NEHRU INSTITUTE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

An ISO 9001 : 2015 and 14001:2015 Certified Institution, Affiliated to Anna University, Chennai(Approved by AICTE, New Delhi and Recognized by UGC with Section 2(f) and 12(B) Re-Accredited by NAAC "A+", NBA Accredited UG Courses : AERO & CSENehru Gardens, Thirumalayampalayam, Coimbatore-641 105

Moulding True Citizens

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM

M.E. – COMMUNICATION SYSTEMS

REGULATION - 2023

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

Our Vision is to mould the youngsters to acquire sound knowledge in technical and scientific fields to face the future challenges by continuous upgradation of all resources and processes for the benefit of humanity as envisaged by our great leader Pandit Jawaharlal Nehru.

MISSION

- To build a strong centre of learning and research in engineering and technology.
- To facilitate the youth to learn and imbibe discipline, culture and spirituality.
- To produce quality engineers, dedicated scientists and leaders.
- To encourage entrepreneurship.
- To face the challenging needs of the global industries.

VISION AND MISSION OF THE DEPARTMENT

VISION

To become a centre of excellence in electronics and communication engineering by impartingquality technical education imbibed with human Values and professional ethics, facilitating research activities and cater to the growing industrial demands and societal needs.

MISSION

- To educate and empower the students with state of art knowledge and latest trends in electronics and communication engineering to meet the growing real world challenges
- To inculcate professional ethics and moral values among the students.
- To impart industrial and managerial skills to promote self-employment and adapt to appropriate technology to meet the challenges arising out of global demand.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

A Graduate of the Communication Systems Program will be able to

- PEO1 : To provide students with strong fundamental concepts and also advanced techniques and tools to build various communication systems.
- PEO2 : To enable graduates to attain successful professional careers by applying their engineering skills in communication system design to meet out the challenges in industries and academia.
- PEO3: To engage graduates in lifelong learning, adapt emerging technology and pursue research for the development of innovative products.

PROGRAM OUTCOMES (POs)

1. An ability to independently carry out research/investigation and development work to solve practical problems.
2. An ability to write and present a substantial technical report/document.
3. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
4. Design and analyze RF, Signal processing, Networking, Adaptive and modern communication systems.
5. Develop the knowledge in 5G communication techniques, mm wave communication, smart antennas , Massive MIMO and Wireless sensor networks.
6. Apply various software tools and cutting edge engineering hardware to provide solutions for complex communication engineering problems.

PROGRAM SPECIFIC OUTCOMES (PSOs)

A Graduate of the Communication Systems Program will be able to

- **PSO1 :** To inculcate the ability in graduates to design and analyze the subsystemssuch as RF, Signal Processing, Modern communication systems and networks.
- **PSO2:** To enhance problem solving skills in communication systems design usinglatest hardware and software tools.
- **PSO3 :** To apply communication engineering principles and practices for developingproducts for scientific and business applications.

SCHEME OF EXAMINATION

M.E. – COMMUNICATION SYSTEMS

Regulation 2023 - Choice Based Credit System

(Applicable to students admitted from the year 2023 -2024 onwards)

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
THEORY								
I	P23LP101	Linear Algebra, Probability and Queueing Theory	FC	4	40	60	100	4
I	P23MG02	Research Methodology and IPR	RMC	2	40	60	100	2
I	P23EC103	Statistical Signal Processing	PCC	3	40	60	100	3
I	P23EC104	Modern Digital Communication Systems	PCC	3	40	60	100	3
I	P23EC105	Advanced Wireless Communication	PCC	3	40	60	100	3
I	P23EC106	Radiating Systems	PCC	3	40	60	100	3
I		Mandatory Course – I	MC	2	100	-	100	0
PRACTICAL								
I	P23EC118	Digital Communication Systems Laboratory	PCC	3	60	40	100	1.5
I	P23EC119	Advanced Digital Signal Processing Laboratory	PCC	3	60	40	100	1.5
TOTAL				**19**	**-**	**-**	**-**	**21**

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
THEORY								
II	P23EC201	RF System Design	PCC	3	40	60	100	3
II	P23EC202	Microwave Integrated Circuits	PCC	5	50	50	100	4
II	P23EC203	Advanced Wireless Networks	PCC	3	40	60	100	3
II	P23EC204	Machine Learning	PCC	5	50	50	100	4
II		Professional Elective I	PEC	3	40	60	100	3
II		Professional Elective II	PEC	3	40	60	100	3
II		Mandatory Course – II	MC	2	100	-	100	0
PRACTICAL								
II	P23EC218	Wireless Communication Laboratory	PCC	4	60	40	100	2
II	P23EC219	Term Paper Writing and seminar	EEC	2	60	40	100	1
TOTAL				**30**	**-**	**-**	**-**	**23**

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
THEORY								
III	P23EC301	Optical Communication and Networking	PCC	3	40	60	100	3
III		Professional Elective III	PEC	3	40	60	100	3
III		Professional Elective IV	PEC	5	50	50	100	4
III		Open Elective	OEC	3	40	60	100	3
PRACTICAL								
III	P23EC315	Project Work I	EEC	12	40	60	100	6
TOTAL				**26**	**-**	**-**	**-**	**19**

SEMESTER	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIOD/ WEEK	EXAMINATION MARKS			CREDITS
					CIA	ESE	TOTAL	
PRACTICAL								
IV	P23EC411	Project Work II	EEC	24	40	60	100	12
TOTAL				**24**	**-**	**-**	**-**	**12**

TOTAL NO. OF CREDITS: 75

CURRICULUM

AND

SYLLABUS

M.E. – COMMUNICATION SYSTEMS

Regulation 2023 – Choice Based Credit System

Semester–I

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
THEORY								
1.	P23LP101	Linear Algebra, Probability and Queueing Theory	FC	3	1	0	4	4
2.	P23MG02	Research Methodology and IPR	RMC	2	0	0	2	2
3.	P23EC103	Statistical Signal Processing	PCC	3	0	0	3	3
4.	P23EC104	Modern Digital Communication Systems	PCC	3	0	0	3	3
5.	P23EC105	Advanced Wireless Communication	PCC	3	0	0	3	3
6.	P23EC106	Radiating Systems	PCC	3	0	0	3	3
7.		Mandatory Course – I	MC	2	0	0	2	0
PRACTICAL								
8.	P23EC118	Digital Communication Systems Laboratory	PCC	0	0	3	3	1.5
9.	P23EC119	Advanced Digital Signal Processing Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**19**	**1**	**6**	**26**	**21**

Course Code	Title					
P23LP101	LINEAR ALGEBRA, PROBABILITY AND QUEUEING THEORY					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	1	0	4		
Course pre-requisites	Matrices and calculus, Statistics and numerical methods random processes and linear algebra					

Course Objectives

1	Grasp the basic concepts of Probability, Random variables, correlation and regression.
2	Characterize the phenomena which evolve with respect to time in a probabilistic manner.
3	Encourage students to develop a working knowledge of the ventral ideas of linear algebra.
4	Acquire skills in analyzing Queueing Models.
5	Develop a fundamental understanding of linear programming models and apply the simplex method for solving linear programming problems.

Course Category	Foundatation Course (FC)
Development Needs	Global / National

Course Description: This course is designed to provide necessary basic concepts in probability, standard distributions and random processes which are widely applied in random signals, linear systems in communication engineering and IT fields. It also covers the concepts of Markovian and advanced queueing models which are essential to design and analyze computer networks.

Course Content

Unit	Description	
I	**LINEAR ALGEBRA** : Vector spaces – Norms – Inner products – Eigenvalues using QR transformations – QR factorization – Generalized eigenvectors – Jordan Canonical forms – Singular value decomposition and applications – Pseudo inverse – Least square approximations.	
	Contact Periods	12
II	**PROBABILITY AND RANDOM VARIABLES** : Probability Concepts – Axioms of probability – Conditional probability – Bayes theorem – Random variables – Probability functions – Two-dimensional random variables – Joint distributions – Marginal and conditional distributions – Correlation – Linear Regression.	
	Contact Periods	12
III	**RANDOM PROCESSES**: Classification – Stationary random process – Markov process – Markov chain – Poisson process – Gaussian process – Auto correlation – Cross correlation.	
	Contact Periods	12
IV	**QUEUEING THEORY**: Markovian queues – Single and multi-server models – Little's formula – Steady state analysis – Self-service queue.	
	Contact Periods	12
V	**LINEAR PROGRAMMING**: Formulation – Graphical solution – Simplex method – Big M method – Variants of Simplex method – Transportation problems – Assignment models.	
	Contact Periods	12
	Total	**60 Periods**

Course Outcomes : At the end of the course the students will be able to		Knowledge Level
CO 1	Apply various methods in Linear Algebra to solve the system of linear equations.	K3
CO 2	Use two-dimensional random variables, correlations and regression in solving application problem.	K2
CO 3	Apply the ideas of Random Processes.	K3
CO 4	Understand the basic characteristic features of a queuing system and acquire skills in analysing queuing models.	K2
CO 5	Apply the Simplex method for solving linear programming problems.	K3
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6:Creating		

Reference Books

1. Miller,S.L. and Childers D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press,2004.
2. Friedberg A.H, Insel A.J. and Spence L, "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
3. Gross, D., Shortie, J.F., Thompson, J.M and Harris, C.M., "Fundamentals of Queueing Theory", 4th Edition, Wiley,2014.
4. T. Veerarajan, "Probability, Statistics and Random Process with Queueing Theory and Queueing Network, Tata McGraw Hill, 4th Edition,2017.
5. Taha H.A., "Operations Research: An Introduction", 9th Edition, Pearson Education Asia, New Delhi,2016.
6. Richard Bronson, "Matrix Operations" Schaum's outline series, McGraw Hill, 2nd Edition, New York,2011.
7. Oliver C. Ibe, " Fundamentals of Applied Probability and Random Processes", Academic Press, (An Imprint of Elsevier), Boston, 2014.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment / Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO 1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	2	2	-	-						
CO2	3	2	2	2	-	-						
CO3	3	2	2	2	-	-						
CO4	3	2	2	2	-	-						
CO5	3	2	2	2	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	1	-
CO2	2	1	-
CO3	2	1	-
CO4	2	1	-
CO5	2	1	-

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS Dr. P. T. HEMAMALINI Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105
Dr. A. Sangeetha Devi Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Course Code	Title					
P23MG02	RESEARCH METHODOLOGY AND IPR					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	2	0	0	2		
Course pre-requisites	NIL					

Course Objectives

1	Identify an appropriate research problem in their interesting domain.
2	Understand ethical issues of preparation of research project thesis.
3	Understand the preparation of a research project thesis report.
4	Understand the law of patents and copyrights
5	Understand the adequate knowledge on IPR.

Course Category	Research Methodology and IPR Course (RMC)
Development Needs	Global / National

Course Description: The Research Methodology and IPR course has been rigorously crafted to provide a thorough understanding of the fundamentals of research methodology as well as the vital area of Intellectual Property Rights (IPR).

Course Content

Unit	Description	
I	**RESEARCH DESIGN:** Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.	
	Contact Periods	**06**
II	**DATA COLLECTION AND SOURCES:** Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.	
	Contact Periods	**06**
III	**DATA ANALYSIS AND REPORTING :** Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.	
	Contact Periods	**06**
IV	**INTELLECTUAL PROPERTY RIGHT** : Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.	
	Contact Periods	**06**
V	**PATENTS** : Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.	
	Contact Periods	**06**
	Total Periods	**30**

Course Outcomes		
Upon successful completion of the course, students will be able to:		
CO1	Identify an appropriate research problem in their interesting domain.	K2
CO2	Understand ethical issues of preparation of research project thesis.	K2
CO3	Understand the preparation of a research project thesis report.	K2
CO4	Understand the law of patents and copyrights.	K2
CO5	Understand the adequate knowledge on IPR.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods",Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	1	1	1	1						
CO2	1	1	1	1	1	1						
CO3	1	1	1	1	1	1						
CO4	1	1	1	1	1	1						
CO5	1	1	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Sukanya.S, MBA Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. P.T. VIJAYA RAJAKUMAR
Professor and Director
Department of Management Studies
Nehru Institute of Engineering and Technology
Coimbatore

Course Code	Title					
P23EC103	STATISTICAL SIGNAL PROCESSING					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	To understand the basics of discrete time random processes.
2	To apply appropriate model for estimation and signal modeling for the given problem
3	To analyze non-parametric and parametric methods for spectral estimation.
4	To design optimum filter for the given problem.
5	To design adaptive filters for different applications.

Course Category	Professional Core Courses (PCC)
Development Needs	Global / National

Course Description: Many practical signals are either random or have been represented as random processes. Statistical Signal Processing involves the processing of these signals and serves as the foundation for modern communication and signal processing systems. This course will cover the three main areas of statistical signal processing: random signal modeling, estimation theory and filters design.

Course Content

Unit	Description	
I	**DISCRETE RANDOM SIGNAL PROCESSING :**Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Auto covariance and Cross covariance- Properties – White noise process – Wiener Khintchine relation - Power spectral density – Filtering random process – Spectral factorization Theorem – Special types of Random Processes – AR, MA, and ARMA Processes – Yule-Walker equations.	
	Contact Periods	**09**
II	**PARAMETER ESTIMATION THEORY**: Principle of estimation and applications-Properties of estimates-unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE)-Cramer Rao bound- Efficient estimators; Criteria of estimation: Methods of maximum likelihood and its properties ; Bayesian estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation	
	Contact Periods	**09**
III	**SPECTRUM ESTIMATION**: Estimation of spectra from finite duration signals, Bias and Consistency of estimators - Non- Parametric methods: Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric Methods: AR, MA and ARMA spectrum estimation - Detection of Harmonic signals - Performance analysis of estimators. MUSIC and ESPRIT algorithms	
	Contact Periods	**09**
IV	**SIGNAL MODELING AND OPTIMUM FILTERS**: Introduction- Least square method – Pade approximation – Prony's method – Levinson Recursion– Lattice filter - FIR Wiener filter – Filtering – Linear Prediction – Non Causal and Causal IIR Wiener Filter –- MSE – State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter	
	Contact Periods	**09**

V	**ADAPTIVE FILTERS**: FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS Adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echo canceller, Adaptive Recursive Filters: RLS adaptive algorithm, Exponentially weighted RLS-sliding window RLS. Matrix inversion Lemma, Initialization, tracking of non stationarity
	Contact Periods 09
	Total Periods 45

Course Outcomes

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

CO1	Understand the basics of discrete time random processes.	K2
CO2	Apply appropriate model for estimation and signal modeling for the given problem.	K3
CO3	Analyze non-parametric and parametric methods for spectral estimation.	K4
CO4	Design optimum filter for the given problem.	K6
CO5	Design adaptive filters for different applications.	K6

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO 2	PO3	PO4	PO5	PO6						
CO1	3	1	1	1	3	3						
CO2	3	1	1	1	3	3						
CO3	3	1	1	1	3	3						
CO4	3	1	1	1	3	3						

CO5	3	1	1	1	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	1	3
CO2	3	1	3
CO3	3	1	3
CO4	3	1	3
CO5	3	1	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. V. JAYARAJ Prof. & Head / ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC104	MODERN DIGITAL COMMUNICATION SYSTEMS					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

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

Course Category	Professional Core Courses (PCC)
Development Needs	Global / National

Course Description: The goal is to present the engineering principles, concepts, and techniques required for the successful design of a digital communication system. The course will look at the design concepts of transmitters and receivers in order to construct an efficient communication link.. It will discuss strategies for analyzing the performance of digital communication systems.

Course Content

Unit	Description	
I	**COHERENT AND NON-COHERENT COMMUNICATION**: Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Non coherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M- DPSK-BER Performance Analysis. Carrier Synchronization Bit synchronization.	
	Contact Periods	**09**
II	**EQUALIZATION TECHNIQUES:** Band Limited Channels- ISI – Nyquist Criterion-Controlled ISI-Partial Response signals- Equalization algorithms– Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.	
	Contact Periods	**09**
III	**BLOCK CODED DIGITAL COMMUNICATION:** Architecture and performance – Binary block codes; – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.	
	Contact Periods	**09**
IV	**CONVOLUTIONAL CODED DIGITAL COMMUNICATION**: 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.	
	Contact Periods	**09**
V	**MULTICARRIER AND MULTIUSER COMMUNICATIONS**: 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.	
	Contact Periods	**09**

	Total Periods	**45**
Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Differentiate coherent and non-coherent receivers and analyze their performance under AWGN channel conditions	K2
CO2	Illustrate the effect of signaling through band limited channels and Equalization techniques used to overcome ISI	K3
CO3	Determine the channel capacity and design various block coding techniques to combat channel errors	K4
CO4	Construct convolutional coders and analyze the performance of different decoding techniques	K5
CO5	Describe the basics of OFDM as a multicarrier communication and CDMA as a multiuser Communication technique.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	-	3	2	2	1						
CO2	2	-	3	2	2	1						
CO3	2	-	3	2	2	1						
CO4	2	-	3	2	2	1						
CO5	2	-	3	2	2	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	1	3	2
CO3	1	3	2
CO4	1	3	2
CO5	1	3	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. M. A. RAJA Department of Electronics & Communication Engineering Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC105	ADVANCED WIRELESS COMMUNICATION					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	To learn the concepts of Wireless Communication
2	To the capacity calculation under different channel conditions
3	To know about the various propagation methods, Channel models, capacity calculations
4	To know the concepts in MIMO Communications
5	To know multiple antennas and multiple user techniques used in the mobile communication

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description:
Students will be able to grasp wireless channel characteristics and modeling, wireless communication principles and methodologies, and how to use these concepts in a cellular system. They will be able to learn about contemporary advancements including opportunistic and multiple input multiple output (MIMO) communication strategies.

Course Content

Unit	Description	
I	**WIRELESS CHANNEL PROPAGATION AND MODEL:** Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-free space, two ray. Small scale fading- channel classification- channel models – COST -231 Hata model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements, propagation scenarios, METIS channel models, Map-based model, stochastic model.	
	Contact Periods	**09**
II	**CAPACITY OF WIRELESS CHANNELS:** Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels. Capacity of MISO, SIMO systems	
	Contact Periods	**09**
III	**DIVERSITY:** 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	
	Contact Periods	**09**
IV	**MIMO COMMUNICATIONS :** 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.	
	Contact Periods	**09**
V	**MULTI USER SYSTEMS**: Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, MIMO-MUD Application of convex optimization to wireless design.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Analyze the wireless channel characteristics and identify appropriate channel models.	K4
CO2	Understand the mathematics behind the capacity calculation under different channel conditions.	K2
CO3	Understand the implication of diversity combining methods and the knowledge of channel.	K2
CO4	Understand the concepts in MIMO Communications.	K2
CO5	Understand multiple access techniques and their use in different multi-user scenarios.	K2
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating		

Reference Books

1. David Tse and Pramod Viswanath, Fundamentals of wireless communications, Cambridge University Press, First Edition, 2012
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007
3. Harry R. Anderson, "Fixed Broadband Wireless System Design", John Wiley, India, 2003.
4. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2006
5. Simon Haykin & Michael Moher, "Modern Wireless Communications", Pearson Education,2007
6. Rappaport. T.S., "Wireless communications", Pearson Education, 2003
7. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
8. Upena Dalal, "Wireless Communication", Oxford Higher Education, 2009

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	1	1	-	-	2						
CO2	2	-	1	2	1	-						
CO3	2	1	1	1	-	-						
CO4	2	1	1	1	2	2						
CO5	1	-	1	1	-	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	-	1
CO2	1	2	-
CO3	2	1	-
CO4	1	1	2
CO5	-	1	-

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
K. NAVARASAN / Electronics & Comm Engg Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS Dr. V. JAYARAJ Professor & Head Department of ECE Nehru Inst. of Engg. & Technology T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC106	RADIATING SYSTEMS					
Semester: I	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	To understand Antenna basics.
2	To learn about Antenna arrays and their characteristics.
3	To study about operating Antennas.
4	To familiarize with modern Antennas and Measurement Techniques.
5	To learn about recent trends in Antenna Design.

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: This course is an advance course towards antenna design and engineering. This course will familiarize student with different practical aspects of antenna design and radiation mechanism.

Course Content

Unit	Description	
I	**ANTENNA FUNDAMENTALS & WIRE ANTENNAS:** Introduction –Types of Antennas – Radiation Mechanism – Current distribution on wire antennas – Maxwell's equations – Antenna fundamental parameters – Radiation integrals – Radiation from surface and line current distributions – dipole, monopole, loop antenna .	
	Contact Periods	**09**
II	**ANTENNA ARRAYS:** Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Linear array synthesis techniques – Binomial and Chebyshev distributions; Two dimensional uniform arrays; phased array antennas, smart antennas, switched beam and adaptive arrays, Mutual Coupling in Finite Arrays	
	Contact Periods	**09**
III	**APERTURE ANTENNAS:** Field equivalence principle, Radiation from Rectangular and Circular apertures, Babinets principle, Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration. Radiation Mechanism and Excitation techniques, Microstrip dipole; Patch, Rectangular patch, Circular patch – Microstrip array and feed network; Lens Antennas.	
	Contact Periods	**09**
IV	**MODERN ANTENNAS & MEASUREMENT TECHNIQUES:** Base station antennas, PIFA – Antennas for WBAN – RFID Antennas – Automotive antennas, MIMO Antennas, Diversity techniques – Antenna impedance and radiation pattern measurements.	
	Contact Periods	**09**
V	**RECENT TRENDS IN ANTENNA DESIGN**: UWB antenna arrays – Vivaldi antenna arrays – Artificial magnetic conductors/ High impedance surfaces – Antennas in medicine – Plasma antennas – Antennas for millimeter wave communication - optimization techniques – Numerical methods .	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Understand the fundamentals behind the different techniques in antenna technology	K2
CO2	Understand the challenges associated in designing antennas based on different technologies	K2
CO3	Understand the capability and assess the performance of various antennas	K2
CO4	Identify the antennas specific to the applications, design and characterize	K2
CO5	Understand the need for optimizing in antenna design and the methodologies for the same.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 3rd Edition, 1982
2. Frank B. Gross, "Frontiers in Antennas", Mc Graw Hill, 2011.
3. S.Drabowitch, A.Papiernik, H.D.Griffiths, J.Encinas, B.L.Smith, "Modern Antennas", Springer Publications, 2nd Edition, 2007
4. Krauss.J.D, "Antennas", John Wiley and sons, New York, 2nd Edition, 1997
5. I.J. Bahl and P. Bhartia,"Microstrip Antennas", Artech House,Inc.,1980
6. Jim R. James,P.S.Hall ,"Handbook of Microstrip Antennas" IEE Electromagnetic wave series 28, Volume 2,1989.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	-	1	1	1	-						
CO2	3	-	2	1	1	-						
CO3	2	-	2	1	2	-						
CO4	3	-	2	3	3	-						
CO5	2	3	2	3	3	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	1	-
CO2	2	2	-
CO3	1	2	1
CO4	1	3	1
CO5	3	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S. MOHAN Electronics & communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS DR. V. JAYARAJ Professor & Head Department of ECE Nehru Inst. of Engg. & Technology T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC118	DIGITAL COMMUNICATION SYSTEMS LABORATORY					
Semester: I	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	3	1.5		
Course pre-requisites	NIL					

Course Objectives

1	To study & measure the performance of digital communication systems
2	To provide a comprehensive knowledge of Wireless Communication
3	To learn about the design of digital filter and its adaptive filtering algorithms.
4	To analyze the performance of optimization algorithms for equalizing the channel or noise/echo cancellation
5	To design synchronization algorithm for Digital Communication systems

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: This course provides students with in-depth knowledge of digital communication systems in practice. This lab covers the essential ideas of OFDM, Digital Modulation Techniques, SDR and MIMO systems.

Course Content

LIST OF EXPERIMENTS

1. Generation & detection of binary digital modulation techniques using SDR
2. Spread Spectrum communication system-Pseudo random binary sequence generation Baseband DSSS.
3. MIMO system transceiver design using MATLAB/SCILAB/LABVIEW
4. Performance evaluation of simulated CDMA system
5. Channel Coder/decoder design (block codes / convolutional codes/ turbo codes)
6. OFDM transceiver design using MATLAB /SCILAB/LABVIEW
7. Channel equalizer design using MATLAB (LMS, RLS algorithms)
8. Design and Analysis of Spectrum Estimators (Bartlett, Welch) using MATLAB
9. BER performance Analysis of M-ary digital Modulation Techniques (coherent & non 18 coherent) in AWGN Environment using MATLAB/SCILAB/LABVIEW
10. Design and performance analysis of Lossless Coding Techniques - Huffman Coding and Lempel Ziv Algorithm using MATLAB/SCILAB/LABVIEW
11. Noise / Echo cancellation using MATLAB (LMS / RLS algorithms).
12. Study of synchronization (frame, bit, symbol.)
13. Wireless channel characterization.

Contact Periods	**45**

Course Outcomes
Upon successful completion of the course, students will be able to:

CO1	Implement the adaptive filtering algorithms	K5
CO2	Generate and detect digital communication signals of various modulation techniques using MATLAB.	K5
CO3	Evaluate cellular mobile communication technology and propagation mode	K5
CO4	Apply mathematical formulation to analyze spectrum estimation of a signal and bit rate determination of a transmission link	K3
CO5	Analyze the performance of optimization algorithms for equalizing the channel or noise/echo cancellation	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Tools for Assessment (40 Marks)

Preparation	Conduct of Experiments	Calculations & Result	Viva-Voce	Total
20	30	40	10	100

Tools for Assessment (20 Marks)

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	3	3	2	3	2						
CO2	2	3	3	2	3	2						
CO3	2	3	3	2	3	2						
CO4	2	3	3	2	3	2						
CO5	2	3	3	2	3	2						
CO6	2	3	3	2	3	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3
CO6	3	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
K. NAVANEETHAN / Electronics & Comm'cation Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC119	ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY					
Semester: I	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	3	1.5		

Course pre-requisites	NIL

Course Objectives

1	To enable the student to verify the basic principles of random signal processing
2	To know spectral estimation methods and additive white Gaussian noise (AWGN) channel characterization
3	To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.
4	To implement adaptive filters using LMS/RLS algorithm
5	To analyze the discrete time systems at various sampling rates

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: This course develops the theory essential to understanding the algorithms that are increasingly found in modern signal processing applications, such as speech, image processing, digital radio and audio, statistical and adaptive systems.

Course Content

LIST OF EXPERIMENTS

1. Generation of Standard discrete time sequences (Unit Impulse, Unit Step, Unit Ramp, Sinusoidal and exponential signals) and carrying out of arithmetic operations and plot the results
2. Generation of random sequences satisfying the given probability distributions such as Uniform, Gaussian, Rayleigh and Rician.
3. Design of FIR filters for the given specification and plot the frequency response of the designed filter
4. Design of IIR filters for the given specification and plot the frequency response of the designed filter
5. Analysis of finite word length effects of FIR filter coefficients
6. Estimation of power spectrum of the given random sequence using Nonparametric methods (Bartlett, Welch and Blackman Tukey)
7. Estimation of power spectrum of the given random sequence using parametric methods (AR, MA and ARMA)
8. Up sampling the discrete time sequence by L times and plot the spectrum of both the given sequence and up sampled sequence
9. Down sampling the discrete time sequence by M times and plot the spectrum of both the given sequence and down sampled sequence
10. Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using LMS Algorithm
11. Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using RLS Algorithm
12. Implementation of Digital Filter Banks for the given specifications

Contact Periods	**45**

Course Outcomes
Upon successful completion of the course, students will be able to:

CO1	Generate deterministic/Random sequences using simulation too	K4
CO2	Design and analyze the frequency response of FIR/IIR digital filters for the given specifications	K6

CO3	Estimate power spectrum of the given random sequence using parametric/nonparametric estimation methods	K5
CO4	Implement adaptive filters using LMS/RLS algorithm	K6
CO5	Analyze the discrete time systems at various sampling rates	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Tools for Assessment (40 Marks)

Preparation	Conduct of Experiments	Calculations & Result	Viva-Voce	Total
20	30	40	10	100

Tools for Assessment (20 Marks)

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	-	-	-	1						
CO2	1	1	-	-	-	1						
CO3	1	1	-	-	-	1						
CO4	2	1	1	1	-	1						
CO5	1	1	-	-	-	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	-	-
CO2	1	-	-
CO3	1	-	-
CO4	1	-	-
CO5	1	-	-

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S. MOHAN Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Semester–II

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
THEORY								
1.	P23EC201	RF System Design	PCC	3	0	0	3	3
2.	P23EC202	Microwave Integrated Circuits	PCC	3	0	2	5	4
3.	P23EC203	Advanced Wireless Networks	PCC	3	0	0	3	3
4.	P23EC204	Machine Learning	PCC	3	0	2	5	4
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Mandatory Course – II	MC	2	0	0	2	0
PRACTICAL								
8.	P23EC218	Wireless Communication Laboratory	PCC	0	0	4	4	2
9.	P23EC219	Term Paper Writing and seminar	EEC	0	0	2	2	1
			TOTAL	**20**	**0**	**10**	**30**	**23**

Course Code	Title					
P23EC201	RF SYSTEM DESIGN					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Advanced Wireless Communication					

Course Objectives

1	Be familiar with RF transceiver system design for wireless communications.
2	Be exposed to design methods of receivers and transmitters used in communication systems.
3	Design RF circuits and systems using an advanced design tool.
4	Exemplify different synchronization methods circuits and describe their block schematic and design criteria.
5	Measure RF circuits and systems with a spectrum analyzer.

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: This course will provide students with a thorough grasp of RF transceiver architecture, including components such as amplifiers, LNA, power amplifiers, mixers, oscillators, VCOs, an introduction to PLL and synthesizers, and how they are integrated into a complete system.

Course Content

Unit	Description	
I	**BASICS OF RADIO FREQUENCY SYSTEM DESIGN**: Definitions and models of Linear systems and Non-linear system. Specification parameters: Gain, noise figure, SNR, Characteristic impedance, S-parameters, Impedance matching and Decibels. Elements of digital base band signalling: complex envelope of band pass signals, Average value, RMS value, Crest factor, Sampling, jitter, modulation techniques, filters, pulse shaping, EVM, BER, sensitivity, selectivity, dynamic range and, adjacent and alternate channel power leakages	
	Contact Periods	**09**
II	**RADIO ARCHITECTURES AND DESIGN CONSIDERATIONS**: Superheterodyne architecture, direct conversion architecture, Low IF architecture, band-pass sampling radio architecture, System Design Considerations for an Analog Frontend Receiver in Cognitive Radio Applications, Interference, Near, In-band & wide-band considerations.	
	Contact Periods	**09**
III	**AMPLIFIER MODELING AND ANALYSIS**: Noise: Noise equivalent model for Radio frequency device, amplifier noise model, cascade performance, minimum detectable signal, performance of noisy systems in cascade. Non-Linearity: Amplifier power transfer curve, gain compression, AM-AM, AM-PM, polynomial approximations, Saleh model, Wiener model and Hammerstein model, intermodulation, Single- and two-tone analyses, second and third order distortions and measurements, SOI and TOI points, cascade performance of nonlinear systems.	
	Contact Periods	**09**
IV	**MIXER AND OSCILLATOR MODELING AND ANALYSIS**:Mixers: Frequency translation mechanisms, frequency inversion, image frequencies, spurious calculations, principles of mixer realizations. Oscillators: phase noise and its effects, effects of oscillator spurious components, frequency accuracy, oscillator realizations: Frequency synthesizers, NCO.	
	Contact Periods	**09**

V	**APPLICATIONS OF SYSTEMS DESIGN**: Multimode and multiband Superheterodyne transceiver: selection of frequency plan, receiver system and transmitter system design – Direct conversion transceiver: receiver system and transmitter system design.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

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

CO1	Understand the specifications of transceiver modules.	K2
CO2	Understand pros and cons of transceiver architectures and their associated design considerations.	K2
CO3	Understand the impact of noise and amplifier non-linearity of amplification modules and also will learn the resultant effect during cascade connections.	K2
CO4	Get exposure about spurs and generation principles during signal generation and frequency translations.	K2
CO5	Understand the case study of transceiver systems and aid to select specification parameters.	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge University Press, 2004.
2. Qizheng Gu, "RF System Design of Transceivers for Wireless Communications", Springer ,2005.
3. Kevin McClaning, "Wireless Receiver Design for Digital Communications," Yes Dee Publications, 2012.
4. M C Jeruchim, P Balapan and K S Shanmugam, "Simulation of Communication systems:Modeling, Methodology and Techniques", Kluwer Academic/Plenum Publishers, 2 nd Edition, 2000.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	2	2	2	2						
CO2	3	2	2	3	3	2						
CO3	2	3	3	2	3	1						
CO4	1	2	3	3	3	3						
CO5	2	1	1	2	2	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	2	2
CO2	3	3	3
CO3	3	3	2
CO4	2	3	3
CO5	2	2	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S. ROHAN Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 10

Course Code	Title					
P23EC202	MICROWAVE INTEGRATED CIRCUITS					
Semester: II	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	RADIATING SYSTEMS					

Course Objectives

1	To familiarize different transmission lines used at Microwave frequencies.
2	To design impedance matching networks using lumped and distributed elements.
3	To design and analyze different microwave components.
4	To use SMITH chart to analyze the region of stability and instability for designing amplifiers and oscillators.
5	To simulate and to test the microwave components under laboratory conditions.

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: Microwave Integrated Circuits is a course that will introduce students, engineers, and scholars to the topic of microwave engineering. Because dispersed circuit effects become more noticeable at microwave frequencies, new circuit theories based on Maxwell's principles must be developed. Furthermore, novel circuit design methodologies and parts are introduced.

Course Content

Unit	Description	
I	**PLANAR TRANSMISSION LINES AND COMPONENTS**: Review of Transmission line theory – S Parameters-Transmission line equations – reflection coefficient – VSWR – Microstrip lines: Structure, waves in microstrip, Quasi-TEM approximation, Coupled lines: Even mode and odd mode analysis – Microstrip discontinuities and components – Strip line – Slot line – Coplanar waveguide – Filters – Power dividers and Couplers	
	Contact Periods	**09**
II	**IMPEDANCE MATCHING NETWORKS**: 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	
	Contact Periods	**09**
III	**MICROWAVE AMPLIFIER AND OSCILLATOR DESIGN**: Characteristics of microwave transistors – Stability considerations in active networks – Gain Consideration in Amplifiers – Noise Consideration in active networks – Broadband Amplifier design – Oscillators: Oscillator versus Amplifier Design – Oscillation conditions – Design and stability considerations of Microwave Transistor Oscillators.	
	Contact Periods	**09**
IV	**MIXERS AND CONTROL CIRCUITS**: Mixer Types – Conversion Loss – SSB and DSB Mixers – Design of Mixers: Single Ended Mixers – Single Balanced Mixers – Sub Harmonic Diode Mixers, Microwave Diodes, Phase Shifters – PIN Diode Attenuators	
	Contact Periods	**09**
V	**MICROWAVE IC DESIGN AND MEASUREMENT TECHNIQUES**: 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, thermal and cryogenic	

measurements, experimental field probing techniques.	
Contact Periods	**09**
Total Periods	**45**

LIST OF EXPERIMENTS

1. Study of transmission line parameters.
2. Impedance analysis Design of impedance matching networks.
3. Design of low pass and high pass filter.
4. Design of band-pass and band-stop filters.
5. Design of branch line couplers.
6. Design of phase shifters.
7. Design of Mixers.
8. Design of Power dividers.

Total Periods	**30**

Course Outcomes

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

CO1	Understand the concepts of planar transmission line	K2
CO2	Design impedance matching circuits using LC components and stubs.	K5
CO3	Design and analyze microwave components.	K5
CO4	Perform stability analysis and be able to design amplifiers and oscillators at microwave frequencies	K4
CO5	Perform simulations, fabricate and test microwave devices	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Jia Sheng Hong, M. J. Lancaster, "Microstrip Filters for RF/Microwave Applications", John Wiley & Sons, 2001.
2. David M. Pozar, "Microwave Engineering", John Wiley & Sons, 4th edition 2012.
3. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition,2001.
4. Thomas H.Lee, "Planar Microwave Engineering", Cambridge University Press, 2004 .
5. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, 2002.

Tools for Assessment - Theory

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total

10	10	10	5	5	40

Tools for Assessment – Practical

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	2	3	3	3						
CO2	2	2	2	3	3	3						
CO3	3	2	3	3	3	3						
CO4	2	2	2	3	3	2						
CO5	2	2	2	3	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	3	3
CO2	3	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
K SIVAKAMI, AP/ ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC203	ADVANCED WIRELESS NETWORKS					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Modern Digital Communication Systems					

Course Objectives

1	Study about advanced wireless network, LTE, 4G and Evolutions from LTE to LTE.
2	Study about wireless IP architecture, Packet Data Protocol and LTE network architecture.
3	Study about adaptive link layer, hybrid ARQ and graphs routing protocol.
4	Study about mobility management.
5	Study about cellular network, and micro cellular networks.

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: This course will cover the fundamental aspects of wireless networks, with emphasis on current and next-generation wireless networks. Various aspects of wireless networking will be covered including: Network Layers, quality of service, mobile management, etc. The goal of this course is to introduce the students to state-of-the-art wireless network protocols and architectures.

Course Content

Unit	Description	
I	**INTRODUCTION**: Introduction to 1G/2G/3G/4G Terminology. Evolution of Public Mobile Services -Motivation for IP Based Wireless Networks -Requirements and Targets for Long Term Evolution (LTE) - Technologies for LTE- 4G Advanced Features and Roadmap Evolutions from LTE to LTE-A - Wireless Standards. Network Model-Network Connectivity-Wireless Network Design with Small World Properties	
	Contact Periods	**09**
II	**WIRELESS IP NETWORK ARCHITECTURES** :3GPP Packet Data Networks - Network Architecture - Packet Data Protocol (PDP) Context Configuring PDP Addresses on Mobile Stations - Accessing IP Networks through PS Domain – LTE network Architecture - Roaming Architecture- Protocol Architecture- Bearer Establishment Procedure -Inter-Working with other RATs	
	Contact Periods	**09**
III	**ADAPTIVE LINK AND NETWORK LAYER**: Link Layer Capacity of Adaptive Air Interfaces-Adaptive Transmission in Ad Hoc Networks' Adaptive Hybrid ARQ Schemes for Wireless Links-Stochastic Learning Link Layer Protocol Infrared Link Access Protocol-Graphs and Routing Protocols-Graph Theory-Routing with Topology Aggregation-Network and Aggregation Models	
	Contact Periods	**09**
IV	**MOBILITY MANAGEMENT**: Cellular Networks-Cellular Systems with Prioritized Handoff-Cell Residing Time Distribution Mobility Prediction in Pico- and Micro-Cellular Networks	
	Contact Periods	**09**
V	**QUALITY OF SERVICE**: QoS Challenges in Wireless IP Networks - QoS in 3GPP - QoS Architecture, Management and Classes -QoS Attributes - Management of End-to-End IP QoS - EPS Bearers and QoS in LTE networks	
	Contact Periods	**09**

Total Periods	**45**

Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Get an exposure to the latest 4G networks and LTE.	K2
CO2	Understand about the wireless IP architecture and LTE network architecture.	K2
CO3	Know the adaptive link layer and network layer graphs and protocol.	K2
CO4	Understand,the mobility management and cellular network.	K2
CO5	Understand the wireless sensor network architecture and its concept.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	1. Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", John Wiley & Sons, 2014. 2. Crosspoint Boulevard, "Wireless and Mobile All-IP Networks", Wiley Publication, 2005. 3. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols", John Wiley & Sons, Inc. Publication,2006. 4. Minoru Etoh, "Next Generation Mobile Systems 3G and Beyond," Wiley Publications,2005. 5. Savo Glisic," Advanced Wireless Networks-Technology and Business Models", Third Edition, John Wiley & Sons, Ltd, 2016 6. Savo Glisic,"Advanced Wireless Networks-4G Technologies", John Wiley & Sons, Ltd,2006. 7. Stefania Sesia, IssamToufik and Matthew Baker, "LTE – The UMTS Long Term Evolution From Theory to Practice", John Wiley & Sons, Inc. Publication, Second Edition, 2011.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	-	3	3	2	3						
CO2	3	-	3	3	2	3						
CO3	3	-	3	3	2	3						
CO4	3	-	3	3	2	3						
CO5	3	-	3	3	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	2	3	3
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

Course designed by	Verified by
P. Nagie Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. D. NAGESWARI Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC204	MACHINE LEARNING					
Semester: II	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	Statistical Signal Processing					

Course Objectives

1	To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning.
2	To explore the different supervised learning techniques including ensemble methods.
3	To learn different aspects of unsupervised learning and reinforcement learning.
4	To learn the role of probabilistic methods for machine learning.
5	To understand the basic concepts of neural networks and deep learning.

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: Machine learning is the study of how to create computer systems that learn via experience. The course will use real-world examples to demonstrate how to create systems that learn and adapt. The key subjects covered include linear discriminants, neural networks, decision trees, support vector machines, unsupervised learning, and reinforcement learning.

Course Content

Unit	Description	
I	**INTRODUCTION AND MATHEMATICAL FOUNDATIONS:** What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory.	
	Contact Periods	**09**
II	**SUPERVISED LEARNING: Introduction**-Discriminative and Generative Models - Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbours - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms.	
	Contact Periods	**09**
III	**UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING: Introduction** - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning	
	Contact Periods	**09**
IV	**PROBABILISTIC METHODS FOR LEARNING: Introduction** -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks - Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models.	
	Contact Periods	**09**

V	**NEURAL NETWORKS AND DEEP LEARNING**: Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases	
	Contact Periods	**09**
	Total Periods	**45**

LIST OF EXPERIMENTS

Suggested Activities:

1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

Practical Exercises:

1.Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.

2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.

3. Classification with Nearest Neighbours. In this question, you will use the scikit-learn's KNN classifer to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset

4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.

5.Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset

6.Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset

7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.

a. Your project may be,a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.

b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.

c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.

d. You must properly provide references to any work that is not your own in the write-up.

e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)

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

Total Periods	**30**

Course Outcomes

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

CO1	Understand and outline problems for each type of machine learning	K2
CO2	Design a Decision tree and Random Forest for an application	K6
CO3	Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.	K5
CO4	Use a tool to implement typical Clustering algorithms for different types of applications	K5
CO5	Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification	K6

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: From Theory to Algorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

Tools for Assessment - Theory

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Tools for Assessment – Practical

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	1	2	-	-	3						
CO2	3	1	2	-	-	3						
CO3	3	1	2	-	-	3						
CO4	3	1	2	-	-	3						
CO5	3	1	2	-	-	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	1	2
CO3	3	1	2
CO4	3	1	2
CO5	3	1	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S.THOHAN Electronics & Communication Engg. Name and Department of the Faculty Member	Dr. V. JAYARAJ Professor & Head Department of ECE Nehru Inst. of Engg. & Technology T.M. Palayam, Coimbatore - 641 105 Name and Seal of the Chairperson-BoS

Course Code	Title					
P23EC218	WIRELESS COMMUNICATION LABORATORY					
Semester: II	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	4	2		
Course pre-requisites	Advanced Wireless Communication					

Course Objectives

1	To enable the student to verify the basic principles of random signal processing, spectral estimation methods, wireless and AWGN channel characterization,
2	To know the application of adaptive filter algorithms for communication system design, coding and modulation design, synchronization aspects and the overall baseband system design
3	To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts
4	To enable the student to appreciate the practical aspects of baseband system design and understand the associated challenges.

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: The course focuses on the design and assessment of wireless communication systems, with an emphasis on the physical layer and single and multi-carrier modulations. This goal is pursued by laboratory activities like as simulator development and subsystem implementation in programmable devices, all in accordance with the software defined radio idea.

Course Content

LIST OF EXPERIMENTS

1. Spectral Characterisation of communication signals (using Spectrum Analyzer)
2. Design and Analysis of Spectrum Estimators (Bartlett , Welch)
3. Design and analysis of digital modulation techniques on an SDR platform
4. Carrier and Symbol timing Synchronization using SDR platform
5. CDMA signal generation and RAKE receiver design using DSP/MATLAB/ SIMULINK
6. Design and performance analysis of error control encoder and decoder (Block and Convolutional Codes)
7. Wireless Channel equalizer design using DSP (ZF / LMS / RLS)
8. Wireless Channel Estimation and Diversity Combining
9. Design and simulation of Microstrip patch antenna
10. Analysis of Antenna Radiation Pattern and measurement

Contact Periods	**45**

Course Outcomes
Upon successful completion of the course, students will be able to:

CO1	The student would be able to design and conduct experiments to demonstrate the trade-offs involved in the design of basic and advanced coding and modulation techniques and the advanced baseband signal conditioning methods.	K6
CO2	The student would be capable of applying communication engineering principles and design tools and will be well practiced in design skills	K3
CO3	The student would be able to comprehensively record and report the measured data, write reports, communicate research ideas and do oral presentations effectively.	K4
CO4	The student would be capable of analyzing and interpreting the experimental measurement data and produce meaningful conclusions	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Tools for Assessment (40 Marks)

Preparation	Conduct of Experiments	Calculations & Result	Viva-Voce	Total

20	30	40	10	100

Tools for Assessment (20 Marks)

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	1	1	1	1	1						
CO2	3	1	1	1	-	2						
CO3	1	2	2	-	-	-						
CO4	1	3	2	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	2	1	1
CO3	2	1	-
CO4	2	1	-

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. D. NAGESWARI Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23EC219	TERM PAPER WRITING AND SEMINAR					
Semester: II	L	T	P	Credits	CIA: 60 Marks	ESE: 40 Marks
	0	0	2	1		
Course pre-requisites	Nil					
Course Objectives						
1.	In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.					
Course Category	Employability Enhancement Course (EEC)					
Development Needs	Global					
Course Description: An understanding of the importance of term paper writing and seminar.						
Course Content						

LIST OF EXPERIMENTS

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

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

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

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1.List 1 Special Interest Groups or professional society 2.List 2 journals 3.List 2 conferences, symposia or workshops 4. List 1 thesis title 5.List 3 web presences (mailing lists, forums, news sites) 6.List 3 authors who publish regularly in your area	3rd week	3% (the selected information must be area specific and of international and national standard)

	7.Attach a call for papers (CFP) from your area.		
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read -try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known • journals and conferences, • Favour "first" or "foundational"	4th week	**6%** (the list of standard papers and reason for selection)
	□ Favour more recent papers, □ Pick a recent survey of the field you can quickly gain an overview, □ Find relationships with respect each other and to your topic area (classification scheme/categorization) □ Mark in the hard copy of whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process □ For each paper form a Table answering the following questions: □ What is the main topic of the article? □ What was/were the main issue(s) the author said they want to discuss? □ Why did the author claim it was important? □ How does the work build on work, in the author's opinion? □ What simplifying assumptions the author claim to be making? □ What did the author do? □ How did the author claim they going to evaluate their work and compare it to others? □ What did the author say were the limitations of their research? □ What did the author say were the	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th. week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting,

			English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce

Contact Periods	**30**

Tools for Assessment (40 Marks)

Preparation	Conduct of Experiments	Calculations & Result	Viva-Voce	Total
20	30	40	10	100

Tools for Assessment (20 Marks)

Model Exam I	Model Exam I	Total
50	50	100

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. V. JAYARAJ Prof. & Head / ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

SEMESTER III

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
THEORY								
1.	P23EC301	Optical Communication and Networking	PCC	3	0	0	3	3
2.		Professional Elective III	PEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	2	5	4
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	P23EC315	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

SEMESTER IV

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
PRACTICALS								
1.	P23EC411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

Course Code	Title					
P23EC301	OPTICAL COMMUNICATION AND NETWORKING					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Modern Digital Communication Systems					

Course Objectives

1	To enable the student to understand the basic principles of operation of optical system components, the different network architectures and issues associated with network design
2	To enable the student to understand the different network architectures and issues associated with network design
3	To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue
4	To enable the student to understand the resource allocation methods and the network management and protection methods in vogue
5	To understand the need for network survivability and the methodologies used

Course Category	Professional Core Course (PCC)
Development Needs	Global / National

Course Description: The Optical Communication and Networking course teaches the fundamentals of optical fiber technology and its applications in long-distance communications and computer networking.

Course Content

Unit	Description	
I	**OPTICAL SYSTEM COMPONENTS AND NETWORK DESIGN :**Optical System Components – MZIM, Multiplexers; filters; switches; wavelength converters; optical amplifiers – EDFA, Raman Amplifiers and hybrid; Transmission system Engineering – System Model, Aimer penalty – transmitter, receiver, cross talk, dispersion compensation, wavelength stabilization, FWM.	
	Contact Periods	**09**
II	**COHERENT SYSTEMS :**Basic principles of Coherent detections – Practical constraints – Injection laser line width state of polarization, local oscillator power, fiber limitations; Modulation formats – ASK, FSK, PSK, DPSK and polarization shift keying (POL SK); Demodulation schemes – Homodyne, Heterodyne – Synchronous and Non synchronous detection; Comparison; Carrier recovery in Coherent detection.	
	Contact Periods	**09**
III	**OPTICAL NETWORK ARCHITECTURES :**Introduction to Optical Networks; First Generation optical networks –SONET / SDH Network, Second Generation (WDM) Optical Networks, Need for Multilayered Architecture-, Layers and Sub-layers, Spectrum partitioning, Optical Network Nodes, Network Access Stations, Overlay Processor, Logical network overlays.	
	Contact Periods	**09**
IV	**NETWORK CONNECTIONS :**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.	
	Contact Periods	**09**

V	**OPTICAL NETWORK SURVIVABILITY**: Protection and Restoration Objectives, Fault Protection and Restoration Techniques in the Logical Layer – Point-to-Point Systems, SONET Self-Healing Rings, Interconnection Techniques, Architectures with Arbitrary Mesh Topologies, Optical-Layer Protection: Point-to-Point and Ring Architectures, Mesh Architectures.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes		
Upon successful completion of the course, students will be able to:		
CO1	Demonstrate an understanding of the differences and challenges involved in the design of optical systems and networks.	K2
CO2	Apply his knowledge for designing a fiber optic system addressing the channel impairments.	K3
CO3	Familiar with the architectures and the protocol stack in use.in optical networks and would be able to identify a suitable backbone infrastructure for our present and future communication needs.	K2
CO4	Understand how connections are managed in the network and the pros and cons of the different approaches.	K2
CO5	Appreciate the need for network survivability and the methodologies used.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	1. Max Ming-Kang Liu, "Principles and Applications of Optical Communication", Tata McGraw Hill Education Pvt., Ltd., New Delhi. 2010 2. Thomas E. Stern, Georgios Ellinas, Krishna Bala, "Multiwavelength Optical Networks – Architecture, Design and control ", Cambridge University Press, 2nd Edition, 2009. 3. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks : A Practical Perspective", Harcourt Asia Pte Ltd., Second Edition 2006.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	3	3	2	-	1						
CO2	3	3	3	2	3	3						
CO3	3	3	3	2	2	1						
CO4	3	3	3	2	2	2						
CO5	3	3	3	2	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	3	-

CO2	3	3	3
CO3	3	3	2
CO4	3	3	2
CO5	3	3	3

Course designed by	Verified by
D. Nagesh Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. D. NAGESWARI Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

PROFESSIONAL ELECTIVES

SEMESTER II, ELECTIVE I

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
1.	P23ECP11	Electromagnetic Interference and Compatibility	PEC	3	0	0	3	3
2.	P23ECP12	Advanced Satellite Communication and Navigation Systems	PEC	3	0	0	3	3
3.	P23ECP13	High Speed Switching and Networking	PEC	3	0	0	3	3
4.	P23ECP14	Signal Integrity for High Speed Design	PEC	3	0	0	3	3
5.	P23ECP15	Wavelets and Subband Coding	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE II

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
1.	P23ECP21	Multimedia Compression Techniques	PEC	3	0	0	3	3
2.	P23ECP22	Cognitive Radio Networks	PEC	3	0	0	3	3
3.	P23ECP23	Speech Processing	PEC	3	0	0	3	3
4.	P23ECP24	mm Wave Communication	PEC	3	0	0	3	3
5.	P23ECP25	Analog and Mixed Signal VLSI Design	PEC	3	0	0	3	3

Course Code	Title					
P23ECP11	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Microwave Integrated Circuits					

Course Objectives

1	To gain broad conceptual understanding of the various aspects of electromagnetic(EM) interference and compatibility.
2	To develop a theoretical understanding of electromagnetic shielding effectiveness.
3	To understand ways of mitigating EMI by using shielding, grounding and filtering.
4	To understand the need for standards and to appreciate measurement methods.
5	To understand how EMI impacts wireless and broadband technologies.

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course will teach about electromagnetic interference (EMI) and electromagnetic compatibility (EMC), covering best practices and a step-by-step approach with application-specific examples.

Course Content

Unit	Description	
I	**INTRODUCTION & SOURCES OF EM INTERFERENCE: Introduction** - Classification of sources - Natural sources - Man-made sources - Survey of the electromagnetic environment	
	Contact Periods	**09**
II	**EM SHIELDING:** Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures	
	Contact Periods	**09**
III	**INTERFERENCE CONTROL TECHNIQUES: Equipment** screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices	
	Contact Periods	**09**
IV	**EMC STANDARDS, MEASUREMENTS AND TESTING :**Need for standards - The international framework - Human exposure limits to EM fields -EMC measurement techniques - Measurement tools - Test environments	
	Contact Periods	**09**
V	**EMC CONSIDERATIONS IN WIRELESS AND BROADBAND TECHNOLOGIES**: Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line telecommunications.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

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

CO1	Demonstrate knowledge of the various sources of electromagnetic interference	K3

CO2	Display an understanding of the effect of how electromagnetic fields couple through apertures, and solve simple problems based on that understanding.	K2
CO3	Explain the EMI mitigation techniques of shielding and grounding.	K3
CO4	Explain the need for standards and EMC measurement methods.	K3
CO5	Discuss the impact of EMC on wireless and broadband technologies.	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Christopoulos C, Principles and Techniques of Electromagnetic Compatibility, CRC Press, Second Edition, Indian Edition, 2013.
2. Paul C R, Introduction to Electromagnetic Compatibility, Wiley India, Second Edition, 2008.
3. Kodali V P, Engineering Electromagnetic Compatibility, Wiley India, Second Edition, 2010.
4. Henry W Ott, Electromagnetic Compatibility Engineering, John Wiley & Sons Inc, Newyork, 2009 .
5. Scott Bennett W, Control and Measurement of Unintentional Electromagnetic Radiation, John Wiley& Sons Inc., Wiley Interscience Series, 1997.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	2	1	2	3	3						
CO2	2	2	2	3	3	2						
CO3	2	1	2	3	3	3						
CO4	2	1	2	3	3	3						
CO5	2	2	2	3	3	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	3	2	3
CO2	2	3	3
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
AP/ Electronics and Communications Engineering Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP12	ADVANCED SATELLITE COMMUNICATION AND NAVIGATION SYSTEMS					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Modern Digital Communication Systems					
Course Objectives						
1	Learn M2M developments and satellite applications.					
2	Understand Satellite Communication In Ipv6 Environment.					
Course Category	Professional Elective Courses (PEC)					
Development Needs	Global / National					

Course Description: The course begins with a broad review of satellite communications, covering subjects such as satcoms in the telecom industry, different types of satellites and their missions. This is followed by a similarly broad survey of navigation systems.

Course Content

Unit	Description	
I	**OVERVIEW OF SATELLITE COMMUNICATION** :Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.	
	Contact Periods	09
II	**M2M DEVELOPMENTS AND SATELLITE APPLICATIONS** :Overview of the Internet of Things and M2M- M2M Applications Examples and Satellite Support- Satellite Roles Context and Applications- Antennas for Satellite M2M Applications- M2M Market Opportunities for Satellite Operators-Ultra HD Video/TV and Satellite Implications-High Throughput Satellites (HTS) and Ka/Ku Spot Beam Technologies- Aeronautical, Maritime and other Mobility Services.	
	Contact Periods	09
III	**SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT** :Overview of IPv6 and its benefits for Satellite Networks - Migration and Coexistence-- Implementation scenarios and support- Preparations for IPv6 in Satellite communication- Satellite specific Protocol issues in IPv6 – Impact of IPv6 on Satellite Network architecture and services- Detailed transitional plan- IPv6 demonstration over satellites - Key results and recommendations.	
	Contact Periods	09
IV	**SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM** :Overview of Radio and Satellite Navigation, GPS Principles, Signal model and Codes, Satellite Signal Acquisition, Mathematical model of GPS observables, Methods of processing GPS data , GPS Receiver Operation and Differential GPS. IRNSS, GAGAN, GLONASS and Galileo.	
	Contact Periods	09
V	**DEEP SPACE NETWORKS AND INTER PLANETARY MISSIONS** :Introduction – Functional description - Design procedure and performance criterion-Mars exploration Rover- Mission and spacecraft summary-Telecommunication subsystem overview-Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and spacecraft summary-Telecommunication subsystem overview-Ground Subsystem-Telecom subsystem and Link performance.Mangalyaan Mission - Mission and spacecraft summary-Telecommunication subsystem overview- Ground Subsystem-Telecom subsystem and	

Link performance.	
Contact Periods	**09**
Total Periods	**45**

Course Outcomes

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

CO1	Discuss Satellite navigation and global positioning system.	K2
CO2	Understand deep space networks and inter planetary missions.	K2
CO3	Demonstrate an understanding of the different interferences and attenuation mechanisms affecting the satellite link design.	K3
CO4	Demonstrate an understanding of the different communication, sensing and navigational applications of satellite.	K3
CO5	Familiar with the implementation aspects of existing satellite based systems.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Adimurthy.V,"Concept design and planning of India's first interplanetary mission" Current Science, VOL. 109, NO. 6, 1054 25 SEPTEMBER 2015.
2. Anil K. Maini, Varsha Agrawal, 'Satellite Technology: Principles and Applications', Third Edition, Wiley, 2014.
3. Daniel Minoli' "Innovations in Satellite Communication and Satellite Technology" Wiley, 2015.
4. Daniel Minoli, "Satellite Systems Engineering in an IPv6 Environment", CRC Press, First Edition, 2009.
5. Hofmann-Wellenhof B., Lichtenegger H., and Elmar Wasle, "Global Navigational Satellite Systems" Springer-Verlag, 2008.
6. Jim Taylor, " Deep Space Communications" John Wiley & Sons, 2016.
7. Louis J. Ippolito, Jr. "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", Second Edition, 2017.
8. http://www.isro.gov.in/pslv-c25-mars-orbiter-mission.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	-	-	1	1						
CO2	-	-	1	-	3	1						
CO3	-	-	1	-	2	1						
CO4	-	-	2	-	2	2						
CO5	3	3	2	3	3	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	-	1
CO2	-	-	2
CO3	-	-	1
CO4	-	1	2
CO5	3	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Mrs. N. Revathi Electronics and communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP13	HIGH SPEED SWITCHING AND NETWORKING					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Modern Digital Communication Systems					

Course Objectives

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

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course will provide students an in-depth understanding of Internet architecture, as well as the underlying technology and applications that handle the difficulties.

Course Content

Unit	Description	
I	**SWITCHING ARCHITECTURES :**Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks – Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches.	
	Contact Periods	09
II	**NETWORK PERFORMANCE ANALYSIS :**Objectives and requirements for Quality of Service (QoS) in high performance networks. Architecture of high performance networks (HPN), design issues, protocols for HPN, VHF backbone networks, virtual interface architectures, virtual interface for networking, High-speed switching and routing - internet and PSTN IP switching techniques, SRP protocols, SRP authentication, and key exchange, comparison of TCP/IP, FTP, TELNET, queuing systems, network modeling as a graph.	
	Contact Periods	09
III	**MULTIMEDIA NETWORKING APPLICATIONS :**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.	
	Contact Periods	**09**
IV	**PACKET QUEUES AND DELAY ANALYSIS :**Littles theorem, Birth and Death process, queueing discipline- Control & stability -, Markovian FIFO queueing system, Non-markovian - PollaczekKhinchin formula and M/G/1, M/D/1, self-similar models and Batch-arrival model, Networks of Queues – Burkes theorem and Jackson Theorem.	
	Contact Periods	**09**
V	**NETWORK SECURITY AND MANAGEMENT** :Principles of cryptography – Elliptic-AES Authentication – integrity – key distribution and certification– Access control and: fire walls – DoS-attacks and counter measures – security in many layers.Infrastructure for network management – The internet standard management framework – SMI, MIB,SNMP, Security and administration – ASN.1.	

Contact Periods	**09**
Total Periods	**45**

Course Outcomes

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

CO1	Understand the fundamental concepts of the switching architecture involved in various switching types	K2
CO2	Interpret the basics of various protocols and QOS in the network performance	K4
CO3	Understand the various types of multimedia networking application	K2
CO4	Recognize the concepts of various analysis method involved in the processing	K4
CO5	Understand fundamental issues involved in providing the security as well as the management.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	2	3	-	-						
CO2	2	-	2	3	-	3						
CO3	2	-	2	3	-	3						
CO4	2	-	2	3	-	-						
CO5	2	-	-	-	-	-						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	3	-
CO2	1	3	1
CO3	1	3	1

CO4	1	3	-
CO5	1	-	-

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Mrs. S.M. Deepa, Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ,
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP14	SIGNAL INTEGRITY FOR HIGH SPEED DESIGN					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

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

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: Signal integrity is critical in high-speed digital design to ensure reliable and efficient transmission of signals through electronic systems. This course provides a comprehensive exploration of signal integrity principles and techniques tailored for engineers involved in designing high-speed electronic circuits and systems.

Course Content

Unit	Description	
I	**SIGNAL PROPAGATION ON TRANSMISSION LINES** :Transmission line equations, wave solution, wave *vs.* circuits, initial wave, delay time, Characteristic impedance , wave propagation, reflection, and bounce diagrams Reactive terminations – L, C , static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching , input impedance ,into a transmission-line section, reflection coefficient, skin-effect, dispersion.	
	Contact Periods	**09**
II	**MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK** :Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossless models	
	Contact Periods	**09**
III	**NON-IDEAL EFFECTS** :Non-ideal signal return paths – gaps, BGA fields, via transitions , Parasitic inductance and capacitance , Transmission line losses – Rs, tanδ , routing parasitic, Common-mode current, differential-mode current , Connectors	
	Contact Periods	**09**
IV	**POWER CONSIDERATIONS AND SYSTEM DESIGN** :SSN/SSO , DC power bus design , layer stack up, SMT decoupling ,, Logic families, power consumption, and system power delivery , Logic families and speed Package types and parasitic ,SPICE, IBIS models ,Bit streams, PRBS and filtering functions of link-path components , Eye diagrams , jitter , inter-symbol interference Bit-error rate ,Timing analysis	
	Contact Periods	**09**
V	**CLOCK DISTRIBUTION AND CLOCK OSCILLATORS** :Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Identify sources affecting the speed of digital circuits.	K2
CO2	Identify methods to improve the signal transmission characteristics	K2
CO3	Characterise and model multiconductor transmission line	K2
CO4	Analyse clock distribution system and understand its design parameters	K4
CO5	Analyse nonideal effects of transmission line	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	2	2	3	3	2						
CO2	2	2	2	3	3	2						
CO3	1	1	2	3	3	3						
CO4	2	2	1	3	3	2						
CO5	2	2	2	3	3	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	2	3	3
CO3	1	3	3
CO4	2	2	3
CO5	2	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S. MOHAN Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP15	WAVELETS AND SUBBAND CODING					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Nil					

Course Objectives

1	To introduce the fundamentals concepts of wavelet transforms.
2	To study system design using Wavelets.
3	To learn the different wavelet families & their applications.
4	To study signal compression and sub-band coding.

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: Wavelets and subband coding are fundamental techniques used in signal processing and data compression. This course provides a detailed exploration of wavelet theory, applications, and subband coding algorithms for efficient signal representation, analysis, and compression.

Course Content

Unit	Description	
I	**INTRODUCTION TO WAVELETS: Introduction** to Multirate signal processing- Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function space.	
	Contact Periods	**,09**
II	**MULTIRESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM:** Multiresolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks- Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.	
	Contact Periods	**09**
III	**WAVELET SYSTEM DESIGN:** Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.	
	Contact Periods	**09**
IV	**WAVELET FAMILIES:** Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.	
	Contact Periods	**09**
V	**SIGNAL COMPRESSION AND SUBBAND CODING**: Compression Systems Based on Linear Transforms - Speech and Audio Compression - Image Compression - Video Compression - Joint Source-Channel Coding.	
	Contact Periods	**09**

Total Periods	**45**

Course Outcomes

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

CO1	Understand the fundamental concepts of wavelet transforms.	K2
CO2	Apprehend detailed knowledge about wavelet transform.	K2
CO3	Understand system design using wavelets.	K2
CO4	Compare different wavelet families.	K2
CO5	Analyze signal compression and sub-band coding.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. C.Sidney Burrus, Ramesh Gopinath & Haito Guo, "Introduction to wavelets and wavelet transform", Prentice Hall, 1998.
2. G.Strang and T.Nguyen, "Wavelet and filter banks", Wesley and Cambridge Press, 1996.
3. Metin Akay, "Time frequency and wavelets in biomedical signal processing", Wiley-IEEE Press, October 1997.
4. M.Vetterli and J. Kovacevic, "Wavelets and sub band coding", Prentice Hall, 1995.
5. P.Vaidyanathan, "Multi rate systems and filter banks", Prentice Hall 1993.
6. Raguveer m Rao & Ajith S. Bopardikar, "Wavelet transforms – Introduction to theory and applications", Addison Wesley, 1998.
7. S.Mallet, "A Wavelet tour of Signal Processing", Academic Press 1998.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	-	1	-	-						
CO2	1	2	2	2	1	-						
CO3	2	3	3	3	1	1						
CO4	1	3	2	2	2	-						
CO5	1	2	2	3	2	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	-	-
CO2	2	3	-
CO3	3	3	1

CO4	3	3	1
CO5	2	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Mrs. S.M. Deepa, Electronics & communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP21	MULTIMEDIA COMPRESSION TECHNIQUES					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	To understand the basic ideas of compression algorithms related to multimedia components – Text, speech, audio, image and Video.
2	To understand the principles and standards and their applications with an emphasis on underlying technologies, algorithms, and performance.
3	To appreciate the use of compression in multimedia processing applications.
4	To understand and implement compression standards in detail.
5	To understand MPEG video coding techniques.

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: Multimedia Compression Techniques is an advanced course that explores the principles, algorithms, and applications of compression methods used in multimedia data processing. In this course, students will gain a deep understanding of how various multimedia formats (such as images, audio, video) are efficiently compressed to reduce file size while maintaining acceptable quality.

Course Content

Unit	Description	
I	**FUNDAMENTALS OF COMPRESSION**: Introduction To multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression.	
	Contact Periods	**09**
II	**TEXT COMPRESSION**: Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.	
	Contact Periods	**09**
III	**IMAGE COMPRESSION**: Image Compression: Fundamentals — Compression Standards – JPEG Standard – Sub-band coding – Wavelet Based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.	
	Contact Periods	**09**
IV	**AUDIO COMPRESSION**: Audio compression Techniques – law, A-Law companding – Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – MPEG audio – progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.	
	Contact Periods	**09**
V	**VIDEO COMPRESSION**: Video compression techniques and Standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current Trends in Compression standards.	
	Contact Periods	**09**

	Total Periods	**45**
Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Implement basic compression algorithms familiar with the use of MATLAB and its equivalent open-source environments	K3
CO2	Design and implement some basic compression standards	K6
CO3	Critically analyze different approaches of compression algorithms in multimedia related mini projects.	K4
CO4	Understand the various audio,speech compression techniques	K2
CO5	Understand and implement MPEG video coding techniques.	K2
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating		
Reference Books	1. Khalid Sayood: Introduction to Data Compression", Morgan Kauffman Harcourt India, Third Edition, 2010. 2. David Solomon, "Data Compression – The Complete Reference", Fourth Edition, Springer Verlog, New York, 2006. 3. Yun Q.Shi, Huifang Sun, "Image and Video Compression for Multimedia Engineering, Algorithms and Fundamentals", CRC Press, 2003 4. Mark S. Drew, Ze-Nian Li, "Fundamentals of Multimedia", PHI, 2009	

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	-	2	1	1	1						
CO2	3	-	3	2	2	1						
CO3	3	-	3	2	2	1						
CO4	2	-	2	2	2	1						
CO5	2	-	2	2	2	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	2	1
CO2	1	3	2
CO3	1	3	2
CO4	1	2	2
CO5	1	2	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. V. Jayaraj Prof. & Head / ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP22	COGNITIVE RADIO NETWORKS					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

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

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: The course explains the fundamentals of software-defined radios. This course covers both the hardware and software architecture of software defined radio. The course covers the construction of wireless networks based on cognitive radios.

Course Content

Unit	Description	
I	**INTRODUCTION TO COGNITIVE RADIO :**Cognitive Radio : Techniques and signal processing History and background, Communication policy and Spectrum Management, Cognitive radio cycle, Cognitive radio architecture, SDR architecture for cognitive radio, Spectrum sensing Single node sensing: energy detection, cyclo stationary and wavelet based sensing- problem formulation and performance analysis based on probability of detection Vs SNR. Cooperative sensing: different fusion rules, wideband spectrum	
	Contact Periods	**09**
II	**SPECTRUM SENSING AND TRADING :**Introduction –Spectrum Sensing – Multiband Spectrum Sensing – Sensing Techniques – Other algorithms – Comparison – Performance Measure & Design Trade-Offs : Receiver operating characteristics – Throughput Performance measure –Fundamental limits and trade-off. Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential)	
	Contact Periods	**09**
III	**MAC PROTOCOLS AND NETWORK LAYER DESIGN:** Functionality of MAC protocol in spectrum access –classification –Interframe spacing and MAC challenges – QOS – Spectrum sharing in CRAHN –CRAHN models – CSMA/CA based MAC protocols for CRAHN – Routing in CRN– Centralized and Distributed protocols – Geographical Protocol	
	Contact Periods	**09**
IV	**DYNAMIC SPECTRUM ACCESS AND MANAGEMENT:** Spectrum broker, Dynamic spectrum access architecture- centralized dynamic spectrum access, distributed dynamic spectrum access, Inter- and intra-RAN dynamic spectrum allocation, Spectrum management, Spectrum sharing, Spectrum mobility issues	
	Contact Periods	**09**

V	**TRUSTED COGNITIVE RADIO NETWORKS AND RESEARCH CHALLENGES**: Trust for CRN: Fundamentals – Models – Effects of Trust Management –Security properties in CRN – Route Disruption attacks –Jamming attacks –PU Emulation attacks. Network layer and transport layer issues, cross layer design for cognitive radio networks

Contact Periods	**09**
Total Periods	**45**

Course Outcomes

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

CO1	Understand the fundamental concepts of cognitive radio networks	K2
CO2	Interpret the basics of various spectrum sensing techniques and algorithms	K4
CO3	Understand the functions of MAC layer and Network layer and its various protocols	K2
CO4	Recognize the concepts of cooperative spectrum sensing and handoff process	K2
CO5	Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better spectrum exploitation.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	-	3	3	2	3						
CO2	3	-	3	3	2	3						
CO3	3	-	3	3	2	3						
CO4	3	-	3	3	2	3						
CO5	3	-	3	3	2	3						

3-High; 2-Medium; 1-Low			
CO \ PSO	**PSO1**	**PSO2**	**PSO3**
CO1	1	3	3
CO2	1	3	3
CO3	1	3	3
CO4	1	3	3
CO5	1	3	3

Course designed by	**Verified by**
Signature of the Faculty Member	Signature of the Chairperson-BoS
IC NAVARASAN / Electronics & Communication Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP23	SPEECH PROCESSING					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

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

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: The course provides an introduction to speech processing oriented to human-computer interaction, i.e. especially to speech synthesis, speech recognition and dialogue systems.

Course Content

Unit		
I	**FUNDAMENTALS OF SPEECH PROCESSING:** Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.	
	Contact Periods	**09**
II	**SPEECH SIGNAL REPRESENTATIONS AND CODING:** Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder, CELP, Vocoders.	
	Contact Periods	**09**
III	**SPEECH RECOGNITION:** Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.	
	Contact Periods	**09**
IV	**TEXT ANALYSIS:** Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.	
	Contact Periods	**09**
V	**SPEECH SYNTHESIS**: Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Model speech production system and describe the fundamentals of speech	K2
CO2	Extract and compare different speech parameters	K2
CO3	Choose an appropriate statistical speech model for a given application	K4
CO4	Design a speech recognition system	K6
CO5	Use different text analysis and speech synthesis techniques	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	-	2	3	1	1						
CO2	3	-	2	3	1	1						
CO3	3	-	2	3	1	1						
CO4	3	-	2	3	1	1						
CO5	3	-	2	3	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	3	1
CO2	1	3	1
CO3	1	3	1
CO4	1	3	1

CO5	1	3	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr.M.A.RAJA Department of Electronics & Communication Engg Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP24	mm WAVE COMMUNICATION					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	MODERN DIGITAL COMMUNICATION TECHNIQUES					

Course Objectives

1	To understand the fundamentals of Millimeter wave devices and circuits
2	To understand the various components of Millimeter wave Communications system
3	To know the antenna design at Millimeter wave frequencies

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: Future communication networks will require significantly higher capacity to accommodate the ever-increasing number of wireless devices and high data speed. Today's millimeter wave technology is advanced enough to meet this demand. Millimeter wave components are often obtained by frequency scaling microwave components. However, when designing a millimeter wave system, an engineer must deal with a number of design issues such as increased loss, a high signal-to-noise ratio, signal distortions, etc. The primary objective of this course is to address design difficulties at millimeter wave frequencies.

Course Content

Unit	Description	
I	**INTRODUCTION**: Millimeter wave characteristics-millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.	
	Contact Periods	**09**
II	**mm WAVE DEVICES AND CIRCUITS:** Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.	
	Contact Periods	**09**
III	**mm WAVE COMMUNICATION SYSTEMS:** Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.	
	Contact Periods	**09**
IV	**mm WAVE MIMO SYSTEMS:** Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, Multiple Transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.	
	Contact Periods	**09**
V	**ANTENNAS FOR MM WAVE SYSTEMS**: Antenna beamwidth, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.	
	Contact Periods	**09**

Total Periods	**45**

Course Outcomes

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

CO1	Understand the Millimeter wave characteristics and implementation challenges faced.	K2
CO2	Understand Millimeter devices and circuits.	K2
CO3	Apply his knowledge on the Modulation techniques for millimeter wave communications.	K3
CO4	Design antenna for Millimeter wave frequencies.	K6
CO5	Familiar with Millimeter wave technology.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March 2011 .
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014.
3. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications: Springer, 2016.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	2	3	3	2	3						
CO2	-	2	3	-	3	3						
CO3	-	2	3	-	3	3						
CO4	2	3	3	3	2	2						
CO5	3	3	3	2	3	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	3	3
CO2	1	1	3
CO3	1	1	3
CO4	3	3	2
CO5	3	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. D. NAGESWARI Electronics & Communication Engg Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP25	ANALOG AND MIXED SIGNAL VLSI DESIGN					
Semester: II	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					
Course Objectives						
1	To study the concepts of MOS large signal model and small signal model.					
2	To understand the concepts of D/A conversion methods and their architectures.					
3	To learn filters for ADC.					
4	To study about the switched capacitor circuits.					
Course Category	Professional Elective Courses (PEC)					
Development Needs	Global / National					

Course Description: Analog and Mixed Signal VLSI Design explores the principles, techniques, and methodologies essential for designing integrated circuits that process both analog and digital signals. This course delves into the challenges and opportunities in integrating analog and digital components on the same chip, essential for modern electronic systems.

Course Content

Unit	Description	
I	**INTRODUCTION AND BASIC MOS DEVICES:** Challenges in analog design-Mixed signal layout issues- MOSFET structures and characteristics large signal and small signal model of single stage Amplifier-Source follower- Common gate stage – Cascode Stage – large and small signal analysis of differential amplifier with active load, pole-zero estimation, zero value time constant method, frequency response of CS, cascade and Cascode amplifiers	
	Contact Periods	**09**
II	**SUBMICRON CIRCUIT DESIGN:** Submicron CMOS process flow, Capacitors and resistors, Current mirrors, Digital Circuit Design, Delay Elements – Adders- OP Amp parameters and Design	
	Contact Periods	**09**
III	**DATA CONVERTERS:** Static and dynamic errors in DAC and ADC – Architectures & Characteristics of Sample and Hold Digital to Analog Converters- DAC- R-2R, weighted DAC, multiplying DAC, segmented DAC and sigma delta DAC. ADC – Flash ADC, pipelined ADC, successive approximation ADC, sigma delta ADC.	
	Contact Periods	**09**
IV	**SNR IN DATA CONVERTERS:** Overview of SNR of Data Converters- Clock Jitters- Improving Using Averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating Filters for DAC	
	Contact Periods	**09**
V	**SWITCHED CAPACITOR CIRCUITS**: Resistors, first order low pass Circuit, switched capacitor Amplifier, Switched Capacitor Integrator – Design of flip around sample and hold circuit – pipelined ADC.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Understand the Basic MOS devices characteristics & Analyze their frequency responses	K2
CO2	Design submicron circuit	K6
CO3	Apply his knowledge on the DAC & ADC conversions	K3
CO4	Analyze the SNR in Data converters	K4
CO5	Design and analyze switched capacitor circuits	K6

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	
	1. J. Jacob Wikner, Mikael Gustavsson, Nianxiong Tan "CMOS Data Converters for Communications" Springer, 2000 2. Van de Plassche, Rudy J., "CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters" Springer, 2003.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	-	2	3	3	1						
CO2	2	-	2	3	3	1						
CO3	2	-	2	3	3	1						
CO4	2	-	2	3	3	1						
CO5	2	-	2	3	3	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	1	3	2
CO3	1	3	2
CO4	1	3	2
CO5	1	3	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS

Dr. V. Jayaraj Prof. & Head Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

PROFESSIONAL ELECTIVES

SEMESTER III, ELECTIVE III

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
1.	P23ECP31	Ultra Wide Band Communications	PEC	3	0	0	3	3
2.	P23ECP32	VLSI for Wireless Communication	PEC	3	0	0	3	3
3.	P23ECP33	MEMS and NEMS	PEC	3	0	0	3	3
4.	P23ECP34	Advanced Antenna Design	PEC	3	0	0	3	3
5.	P23ECP35	Software Defined Radios	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S.No.	Course Code	Course Title	Category	L	T	P	Contact Period	C
1.	P23ECP41	Image Processing and Video Analytics	PEC	3	0	2	5	4
2.	P23ECP42	Radar Signal Processing	PEC	3	0	2	5	4
3.	P23ECP43	Telecommunication System Modeling and Simulation	PEC	3	0	2	5	4
4.	P23ECP44	Signal Detection and Estimation	PEC	3	0	2	5	4
5.	P23ECP45	Real Time Embedded Systems	PEC	3	0	2	5	4

Course Code	Title					
P23ECP31	ULTRA WIDE BAND COMMUNICATIONS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Modern Digital Communication Systems					

Course Objectives

1	To give fundamental concepts related to Ultra wide band
2	To understand the channel model for UWB
3	To understand the signal processing for UWB
4	To acquire knowledge about UWB antennas
5	To acquire knowledge about UWB regulations

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: The Ultra-Wideband Communications (UWB) course provides a thorough grasp of UWB technology, which is noted for its high bandwidth across short distances. This course is perfect for anybody interested in wireless communication systems, developing technologies, or signal processing.

Course Content

Unit	Description	
I	**INTRODUCTION TO UWB :**History, Definition, FCC Mask, UWB features, Benefits and challenges, UWB Interference: IEEE 802.11.a Interference, Signal to Interference ratio calculation, Interference with other wireless services.	
	Contact Periods	**09**
II	**UWB TECHNOLOGIES AND CHANNEL MODELS :**Impulse Radio, Pulsed Multiband, Multiband OFDM, features : Complexity, Power Consumption, Security and achievable data rate. MIMO Multiband OFDM, Differential multiband OFDM, Performance characterization, Ultra Wide Band Wireless Channels Channel model: Impulse Response Modeling of UWB Wireless Channels, IEEE UWB channel model, Path loss, Delay profiles, Time and frequency modelling.	
	Contact Periods	**09**
III	**UWB SIGNAL PROCESSING :**Data Modulation schemes, UWB Multiple Access Modulation, BER, Rake Receiver, Transmit- Reference (T-R) Technique, UWB Range-Data Rate Performance, UWB Channel Capacity, UWB Wireless Locationing: Position Locationing Methods, Time of Arrival Estimation, NLOS Location Error , Locationing with OFDM.	
	Contact Periods	**09**
IV	**UWB ANTENNAS :**Antenna Requirements, Radiation Mechanism of the UWB Antennas, Types of Broad band antennas, Parameters, Analysis of UWB Antennas, Link Budget for UWB System. Design examples of broad band UWB antennas.	
	Contact Periods	**09**
V	**UWB APPLICATIONS AND REGULATIONS** :Ultra wideband receiver architecture, Wireless Ad hoc Networking, UWB Wireless Sensor, RFID, Consumer Electronics and Personal, Asset Location, Medical applications, UWB Regulation and standards in various countries , UWB Regulation in ITU, IEEE Standardization	
	Contact Periods	**09**

	Total Periods	**45**
Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Understand the basic concepts of UWB	K2
CO2	Understand the basic concepts of UWB technologies	K2
CO3	Assess the performance of UWB channels	K3
CO4	Apply the UWB signal processing	K3
CO5	Design UWB antenna for various applications	K6
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating		

Reference Books

1. Homayoun Nikookar and Ramjee Prasad, "Introduction to Ultra Wideband for Wireless Communications"1st Edition, Springer Science & Business Media B.V. 2010.
2. Thomas Kaiser, Feng Zheng "Ultra Wideband Systems with MIMO", 1st Edition, John Wiley & Sons Ltd, New York, 2010.
3. W. Pam Siriwongpairat and K. J. Ray Liu, "Ultra-Wideband Communications Systems: Multiband OFDM approach" John Wiley and IEEE press, New York 2008.
4. Huseyin Arslan,Zhi Ning Chen,Maria-Gabriella Di Benedetto "Ultra Wideband Wireless communication" Wiley-Interscience; 1st edition 2006.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	2	3	2	2						
CO2	-	-	2	3	2	2						
CO3	-	-	-	-	-	2						
CO4	-	-	2	3	2	2						
CO5	-	-	-	3	2	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	3	1
CO2	-	3	1
CO3	-	-	-
CO4	-	3	1

CO5	-	1	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Mrs. S.M. Deepa, Electronics & Communication Engg Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP32	VLSI FOR WIRELESS COMMUNICATION					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Modern digital communication systems					

Course Objectives

1	To understand the concepts of basic wireless communication concepts
2	To study the parameters in receiver and low noise amplifier design
3	To study the various types of mixers designed for wireless communication
4	To study and design PLL and VCO
5	To understand the concepts of transmitters and power amplifiers in wireless communication

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course will cover the VLSI circuits used in modern communication systems, design trade-offs, Low Noise Amplifiers, Power Amplifiers, Transmitter Architectures.

Course Content

Unit	Description	
I	**COMMUNICATION CONCEPTS** :Introduction – Overview of Wireless systems – Standards – Access Methods – Modulation schemes – Classical channel – Wireless channel description – Path loss – Multipath fading – Standard Translation.	
	Contact Periods	**09**
II	**RECEIVER ARCHITECTURE & LOW NOISE AMPLIFIERS** :Receiver front end – Filter design – Non-idealities – Design parameters – Noise figure & Input intercept point. LNA Introduction – Wideband LNA design – Narrow band LNA design: Impedance matching & Core amplifier.	
	Contact Periods	**09**
III	**MIXERS** :Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion – Noise - A Complete Active Mixer. Switching Mixer – Distortion, Conversion Gain & Noise in Unbalanced Switching Mixer - A Practical Unbalanced Switching Mixer. Sampling Mixer - Conversion Gain, Distortion, Intrinsic & Extrinsic Noise in Single Ended Sampling Mixer.	
	Contact Periods	**09**
IV	**FREQUENCY SYNTHESIZERS** :PLL – Phase detector – Dividers – Voltage Controlled Oscillators – LC oscillators – Ring Oscillators – Phase noise – Loop filters & design approaches – A complete synthesizer design example (DECT) – Frequency synthesizer with fractional divider.	
	Contact Periods	**09**
V	**TRANSMITTER ARCHITECTURES & POWER AMPLIFIERS** :Transmitter back end design – Quadrature LO generator – Power amplifier design.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

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

CO1	Able to recollect basic wireless communication concepts	K1
CO2	To understand the parameters in receiver and design a low noise amplifier	K2
CO3	In a position to apply his knowledge on various types of mixers designed for wireless communication	K3
CO4	Design PLL and VCO	K6
CO5	Understand the concepts of transmitters and utilize the power amplifiers in wireless communication	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2002
2. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,1998.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 1999
4. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI wireless design – Circuits & Systems", Kluwer Academic Publishers, 2000.
5. J. Crols and M. Steyaert, "CMOS Wireless Transceiver Design," Boston, Kluwer Academic Pub., 1997
6. Thomas H.Lee, "The Design of CMOS Radio – Frequency Integrated Circuits", Cambridge University Press ,2003.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	1	1	-	-	-						
CO2	1	-	2	3	-	-						
CO3	2	-	2	1	1	1						
CO4	1	-	2	2	1	1						
CO5	2	-	2	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	-	-
CO2	-	3	-
CO3	-	2	-
CO4	-	2	1
CO5	-	2	1

Course designed by	Verified by

Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. V. Jayaraj Prof. & Head / ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP33	MEMS AND NEMS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	To introduce the concepts of Micro Electro Mechanical devices
2	To know the fabrication process of microsystems
3	To know the design concepts of micro sensors and micro actuators
4	To know the design concepts of micro actuators
5	To familiarize concepts of Quantum Mechanics and Nano systems

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course focuses on Micro Electro Mechanical Systems (MEMS), which have components smaller than 1mm. MEMS performs the majority of engineering duties via electromechanical or electrochemical techniques. This course delivers comprehensive treatments with the synergetic integration of a broad spectrum of disciplines in science and engineering to adapt to the multidisciplinary character of Nano Electro Mechanical Systems (NEMS).

Course Content

Unit	Description	
I	**OVERVIEW:** New trends in Engineering and Science: Micro and Nanoscale systems, introduction to design of MEMS and NEMS, MEMS and NEMS – applications, devices and structures. Materials for MEMS: Silicon, Silicon compounds, polymers, metals.	
	Contact Periods	**09**
II	**MEMS FABRICATION TECHNOLOGIES:** Microsystem Fabrication Processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin Film Depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching Techniques: Dry and Wet Etching, Electrochemical Etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-Like) Technology; Packaging: Microsystems Packaging, Essential Packaging Technologies, Selection of Packaging Materials.	
	Contact Periods	**09**
III	**MICRO SENSORS :** MEMS Sensors: Design of Acoustic Wave Sensors, Resonant Sensor, Vibratory Gyroscope, Capacitive and Piezo Resistive Pressure Sensors- Engineering Mechanics Behind These Microsensors. Case Study: Piezo-Resistive Pressure Sensor.	
	Contact Periods	**09**
IV	**MICRO ACTUATORS :**Design of Actuators: Actuation Using Thermal Forces, Actuation Using Shape Memory Alloys, Actuation Using Piezoelectric Crystals, Actuation using Electrostatic Forces (Parallel Plate, Torsion Bar, Comb Drive Actuators), Micromechanical Motors and Pumps. Case Study: Comb Drive Actuators.	
	Contact Periods	**09**
V	**NANOSYSTEMS AND QUANTUM MECHANICS**:Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave Function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their Quantization, Molecular Wires and Molecular Circuits	
	Contact Periods	**09**

Total Periods	**45**

Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Discuss micro sensors	K4
CO2	Explain micro actuators	K2
CO3	Outline nanosystems and Quantum mechanics	K2
CO4	Design micro actuators for different applications	K6
CO5	Analyze atomic structures	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	
	1. Chang Liu, "Foundations of MEMS", Pearson Education India Limited, 2006 2. Marc Madou, "Fundamentals of Microfabrication", CRC Press 1997 3. Stephen D. Senturia," Micro System Design", Kluwer Academic Publishers,2001 4. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002 5. Tai Ran Hsu ,"MEMS and Microsystems Design and Manufacture" ,Tata Mcraw Hill, 2002

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	1	3	3	2						
CO2	2	2	2	3	3	2						
CO3	2	1	2	3	3	2						
CO4	2	2	2	2	2	2						
CO5	1	2	1	2	2	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	3	3
CO3	2	3	3
CO4	2	2	3
CO5	2	2	3

Course designed by	Verified by

Signature of the Faculty Member	Signature of the Chairperson-BoS
S. ROHAN Electronics & communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP34	ADVANCED ANTENNA DESIGN					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Radiating Systems					

Course Objectives

1	To understand the antenna radiation characteristics
2	To understand the antenna and arrays
3	To enhance the student knowledge in the area of various antenna design
4	To understand the effects of mutual coupling of antennas
5	To enhance the student knowledge in the area of antenna for practical applications

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course aims to teach students the fundamental principles of antenna design and analysis. Students will learn how to characterize, use, and design antennas using electromagnetic simulation tools. The course will cover various types of antennas and their characteristics.

Course Content

Unit	Description	
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.	
	Contact Periods	**09**
II	**THIN LINEAR ANTENNAS AND ARRAYS :**Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop, N-Element Linear Array, Antenna element spacing without grating lobes, Linear broadside array with non-uniform distributions, Gain of regularly spaced planar arrays with $d = \lambda/2$, Tchebyscheff Array antennas.	
	Contact Periods	**09**
III	**SECONDARY SOURCES AND APERTURE ANTENNAS :**Magnetic currents, Duality, Images of electric and magnetic currents, electric and magnetic currents as sheet sources, Impressed and induced current sources, Induction and equivalence theorems, Field of a secondary or Huygens source, Radiation from open end of a coaxial line, Radiation through an aperture in conducting screen, slot antenna.	
	Contact Periods	**09**
IV	**EFFECT OF MUTUAL COUPLING ON ANTENNAS :**Accounting for mutual effects for dipole array compensation using open-circuit voltages, compensation using the minimum norm formulation, Effect of mutual coupling- constant Jammers, Constant Signal, Compensation of mutual coupling- constant Jammers, Constant Signal, Result of different elevation angle.	
	Contact Periods	**09**
V	**ADAPTIVE ARRAY CONCEPT** :Motivation of using Adaptive Arrays, Adaptive Array problem statement, Signal Environment, Array Element Spacing considerations, Array Performance, Concept of optimum Array Processing, Recursive Methods for Adaptive Error Processing.	

Contact Periods	**09**
Total Periods	**45**

Course Outcomes

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

CO1	Acquire the knowledge about basic antenna parameters	K3
CO2	Theoretically analyze wire antennas and arrays	K4
CO3	Identify secondary sources, aperture, broadband and frequency independent antennas	K2
CO4	Apply the knowledge of mutual coupling on antennas, applications and numerical techniques	K3
CO5	Acquire brief knowledge about adaptive array concept.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Milligan, Thomas A., Modern Antenna Design 2nd edition, IEEE press, Wiley Interscience (2005).
2. David B. Davidson, Computational Electromagnetics for RF and Microwave Engineering, Cambridge University Press 2005
3. Neelakanta, Perambur S., and Chatterjee, Rajeswari, Antennas for Information Super Skyways: An Exposition on Outdoor and Indoor Wireless Antennas, Research Studies Press Ltd. (2004).
4. Godara, Lal Chand, Smart Antennas, CRC Press (2004).
5. Munk, Ben A., Finite Antenna Arrays and FSS, John Wiley and Sons (2003).

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	2	3	3	2						
CO2	3	3	3	3	3	2						
CO3	2	2	2	3	3	2						
CO4	2	2	2	3	3	2						
CO5	2	2	2	3	3	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	3	3
CO2	3	3	3
CO3	2	3	3

CO4	2	3	3
CO5	2	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Mrs. S. Sri. Deepa, Electronics & communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP35	SOFTWARE DEFINED RADIOS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Advanced Wireless Networks					

Course Objectives

1	To learn various design principles of software defined radio
2	To understand challenges of receiver design
3	To understand multirate signal processing in SDR
4	To design smart antennas for SDR.
5	To learnthe techniques for the development of scientific and technological knowledge in designing software defined radios

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: Software-defined radio (SDR) is an essential component of modern communication systems, where many processes that were previously implemented in hardware are now defined in the software domain for greater flexibility and configurability. This course explains the components of software-defined radios, their limitations, and how to use "software-defined solutions" to overcome them. Understanding the interplay of analog and digital signal processing for power and spectrum efficient signal transmission and reception leads to an optimized but practical radio system.

Course Content

Unit		
I	**INTRODUCTION TO SOFTWARE RADIO CONCEPTS :**SDR concepts & history, Benefits of SDR,. SDR Forum, Ideal SDR architecture, SDR Based End-to-End Communication, Worldwide frequency band plans, Aim and requirements of the SCA. Architecture Overview, Functional View, Networking Overview, Core Framework, Real Time Operating Systems.	
	Contact Periods	**09**
II	**RADIO FREQUENCY IMPLEMENTATION ISSUES :**Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, ADC & DAC distortion, Pre-distortion, Flexible RF systems using micro-electromechanical systems.	
	Contact Periods	**09**
III	**MULTIRATE SIGNAL PROCESSING IN SDR :**Sample rate conversion principles, Polyphase filters, Digital filter banks, Timing recovery in digital receivers using multirate digital filters.	
	Contact Periods	**09**
IV	**SMART ANTENNAS :**Smart antennas, Adaptive techniques, Phased array antennas, Applying SDR principles to antenna systems, Smart antenna architectures, Low Cost SDR Platform, Requirements and system architecture, Convergence between military and commercial systems, The Future For Software Defined Radio	
	Contact Periods	**09**
V	**OBJECT ORIENTED REPRESENTATION OF RADIOS AND NETWORK :**Networks, Object –oriented programming, Object brokers, Mobile application environments, Joint Tactical radio system. Case Studies in Software Radio Design: SPEAKeasy, JTRS, Wireless Information transfer system, SDR-3000 digital transceiver	

	subsystem, Spectrum Ware, Brief introduction to Cognitive Networking. Processing, Recursive Methods for Adaptive Error Processing.
Contact Periods	**09**
Total Periods	**45**

Course Outcomes

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

CO1	Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and technologies for its implementation	K3
CO2	Analyse complex problems critically in the domains of Radio frequency implementation issues	K4
CO3	Apply multirate signal processing in SDR	K3
CO4	Implement Smart antenna techniques for better spectrum exploitation for conducting research.	K5
CO5	Apply appropriate techniques for the development of scientific and technological knowledge in designing software defined radios	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002.
3. Tony J Rouphael, "RF and DSP for SDR," Elsevier Newnes Press, 2008.
4. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005.
5. Dillinger, Madani, Alonistioti (Eds.), Software Defined Radio, Architectures, Systems and Functions, Wiley, 2003.
6. Bard, Kovarik, Software Defined Radio, the Software Communications Architecture, Wiley, 2007.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	-	3	3	2	3						
CO2	3	-	3	3	2	3						
CO3	3	-	3	3	2	3						
CO4	3	-	3	3	2	3						
CO5	3	-	3	3	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	3	3

CO2	2	3	3
CO3	2	3	3
CO4	2	3	3
CO5	2	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
IC. NAHARAJAN / Electronics & Communication. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP41	IMAGE PROCESSING AND VIDEO ANALYTICS					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	NIL					

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

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course will cover the foundations and applications of image processing and analysis. It covers traditional image processing strategies (such as filtering, converting, and contouring) as well as advanced image analysis approaches (such as picture classification, object localization, and deep learning end-to-end).

Course Content

Unit	Description	
I	**INTRODUCTION AND DIGITAL IMAGE FUNDAMENTALS :Introduction**: Introduction & Applications, Elements of visual perception, Image sensing and acquisition, simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to colour image – RGB and HSI Models. **Image enhancement in Spatial domain**: Introduction to image enhancement, basic grey level transforms, Histogram, Histogram-processing equalization, Matching & colour histogram, Enhancement using arithmetic/logic operations, spatial filtering, Smoothing spatial filtering, Sharpening spatial filtering.	
	Contact Periods	**09**
II	**IMAGE PROCESSING TECHNIQUES :**Image Enhancement: Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters Frequency Domain methods: Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation concepts, point, line and Edge detection, Thresholding, region based segmentation	
	Contact Periods	**09**
III	**VIDEO PROCESSING AND MOTION ESTIMATION :**Analog video, Digital Video, Time varying Image Formation models : 3D motion models, Geometric Image formation , Photometric Image formation, sampling of video signals, filtering operations 2-D Motion Estimation: Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block based transform coding, predictive coding, Application of motion estimation in video coding	
	Contact Periods	**09**

IV	**INTRODUCTION: VIDEO ANALYTICS** :Computer Vision: Challenges- Spatial Domain Processing – Frequency Domain Processing- Background Modeling-Shadow Detection-Eigen Faces - Object Detection -Local Features-Mean Shift: Clustering, Tracking - Object Tracking using Active Contours – Tracking & Video Analysis- Kalman filters, condensation, particle, Bayesian filters, hidden Markov models, change detection and model based tracking	
	Contact Periods	**09**
V	**MOTION UNDERSTANDING** :Motion estimation and Compensation-Block Matching Method, Motion Segmentation -Thresholding for Change Detection, Estimation of Model parameters - Optical Flow Segmentation-Modified Hough Transform Method-Segmentation for Layered Video Representation-Bayesian Segmentation -Simultaneous Estimation and Segmentation-Motion Field Model - Action Recognition - Low ,Level Image Processing for Action Recognition	
	Contact Periods	**09**
	Total Periods	**45**

LIST OF EXPERIMENTS

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

Total Periods	**30**

Course Outcomes

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

CO1	Explore of the limitations of the computational methods on digital images	K2
CO2	Implement the spatial and frequency domain image transforms on enhancement and restoration of images	K3
CO3	Define the need for compression and evaluate the basic compression algorithms	K2
CO4	Study the techniques to recover the desired signal parameters and information from the signal corrupted by noisy channel	K2
CO5	Understand the algorithms available for performing analysis on video data and address the challenges	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

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

Tools for Assessment - Theory (50 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Tools for Assessment – Practical (50 Marks)

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	1	1	-	3						
CO2	-	-	1	1	-	3						
CO3	-	-	1	1	-	3						
CO4	2	2	2	2	1	3						
CO5	3	3	3	3	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	1	1
CO2	-	1	1
CO3	-	1	1
CO4	1	2	3
CO5	3	3	3

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Dr. V. JAYARAJ Prof. & Head / ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP42	RADAR SIGNAL PROCESSING					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	Statistical Signal Processing					

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

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course presents the principles and techniques fundamental to the operation of the signal processing found in a radar system.

Course Content

Unit	Description	
I	**INTRODUCTION TO RADAR SYSTEMS:**History and application of radar, basic radar function, elements of pulsed radar, review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing.	
	Contact Periods	**09**
II	**SIGNAL MODELS:**Components of a radar signal, amplitude models, types of clutters, noise model and signal-to noise ratio, jamming, frequency models: the doppler shift, spatial models, spectral model.	
	Contact Periods	**09**
III	**SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS:**Domains and criteria for sampling radar signals, Sampling in the fast time dimension,Sampling in slow time: selecting the pulse repetition interval, sampling the doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.	
	Contact Periods	**09**
IV	**RADAR WAVEFORMS:**Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range sidelobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency Codes .	
	Contact Periods	**09**
V	**DOPPLER PROCESSING :**Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing.	
	Contact Periods	**09**
	Total Periods	**45**

LIST OF EXPERIMENTS	
1.Matched filtering operation 2.Modeling the Propagation of Radar Signals 3.Modeling of radar targets 4. Density-based algorithm for clustering data. 5.MTI radar design, target detection in noise 6.Estimation of bearing angle in noise, clutter modelling 7.Frequency modulated radar signal generation 8.Doppler shift Signal strength 9.SNR loss measurement in pulse compression. 10.Detection performance of a radar system	
Total Periods	**30**

Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Perform radar signal acquisition and sampling	K3
CO2	Perform algorithm on radar processing	K3
CO3	Design basic radar algorithm	K6
CO4	Design on aperture imaging and array processing	K6
CO5	Illustrate theoretical results are derived and applied in practice	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

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

Tools for Assessment - Theory

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Tools for Assessment – Practical

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	1	1	1	1						
CO2	2	2	2	1	2	1						
CO3	3	3	2	3	3	3						

CO4	3	3	2	3	3	3						
CO5	2	2	2	2	2	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	2	1	1
CO3	3	3	3
CO4	3	3	3
CO5	2	2	2

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. V. JAYARAJ Prof. & Head/ECE Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP43	TELECOMMUNICATION SYSTEM MODELING AND SIMULATION					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	NIL					

Course Objectives

1	To enable the student to understand the various aspects of simulation methodology and performance.
2	To appreciate the significance of selecting sampling frequency and modeling different types of signals and processing them.
3	To enable to understand the Monte carlo simulation.
4	To expose the student to the different simulation techniques, their pros and cons.
5	To enable them to understand and interpret results using case studies.

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course introduces the concepts of signal generation & processing, simulations techniques used in the telecommunication for effective communication.

Course Content

Unit	Description	
I	**SIMULATION METHODOLOGY** :Introduction, Aspects of methodology, Performance Estimation, Simulation sampling frequency, Low pass equivalent simulation models for bandpass signals, Multicarrier signals, Non-linear and time-varying systems, Post processing – Basic graphical techniques and estimations.	
	Contact Periods	**09**
II	**RANDOM SIGNAL GENERATION & PROCESSING** :Uniform random number generation, Mapping uniform random variables to an arbitrary pdf, Correlated and Uncorrelated Gaussian random number generation, PN sequence generation, Random signal processing, Testing of random number generators.	
	Contact Periods	**09**
III	**MONTE CARLO SIMULATION** :Fundamental concepts, Application to communication systems, Monte Carlo integration, Semi - analytic techniques, Case study: Performance estimation of a wireless system.	
	Contact Periods	**09**
IV	**ADVANCED MODELS & SIMULATION TECHNIQUES** :Modeling and simulation of non-linearities : Types, Memoryless non-linearities, Non-linearities with memory, Modeling and simulation of Time varying systems : Random process models, Tapped delay line model, Modeling and simulation of waveform channels, Discrete memoryless channel models, Markov model for discrete channels with memory.	
	Contact Periods	**09**
V	**EFFICIENT SIMULATION TECHNIQUES** :Tail extrapolation, pdf estimators, Importance Sampling methods, Case study: Simulation of a Cellular Radio System.	
	Contact Periods	**09**
	Total Periods	**45**

LIST OF EXPERIMENTS	
PRACTICAL EXERCISES 1. Study the spectrum of response of linear and non-linear systems for single tone input 2. Generation of OFDM (multicarrier) signal and plot the spectrum (RF and Low pass equivalent) 3. Generation of uniform / Gaussian random numbers and verification of their probability distribution, autocorrelation and spectrum 4. Generation of uncorrelated and correlated random processes and verification of cross-correlations 5. Generation of PN sequence and verification of properties and spectrum. 6. Application of Monte Carlo simulation for estimation of BER of a wireless communication link 7. Study the impact of non-linearity of amplifier on transmitter symbol constellation with the help of Saleh model 8. Studying the effect of time invariant (slow fading) frequency selecting channel with the help of symbol constellation 9. Studying the effect of time variant flat fading (memoryless) channel with the help of symbol constellation	
Total Periods	**30**

Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Understand the different signal generation and processing methods	K2
CO2	Mathematically model a physical phenomena	K5
CO3	Simulate a phenomena so as to depict the characteristics that may be observed in a real experiment	K2
CO4	Apply knowledge of the different simulation techniques for designing a communication system or channel	K3
CO5	Validate a simulated system performance so as to match a realistic scenario	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	1. William.H.Tranter, K. Sam Shanmugam, Theodore. S. Rappaport, Kurt L. Kosbar, Principles of Communication Systems, Simulation, Pearson Education (Singapore) Pvt. Ltd, 2004 2. M.C. Jeruchim, P.Balaban and K. Sam Shanmugam, Simulation of Communication Systems: Modeling, Methodology and Techniques, Plenum Press, New York, 2001. 3. Averill.M.Law and W. David Kelton, Simulation Modeling and Analysis, McGraw Hill Inc., 2000 4. Geoffrey Gorden, System Simulation, Prentice Hall of India, 2nd Edition, 1992 5. Jerry Banks and John S. Carson, Discrete Event System Simulation, Prentice Hall of India, 1984.

Tools for Assessment - Theory

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total

10	10	10	5	5	40

Tools for Assessment – Practical

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	-	-	2	3	3	-						
CO2	-	-	2	-	-	-						
CO3	2	-	2	3	-	3						
CO4	-	-	2	3	3	3						
CO5	2	-	-	-	-	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	-	3	1
CO2	-	1	-
CO3	1	3	-
CO4	-	3	3
CO5	1	-	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S. ROHAN Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP44	SIGNAL DETECTION AND ESTIMATION					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	Statistical Signal Processing					

Course Objectives

1	To understand the concepts of detection and estimation
2	To learn the basics of multi-user detection theory
3	To understand the theory behind various estimation techniques
4	To understand Wiener filter and Kalman filter in detail
5	To learn the applications of Statistical Signal Processing

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: Signal detection and estimation is the area of study that deals with the processing of information-bearing signals for the purpose of extracting information from them. Applications of the theory of signal detection and estimation are in many areas, such as communications, automatic control, radar/ sonar, speech and image processing and medical signal processing. This course deals with the study of estimation theory, detection techniques and its applications.

Course Content

Unit	Description	
I	**REVIEW OF PROBABILITY AND STOCHASTIC PROCESS :**Conditional Probability, Bayes' Theorem , Random Variables, Conditional Distributions and Densities, moments and distribution of random variables., Stationary Processes Cyclostationary Processes Averages and Ergodicity Autocorrelation Function Power Spectral Density Discrete Time Stochastic Processes, Spatial Stochastic Processes, Random Signals, Relationship of Power Spectral Density and Autocorrelation Function	
	Contact Periods	**09**
II	**SINGLE AND MULTIPLE SAMPLE DETECTION :**Hypothesis Testing and the MAP Criterion, Bayes Criterion, Minimax Criterion, Neyman-Pearson Criterion, Sequential Detection, The Optimum Digital Detector in Additive Gaussian Noise , Performance of Binary Receivers in AWGN	
	Contact Periods	**09**
III	**FUNDAMENTALS OF ESTIMATION THEORY :**Formulation of the General Parameter Estimation Problem, Relationship between Detection and Estimation Theory, Types of Estimation Problems, Properties of Estimators, Bayes estimation, Minimax Estimation, Maximum-Likelihood Estimation, Comparison of Estimators of Parameters	
	Contact Periods	**09**
IV	**WIENER AND KALMAN FILTERS :**Orthogonality Principle, Autoregressive Techniques, Discrete Wiener Filter, Continuous Wiener Filter, Generalization of Discrete and Continuous Filter Representations , Linear Least-Squares Methods, Minimum-Variance Weighted Least-Squares Methods, Minimum-Variance, Least Squares, Kalman Algorithm - Computational Considerations, Signal Estimation, Continuous Kalman Filter, Extended Kalman Filter	
	Contact Periods	**09**
V	**APPLICATIONS :**Detector Structures in Non-Gaussian Noise , Examples of Noise Models, Receiver Structures, and Error-Rate Performance, Estimation of Non-Gaussian Noise Parameters Fading Multipath Channel Models, Receiver Structures with Known	

Channel Parameters, Receiver Structures without Knowledge of Phase, Receiver Structures without Knowledge of Amplitude or Phase, Receiver Structures and Performance with No Channel Knowledge	
Contact Periods	**09**
Total Periods	**45**

LIST OF EXPERIMENTS

Software Requirement: Matlab / Python / Equivalent

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

Total Periods	**30**

Course Outcomes

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

CO1	Able to understand the importance of probability and stochastic process concepts in detection and estimation.	K2
CO2	Able to design optimum detector and estimator for AWGN channe.	K5
CO3	Able to design and analyze the various estimators.	K5
CO4	Able to design Wiener and Kalman filters to solve linear estimation problems.	K5
CO5	Able to design and develop novel receiver structures suitable for modern technology.	K5

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Harry L. Van Trees, "Detection, Estimation and Modulation Theory", Part I John Wiley and Sons, New York, 2004.
2. Ludeman, Lonnie C. Random processes: filtering, estimation, and detection. John Wiley & Sons, Inc., 2003
3. Sergio Verdu " Multi User Detection" Cambridge University Press, 1998
4. Steven M. Kay, "Fundamentals of Statistical Processing, Volume I: Estimation Theory", Prentice Hall Signal Processing Series, Prentice Hall, PTR, NewJersy, 1993
5. Thomas Schonhoff, "Detection and Estimation Theory", Prentice Hall, NewJersy, 2007.

Tools for Assessment - Theory

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Tools for Assessment – Practical

Model Exam I	Model Exam I	Total
50	50	100

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	1	2	2	3	2						
CO2	3	1	2	2	3	2						
CO3	3	2	2	3	3	2						
CO4	3	2	2	3	3	2						
CO5	3	2	2	3	3	2						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	3	3
CO3	3	3	3
CO4	3	3	3
CO5	3	3	3

Course designed by	Verified by
R. Saranya Signature of the Faculty Member	Signature of the Chairperson-BoS
R-SARANYA ELECTRONICS & COMMUNICATION Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECP45	REAL TIME EMBEDDED SYSTEMS					
Semester: III	L	T	P	Credits	CIA: 50 Marks	ESE: 50 Marks
	3	0	2	4		
Course pre-requisites	Nil					

Course Objectives

1	To understand the basics of embedded system and ARM architecture.
2	To understand the RTOS concepts like scheduling and memory management related to the embedded system.
3	To learn about the programming aspects of RTOS.
4	To learn the different protocols of embedded wireless application.
5	To understand concepts involved in the design of hardware and software components for an embedded system.

Course Category	Professional Elective Courses (PEC)
Development Needs	Global / National

Course Description: This course will teach students how to develop and build a microprocessor-based embedded system application utilizing Embedded Linux and a real-time operating system. The course focuses on the technique and basics of integrating microprocessor-based embedded system parts for digital command and control of common embedded hardware systems.

Course Content

Unit	Description	
I	**INTRODUCTION** :Real Time System – Embedded Systems – Architecture of Embedded System – Simple Programming for Embedded System – Process of Embedded System Development – Pervasive Computing – Information Access Devices – Smart Cards – Microcontrollers –. ARM Processor -Real Time Microcontrollers.	
	Contact Periods	09
II	**EMBEDDED/REAL TIME OPERATING SYSTEM** :Operating System Concepts: Processes, Threads, Interrupts, Events - Real Time Scheduling Algorithms - Memory Management – Overview of Operating Systems for Embedded, Real Time Handheld Devices – Target Image Creation – Programming In Linux, Rtlinux, Vxworks, Microcontroller Operating System Overview	
	Contact Periods	09
III	**CONNECTIVITY** :Wireless Connectivity - Bluetooth – Other Short Range Protocols – Wireless Application Environment – Service Discovery – Middleware	
	Contact Periods	09
IV	**REAL TIME UML** :The Rapid Object-Oriented Process for Embedded Systems (ROPES) Process. MDA and Platform- Independent Models- Scheduling Model-Based Projects-Model Organization Principles- Working with Model-Based Projects - Object Orientation with UML 2.0-Structural Aspects-Object Orientation with UML 2.0-Dynamic Aspects-UML Profile for Schedulability, Performance, and Time. Requirements Analysis – Object Identification Strategies – Object Behaviour – Real Time Design Patterns	
	Contact Periods	09
V	**SOFTWARE DEVELOPMENT AND APPLICATION** :Concurrency – Exceptions – Tools – Debugging Techniques – Optimization –Interfacing Digital Camera With USB Port. Interfacing of Sensors and Actuators for a Real Time Industrial Application.	
	Contact Periods	09

Total Periods	**45**
LIST OF EXPERIMENTS	
1. Read Input From Switch And Automatic Control/Flash LED for ARM Processor 2. Laboratory Exercises On Task Scheduling 3. Simple Program In Linux, Rtlinux And Vxworks 4. Develop a Real Time Security Monitoing System	K4
Total Periods	**30**

Course Outcomes

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

CO1	Make a choice of suitable embedded processor for a given application	K2
CO2	Design the hardware and software for the embedded system	K5
CO3	Design and develop the real time kernel/operating system functions, task control block structure and analyze different task states	K5
CO4	Implement different types of inter task communication and synchronization techniques	K5
CO5	Know about the aspects embedded connectivity in real time systems	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. R.J.a.Buhr, D.L.Bailey, "An Introduction To Real-Time Systems", Prentice-Hall International,1999
2. David E-Simon, "An Embedded Software Primer", Pearson Education, 2007
3. C.M.Krishna, Kang G.Shin, "Real Time Systems", Mc-Graw Hill, 2010
4. B.P.Douglass, "Real Time Uml - Advances In the UML for Real-Time Systems, 3rd Edition Addison-Wesley, 2004
5. K.V.K. Prasad, "Embedded/Real Time Systems: Concepts, Design And Programming", Dream Tech Press, Black Book, 2005
6. R.Barnett, L.O.Cull, S.Cox, "Embedded C Programming and the Microchip PIC ", Thomason Learning, 2004
7. Wayne Wolf, "Computers As Components - Principles of Embedded Computer System Design", Mergen Kaufmann Publisher, 2006
8. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc-Graw Hill, 2004.

Tools for Assessment - Theory

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Tools for Assessment – Practical

Model Exam I	Model Exam I	Total
50	50	100

Mapping												
CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	3	-	3	3	2	2						
CO2	3	1	2	2	3	2						
CO3	2	-	2	2	-	3						
CO4	1	-	2	1	-	2						
CO5	1	-	2	3	3	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	3	2
CO2	2	2	3
CO3	1	2	1
CO4	-	1	1
CO5	-	2	2

Course designed by	Verified by
R.S Signature of the Faculty Member	Signature of the Chairperson-BoS
R-SARANYA ELECTRONICS & COMMUNICATION Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

LIST OF OPEN ELECTIVES

S. No.	Course Code	Course Title	L	T	P	Contact Period	C
1.	P23ECO01	Integrated Water Resources Management	3	0	0	3	3
2.	P23ECO02	Principles of Sustainable Development	3	0	0	3	3
3.	P23ECO03	Blockchain Technologies	3	0	0	3	3
4.	P23ECO04	Deep Learning	3	0	0	3	3
5.	P23ECO05	Intellectual Property Rights	3	0	0	3	3

MANDATORY COURSES (MC)

S.No.	Course Code	Course Title	L	T	P	Contact Period	C
1.	P23MC01	English for Research Paper Writing	2	0	0	2	0
2.	P23MG01	Disaster Management	2	0	0	2	0
3.	P23MC03	Constitution of India	2	0	0	2	0
4.	P23MC04	நற்றமிழ் இலக்கியம்	2	0	0	2	0

Course Code	Title					
P23ECO01	INTEGRATED WATER RESOURCES MANAGEMENT					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1 Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings

Course Category	Open Elective Courses (OEC)
Development Needs	Global / National

Course Description: The course teaches students about Integrated Water Resources Management (IWRM). The goal of this course is to provide students studying water resources management with a more comprehensive grasp of IWRM and the methods and tools available for its implementation.

Course Content

Unit	Description	
I	**CONTEXT FOR IWRM** :Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment – SDGs	
	Contact Periods	**09**
II	**WATER ECONOMICS** :Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies	
	Contact Periods	**09**
III	**LEGAL AND REGULATORY SETTINGS** :Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.	
	Contact Periods	**09**
IV	**WATER AND HEALTH WITHIN THE IWRM CONTEXT** :Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies	
	Contact Periods	**09**
V	**AGRICULTURE IN THE CONCEPT OF IWRM** :Water for food production: 'blue' versus 'green' water debate – Water foot print - Virtual water trade for achieving global water and food security –- Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.	K2
CO2	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.	K2
CO3	Apply law and governance in the context of IWRM.	K3
CO4	Discuss the linkages between water-health; develop a HIA framework.	K2
CO5	Analyse how the virtual water concept pave way to alternate policy options	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Cech Thomas V., Principles of water resources: history, development, management and policy. John Wiley and Sons Inc., New York. 2003.
2. Mollinga .P. etal " Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.
3. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002
4. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background paper No: 3. Global water partnership, Stockholm, Sweden. 1999
5. Technical Advisory Committee, Effective Water Governance". Technical Advisory Committee Background paper No: 7. Global water partnership, Stockholm, Sweden, 2003

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	1	1	-	-	-						
CO2	1	-	2	3	-	-						
CO3	2	-	2	1	1	1						
CO4	1	-	2	2	1	1						
CO5	2	-	2	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	-	-
CO2	-	3	-
CO3	-	2	-
CO4	-	2	1

CO5	-	2	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
S. ROHAN Electronics & Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECO02	PRINCIPLES OF SUSTAINABLE DEVELOPMENT					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development

Course Category	Open Elective Courses (OEC)
Development Needs	Global / National

Course Description: Sustainable development is defined as development that satisfies current demands while preserving future generations' ability to meet their own needs. This course teaches about sustainable development goals, the benefits of an environmental management system, and how organisations may assist prevent pollution.

Course Content

Unit	Description	
I	**SUSTAINABILITY AND DEVELOPMENT CHALLEGES** :Definition of sustainability – environmental, economical and social dimensions of sustainability - sustainable development models – strong and weak sustainability – defining development-millennium development goals – mindsets for sustainability: earthly, analytical, precautionary, action and collaborative– syndromes of global change: utilisation syndromes, development syndromes, and sink syndromes – core problems and cross cutting Issues of the 21 century - global, regional and local environmental issues – social insecurity - resource degradation –climate change – desertification.	
	Contact Periods	**09**
II	**PRINCIPLES AND FRAME WORK** :History and emergence of the concept of sustainable development - our common future - Stockholm to Rio plus 20– Rio Principles of sustainable development – Agenda 21 natural step-peoples earth charter – business charter for sustainable development –UN Global Compact - Role of civil society, business and government – United Nations' 2030 Agenda for sustainable development – 17 sustainable development goals and targets, indicators and intervention areas.	
	Contact Periods	**09**
III	**SUSTAINABLE DEVELOPMENT AND WELLBEING** :The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger – Sustainable Livelihood Framework- Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.	
	Contact Periods	**09**
IV	**SUSTAINABLE SOCIO-ECONOMIC SYSTEMS** :Sustainable Development Goals and Linkage to Sustainable Consumption and Production – Investing in Natural Capital- Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture- Water and sanitation - Biodiversity conservation and Ecosystem integrity – Ecotourism - Sustainable Cities – Sustainable Habitats- Green Buildings - Sustainable Transportation — Sustainable Mining - Sustainable Energy– Climate Change –Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms.	
	Contact Periods	**09**

V	**ASSESSING PROGRESS AND WAY FORWARD** :Nature of sustainable development strategies and current practice- Sustainability in global, regional and national context – Approaches to measuring and analysing sustainability– limitations of GDP-Ecological Footprint- Human Development Index- Human Development Report – National initiatives for Sustainable Development - Hurdles to Sustainability - Science and Technology for sustainable development –Performance indicators of sustainability and Assessment mechanism – Inclusive Green Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals.
Contact Periods	**09**
Total Periods	**45**

Course Outcomes

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

CO1	Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises	K5
CO2	Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals	K4
CO3	Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption	K6
CO4	Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems .	K5
CO5	Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability	K4

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Tom Theis and Jonathan Tomkin, Sustainability: A Comprehensive Foundation, Rice University, Houston, Texas, 2012
2. A guide to SDG interactions:from science to implementation, International Council for Science, Paris,2017
3. Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Rouledge Taylor and Francis, 2017.
4. The New Global Frontier - Urbanization, Poverty and Environmentin the 21st Century - George Martine,Gordon McGranahan,Mark Montgomery and Rogelio Fernández-Castilla, IIED and UNFPA, Earthscan, UK, 2008
5. Nolberto Munier, Introduction to Sustainability: Road to a Better Future, Springer, 2006
6. Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	1	1	-	-	1						

CO2	1	1	2	3	-	1						
CO3	2	1	2	1	1	1						
CO4	1	1	2	2	1	1						
CO5	2	1	2	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	-	-
CO2	1	3	-
CO3	1	2	-
CO4	1	2	1
CO5	1	2	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
K. NAVARASU / Electronics & Communication Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECO03	BLOCKCHAIN TECHNOLOGIES					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	NIL					

Course Objectives

1	This course is intended to study the basics of Blockchain technology.
2	To understand the concept of Bitcoin and Cryptocurrency.
3	By implementing, learners will have idea about private and public Blockchain, and smart contract.
4	To know the hyperledger and solidity programming.
5	During this course the learner will explore various aspects of Blockchain technology like application in various domains.

Course Category	Open Elective Courses (OEC)
Development Needs	Global / National

Course Description: The course uses economic theory to provide students with a thorough and practical grasp of block chain technology, as well as to effectively demonstrate its significant potential for company innovation and efficiency.

Course Content

Unit	Description	
I	**INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN**: Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.	
	Contact Periods	**09**
II	**BITCOIN AND CRYPTOCURRENCY**: Introduction to Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain and Digital Currency, Transactional Blocks, Impact of Blockchain Technology on Cryptocurrency.	
	Contact Periods	**09**
III	**INTRODUCTION TO ETHEREUM**: Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, , Transactions, Receiving Ethers, Smart Contracts.	
	Contact Periods	**09**
IV	**INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING**: Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types.	
	Contact Periods	**09**
V	**BLOCKCHAIN APPLICATIONS**: Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.	
	Contact Periods	**09**

	Total Periods	**45**
Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Understand and explore the working of Blockchain technology.	K2
CO2	Analyze the working of Smart Contracts.	K4
CO3	Understand and analyze the working of Hyperledger.	K4
CO4	Apply the learning of solidity to build de-centralized apps on Ethereum.	K3
CO5	Develop applications on Blockchain.	K5
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating		

Reference Books	1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained", Second Edition, Packt Publishing, 2018. 2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016. 3. Antonopoulos, Mastering Bitcoin, O'Reilly Publishing, 2014. 4. Antonopoulos and G. Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", O'Reilly Publishing, 2018. 5. D. Drescher, Blockchain Basics. Apress, 2017.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	2	2	2	2	2	3						
CO2	2	2	2	2	2	3						
CO3	2	2	2	2	2	3						
CO4	2	2	2	2	2	3						
CO5	2	2	2	2	2	3						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	2	3
CO2	2	2	3
CO3	2	2	3
CO4	2	2	3
CO5	2	2	3

Course designed by	Verified by

Signature of the Faculty Member	Signature of the Chairperson-BoS
S. ROHAN Electronics and Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECO04	DEEP LEARNING					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Nil					

Course Objectives

1	Develop and Train Deep Neural Networks
2	Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
3	Build and train RNNs, work with NLP and Word Embeddings
4	The internal structure of LSTM and GRU and the differences between them
5	The Auto Encoders for Image Processing

Course Category	Open Elective Courses (OEC)
Development Needs	Global / National

Course Description: This is an introductory course to deep learning. The course will cover theories, principles, and practices of traditional neural networks and modern deep learning. The topics of the course are structured into five-fold: (i) Deep Learning Concepts, (ii) Neural Networks, (iii) CNN (iv) Natural Language Processing using RNN (v) Unsupervised Learning

Course Content

Unit	Description	
I	**DEEP LEARNING CONCEPTS:** Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.	
	Contact Periods	**09**
II	**NEURAL NETWORKS :**About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.	
	Contact Periods	**09**
III	**CONVOLUTIONAL NEURAL NETWORK:** About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO.	
	Contact Periods	**09**
IV	**NATURAL LANGUAGE PROCESSING USING RNN:** About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.	
	Contact Periods	**09**

V	**DEEP REINFORCEMENT & UNSUPERVISED LEARNING:** About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes

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

CO1	Feature Extraction from Image and Video Data.	K2
CO2	Implement Image Segmentation and Instance Segmentation in Images.	K4
CO3	Implement image recognition and image classification using a pretrained network (Transfer Learning).	K4
CO4	Traffic Information analysis using Twitter Data.	K3
CO5	Autoencoder for Classification & Feature Extraction.	K5

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017.
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018.
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	2	2	1	2	1						
CO2	1	2	2	1	2	1						
CO3	1	2	2	1	2	1						
CO4	1	2	2	1	2	1						
CO5	1	2	2	1	2	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	2	2	2
CO2	2	2	2

CO3	2	2	2
CO4	2	2	2
CO5	2	2	2

Course designed by	Verified by
R. S Signature of the Faculty Member	V. J Signature of the Chairperson-BoS
R-SARANYA ELECTRONICS & COMMUNICATION Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23ECO05	INTELLECTUAL PROPERTY RIGHTS					
Semester: III	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	3	0	0	3		
Course pre-requisites	Nil					

Course Objectives

1	To understand the intellectual property and appreciation of the need to protect it.
2	To know about the process of patenting.
3	To Understand the statutes related to IPR.
4	To know strategies to protect intellectual property.
5	To apply models for making strategic decisions related to IPR.

Course Category	Open Elective Courses (OEC)
Development Needs	Global / National

Course Description: This course will provide an analytical review of the substance and structure of the institution of intellectual property rights, as well as its developmental trajectory. The course will cover the philosophy of intellectual property rights, numerous technological and legal dimensions of IPR, and the implications of IPR for scientific growth and development, as well as the various socioeconomic and ethical-legal ramifications of IPR on economic development.

Course Content

Unit	Description	
I	**INTRODUCTION**: Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.	
	Contact Periods	**09**
II	**PROCESS**: New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.	
	Contact Periods	**09**
III	**STATUTES**: International Treaties and conventions on IPRs, The TRIPs Agreement, PCT Agreement, The Patent Act of India, Patent Amendment Act (2005), Desigh Act, Trademark Act, Geographical Indication Act, Bayh- Dole Act and Issues of Academic Entrepreneurship.	
	Contact Periods	**09**
IV	**STRATEGIES IN INTELLECTUAL PROPERTY**: Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies	
	Contact Periods	**09**
V	**MODELS**: The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.	
	Contact Periods	**09**
	Total Periods	**45**

Course Outcomes Upon successful completion of the course, students will be able to:		
CO1	Understanding of intellectual property and appreciation of the need to protect it.	K2
CO2	Awareness about the process of patenting.	K2
CO3	Understanding of the statutes related to IPR.	K2
CO4	Ability to apply strategies to protect intellectual property.	K3
CO5	Ability to apply models for making strategic decisions related to IPR.	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	1. V. Sople Vinod, Managing Intellectual Property by (Prentice hall of India Pvt.Ltd), 2006. 2. Intellectual Property rights and copyrights, EssEss Publications 3. Primer, R. Anita Rao and Bhanoji Rao, Intellectual Property Rights, Lastain Book company. 4. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2006 5. WIPO Intellectual Property Hand book

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	1	1	1	1						
CO2	1	1	1	1	1	1						
CO3	1	1	1	1	1	1						
CO4	1	1	1	1	1	1						
CO5	1	1	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS

S. MOHAN Electronics and Communication Engg. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. V. JAYARAJ
Professor & Head
Department of ECE
Nehru Inst. of Engg. & Technology
T.M. Palayam, Coimbatore - 641 105

Course Code	Title					
P23MC01	ENGLISH FOR RESEARCH PAPER WRITING					
Semester:	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	2	0	0	0		
Course pre-requisites	NIL					

Course Objectives

1	Teach how to improve writing skills and level of readability
2	Tell about what to write in each section
3	Summarize the skills needed when writing a Title
4	Infer the skills needed when writing the Conclusion
5	Ensure the quality of paper at very first-time submission

Course Category	MANDATORY COURSE (MC)
Development Needs	Global / National

Course Description: This course will teach how to create well-researched, organized, and properly documented research articles. Teaches how to discover, analyze, and document sources, as well as incorporate research-based knowledge into your writing while adhering to academic honesty rules.

Course Content

Unit	Description	
I	**INTRODUCTION TO RESEARCH PAPER WRITING**: Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	
	Contact Periods	06
II	**PRESENTATION SKILLS**: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.	
	Contact Periods	06
III	**TITLE WRITING SKILLS**: Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	
	Contact Periods	06
IV	**RESULT WRITING SKILLS**: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.	
	Contact Periods	06
V	**VERIFICATION SKILLS**: Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.	
	Contact Periods	06
	Total Periods	30

Course Outcomes

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

CO1	Understand that how to improve your writing skills and level of readability	K2

CO2	Learn about what to write in each section	K2
CO3	Understand the skills needed when writing a Title	K2
CO4	Understand the skills needed when writing the Conclusion	K2
CO5	Ensure the good quality of paper at very first-time submission	K3

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books

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

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	1	1	1	1						
CO2	1	1	1	1	1	1						
CO3	1	1	1	1	1	1						
CO4	1	1	1	1	1	1						
CO5	1	1	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

Course designed by	Verified by
R. Hg Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr-R. Deepa ASP-S&H. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Head of the Department
Department of Science & Humanities
Nehru Institute of Engineering & Technology
Nehru Gardens, Thirumalayampalayam,
Coimbatore - 641 105

Course Code	Title					
P23MG01	DISASTER MANAGEMENT					
Semester:	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	2	0	0	0		
Course pre-requisites	NIL					

Course Objectives

1	Summarize basics of disaster.
2	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
3	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives,
4	Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
5	Develop the strengths and weaknesses of disaster management approaches.

Course Category	MANDATORY COURSE (MC)
Development Needs	Global / National

Course Description: The course is designed to provide a general understanding of the dimensions of natural catastrophes beyond human control, as well as human-caused disasters and environmental risks, with an emphasis on disaster preparedness, response, and recovery.

Course Content

Unit	Description	
I	**INTRODUCTION** :Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	
	Contact Periods	**06**
II	**REPERCUSSIONS OF DISASTERS AND HAZARDS:** Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	
	Contact Periods	**06**
III	**DISASTER PRONE AREAS IN INDIA :**Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.	
	Contact Periods	**06**
IV	**DISASTER PREPAREDNESS AND MANAGEMENT**: Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.	
	Contact Periods	**06**
V	**RISK ASSESSMENT**: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	
	Contact Periods	**06**

	Total Periods	**30**
Course Outcomes **Upon successful completion of the course, students will be able to:**		
CO1	Ability to summarize basics of disaster	K2
CO2	Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response	K2
CO3	Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives	K2
CO4	Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations	K2
CO5	Ability to develop the strengths and weaknesses of disaster management approaches	K3
K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating		
Reference Books	1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009. 2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007 3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.	

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	-	-	1	1						
CO2	1	1	-	-	1	1						
CO3	1	1	-	-	1	1						
CO4	1	1	-	-	1	1						
CO5	1	1	-	-	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	-	1
CO2	1	-	1
CO3	1	-	1
CO4	1	-	1
CO5	1	-	1

Course designed by	Verified by
 Signature of the Faculty Member	 Signature of the Chairperson-BoS
Sukanya. S, MBA. Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS

Dr. P.T. VIJAYA RAJAKUMAR
Professor and Director
Department of Management Studies
Nehru Institute of Engineering and Technology
Coimbatore

Course Code	Title					
P23MC03	CONSTITUTION OF INDIA					
Semester:	L	T	P	Credits	CIA: 40 Marks	ESE: 60 Marks
	2	0	0	0		
Course pre-requisites	NIL					

Course Objectives

1	Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
2	To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
3	Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism
4	To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917 and its impact on the initial drafting of the Indian Constitution

Course Category	MANDATORY COURSE (MC)
Development Needs	Global / National

Course Description: The India Constitution course focuses on major characteristics of the Indian Constitution, such as guiding principles of state policy, fundamental rights and duties, and the many organs of the constitution. The course is not intended to provide legal education, but rather to raise general understanding of the Indian Constitution.

Course Content

Unit	Description	
I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION:** History, Drafting Committee, (Composition & Working).	
	Contact Periods	**05**
II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**:Preamble, Salient Features.	
	Contact Periods	**05**
III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES** : Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	
	Contact Periods	**05**
IV	**ORGANS OF GOVERNANCE**:Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions	
	Contact Periods	**05**
V	**LOCAL ADMINISTRATION**: Or and role of elected representative CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.	
	Contact Periods	**05**
VI	**ELECTION COMMISSION**:Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	

Contact Periods	**05**
Total Periods	**30**

Course Outcomes		
Upon successful completion of the course, students will be able to:		
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics	K2
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India	K2
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution	K2
CO4	Discuss the passage of the Hindu Code Bill of 1956	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Reference Books	1. The Constitution of India,1950(Bare Act), Government Publication 2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015. 3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Tools for Assessment (40 Marks)

CIA I	CIA II	CIA III	Assignment/ Seminar / Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6						
CO1	1	1	1	1	1	1						
CO2	1	1	1	1	1	1						
CO3	1	1	1	1	1	1						
CO4	1	1	1	1	1	1						

3-High; 2-Medium; 1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1

Course designed by	Verified by

Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. R. Deepa ASP - S&H Name and Department of the Faculty Member	Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105 Name and Seal of the Chairperson-BoS

Course Code	Title				
P23MC04	நற்றமிழ் இலக்கியம்				
Semester:I	L	T	P	Credits	Internal Assessment:100 Marks
	2	0	0	0	
Course pre-requisites	Higher Secondary Level				

Course Objectives

1	To learn the extensive literature of classical Tamil.
2	To review the morality of Tamil Literature.
3	To realize the two epic Tamil literatures.
4	To understand the role of ethics in Sangam literature.
5	To examine Tamil modern literature.

Course Category	Humanities, Social Science and Management Course (HSMC)
Development Needs	Global/National

Course Description: Used to explores the extensive literature of classical and modern Tamil literature based on its morality, epics and ethics of Tamil community.

Course Content

Unit	Description	
I	**சங்க இலக்கியம்:** 1. தமிழின் துவக்க நூல் தொல்காப்பியம் – எழுத்து, சொல்,பொருள், 2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம், 3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி, 4. புறநானூறு (95,195) - போரை நிறுத்திய ஔவையார்.	
		Contact periods 06
II	**அறநெறித் தமிழ்:** 1. அறநெறி வகுத்த திருவள்ளுவர் அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ், 2. பிற அறநூல்கள் - இலக்கிய மருந்து ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்).	
		Contact periods 06
III	**இரட்டைக் காப்பியங்கள்**: 1. கண்ணகியின் புரட்சி சிலப்பதிகார வழக்குரை காதை, 2. சமூகசேவை இலக்கியம் மணிமேகலை சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை.	
		Contact periods 06
IV	**அருள்நெறித் தமிழ்:** 1.சிறுபாணாற்றுப்படை பாரி முல்லைக்குத் தேர் கொடுத்தது. பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைச் நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள், 2.நற்றிணை - அன்னைக்குரிய புன்னை சிறப்பு, 3.திருமந்திரம் (617,618) இயமம் நியமம் விதிகள், 4.தர்மச்சாலையை நிறுவிய வள்ளலார். 5.புறநானூறு சிறுவனே வள்ளலானான, 6. அகநானூறு (4) வண்டு நற்றிணை (11) நண்டு கலித்தொகை (11) யானை, புறா ஐந்திணை 50 (27) மான ஆகியவை பற்றிய செய்திகள்.	
		Contact periods 06

V	**நவீன தமிழ் இலக்கியம்:** 1. உரைநடைத் தமிழ். தமிழின் முதல் புதினம், தமிழின் முதல் சிறுகதை. கட்டுரை இலக்கியம், பயண இலக்கியம், நாடகம், 2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும், 3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும், 4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும், 5. அறிவியல் தமிழ், 6.இணையத்தில் தமிழ், 7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.
	Contact Periods 06
	Total Periods 30

Course Outcomes

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

CO 1	Remember the extensive literature of Tamil and its classical nature.	K1
CO 2	Remember the morality of Tamil literature.	K1
CO 3	Understand the two epic Tamil literature.	K2
CO 4	Understand the role of ethics in Sangam literature.	K2
CO 5	Understand the Tamil modern literature.	K2

K1: Remembering; K2: Understanding; K3: Applying; K4: Analyzing; K5: Evaluating; K6: Creating

Text Books	1. தமிழகவரலாறு – மக்களும்பண்பாடும் – .கே. கேபிள்ளை (வெளியீடு:தமிழ்நாடுபாடநூல்மற்றும்கல்வியியல்பணிகள் கழகம். 2. வாழ்வியல் களஞ்சியம் தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்.
Reference Books	1. தமிழ் இணைய கல்விக்கழகம் - Tamil Virtual University - www.tamilvu.org. 2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - https //ta.wikipedia.org. 3. தர்மபுர ஆதீன வெளியீடு. 4. .தமிழ்கலைக்களஞ்சியம் தமிழ் வளர்ச்சித்துறை - thamilvalarchithurai.com. 5. அறிவியல் களஞ்சியம் தமிழ்ப் பல்கலைக்கழகம , தஞ்சாவூர்.

Tools for Assessment (40 Marks)

CIAI	CIAII	CIAIII	Assignment/Seminar/ Case Study	Attendance	Total
10	10	10	5	5	40

Mapping

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	1	2	-	-	1
CO2	-	1	2	-	-	1
CO3	-	1	2	-	-	1
CO4	-	1	2	-	-	1
CO5	-	1	2	-	-	1

3-High;2-Medium;1-Low

CO \ PSO	PSO1	PSO2	PSO3
CO1	1	1	1
CO2	1	1	1
CO3	1	1	1
CO4	1	1	1
CO5	1	1	1

Course designed by	Verified by
Signature of the Faculty Member	Signature of the Chairperson-BoS
Dr. DEEPAK. A. S&H Dept.	Dr.P.J. Hemamalini Head of the Department Department of Science & Humanities Nehru Institute of Engineering & Technology Nehru Gardens, Thirumalayampalayam, Coimbatore - 641 105
Name and Department of the Faculty Member	Name and Seal of the Chairperson-BoS