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

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.

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NAGAPATTINAM – 611002

M.E. COMMUNICATION SYSTEMS

REGULATION - 2021

First Year – First Semester

Course Category		Course Name	L	T	P	C	Maximum Marks		
							CA	ES	Total
Theory Course									
FC	2101CO101	Applied Engineering Mathematics for Communication System	3	2	0	4	40	60	100
PCC	2102CO102	Antenna Design and Analysis	3	0	0	3	40	60	100
PEC	2103CO001	Program Elective – I (Electromagnetic Interference and Compatibility in System Design)	3	0	0	3	40	60	100
PEC	2103CO006	Program Elective – II (Network Routing Algorithms)	3	0	0	3	40	60	100
RMC	2101RMX01	Research Methodology and IPR	3	0	0	3	100	00	100
AC		Audit Course – I	2	0	0	0	100	00	100
Laboratory Course									
PCC	2102CO103	Communication System Laboratory	0	0	4	2	50	50	100
PCC	2102CO104	RF System Design Laboratory	0	0	2	1	50	50	100
Total			**17**	**0**	**6**	**19**	**560**	**340**	**900**

2101CO101	APPLIED ENGINEERING MATHEMATICS FOR COMMUNICATION SYSTEM	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, linear equations.	
	3. To acquire the knowledge of interest in Special functions	
MODULE I	**LINEAR PROGRAMMING**	**9 Hours**
Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models		
MODULE II	**ADVANCE MATRIX THEORY**	**9 Hours**
Diagonalization of symmetric matrices - Quadratic forms - Singular values decomposition - Change of basis, Cramer"s rule, Matrix factorizations.		
MODULE 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.		
MODULE IV	**RANDOM PROCESSES**	**9 Hours**
Classification – Auto Correlation – Cross Correlation – Stationary random process – Markov process –Markov Chain – Poisson process – Gaussian process.		
MODULE 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**

Entrepreneurship / Skill Development

COURSE OUTCOMES:	After completion of the course, Student will be able to
	1. Have knowledge in the fields of linear algebra and linear programming
	2. Provide the students with outstanding educational skills that will enable them to integrate under graduate fundamentals with advanced knowledge to solve complex problems
	3. 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**",JohnWiley &Sons, Ninth Edition,2008.
4. David C. Lay, Steven R Lay and Judy J McDonald "**Linear Algebra and it Applications**", Global Edition Pearson Education Ltd, 2015
5. Raisinghania. M. D, **Ordinary and partial differential equations**, S. Chand & Co, New Delhi, 2006.
6. Seymour Lipschutz, Marc Lipson,"**Schaum's Outline of Linear Algebra**", McGraw Hill, Fifth Edition, 2013
7. Taha H.A. —Operations Research: An introduction‖ Ninth Edition, Pearson Education, Asia, New Delhi 2012

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2102CO102	ANTENNA DESIGN AND ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn fundamental concepts of antennas
2. To explore the types of radiation from antennas and antenna arrays.
3. To design micro strip antennas and measure the antenna parameters

MODULE I	ANTENNA FUNDAMENTALS	9 Hours

Review of Electromagnetic Theory, Vector Potential Approach. Antenna fundamental parameters Solution Procedure Hertzian Dipole Short Dipole, Radiation Resistance and Directivity, Half-wave Dipole, Monopole, Small Loop Antenna.

MODULE II	APERTURE ANTENNAS	9 Hours

Aperture Antennas: Introduction, Magnetic Current and its Fields, Uniqueness Theorem Field Equivalence Principle, Huygens Principle - Radiation Equation – Directivity - Rectangular Aperture - TE10 - Mode - Circular Aperture - TE11 – Mode - Design Considerations - Fourier Transforms in Aperture Antenna Theory, E-Plane Sectoral Horn - applications.

MODULE III	ANTENNA SYNTHESIS	9 Hours

Linear array and Planar array - Characteristics, synthesis techniques - Fourier Transform method, and Taylor Line Source synthesis and Dolph - Chebyshev distributions. Circular array antennas.

MODULE IV	ANALYSIS AND DESIGN OF MICROSTRIP PATCH ANTENNAS	9 Hours

Configurations - Excitations and radiation mechanism of micro strip patch antennas - Radiation resistance - Power and input impendence. Modeling of rectangular and circular micro strip patch antennas - Transmission line model and cavity model method. Circular polarization and bandwidth of micro strip patch antennas. Simulation of micro strip antennas using Simulation Software-Case studies.

MODULE V	ANTENNAS FOR SPECIAL APPLICATIONS	9 Hours

Introduction. Antenna design considerations for satellite communication, architecturally acceptable antennas, ILS antennas, LEO satellite link antennas, UWB antennas fir digital applications, Plasma antenna.

Total: 45 Hours

COURSE OUTCOMES:

Employability

After completion of the course, Student will be able to

1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
2. Estimate the radiation pattern from aperture antennas.
3. Synthesis the antenna arrays using different techniques.
4. Design micro strip antennas and feed networks for micro strip antennas.
5. Design and Analyze the antennas for specific applications

REFERENCES:

1. Balanis. A, 'Antenna Theory Analysis and Design', John Wiley and Sons, New York, 1982
2. John D Kraus, 'Antennas for all applications', Third Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Hubregt. J. Visser 'Antenna Theory and Applications' 1st Edition, John Wiley & Sons Ltd, Newyork,2012.
4. Zhijun Zhang, 'Antenna Design for Mobile Devices', 1st Edition, John Wiley & Sons (Asia) Ltd, Newyork,2011
5. Xavier Begaud, 'Ultra-Wide Band Antennas', 1st Edition, ISTE Ltd and John Wiley & Sons Ltd, Newyork,2013.
6. I.J. Bahl and P. Bhartia, "Microstrip Antennas", Artech House,Inc.,1980

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2101RMX01	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:	1. Problem formulation, analysis and solutions.
	2. Technical paper writing / presentation without violating professional ethics
	3. Patent drafting and filing patents.

MODULE I	**RESEARCH PROBLEM FORMULATION**	**9 Hours**

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

MODULE II	**LITERATURE REVIEW**	**7 Hours**

Effective literature studies approaches, analysis, plagiarism, and research ethics.

MODULE III	**TECHNICALWRITING /PRESENTATION**	**9 Hours**

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

MODULE IV	**INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)**	**9 Hours**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

MODULE V	**INTELLECTUAL PROPERTY RIGHTS (IPR)**	**11 Hours**

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems. Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

	Total:	**45 Hours**

FURTHER READING:	
COURSE OUTCOMES:	
	After completion of the course, Student will be able to
	1. Ability to formulate research problem
	2. Ability to carry out research analysis
	3. Ability to follow research ethics
	4. Ability to understand that today`s world is controlled by Computer, Information Technology.but tomorrow world will be ruled by ideas, concept, and creativity
	5. Ability to understand about IPR and filing patents in R & D.

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guidefor beginners" 2010

2102CO103	COMMUNICATION SYSTEM 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 multirate 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

1. Able to learn about signal processing concepts and to implement the adaptive filteringalgorithms
2. Able to understand the image and speech processing algorithms
3. Able to analyze the various modulation, coding techniques and multirate systems

2102CO104	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:					
	After completion of the course, Student will be able to				
	1. Understanding of various MIC technologies				
	2. Knowledge of microstrip transmission lines and their parameters				
	3. Discussion about passive and non-passive reciprocal devices and their analysis				
	4. Learn the various coplanar MICs and their applications				
	5. Design of various microwave circuits like amplifiers, oscillators and mixers				