E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

Accredited by NAAC with „A" Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

M.E. COMMUNICATION SYSTEMS

Full Time Curriculum and Syllabus

First Year – First Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1701CO101	Applied Engineering Mathematics	2	2	0	3	40	60	100
1702CO102	Advanced Digital Signal Processing	2	2	0	3	40	60	100
1702CO103	High Speed Communication Networks	3	0	0	3	40	60	100
1702CO104	Advanced Digital Communication	3	0	0	3	40	60	100
1702CO105	Wireless Communication Engineering	3	0	0	3	40	60	100
	Elective - I	3	0	0	3	40	60	100
Laboratory Course								
1704CO106	Signals Processing and Communication Laboratory	0	0	4	2	50	50	100
1704CO107	Wireless Communication Networks Lab	0	0	4	2	50	50	100
1704CO108	Communication Skills Laboratory - I	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1701CO101	APPLIED ENGINEERING MATHEMATICS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

1. To expose the students to solve ordinary differential equations by various techniques.
2. To understand basic concepts of advanced techniques in Matrix operations, linearequations.
3. To acquire the knowledge of interest in Special functions

UNIT I LINEAR PROGRAMMING **9 Hours**

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

UNIT II ADVANCE MATRIX THEORY **9 Hours**

Diagonalization of symmetric matrices - Quadratic forms - Singular values decomposition - Change of basis, Cramer"s rule, Matrixfactorizations

UNIT III ORDINARY DIFFERENTIAL EQUATIONS **9 Hours**

Runge-Kutta Methods for system of IVPs, numerical stability, Adams-Bash forth multistep method, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerk in finite element method.

UNIT IV LINEAR ALGEBRA **9 Hours**

Vector spaces – norms – Inner Products – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations --To eplitz matrices and some applications

UNIT V SPECIAL FUNCTIONS **9 Hours**

Bessel"s equation – Bessel functions – Legendre"s equation – Legendre"s polynomials – Rodrigue"s formula – Recurrence relations – Generating functions and orthogonal property for Bessel"s functions– Strum-Liouville problem – Error functions.

TOTAL: 30 + 15 HOURS

FURTHER READING:

Matrix norms - Jordan canonical form - Pseudo inverse - Least square approximations - QR algorithm

COURSE OUTCOMES:

Entrepreneurship

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

CO1 Have knowledge in the fields of linear algebra and linear programming

CO2 Provide the students with outstanding educational skills that will enable them to integrate under graduate fundamentals with advanced knowledge to solve complex problems

CO3 Recall combination of theoretical knowledge and independent mathematical thinking using special functions

REFERENCES:

1. Elsgolts. L, Differential Equation and Calculus of variations, MIR Publishers, 1996
2. Grewal B S, Higher Engineering Mathematics, Fortieth Edition, Khanna Publications, New Delhi 2014.
3. Howard. A. Anton," Elementary Linear Algebra", John Wiley & Sons, NinthEdition,2008.
4. David C. Lay, Steven R Lay and Judy J McDonald "Linear Algebra and it Applications", Global Edition Pearson Education Ltd,2015
5. Rai Singhania. M. D, Ordinary and partial differential equations, S. Chand & Co, New Delhi, 2006.
6. SeymourLipschutz,MarcLipson,"Schaum'sOutlineofLinearAlgebra",McGrawHill,FifthEdition,2013
7. Taha H.A. —Operations Research: An introduction‖ Ninth Edition, Pearson Education, Asia, New Delhi 2012

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1702CO102	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

1. To explore the concepts of multi rate signal processing and multi rate filters.
2. To study the adaptive filters and its applications.
3. To know about Linear and Prediction concepts.
4. To learn fundamental concepts on signal processing in power spectrum estimation.

UNIT I MULTI RATE DIGITAL SIGNAL PROCESSING **9 Hours**

Introduction-Sampling and Signal Reconstruction-Sampling rate conversion – Decimation by an integer factor – interpolation by an integer factor –Sampling rate conversion by a rational factor – poly-phase FIR structures – FIR structures with time varying coefficients - Sampling rate conversion by a rational factor- Multistage design of decimator and interpolator.

UNIT II MULTI RATE FIR FILTER DESIGN **9 Hours**

Design of FIR filters for sampling rate conversion –Applications of Interpolation and decimation in signal processing –Filter bank implementation –Two channel filter banks-QMF filter banks –Perfect Reconstruction Filter banks – tree structured filter banks - DFT filter Banks – M-channel filter banks-octave filter banks

UNIT III LINEAR ESTIMATION AND PREDICTION **9 Hours**

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

UNIT IV DESIGN OF ADAPTIVE FILTERS **9 Hours**

FIR Adaptive filters - Newton's steepest descent method – Adaptive filters based on steepest descent method - LMS Adaptive algorithm – other LMS based adaptive filters- RLS, Exponentially weighted RLS - Sliding window RLS – Simplified IIR Application: channel equalization, noise cancellation, prediction.

UNIT V POWER SPECTRAL ESTIMATION **9 Hours**

Estimation of spectra from finite duration observations of a signal –The Periodogram-Use of DFT in Power spectral Estimation –Non-Parametric methods for Power spectrum Estimation – Bartlett. Welch and Blackman–Tukey methods –Comparison of performance of Non – Parametric power spectrum Estimation methods – Parametric Methods - Relationship between auto correlation and model parameters, Yule-Walker equations, solutions using Durbin"s algorithm, AR, MA, ARMA model based spectral estimation.

TOTAL: 45 + 15 HOURS

FURTHER READING:

Applications of adaptive filters: Adaptive channel equalization Adaptive echo canceller - Adaptive noise cancellation-, 1/M-octave-band filter banks, Speech enhancement using spectrum estimation

Entrepreneurship / Emp loyability

COURSE OUTCOMES:

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

CO1: Design and implement decimator and interpolator and to design multi rate filter bank and acquires knowledge of how a multi rate system work

CO2: Understand different spectral estimation techniques and linear prediction

CO3: Explain about LMS and RLS adaptive filters for signal enhancement, channel equalization

CO4: Illustrate different Power spectrum methods and solutions

REFERENCES:

1. H. Monson Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc., 2008.
2. G. John Proakis and G. Dimitris Manolakis, Digital Signal Processing, Pearson Education, 2006.
3. P.P.Vaidyanathan, Multirate Systems and Filter Banks, Pearson Education, 2008.
4. N.J.Filege, Multirate Digital Signal Processing, John Wiley and Sons, 2000.
5. G.John Proakis, Algorithms for Statistical Signal Processing, Pearson Education, 2002.
6. G.Dimitris and G.Manolakis,Statistical and Adaptive Signal Processing, McGraw Hill, 2002.
7. Sophoncles J. Orfanidis, Optimum Signal Processing, McGraw Hill, 2007.

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1702CO103	HIGH SPEED COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To develop a comprehensive understanding of multimedia networking.
2. To study the types of VPN and tunneling protocols for security.
3. To learn about network security in many layers and network management.

UNIT I INTRODUCTION **9 Hours**

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

UNIT II MULTIMEDIANETWORKING APPLICATIONS **9 Hours**

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

UNIT III ADVANCED NETWORKS CONCEPTS **9 Hours**

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

UNIT IV TRAFFIC MODELLING **9 Hours**

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

UNIT V NETWORK SECURITYAND MANAGEMENT **9 Hours**

Principles of cryptography –Authentication–integrity–key distribution and certification–Access control and: firewalls–attacks and counter measures–security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration–ASN.1

TOTAL: 45 HOURS

FURTHER READING:

IP Switching ,Ipv6,Ipv6 over ATM

Entrepreneurship

COURSE OUTCOMES:

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

CO1 Know basics of networks
CO2 Understand applications of multimedia networking
CO3 Examine advanced networking techniques
CO4 Illustrate traffic modeling concepts
CO5 Know security basics and its management

REFERENCES:

1. J.F. Kurose &K.W. Ross," Computer Networking- A top down approach featuring the internet", Pearson 2nd edition, 2003.
2. Walrand.J. Varatya ,High performance communication network, Morgan Kauffman– Harcourt Asia Pvt. Ltd. 2nd Edition, 2000.
3. LEOM-GarCIA, WIDJAJA, "Communication networks", TMH seventh reprint2002.
4. Aunuragkumar,D.MAnjunath, Joykuri, "Communication Networking", Morgan Kaufmann Publishers, 1st Edition 2004.
5. Hersent Gurle& petit, "IP Telephony, packet Pored Multimedia communication Systems", Pearson education 2003.
6. Fred Halsall and Lingana Gouda Kulkarni," Computer Networking and the Internet" fifth edition, Pearson education
7. Nader F. Mir, Computer and Communication Networks, First Edition.
8. Larryl .Peterson & Bruce S. David, "Computer Networks: A System Approach"-1996

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1702CO104	ADVANCED DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the role of the communication in the design approaches for coding and modulation techniques.
2. To know the trade-offs involved in the design of basic and advanced coding and modulation techniques.
3. To learn the advanced baseband signal conditioning methods evolved for exploiting the channel and user application characteristics
4. To familiarize on modern coding techniquesTo study the types of VPN and tunneling protocols for security.
5. To learn about network security in many layers and network management

UNIT I REVIEW OF ANALOG AND DIGITAL MODULATION TECHNIQUES **9 Hours**

Review of PSK, FSK, and ASK, Base band and band pass communication; Signal space representation, Linear and nonlinear modulation techniques, M-ary modulation techniques; Spectral characteristics of digital modulation, Spread spectrum modulation techniques.

UNIT II RECEIVERS FOR AWGN AND FADING CHANNELS **9 Hours**

Optimum receivers for AWGN channel -Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques-Digital transmission over Fading channel.

UNIT III ADVANCED MODULATION TECHNIQUES ANDMULTICARRIER SYSTEMS **9 Hours**

Modulation techniques in MIMO system, Cognitive radio modulation technique, OFDM- Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; Peak to Average Power reduction schemes; Multicarrier CDMA- System design, Performance parameters.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION **9 Hours**

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

UNIT V TRELLIS CODED MODULATION **9 Hours**

Coded modulation for bandwidth-constrained channels-Trellis coded modulation; Set Partitioning, Four –state Trellis-coded modulation with 8-PSK signal constellation, Eight-state Trellis code for coded 8-PSK modulation, Eight-state Trellis for rectangular QAM signal constellations, Decoding methods and implementation issues.

TOTAL: 45 HOURS

FURTHER READING: MODERN CODING TECHNIQUES

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

COURSE OUTCOMES:

Employability / Entrepreneurship

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

CO1: Demonstrate an understanding of the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advanced baseband signal conditioning methods evolved for exploiting the channel and user application characteristics.

CO2: Demonstrate an understanding of the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advanced baseband signal conditioning methods evolved for exploiting the channel and user application characteristics.

CO3: Analyze the user requirements and the type of channel over which the system has to function.

CO4: Apply the knowledge for designing the baseband signaling waveforms that would address the channel impairments. Examine advanced networking techniques

REFERENCES:

1. Bernard Sklar., Digital Communications,, second edition, Pearson Education, 2001.
2. John G. Proakis.,Digital Communication,, 4 th edition, McGraw Hill Publication, 2001
3. Richard Van Nee & Ramjee Prasad.,OFDM for Multimedia Communications,, Artech House Publication, 2001.
4. Theodore S.Rappaport., _Wireless Communications,, 2nd edition, Pearson Education, 2002.
5. Heinrich Meyer, Mare Moene clacy, Stefan .A.Fechtel, " Digital communication receivers ", Vol I &Vol II, John Wiley, New York, 1997.
6. Sergio Verdu, —Multiuser Detection|, Cambridge University Press, 1998.
7. Andrea Goldsmith , —Wireless Communications|, Cambridge University Press, 2006

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1702CO105	WIRELESS COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

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

UNIT I WIRELESS CHANNEL PROPAGATION AND MODEL **9 Hours**

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

UNIT II CAPACITY OF WIRELESS CHANNELS **9 Hours**

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

UNIT III DIVERSITY **9 Hours**

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

UNIT IV MIMO COMMUNICATIONS **9 Hours**

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

UNIT V MULTI USER SYSTEMS **9 Hours**

Review of Multiple Access Techniques, Scheduling, power control, Uplink and Downlink channel capacity, multiuser diversity, MIMO-MU systems.

TOTAL: 45 HOURS

FURTHER READING:

Non-regenerative MIMO wireless relays, Finite state Markov model of correlated Rician-fading channels, Fractionally Spaced Equalizer Passband Equalization -Optimum Digital Detector in Additive Gaussian Noise Detection of binary data using spectrum estimation techniques.

COURSE OUTCOMES:

Entrepreneurship

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

CO1 Analyze the state of art techniques in wireless communication.
CO2 Describe MIMO Communications
CO3 Review multiple access techniques

REFERENCES:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
2. Harry R. Anderson, —Fixed Broadband Wireless System Design‖ John Wiley – India, 2003.
3. Education 2009.
4. Andreas.F. Molisch, —Wireless Communications‖, John Wiley – India, 2006.
5. Simon Haykin& Michael Moher, —Modern Wireless Communications‖, Pearson Education,
6. 2007.
7. Rappaport. T.S., —Wireless communications‖, Pearson Education, 2003.
8. Gordon L. Stuber, —Principles of Mobile Communication‖, Springer International Ltd., 2001.
9. UpenaDalal, —Wireless Communication — Oxford Higher

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1704CO106	SIGNAL PROCESSING AND COMMUNICATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To understand underlying concepts in signal, speech and image processing
2. To provide a comprehensive analysis of digital modulation techniques.
3. To learn about the adaptive filtering algorithms.
4. To understand the mechanism of multi rate systems, source control coding, error control coding and OFDM.

LIST OF EXPERIMENTS:

1. Implementation of LMS, RLS adaptive filters to remove noise to the estimation of Channel.
2. Implementation of Digital Modulation Techniques
3. Compare Gaussian minimum shift keying (GMSK) and minimum shift keying (MSK) modulation schemes
4. Simulation of Linear, Convolutional and Cyclic Codes
5. Design and simulation of Multirate systems
6. Design and Analysis of spectrum estimators (Barlett,Welch)
7. Simulation and analysis of speech and image compression algorithms
8. Design and implementation of source coding technique
9. Implementation of Pulse Coded Modulation using Simulink
10. Implementation of OFDM physical link using Simulink

MINI PROJECT:

- Signal enhancement using spectral subtraction
- Image denoising
- Audio compression
- Adaptive Echo/Noise canceller
- Radar Tracking System
- GSM

TOTAL: 30 HOURS

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1: 1. Able to learn about signal processing concepts and to implement the adaptive filtering algorithms

CO2: 2. Able to understand the image and speech processing algorithms

CO3: 3. Able to analyze the various modulation, coding techniques and multirate systems

1704CO107	WIRELESS COMMUNICATION NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To study the network simulators for implementation of different layered protocols
2. To Implement MAC and Routing algorithms
3. To perform simulation and analysis of various network protocols, Mobility model

LIST OF EXPERIMENTS:

1. Design and Implementation of wired network in open source simulator and performance analysis
2. Simulation of Distance Vector and Link state routing in NS2
3. Simulation of a multicast routing mechanism in NS2
4. Simulation and Performance analysis of IEEE 802.11 networks based on Throughput, PDR, Average End to End delay and Jitter
5. Simulation of IEEE 802.11 networks with Mobility and performance comparison based on Throughput, PDR, Average End to End Delay and Jitter
6. Simulation and Performance analysis of IEEE 802.16 WiMAX networks
7. Design and Simulation of Handover mechanism in WiMAX systems and performance analysis based on Packets sent and received
8. Simulation and Performance analysis of Table Driven routing protocol in Mobile Ad Hoc Networks
9. Simulation of On-Demand Routing Protocols in Mobile Adhoc networks and Performance comparison with Table Driven Protocols
10. Simulation of a security attack in Wireless Networks and analysis of performance degradation
11. Performance analysis of secure routing mechanism in Wireless Networks and study on network performance in the presence of an attack
12. Design and simulation of Wireless Sensor Networks using Zigbee and performance analysis based on battery model

MINI PROJECT

1. Design of Vehicular Ad Hoc Network and performance analysis based on different Mobility conditions
2. Design of Wireless sensor networks for a specific application of Patient Health Monitoring
3. Performance analysis and comparison of Battery aware models in Wireless Networks
4. Performance evaluation of Medium Access Control in Heterogeneous wireless networks
5. Design and simulation of GSM network and their performance analysis

TOTAL: 30 HOURS

COURSE OUTCOMES:

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

- CO1 Able to analyze characteristics of analog and digital channels in a communication systems
- CO2 Able to understand wireless medium access mechanisms
- CO3 Able to analyze and test performance of routing protocols
- CO4 Able to analyze IP and TCP traffic in static and mobile adhoc network

1704CO108	COMMUNICATION SKILLS LAB I (Common to all M.E Progarmmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To acquire skills for using English in workplace effectively.
2. To communicate for essential business needs.
3. To prepare students for taking BEC Vantage level examination which is an International Benchmark for English language proficiency of Cambridge English Language Assessment

LIST OF EXPERIMENTS:

1. **GRAMMAR AND VOCABULARY**
   Forming asking complex questions – expressing purpose and function –modal verbs – impersonal passive voice– Reported speech – cause and effect – relative pronouns – expressions followed by – *ing* forms– acronyms – marketing terms / vocabulary – financial terms – collocations – discourse markers
2. **LISTENING**
   Purposes of listening – features of listening texts – potential barriers to listening – specific listening skills – strategies to use when listening– distinguishing relevant from irrelevant information – gap filling exercise – multiple-choice options – note completion – matching and multiple choice questions – listening for specific information, gist, topic, context and function.
3. **SPEAKING**
   Word and sentence stress – clear individual sounds – turn taking – initiating and responding - intonation patterns – pronunciation – mother tongue intrusion– conversation practice – turn-taking and sustaining the interaction by initiating and responding appropriately- Public Speech – Lectures.
4. **READING**
   Purposes of reading – potential barriers to reading – paraphrasing – identifying facts and ideas – skimming and scanning for information – matching statements with texts– spotting reference words – understanding text structure – understanding the ideas in a text – distinguishing between the correct answer and the distracter – understanding cohesion in a text – deciphering contextual meaning of words and phrases – cloze – proof reading - transcoding.
5. **WRITING**
   Paragraphing a text – using appropriate connectives – editing practice –Longer Documents: writing a proposal & Reports. Agenda – Minutes – Circular

TOTAL: 30 HOURS

ADDITIONAL EXPERIMENTS:

1. Body Language: Kinesics, Proxemics, Para linguistic, Nuances of Speech Delivery
2. Personality Development: Building self esteem
3. Team work

COURSE OUTCOMES:

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

CO1: To enable students to get International recognition for work and study.

CO2: To use English confidently in the International business environments.

CO3: To be able to take part in business discussion, read company literature, write formal and informal business correspondences and listen and understand business conversations

REFERENCES:

1. Guy Brook-Hart, "BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student"s Book", 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE – Self-study Edition", Cambridge University Press, UK, 2005.
3. Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting
4. The Process of Writing: Planning and Research, Writing, Drafting and Revising

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NAGAPATTINAM – 611 002

M.E. COMMUNICATION SYSTEMS

Full Time Curriculum and Syllabus

First Year – Second Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1702CO201	FPGA Based Communication System Design	3	0	0	3	40	60	100
1702CO202	Microwave Integrated Circuits	3	0	0	3	40	60	100
1702CO203	Optical Switching and Networking	3	0	0	3	40	60	100
1702CO204	Information Theory and Coding	3	0	0	3	40	60	100
	Elective – II	3	0	0	3	40	60	100
	Elective – III	3	0	0	3	40	60	100
Laboratory Course								
1704CO205	RF System Design Laboratory	0	0	4	2	50	50	100
1704CO206	Technical Seminar	0	0	2	1	100	0	100
1704CO207	Communication Skills Laboratory -II	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester.

1702CO201 FPGA BASED COMMUNICATION SYSTEM DESIGN

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To elicit, analyze, prioritize, and manage both functional and quality requirements
2. To estimate efforts required, plan, and track the plans
3. To understand and apply configuration and quality management techniques

UNIT I WIRELESS COMMUNICATION BASICS **9 Hours**

Digital communication systems- minimum bandwidth requirement, the Shanon limit- overview of modulation schemes- classical channel- wireless channel description- path loss- multipath fading basics of spread spectrum and spread spectrum techniques- PN sequence.

UNIT II TRANSCEIVER ARCHITECTURE **9 Hours**

Transceiver design constraints- baseband subsystem design- RF subsystem design- Super heterodyne receiver and direct conversion receiver- Receiver front-end- filter design- non-idealities and design parameters- derivation of noise figure and IP3 of receiver front end.

UNIT III LOW POWER DESIGN TECHNIQUES **9 Hours**

Source of power dissipation- estimation of power dissipation- reducing power dissipation at device and circuit levels- low voltage and low power operation- reducing power dissipation at architecture and algorithm levels.

UNIT IV WIRELESS CIRCUITS **9 Hours**

VLSI Design of LNA-wideband and narrow band-impedance matching. Automatic Gain Control (AGC) amplifier-power amplifier- Active mixer- analysis, conversion gain, distortion analysis- low frequency and high frequency case. noise. Passive mixer- sampling mixer and switching mixer analysis of distortion, conversion gain and noise in these mixers.

UNIT V VLSI DESIGN OF SYNTHESIZERS **9 Hours**

VLSI design of Frequency Synthesizers (FS) – Parameters of FS - VCO- LC oscillators- ring oscillator- phase noise- loop filter description, design approaches, PLL based frequency synthesizer, phase detector/charge pump- dividers

TOTAL: 45 HOURS

FURTHER READING:

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System

Efficient VLSI Architecture for Base Band Signal processing.- Phase Noise - A Complete Synthesizer Design Example (DECT Application).

VLSI architecture for Multitier Wireless System - Hardware Design Issues for a Next generation CDMA System

Entrepreneurship / Employability

COURSE OUTCOMES:

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

CO1: Understanding of application of VLSI circuits in wireless communication
CO2: Knowledge of various architectures used in implementing wireless systems
CO3: Discussion about design and simulation of low power techniques using software
CO4: Learn the VLSI design of wireless circuits

REFERENCES:

1. Bosco Leung, VLSI for Wireless Communication, Springer, 2011.
2. Elmad N Farag and Mohamed I Elmasry, Mixed Signal VLSI Wireless Design-Circuits and Systems, Kluwer Academic Publishers, 2002.

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1702CO202 **MICROWAVE INTEGRATED CIRCUITS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To understand the fundamentals of RF radio system design
2. To understand the various components that constitute an RF radio system for wireless Communications
3. To know the basic analysis techniques needed for evaluating the performance of an RF radio system for Wireless applications

UNIT I CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES **9 Hours**

CMOS: Introduction to MOSFET Physics – Noise: Thermal, shot, flicker, popcorn noise transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP2, IP3,Sensitivity, SFDR, Phase noise - Specification distribution over a communication link Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures – Transmitter: Direct up conversion, Two step up conversion

UNIT II INTRODUCTION TO RF FILTER, OSCILLATOR AND MIXER **9 Hours**

Overview –basic resonator and filter configuration-special filter realization-filter implementation. Basic oscillator model-high frequency oscillator configuration-basic characteristics of mixer- phase locked loops-RF Directional Couplers - hybrid couplers –detector and demodulator circuits.

UNIT III INTRODUCTION TO MICROWAVE CIRCUITS **9 Hours**

Definitions – Frequency Bands – Lumped versus Distributed Circuits - Behavior of finite length transmission lines – General Characteristics of PC Boards – Transmission Lines on PC Boards – Passives made from Transmission Lines – Resonators - Combiners, Splitters and Couplers

UNIT IV MATCHING NETWORKS AND AMPLIFIERS **9 Hours**

Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements, Amplifiers: Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks – Broadband Amplifier design – Low Noise Amplifier Design.

UNIT V MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES **9 Hours**

Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology - Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements.

TOTAL: 45 HOURS

FURTHER READING:

Thermal and cryogenic measurements, experimental field probing techniques

COURSE OUTCOMES:

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

CO1: Design RF circuits
CO2: Analyse the performance of RF circuits

REFERENCES:

1. T. Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004
2. B.Razavi, "RF Microelectronics", Pearson Education, 1997.
3. Jan Crols, MichielSteyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publications, 1997
4. B. Razavi, Design of analog CMOS Integrated Circuits", McGraw Hill,2001
5. D. Robertson &S. Lucy szyn, "RFIC and MMIC Design and Technology", IEE Circuits, Devices and Systems series 13, London, UK, 2001

1702CO203 **OPTICAL SWITCHING AND NETWORKING**

L	T	P	C
3	0	0	3

Course Objectives:

1. To enable the student to understand the importance of optical switches and network architecture and connections
2. To enable the student to understand the differences in routing, switching and the resource allocation methods and the network management and protection methods .
3. To expose the student to the advances in networking and switching domains and recent trends in optical network

UNIT I OPTICAL SWITCHES **9 Hours**

Introduction to Optical Switches, Electro-Optical switches, Thermo-optical switches, Magneto-optical switches, MEMs based optical switches, SOA based optical switches, Liquid crystal optical switches, Photonic crystal all-optical switches and its application

UNIT II OPTICAL NETWORK ARCHITECTURES AND CONNECTIONS **9 Hours**

Introduction to Optical Networks, Need for Multi-layered Architecture, Layers and Sub-layers, Spectrum partitioning, Optical Net-work Nodes, Network Access Stations, Overlay Processor, Logical network overlays, Generalized Multiprotocol Label Switching, Connection Management and Control, Static Networks, Wavelength Routed Networks, Linear Light wave networks, Logically Routed Networks, Routing and Wavelength Assignment , Traffic Grooming in Optical Networks.

UNIT III OPTICAL NETWORK SURVIVABILITY **9 Hours**

Protection and Restoration Objectives, Fault Protection and Restoration Techniques in the Logical Layer - Point-to-Point Systems, Protection in SONET/SDH and client layer, Self-Healing Rings, Interconnection Techniques, Architectures with Arbitrary Mesh Topologies, Optical-Layer Protection: Point-to-Point and Ring Architectures, Mesh Architectures, Survivability Techniques for Multicast Connections

UNIT IV OPTICAL PACKET SWITCHING NETWORKS **9 Hours**

Optical Packet-Switching Network Architectures, Contention Resolution, OPS Enabling Technologies, Optical Burst Switching, Contention Resolution in OBS Networks, Optical Label Switching, All-Optical Label Swapping, Contention Resolution in OLS

UNIT V NETWORK PERFORMANCE AND RECENT TRENDS **9 Hours**

Performance Impairments in an Optical Network Environment, The Passive Optical Networks, Metropolitan Area Networks, Long-Haul and Ultra Long-Haul Networks, Introduction to Software Defined Networking, Reconfigurable Optical Add/Drop Multiplexer (ROADM).

TOTAL: 45 HOURS

FURTHER READING:

Plastic optical fiber, Fiber optic Connectors, Li-Fi technology, Test equipments-Fault locators, fiber identifiers

COURSE OUTCOMES: Skill Development | Entrepreneurship

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

CO1: Use the backbone infrastructure for our present and recent communication needs
CO2: Compare the differences in routing, switching, resource allocation methods, network management and protection methods
CO3: Describe the advances and recent trends in the networking and switching approaches

REFERENCES:

1. Thomas E. Stern, Georgios Ellinas, Krishna Bala, —Multi wavelength Optical Networks – Architecture, Design and control —, Cambridge University Press, 2nd Edition, 2009
2. Rajiv Ramaswami and Kumar N. Sivarajan, —Optical Networks: A Practical Perspective‖, Harcourt Asia Pte Ltd., Second Edition 2006
3. C. Siva Ram Moorthy and Mohan Gurus amy, —WDM Optical Networks : Concept, Design and Algorithms‖, Prentice Hall of India, Ist Edition, 2002
4. P.E. Green, Jr., —Fiber Optic Networks‖, Prentice Hall, NJ, 1993
5. Biswanath Mukherjee, —Optical WDM Networks‖, Springer, 2006
6. S J Chua B Li-Optical Switches, Wood head Publishing,2010
7. Thomas E. Stern, Georgios Ellinas, Krishna Bala, —Multi wavelength Optical Networks – Architecture,

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Design and control —, Cambridge University Press, 2nd Edition, 2009
8. Rajiv Ramaswami and Kumar N. Sivarajan, —Optical Networks: A Practical Perspectivell, Harcourt Asia Pte Ltd., Second Edition 2006

1702CO204 INFORMATION THEORY AND CODING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To have a complete understanding of Information Theory
2. To understand Source coding and Channel coding theorem
3. To have a complete understanding of error control coding
4. To introduce methods for the generation of these codes and their decoding techniques

UNIT I INFORMATION THEORY **9 Hours**

Introduction-Measure of information- Average information content of symbols in long independent sequences-Average information content of symbols in long dependent sequences-Mark-off statistical model for information source-Entropy and information rate of mark-off source.

UNIT II SOURCE CODING AND FUNDAMENTAL LIMITS ON PERFORMANCE **9 Hours**

Encoding of the source output-Shannon's encoding algorithm-Communication Channels-Discrete communication channels-Continuous channels-Source coding theorem-Huffman coding-Discrete memory less Channels-Mutual information-Channel Capacity

UNIT III CHANNEL CODING THEOREM AND BINARY CYCLIC CODES **9 Hours**

Channel coding theorem-Differential entropy and mutual information for continuous ensembles-Channel capacity Theorem. Binary Cycle Codes-Algebraic structures of cyclic codes

UNIT IV INTRODUCTION TO ERROR CONTROL CODING **9 Hours**

Introduction-Types of errors-examples-Types of codes Linear Block Codes: Matrix description-Error detection and correction-Standard arrays and table look up for decoding

UNIT V RS CODES, GOLAY CODES, SHORTENED CYCLIC CODES AND CONVOLUTION CODES **9 Hours**

RS codes-Golay codes-Shortened cyclic codes-Burst error correcting codes-Burst and Random Error correcting codes-Convolution Codes-Time domain approach-Transform domain approach

TOTAL: 45 HOURS

FURTHER READING:

Encoding using an (n-k) bit shift register-Syndrome calculation-BCH codes

COURSE OUTCOMES:

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

CO1: Able to understand the concept of Information theory
CO2: Able to illustrate the practical implementation issues, such as Error control coding, convolution code
CO3: Able to know various coding techniques.

REFERENCES:

1. Simon Haykin, Communication Systems, John Wiley & Sons. Pvt. Ltd, 2009
2. Taub& Schilling, Principles of Communication Systems, Tata McGraw-Hill, 2007
3. Das, Mullick& Chatterjee, Principles of Digital Communication ,Wiley Eastern Ltd,2002
4. Shu Lin & Daniel J. Costello, Error Control Coding Fundamentals and Applications, Jr., Prentice Hall Inc.2004
5. Information Theory and Reliable Communication, R. G. Gallager, Wiley, 1966

1704CO205	RF SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

1. To provide experience in Simulation & Implementation of the Micro strip antennas and planar array antenna
2. To provide experience in design, Implementation and testing of a Micro strip coupler and coplanar waveguides using simulation software

LIST OF EXPERIMENTS:

1. Characteristics of RF diodes, transistors
2. Determination of S-parameter for MIC components
3. Design and simulation of Micro strip filters and switches
4. Design and implementation of Micro strip Couplers
5. Design and simulation of Phase shifters
6. Design parameters of planar waveguides
7. Design and simulation of wired and Micro strip antenna
8. Design and simulation of Micro strip antenna arrays

MINI PROJECT

9. Design and implementation of RF circuits like amplifiers, mixers and oscillators
10. Analysis and testing the performance of thin film resistances
11. Design and analysis of antenna arrays

TOTAL: 30 HOURS

COURSE OUTCOMES:

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

CO1: Understanding of various MIC technologies
CO2: Knowledge of micro strip transmission lines and their parameters
CO3: Discussion about passive and non-passive reciprocal devices and their analysis
CO4: Learn the various coplanar MICs and their applications
CO5: Design of various microwave circuits like amplifiers, oscillators and mixers

1704CO207	COMMUNICATION SKILLS LAB II (Common to all M.E Progarmmes)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To acquire skills for using English in business environment.
2. To communicate appropriately in business contexts.
3. To prepare students for taking BEC Vantage level examination conducted by the Cambridge English Language Assessment (CELA).

SPEAKING

Non-verbal communication – agreeing / disagreeing, reaching decisions, giving and supporting opinions – making mini presentations – extending on conservations – collaborative task – tongue twisters.

WRITING

Business letters – fax – Shorter Documents: e-mail - memo – message - note – report writing – formal / informal styles.

TOTAL: 15 HOURS

COURSE OUTCOMES:

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

CO1: To enable students to acquire business terms for communication.

CO2: To use English confidently in the business contexts.

CO3: To be able to take part in business discussion and write formal and informal business correspondences.

REFERENCES:

1. Guy Brook-Hart, "BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book", 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE – Self-study Edition", Cambridge University Press, UK, 2005.
3. Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting
4. The Process of Writing: Planning and Research, Writing, Drafting and Revising

1703CO001 **ADVANCED DIGITAL IMAGE PROCESSING**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand basics of color image processing
2. To know image segmentation and representation
3. To understand object recognition

UNIT I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING **9 Hours**

ElementsofVisualPerception-Imageacquisition,digitization-Histogram-Image enhancement–Spatial filters for smoothing and sharpening–Discrete 2Dtransforms-DFT,DCT,Walsh-Hadamard,Slant,KL,Wavelet Transform–Haarwavelet.

UNIT II COLOR IMAGE PROCESSSING **9 Hours**

Color Image Fundamentals-Color Models-RGB,CMY, CMYK and HISColor Models-PseudocolorImage Processing-Intensity Slicing-IntensitytoColortransformations-BasicsofColorImageProcessing-Color Transformation-ColorImageSmoothingandSharpening-ColorSegmentation -Noise in Color Images.

UNIT III MORPHOLOGICAL IMAGE PROCESSING **9 Hours**

Preliminaries- Basic Concepts from Set Theory-Logic Operations Involving Binary Images-Dilation and Erosion–Opening and Closing-Hit-or-MissTransformation-BasicMorphologicalAlgorithms-Boundary Extraction-Region Filling- Extraction of Connected Components-Convex Hull- Thinning-Thickening-Skeletons-Pruning--Gray-Scale Morphology.

UNIT IV SEGMENTATION, REPRESENTATION AND DESCRIPTION **9 Hours**

Edge Detection - Edge Linking and Boundary Detection -Thresholding- Segmentation by Morphological Watershed Segmentation Algorithm-Use of Markers-Representation and Boundary Descriptors

UNIT V OBJECT RECOGNITION AND IMAGE PROCESSING APPLICATIONS **9 Hours**

Patterns and Pattern Classes -Recognition Based on Decision-Theoretic Methods -Matching - Optimum Statistical Classifiers-Neural Networks, Watermarking-Steganography.

TOTAL: 45 HOURS

FURTHER READING:

Fuzzy Systems-GA.Imagecompression-JPEG,JPEG2000JBIG standards-

COURSE OUTCOMES:

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

CO1: Demonstrate knowledge of image acquisition, digitization and spatial filters for enhancement
CO2: Employ color image processing techniques
CO3: Apply morphological image processing algorithms
CO4: Apply segmentation algorithms and descriptors for image processing.
CO5: Use neural networks, fuzzy logic and genetic algorithms in object recognition
CO6: Apply compression, watermarking and Steganographyalgorithms to images

REFERENCES:

1. Rafael C.Gonzalez,**"DigitalImage Processing"**,PearsonEducation,Inc.,3rd Edition,2008
2. MilmanSonka, Vaclav Hlavac, Roger Boyle, **"Image Processing, Analysis and Machine Vision"**, Brooks/Cloe,VikasPublishingHouse2nd Edition,1999
3. Khalid Sayood,**"Data Compression"**,MorganKaufmann Publishers(Elsevier).,3rd Edition,2006
4. RafaelC.Gonzalez, RichardsE.Woods,StevenEddins,"**Digital Image Processing using MATLAB"**. PearsonEducation,Inc.,2004
5. WillamK.Pratt,**"DigitalImage Processing"**,JohnWilcy,NewYork,2002

1703CO017 **MOBILE AD HOC NETWORKS**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To introduce the characteristic features of ad hoc wireless networks and their applications to the students
2. To enable the student to understand the functioning of different access and routing protocols that can be used for ad hoc networks
3. To enable the student to understand the need for security and the challenges and also the role of cross layer design in enhancing the network performance

UNIT I INTRODUCTION **9 Hours**

Introduction to Ad Hoc networks – definition, characteristics features, applications. Characteristics of Wireless channel, Adhoc Mobility Models: - entity and group models

UNIT II MEDIUM ACCESS PROTOCOLS **9 Hours**

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

UNIT III NETWORK PROTOCOLS **9 Hours**

Addressing issues in ad hoc network, Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, Unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, Power/ Energy aware routing algorithm, Hierarchical Routing, QoS aware routing

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

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

UNIT V CROSS LAYER DESIGN AND INTEGRATION **9 Hours**

Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, Cross layer cautionary perspective, Co-operative networks:- Architecture

TOTAL: 45 HOURS

FURTHER READING: Entrepreneurship

Methods of co-operation, co-operative antennas, Integration of ad hoc network with other wired and wireless networks

COURSE OUTCOMES:

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

CO1: The student would be able to demonstrate an understanding of the trade-offs involved in the design of adhoc networks

CO2: The student would be able to design and implement protocols suitable to adhoc communication scenario using design tools and characterize them

CO3: The student is exposed to the advances in adhoc network design concepts

REFERENCES:

1. C.Siva Ram Murthy and B.S.Manoj, —Ad hoc Wireless Networks Architectures and protocols‖, 2nd edition, Pearson Education, 2007
2. Charles E. Perkins, —Ad hoc Networking‖, Addison – Wesley, 2000
3. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, —Mobile adhoc networking‖, Wiley-IEEE press, 2004
4. Mohammad Ilyas, —The handbook of adhoc wireless networks‖, CRC press, 2002
5. T. Camp, J. Boleng, and V. Davies —A Survey of Mobility Models for Ad Hoc Network Research,‖ Wireless Communication and Mobile Comp., Special Issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502
6. Fekri M. Abduljalil and Shrikant K. Bodhe , —A survey of integrating IP mobility protocols and Mobile Ad hoc networks‖, IEEE communication Survey and tutorials, v 9.no.1 2007
7. ErdalÇayırcı and ChunmingRong c, — Securityin Wireless Ad Hoc and Sensor Networks2009, John Wiley & Sons, Ltd. ISBN: 978-0-470-02748-6

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NAGAPATTINAM – 611 002

M.E. COMMUNICATION SYSTEMS

Full Time Curriculum and Syllabus

Second Year – Third Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1702CO301	Electromagnetic Interference and Compatibility in System Design	2	2	0	3	40	60	100
1703CO024	**Elective IV** - Machine Learning Algorithms	3	0	0	3	40	60	100
1703CP017	**Elective V** - Embedded Software Development	3	0	0	3	40	60	100
Laboratory Course								
1704CO302	Project Work Phase-I	0	0	12	6	50	50	100
Open Electives								
1703CO033	Wireless Sensor Networks	3	0	0	3	40	60	100
1703CO034	Optical Signal Processing	3	0	0	3	40	60	100
1703CO035	High Speed Switching Architecture	3	0	0	3	40	60	100
1703CO036	Network Engineering And Management	3	0	0	3	40	60	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1702CO301	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY IN SYSTEM DESIGN	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Antenna and Wave propagation
2. Electromagnetic Fields

COURSE OBJECTIVES:

1. To explore the concepts of EMI Environment and EMI Coupling Principles
2. To focus on popular EMI/EMC Standards and Measurements
3. To study the control techniques involved in Electromagnetic Interference

UNIT I EMI ENVIRONMENT **9 Hours**

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

UNIT II EMI COUPLING PRINCIPLES **9 Hours**

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

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

Civilian standards - FCC, CISPR, IEC, EN, Military standards - MIL STD 461D/462, EMI Test Instruments /Systems, EMI Shielded Chamber, Open Area Test Site, Military Test Method and Procedures (462).

UNIT IV EMI CONTROL TECHNIQUES **9 Hours**

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

UNIT V EMC DESIGN OF PCBS **9 Hours**

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning, Motherboard Designs and Propagation Delay Performance Models, Electrical, Magnetic and Thermal analysis of circuits for EMC.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. TEM Cell.
2. Sensors/Injectors/Couplers.
3. Test beds for ESD and EFT.

Entrepreneurship

COURSE OUTCOMES:

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

CO1 Recall electromagnetic concepts and its measuring parameters.
CO2 Uunderstand the EMI coupling principle and its types.
CO3 Know the design and architecture of Micro machined Antennas.
CO4 Explain Mems phase shifters and its applications.
CO5 Demonstrate Designing of PCBs.

REFERENCES:

1. Henry W.Ott, Noise Reduction Techniques in Electronic System, John Wiley and Sons, 2008
2. C.R. Paul, Introduction to Electromagnetic Compatibility, John Wiley and Sons, Inc, 2005
3. V.P.Kodali., Engineering EMC Principles, Measurements and Technologies, IEEE Press, 1996
4. Bernhard Keiser, Principles of Electromagnetic Compatibility, Artech house, 1986

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1703CO024	MACHINE LEARNING ALGORITHMS	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Soft Computing
2. Robotics and Automation

COURSE OBJECTIVES:

1. To understand the concepts of machine learning
2. To appreciate supervised and unsupervised learning and their applications
3. To understand the theoretical and practical aspects of Probabilistic Graphical Models
4. To appreciate the concepts and algorithms of reinforcement learning
5. To learn aspects of computational learning theory

UNIT I INTRODUCTION **9 Hours**

Machine Learning -Machine Learning Foundations –Overview –Design of a Learning system -Types of machine learning –Applications Mathematical foundations of machine learning -random variables and probabilities -Probability Theory –Probability distributions -Decision Theory-Bayes Decision Theory - Information Theory.

UNIT II SUPERVISED LEARNING **9 Hours**

Linear Models for Regression -Linear Models for Classification –Naïve Bayes -Discriminant Functions - Probabilistic Generative Models -Probabilistic Discriminative Models-Bayesian Logistic Regression. Decision Trees-Classification Trees-egression Trees -Pruning. Neural Networks -Feed-forward Network Functions - Back-propagation. Support vector machines -Ensemble methods-Bagging-Boosting.

UNIT III UNSUPERVISED LEARNING **9 Hours**

Clustering-K-means -EM Algorithm-Mixtures of Gaussians. The Curse of Dimensionality-Dimensionality Reduction -Factor analysis -Principal Component Analysis -Probabilistic PCA-Independent components analysis.

UNIT IV PROBABILISTIC GRAPHICAL MODELS **9 Hours**

Graphical Models -Undirected graphical models-Markov Random Fields-Directed Graphical Models - Bayesian Networks -Conditional independence properties -Inference –Learning-Generalization -Hidden Markov Models -Conditional random fields(CRFs).

UNIT V ADVANCED LEARNING **9 Hours**

Sampling–Basic sampling methods –Monte Carlo. Reinforcement Learning-K-Armed Bandit-Elements - Model-Based Learning-Value Iteration-Policy Iteration. Temporal Difference Learning-Exploration Strategies-Deterministic and Non-deterministic Rewards and Actions.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Computational Learning Theory -Mistake bound analysis, VC dimension.
2. Occam learning, Sample complexity analysis
3. Accuracy and confidence boosting.

COURSE OUTCOMES:

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

CO1 Design a neural network for an application of your choice.

CO2 Implement probabilistic discriminative and generative algorithms for an application of your choice and analyze the results.

CO3 Use a tool to implement typical clustering algorithms for different types of applications.

CO4 Design and implement an HMM for a sequence model type of application.

CO5 Identify applications suitable for different types of machine learning with suitable justification.

REFERENCES:

1. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.
2. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
3. EthemAlpaydin, "Introduction to Machine Learning", MIT Press,Third Edition, 2014.
4. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, Second Edition, 2011.
6. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Chapman and Hall/CRC Press, Second Edition, 2014

1703CP017	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Embedded Systems
2. Computer Organization and Architecture

COURSE OBJECTIVES:

1. To understand processors and their instruction sets for embedded systems.
2. To understand hardware platform for embedded systems.
3. To design and analyze programs for embedded systems.
4. To design multi-tasking embedded systems with RTOS.
5. To understand overall embedded systems development lifecycle.

UNIT I PROCESSORS AND INSTRUCTION SETS **9 Hours**

Introduction to embedded computing – overview of embedded system design process – instruction sets of processors: ARM, PIC, TI C55x, TI C64x – programming I/O – modes and exceptions – coprocessors – memory system – CPU performance – CPU power consumption.

UNIT II EMBEDDED COMPUTING PLATFORM **9 Hours**

Basic computing platforms – CPU Bus – memory devices and systems – choosing a platform – development environments – debugging – consumer electronics architecture – platform-level performance analysis – design example: Audio Player.

UNIT III PROGRAM DESIGN AND ANALYSIS **9 Hours**

Components for embedded programs – models of programs – Assembly, linking, and loading – compiler optimizations – program-level performance analysis – performance optimization – program-level energy optimization – optimizing program size – program validation and testing.

UNIT IV PROCESSES AND OPERATING SYSTEMS **9 Hours**

Multiples tasks and multiple processes – multirate systems – pre-emptive RTOS – priority-based scheduling – inter-process communication – evaluating OS performance – processes and power optimization – Case study: Real-time and embedded Linux – design example: Telephone answering machine.

UNIT V SYSTEM DESIGN, NETWORKS, AND MULTIPROCESSORS **9 Hours**

System design methodologies – requirements analysis – specifications – architecture design – quality assurance – distributed embedded systems – shared-memory multiprocessors – design example: Video accelerator.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Distributed Embedded Systems
2. Embedded and real time systems

COURSE OUTCOMES:

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

CO1 Develop assembly code for processors such as ARM, PIC Microcontroller, TI C55x, TI C64x, etc.
CO2 Choose appropriate hardware platform for a given application.
CO3 Perform platform-level performance analysis.
CO4 Design, develop, and debug embedded programs optimized for size or performance.
CO5 Develop embedded applications using an RTOS.

REFERENCES:

1. Marilyn Wolf, "Computers as Components: Principles of Embedded Computing Systems Design", Third Edition, Morgan Kaufmann, 2012.
2. Christopher Hallinan, "Embedded Linux Primer: A Practical Real-World Approach", Second Edition, Prentice Hall, 2010.
3. Karim Yaghmour et al., "Building Embedded Linux Systems", O'Reilly, 2008.
4. Arnold S. Berger, "Embedded Systems Design: An Introduction to Processes, Tools, and Techniques", CMP Books, 2001
5. David E. Simon, "An embedded Software Primer", Addison-Wesley, 1999.