &digital communication
Design/development of solutions: Conducting experiments in image processing.
Modern tool usage: Use of Matlab and other image processing software for image analysis.

Advanced Antenna Engineering
MCE205D
Contacts: 4-0-0
Credits: 4

Prerequisite: Engineering Electromagnetic
Program Educational Objectives:
1. To understand the fundamental concepts of radiation mechanisms.
2. To understand how to measure various antenna parameters
3. To understand the various possible configurations of antennas and their comparative merits.
4. To understand the working principles of various Antennas.

Module-I
Fundamental Concepts.
Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.
Module-II
Radiation from Wires and Loops.
Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.
Module-III
Aperture and Reflector Antennas.
Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas.
Module-IV
Broadband Antennas.
Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas.
Module-V
Microstrip Antennas.
Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.
Module-VI
Antenna Arrays.
Analysis of uniformly spaced arrays with uniform and non uniform excitation amplitudes, extension

to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Woodward-Lawson method.

Module-VII

Basic Concepts of Smart Antenns. Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming.

Learning Outcome:

Outcome 1: Solve antenna related problems.

Outcome 2: Calculate the parametric value to design an antenna.

Outcome 3: self learning starts in antenna related research article discussion.

Text:

1. C. A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley & Sons., 2005.
2. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley & Sons., 1998.
3. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

Reference

1. R. E. Collin, "Antennas and Radio Wave Propagation", McGraw-Hill., 1985.
2. F. B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.

Communication systems Lab
Code: MCE291
Contacts: 0-0-3
Credits: 2

Program Objectives:

- To introduce the basic principles, methods, and applications of various communication systems.
- To learn measurement and synchronization with ambient changes.

Learning outcomes:

- Learn to represent real world signals in digital format to representation of the signals;
- Learn to apply the knowledge for proper data recovery.
- Learn the basic blocks of communication systems.

Experiments:

1. Numerical aperture of optical fiber
2. Satellite signal strength indication
3. Losses in optical fiber.
4. Satellite azimuth and elevation using sky plot window
5. Basic configuration of isdn system
6. Network topologies

MANAGEMENT OF TECHNOLOGY
Code: MCE301
Contacts: 4-0-0
Credits: 4

MODULE 1: 11L

Research Methodology and Techniques:
Meaning of Research: Objective, Motivation and Types of research; Research Process: Its representation through flow chart; Sample Designing: Different types of sample designing; Testing of hypothesis; Chi-square test: A statistical measure of sampling analysis. 5L
Data collection and storing through Database Management Systems ; Concept of Data Warehouses and Data Marts; Concept of Multidimensional analysis of project data; Different types of statistical analysis through SQL. 6L
MODULE 2: 8L
Agreement on Trade-Related aspects of Intellectual Property Rights (TRIPS): What is Intellectual Property, Importance of IPR, Patent, Types of Patents, Patentable inventions, Application and Registration of patents, Who can apply, rights and duties of patentee, infringement and remedies. 5L
R&D activities in educational institutes, IPR and patent issues. 3L
MODULE 3: 15L
Management: Definition, Functions, Skills, Motivational Theories, Communication: Types, Nature, Importance, Channel richness, how to increase the effectiveness of organizational communication. 3L
Quality: Concept, Deciphering quality aspect of different products and services; Quality improvement; identification of potential areas. 3L
Basics of project management: Concept, Types, Productivity, Effectiveness& Competitiveness: Lifecycle of process, Feasibility, Viability, Cost Benefit analysis, PERT and CPM, SWOT analysis, Resource smoothing and Resource Leveling through Critical Path Analysis (CPA), Simulation. 6L
Cost classification: Fixed cost, variable cost, semi-variable cost; Cost of Capital, Capital Budgeting, Budgeting; Master budget; Concept of Taxes: Direct Tax and Indirect Tax. 3L
MODULE 4: 6L
Project Management – A case study. Application and techniques described in Module 1.Implementation Phase, Human aspects, Time estimation,

Text Book:
1. Management of Technology, Tarek M.Khalil, McGraw Hill, 2000
2. Financial Management,Text,Problems and Cases, M Y Khan & P.K.Jain, McGraw Hill
3. Financial Management: Principles And Applications, 10/e, Keown,Pearson Education India

ELECTIVE – IV

Ad-hoc networking
Code: MCE 302A
Contacts: 4-0-0
Credits: 4

Prerequisites:
Idea of basic networking and wireless networks.

The objectives of this course are to:
1.Provide knowledge of mobile ad hoc networks, design and implementation issues, and available solutions.
2.Provide knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid.
3.Provide knowledge of clustering mechanisms and the different schemes that have

been employed, e.g., hierarchical, flat, and leaderless.
4.Provide knowledge of the 802.11 Wireless Lan (WiFi) and Bluetooth standards. This includes their designs, operations, plus approaches to interoperability.
5.Provide knowledge of sensor networks and their characteristics. This includes design of MAC layer protocols, understanding of power management, query processing, and sensor databases.

Module 1

O Ad hoc wireless Network: Introduction, Basic concept on ad hoc network, static and mobile ad hoc network, transmitter-receiver constraints, Applications. 4L
O MAC protocol: Hidden terminal, Exposed terminal, IEEE802.11 in ad hoc mode. 6L

Module 2:

O Routing protocols: Proactive, Reactive and hybrid routing protocol, Destination sequenced distance vector algorithm, Dynamic source routing, Ad hoc on-demand routing, Location aided routing, Link reversal routing. 8L
O Analysis of TCP performance in wireless ad hoc network: TCP window management and problems, different solution schemes, QoS in wireless ad hoc network 6L

Module 3:

O Achieving energy efficiency in wireless ad hoc network: Different schemes to increase the lifetime of the node in ad hoc network – MAC layer protocol, Routing protocol. 6L
O Localization Management: Location acquisition technique, location sensing technique, location aware routing protocol. 4L

Module 4:

O Security for wireless ad hoc network: Security goals, threats and challenges, Different schemes of security in ad hoc network, routing security. 3L
O Case study: Sensor Network, Wi – Max. 3L

Course Learning Outcomes

At the end of the course, students should be able to:
1.describe the principles of mobile ad hoc networks and what distinguishes them from infrastructure-based networks.
2.understand how proactive routing protocols function
3.understand how reactive routing protocols function
4.understand the issue of broadcast storms and flooding, and how some techniques attempt to reduce them.
5.identify the layers of the WiFi standard and their functions
6.identify the layers Bluetooth and their functions
7.describe how nodes within a piconet communicate
8.understand the principles and characteristics of sensor networks
9.describe the limitations of wireless sensor networks, especially energy constraints, and the devised solutions.
10.understand the components of a wireless sensor nodes and the role of each component in the wireless sensor network.
11.understand the application layer support for implementations.
12.describe the mechanisms employed in clock synchronizing
13.understand the techniques and strategies for localizing sensor nodes in a network by means of exact and relative positioning techniques.
14.understand the differences between routing in MANETs and routing in WSNs, and the general techniques used work on a project that addresses an issue applicable to MANETs or WSNs and propose a solution for it.

PO Table

Paper Code	a	b	c	d	e	f	g	h	i	j	k	l
MCE302A	√		√		√							

PO Statement

1. Engineering knowledge: Apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of AdHoc Networking problems.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Ad-hoc networking

Text Books :

1. Ad-hoc networking – Charlse E perkins,Addision–Wesley Professional ; 1 edition (January 8,2001)

2. Ad-hoc networking : Fundamental propertics and network topologies – **Hekmat,** Ramin, Springer

3. Guide to Wireless Ad Hoc Networks – Misra, Sudip ; Woungang, Isaac ; Misra, Subhas Chandra (Eds.) 2009, Springer

4. Ad-hoc networking : Technologies and Protocols – Prasant Mohapatra (Editor), Srikanth Krishnamurthy (Editor)

Reference Books:

1.AdHoc Wireless Networks:Architectures and Protocols,C.Siva Ram Murthy and B.S.Manoj,Pearson Education

2. Wireless and Mobile Networks: Concepts and Protocols, Sunilkumar S. Manvi ,Mahabaleshwar S.Kakkasageri,Wiley India

3)Ad Hoc Mobile Wireless Networks: Protocols and Systems,C.K.Toh,Pearson

4) Mobile Ad Hoc Networking,Stefano Basagni , Marco Conti , Silvia Giordano , Ivan Stojmenovic,WILEY.

Broadband Communication Networks
Code MCE 302B
Contacts: 4-0-0
Credits: 4

Prerequisite: Digital Communication, Telecommunication

Objective :

1. An understanding of how broadband devices are used in network.
2. An understanding of how data transmission rate can be increased.

Outcome:

After the course, student will be able to

1. Analyze various protocols used in broadband communication
2. Design networking structure in broadband communication.

Module 1

Introduction and basic Principles : Definition and concepts. Network structures Broadband

Networks in the OSI Model. Multiplexing principles Switching principles review of the basic of traffic Theory (Queuing Theory)

Media Access Protocols :(MAC) for packet Switched lans : The Basic problem, Classification ofMAC protocols, Reservation Techniques (Polling) Reservation Techniques with Distributed Control, Collision Techniques (Random Access) Frame Formate Comparison.

Hybrid Access Protocols : General Hybrid solutions STM / Token Combination TDM / ATM Combination Allocation of STREAM (Isochronous) TDM Channels.

Module 2
Logical Link Control (LLC) and Higher Layer Protocols :LLC National and International Standardization.

Lan Controllers (Hardware / Software): Control Funtions Transmission System Adapter and MAU (Transceiver) Hardware Adapter Software.

Reliability Safety and fault Tolerance : Overview Goals Terminology Fault Detection Fault Tolerance Concepts.

Module 3
Network Interconnection (Overview) : Goals; Types of Interconnection Network Interconnectionin the OSI Model. Types of Gateways.Protocol Conversion and Adaptation.
Switched Broadband Networks (i) : Circuit Switched Architectures Introduction and Motivation.TDM Multiplexing of Signals with Different Bitrates.Broadband TDM Switching Networks.
Boardband Networks (ii) : Asynchronous Transfer Mode ATM Motivation Block Multiplexing (Cell Multiplexing). Switching Techniques ATM Switching Fabrics ATM Traffic Engineering Signaling Potocols ATM Adaptation Layer AAL Virtual Paths.
Module 4
Photonic Networks : Introduction Propagation of signals on Optical Fiber Components Modulationand Demodulation Transmission System EngineeringEvolution of Optical Networks. WabelengthRouting Networks.Boardcast and Select Networks Optical Access Networkss Photonic PacketSwitching Control and Management of Optical Networks.

Text and Reference Books :
1. Data Communication – William,Stallings
2. Data & Computer Communication – B.S.Farouzan,TMH
3. Computer Networks – Tanenbaum

PEO Mapping

a	b	c	d	e	f	g	h	i	j	k	l
√		√		√							

Engineering knowledge: Apply knowledge of digital communication and computer network
Design/development of solutions: Conducting experiments in broadband network setup
Modern tool usage: Share knowledge regarding up gradation of broadband network.

Digital Wireless Communications System Design
MCE 302C

Contacts: 4
Credit: 4

Prerequisites:
Prior idea of communication system and Digital signal processing

The objectives of this course are to:
1.Provide knowledge of Digital Wireless Communications System modeling and design
2.Provide knowledge of system architecture and top down process of designing .This includes transmitter architecture, channel and receiver architecture
3.Provide knowledge of pulse shaping filtering (Square-root raised cosine) & design, D/A and RF up-conversion methods & Design.

4.Provide knowledge of channel coding,spreading,despreading, deinterleaving,and decoding
5.Provide knowledge of s Simulation techniques for performance simulation, Baseband filtering ,calibration of noise variance, energy per Symbol,SNR.

6.Provide knowledge of design trade off as simulation of a diversity reception system over time -varying Rayleigh fading channels

Module 1:
Introduction to digital communications system modeling,simulation, & design.Elements of a digital communication system, Multiple access schems, Wideband transmission and reception,Finding Chanels, interference,noise. 6L

Module 2:
Top-down design process of a digital communication system
General system architecture and specifications, components modeling and Design,Transmitter Architecutre, Chnnel coding (convolutional), inter-leaving, Spreading, Baseband modulation,pulse shaping filtering (Square-root raised cosine) & design, D/A and RF up-conversion methods & design, 6L
Channel and receiver archiecture, Flat time varying rayleigh (focus) and frequency-selective fading,Low -noise amplification & noise figure, Carrier recovery and RF demodulation,Timing recovery,A/D conversion and recive filtering & design,Despreading, deinterleaving,and decoding. 8L

Module 3:
Performance Simulation and design tradeoff :
Simulation techniques, Baseband filtering ,calibration of noise variance, energy per Symbol,SNR and Eb/No Modeling of random variables and process, A method to generate time-varying fading channel coefficients, 10L
Performance simulation (BER vs.Eb/No),examples,Diversity reception in timevarying frequency-nonselective Rayleigh fading chanels, A wideband code-division multiple-access system Design tradeoff, simulation of a diversity reception system over time -varying Rayleigh fading channels 10L

Course Learning Outcomes
At the end of the course, students should be able to:
1.describe the concept of digital wireless system communication and issues like interference,noise.
2.understand how Wideband transmission and reception happen
3.understand how channel coding, interleaving, spreading function
4.understand the method of pulse shape filtering.
5.understand D/A and RF up conversion method and A/D conversion and filtering.

6.understnd the SNR and Eb/No Modeling of random variables and process,

7.understand how to to generate time-varying fading chanel coefficients.

8.describe how a wideband code-division multiple-access system Design tradeoff happens.

9.understand the transmitter and receiver architecture.
10.describe the carrier recovery and timing recovery.
11.understand the Performance simulation technique (BER vs.Eb/No),
12.understand thesimulation of a diversity reception system over time -varying Rayleigh fading channels.

PO Table

Paper Code	a	B	c	d	e	f	G	h	i	j	k	l
MCE302C	√	√	√		√							

PO Statement

5. Engineering knowledge: Apply the knowledge of engineering fundamentals, and an engineering specialization to the solution of AdHoc Networking problems.

2.Problem analysis: Strong foundation in theoretical/experimental work for being able to analyze, synthesize and design engineering products

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

Digital Wireless Communications System Design

Text Reference Books :

1. Wireless & Mobile Communications. Edited by jack m. Holtzman and David J.Goodman.Kluwer Academic Publishers, 1994 ,304p.
2. The mobile Communications Handbook. Edited by Jerry D. Gibson,C RC Press,1995,592p ISBN 0-8493-8573-3
3. Mobile Data & wireless LAN Technologies, Prentice Hall,1997. ISBN 0- 13- 839051-7
4. Mobile & Wireless networks, Ulysses black, Prentice Hall,1996, ISBN 0- 13- 440546-3
5. Digital Communications -E Lee & D. Messerschmitt, Kluwer Academic Publishers