ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY

(AUTONOMOUS)

(Anjugramam-Kanyakumari Main Road, Palkulam,Variyoor P.O.-629 401, K.K.Dist.)

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

Accredited with A+ Grade by NAAC

Department of Electronics and Communication Engineering

M.E. Communication Systems

Curriculum & Syllabus

(*2024-2025 Admitted Students Onwards*)

Vision Statement of RCET

To be an academic institute of continuous excellence towards education and research in rural regime and provide service to nation in terms of nurturing potentially higher social, ethical and engineering companion graduands.

Mission Statement of RCET

To foster and promote technically competent graduands by imparting the state of art Engineering education in rural regime.

To enunciate research assisted scientific learning by dissemination of knowledge towards science, agriculture, industry and national security.

Vision of the Department

To promote ethical and innovative Electronics and Communication Engineers through excellence in teaching, training and research so as to contribute to the advancement of the rural society and mankind.

Mission of the Department

- To focus on quality teaching and learning that will make students to adapt to the needs of the industry and higher learning.
- To infuse a spirit of social responsibility, innovation, creativity and ethical practices through all round development activities of students.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1 Graduates shall be able to lead a successful career by applying the Scientific and Engineering fundamentals to formulate and solve the real-life problems.

PEO2 Graduates shall be able to practice the ethics of their profession, consistent with a sense of social responsibility and aptitude for innovations as they work individually and in multi-disciplinary teams.

PEO3 Graduates shall be receptive to recent technologies so as to excel in industry and accomplish professional competence through lifelong learning.

PROGRAMME OUTCOMES (POs)

PO1 An ability to independently carry out research /investigation and development work to solve practical problems.

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

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

CREDIT INFO		
Sl.No	Category	Credits
1	Foundation Course (FC)	4
2	Professional Core Courses (PCC)	34
3	Professional Electives Courses (PEC)	13
4	Research Methodology and IPR (RMC)	2
5	Open Electives Courses (OEC)	3
6	Employability Enhancement Courses (EEC)	19
7	Audit Course	--
Total Credits		75

Foundation Course (FC)							
Sl. No	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1.	24CM101	Linear Algebra, Probability and Queueing Theory	FC	3	1	0	4

Professional Core Courses (PCC)							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CM102	Statistical Signal Processing	PCC	3	0	0	3
2	24CM103	Modern Digital Communication Systems	PCC	3	0	0	3
3	24CM104	Advanced Wireless Networks	PCC	3	0	0	3
4	24CM105	Radiating Systems	PCC	3	0	0	3
5	24CM131	Digital Communication Systems Laboratory	PCC	0	0	3	1.5
6	24CM132	Advanced Digital Signal Processing Laboratory	PCC	0	0	3	1.5
7	24CM201	RF System Design	PCC	3	0	0	3
8	24CM202	Microwave Integrated Circuits	PCC	3	0	2	4
9	24CM203	Optical Communication and Networking	PCC	3	0	0	3
10	24CM204	Machine Learning	PCC	3	0	2	4
11	24CM231	Wireless Communication Laboratory	PCC	0	0	4	2
12	24CM301	4G/5G Communication Networks	PCC	3	0	0	3

Professional Elective Courses (PEC): Semester II, Elective I							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CM211	Electromagnetic Interference andCompatibility	PEC	3	0	0	3

2	24CM212	Advanced Satellite Communication andNavigation Systems	PEC	3	0	0	3
3	24CM213	High Speed Switching and Networking	PEC	3	0	0	3
4	24CM214	Signal Integrity for High Speed Design	PEC	3	0	0	3
5	24CM215	Wavelets and Subband Coding	PEC	3	0	0	3

Professional Elective Courses (PEC): Semester II, Elective II							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CM221	Multimedia Compression Techniques	PEC	3	0	0	3
2	24CM222	Cognitive Radio Networks	PEC	3	0	0	3
3	24CM223	Speech Processing	PEC	3	0	0	3
4	24CM224	mm Wave Communication	PEC	3	0	0	3
5	24CM225	Analog and Mixed Signal VLSI Design	PEC	3	0	0	3

Professional Elective Courses (PEC): Semester III, Elective III							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CM311	Ultra-Wide Band Communications	PEC	3	0	0	3
2	24CM312	VLSI for Wireless Communication	PEC	3	0	0	3
3	24CM313	MEMS and NEMS	PEC	3	0	0	3
4	24CM314	Advanced Antenna Design	PEC	3	0	0	3
5	24CM315	Software Defined Radios	PEC	3	0	0	3
6	24CM311	Ultra-Wide Band Communications	PEC	3	0	0	3

Professional Elective Courses (PEC): Semester III, Elective IV							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CM321	Image Processing and Video Analytics	PEC	3	0	2	4
2	24CM322	Radar Signal Processing	PEC	3	0	2	4
3	24CM323	Telecommunication System Modelingand Simulation	PEC	3	0	2	4
4	24CM324	Signal Detection and Estimation	PEC	3	0	2	4
5	24CM325	Real Time Embedded Systems	PEC	3	0	2	4

AUDIT COURSES (AC)							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24AC201	English for Research Paper Writing	AC	2	0	0	*
2	24AC202	Disaster Management	AC	2	0	0	*
3	24AC203	Constitution of India	AC	2	0	0	*
4	24AC204	தற்தமிழர் இலக்கியம்	AC	2	0	0	*
* *Non-Credit Course*							

OPEN ELECTIVE COURSES (OEC)							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CI341	Integrated Water Resources Management	OEC	3	0	0	3
2	24CI342	Water, Sanitation and Health	OEC	3	0	0	3
3	24CI343	Principles of Sustainable Development	OEC	3	0	0	3
4	24CI344	Environmental Impact Assessment	OEC	3	0	0	3
5	24CP311	Blockchain Technologies	OEC	3	0	0	3
6	24CP310	Deep Learning	OEC	3	0	0	3
7	24IS342	Vibration and Noise Control Strategies	OEC	3	0	0	3
8	24TE341	Energy Conservation and Management in Domestic Sectors	OEC	3	0	0	3
9	24TE342	Electric Vehicle Technology	OEC	3	0	0	3
10	24TE343	New Product Development	OEC	3	0	0	3
11	24CI345	Sustainable Management	OEC	3	0	0	3
12	24IS341	Micro and Small Business Management	OEC	3	0	0	3
13	24IS343	Intellectual Property Rights	OEC	3	0	0	3
14	24IS344	Ethical Management	OEC	3	0	0	3
15	24EN341	IoT for Smart Systems	OEC	3	0	0	3
16	24EM342	Smart Grid	OEC	3	0	0	3
17	24TC344	Design Thinking	OEC	3	0	0	3
18	24CP341	Principles of Multimedia	OEC	3	0	0	3
19	24CI346	Environmental Sustainability	OEC	3	0	0	3
20	24TE345	Textile Reinforced Composites	OEC	3	0	0	3
21	24TE346	Nanocomposite Materials	OEC	3	0	0	3

Employability Enhancement Courses (EEC)							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1	24CM251	Term Paper Writing and Seminar	EEC	0	0	2	1
2	24CM351	Project Work I	EEC	0	0	12	6
3	24CM451	Project Work II	EEC	0	0	24	12

Research Methodology and IPR (RMC)							
Sl. No.	**Course Code**	**Course Title**	**Course Type**	**L**	**T**	**P**	**Credit**
1.	24RM101	Research Methodology and IPR	RMC	2	0	0	2

SCHEME OF INSTRUCTION FOR FIRST YEAR M.E

1st SEMESTER

S. No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY COURSES							
1.	24CM101	Linear Algebra, Probability and Queueing Theory	FCC	3	1	0	4
2.	24RM101	Research Methodology and IPR	RMC	2	0	0	2
3.	24CM102	Statistical Signal Processing	PCC	3	0	0	3
4.	24CM103	Modern Digital Communication Systems	PCC	3	0	0	3
5.	24CM104	Advanced Wireless Networks	PCC	3	0	0	3
6.	24CM105	Radiating Systems	PCC	3	0	0	3
7	24AC1XX	Audit Course – I*	AC	2	0	0	0
LABORATORY COURSES							
8.	24CM131	Digital Communication Systems Laboratory	PCC	0	0	3	1.5
9.	24CM132	Advanced Digital Signal Processing Laboratory	PCC	0	0	3	1.5
		Total		**19**	**1**	**6**	**21**

2nd SEMESTER

S. No.	Course Code	Course Title	Course Category	L	T	P	C
THEORY COURSES							
1.	24CM201	RF System Design	PCC	3	0	0	3
2.	24CM202	Microwave Integrated Circuits	PCC	3	0	2	4
3.	24CM203	Optical Communication and Networking	PCC	3	0	0	3
4.	24CM204	Machine Learning	PCC	3	0	2	4
5.	24CM21X	Professional Elective I	PEC	3	0	0	3
6.	24CM22X	Professional Elective II	PEC	3	0	0	3
7.	24AC2XX	Audit Course – II*	AC	2	0	0	2
LABORATORY COURSES							
8.	24CM231	Wireless Communication Laboratory	PCC	0	0	4	2
9.	24CM251	Term Paper Writing and Seminar	EEC	0	0	2	1
		Total		**20**	**0**	**10**	**23**

Course Code:	24CM101	Course Title:	LINEAR ALGEBRA PROBABILITY AND QUEUING THEORY
Credits:	4	L – T – P	3 – 1 – 0

Course objectives:

- To develop a working knowledge of the central ideas of Linear Algebra.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To develop a knowledge of linear programming models and apply the simplex method for solving linear programming problems.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of queueing models and apply in engineering.

Teaching-Learning Process:

These are sample strategies which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method does not mean only traditional method, but different type of teaching methods may be adopted to develop the outcomes.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world and when that's possible, it helps to improve the students' understanding.

UNIT I – Linear Algebra	[12 hours]
Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and	

applications – pseudo inverse – least square approximations.

UNIT II – Probability and Random Variables	**[12 hours]**
Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.	

UNIT III – Random Processes	**[12 hours]**
Joint distributions – Marginal and conditional distributions – Functions of two-dimensional random variables – Regression curve – Correlation.	

UNIT IV – Queueing Theory	**[12 hours]**
Markovian queues – Single and multi - server models – Little's formula – Steady state analysis – Self - service queue.	

UNIT V – Linear Programming	**[12 hours]**
Formulation – Graphical solution – Simplex method – Big-M method – Variants of Simplex method – Transportation and Assignment problems.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Apply the concepts of Linear Algebra to solve real time problems.	K3
CO2	Develop the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.	K3
CO3	Apply the concept of random processes in engineering problems.	K3

CO4	Apply the concept of Queuing Models in real life problem	K3
CO5	Solve transportation and assignment problems using suitable techniques.	K3

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	3	3	1
CO2	3	2	2
CO3	2	2	2
CO4	3	3	1
CO5	3	3	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE)	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment – I	40	40		
	Skill Assessment – II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Skill Assessment Components: Individual Assignment / Worksheet / Case Study / Mini Project

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	20
Apply	60	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or choice).
- All the fifteen questions have to be answered.

Reference Books:

1. Gupta.S.C., and Kapoor, V.K., "Fundamentals of Mathematical Statistics", 12th Edition, Sultan Chand and Sons, 2020.
2. Jay L. Devore, "Probability and statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2014.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.
4. Sheldon M.Ross, "Probability and Statistics for Engineers and Scientists", Academic Press
5. Bronson, R., "Matrix Operation" Schaum's outline series, Tata McGraw Hill, New York, 2011.

Web Links and Video Lectures (E-Resources):

1. Vector Spaces : https://www.nptelvideos.com/lecture.php?id=13956
2. Queuing Models: M/M/I, Birth and death process, Little's formulae:

https://www.nptelvideos.com/lecture.php?id=14466

3. Probability Distributions : https://www.nptelvideos.com/lecture.php?id=14400

Equivalent NPTEL/SWAYAM Courses:

S.No.	Course Title	Course Instructor	Host Institute
1	Linear Algebra	Prof. Dilip P. Patil	IISc Bangalore
2	Introduction to Probability Theory and Stochastic Processes	Prof. S Dharmaraja	IIT Delhi

Course Code:	24RM101	Course Title:	RESEARCH METHODOLOGY AND IPR
Credits:	2	L – T – P	2-0-0

Course objectives:

- To study various research process and design
- To prepare and explore various data collection methods and sources
- To study about various research data analysing techniques and reporting formats
- To study the various practices involved in Intellectual Property Rights
- To study about the registration of Patent

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. NPTEL and Other Videos
3. Smart Class Room
4. Flipped Class
5. Technical Seminar
6. Poster Presentation

UNIT I – RESEARCH DESIGN	[6 hours]
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.	

UNIT II – DATA COLLECTION AND SOURCES	[6 hours]
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data- Preparing, Exploring, examining and displaying.	

UNIT III – DATA ANALYSIS AND REPORTING	[6 hours]
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. PresentingInsights and findings using written reports and oral presentation.	

UNIT IV – INTELLECTUAL PROPERTY RIGHTS	[6 hours]
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.	

UNIT V – PATENTS	[6 hours]
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	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Describe the various processes and design for research methodology	K2
CO2	Make use of literature review to find research gaps and research	K3

	objectives	
CO3	Summarize the various data analysis methods and report generating formats	K2
CO4	Explain the various practices in intellectual property rights	K2
CO5	Recognize about the registration of patent considering various factors	K2

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	2	-	-
CO2	2	1	-
CO3	2	2	-
CO4	3	1	-
CO5	3	2	-

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) -	CIE – I	100	60	100	40
	CIE – II	100			
	Skill Assessment - I	40			

Theory	Skill Assessment - II	40	40		
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or choice).
- All the fifteen questions have to be answered

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.

Web Links and Video Lectures (E-Resources):

1. https://onlinecourses.nptel.ac.in/noc23_ge36/preview

Suggested Skill Activities:

1. Developing a Research Plan
2. Data Collection Analysis for a defined problem
3. Poster preparation
4. Thesis Report Writing
5. Case studies using patent database

Course Code:	24CM102	**Course Title:**	**STATISTICAL SIGNAL PROCESSING**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

To impart knowledge on the

- To introduce the basics of random signal processing
- To learn the concept of estimation and signal modeling
- To know about optimum filters and adaptive filtering and its applications

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1.Chalk and Talk
2.Interactive Simulations
3.Blended Mode of Learning
4.Experiential Learning
5.NPTEL and Other Videos
6.Smart Class Room
7.Flipped Class

UNIT I – DISCRETE RANDOM SIGNAL PROCESSING	**[9 hours]**

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, ARMA Processes – Yule-Walker equations.

UNIT II – PARAMETER ESTIMATION THEORY	**[9 hours]**

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

UNIT III – SPECTRUM ESTIMATION	**[9 hours]**

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

UNIT IV – SIGNAL MODELING AND OPTIMUM FILTERS	**[9 hours]**

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.

UNIT V – ADAPTIVE FILTERS	**[9 hours]**

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.

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Analyze the discrete time random processes	K4
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	Identify an optimum filter for the given problem	K3
CO5	Identify an adaptive filter for different applications	K3

COs and POs Mapping:

COs	POs		
	1	2	3
CO1	2	1	2
CO2	2	1	2
CO3	2	1	3
CO4	3	-	3
CO5	3	-	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	20
Apply	60	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

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, CRCPress, 2019.
6. S Nandi, D Kundu, Statistical Signal Processing- Frequency Estimation, Springer NatureSingapore, 2nd edition , 2020.
7. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Statistical Signal Processing withApplications, PHI, 1996.

Course Code:	**24CM103**	**Course Title:**	**MODERN DIGITAL COMMUNICATION SYSTEMS**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

To impart knowledge on the

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1.Chalk and Talk

2.Interactive Simulations

3.Blended Mode of Learning

4.Project based Learning

5.Experiential Learning

6.NPTEL and Other Videos

7.Smart Class Room

8.Flipped Class

UNIT I – COHERENT AND NON-COHERENT COMMUNICATION	**[9 hours]**
Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Noncoherent 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.	
UNIT II – EQUALIZATION TECHNIQUES	**[9 hours]**
Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals- Equalization algorithms– Linear equalizer – Decision feedback equalization – Adaptive Equalization algorithms.	

UNIT III – BLOCK CODED DIGITAL COMMUNICATION	**[9 hours]**
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.	
UNIT IV – CONVOLUTIONAL CODED DIGITAL COMMUNICATION	**[9 hours]**

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

UNIT V – MULTICARRIER AND MULTIUSER COMMUNICATIONS	**[9 hours]**

Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Differentiate coherent and non-coherent receivers and analyze their performance underAWGN channel conditions	K2
CO2	Illustrate the effect of signaling through bandlimited channels and Equalizationtechniques used to overcome ISI	K2
CO3	Determine the channel capacity and design various block coding techniques to combatchannel errors	K2
CO4	Construct convolutional coders and analyze the performance of different decoding techniques.	K4
CO5	Describe the basics of OFDM as a multicarrier communication and CDMA as a multiusercommunication technique.	K2

COs and POs Mapping:

COs	POs		
	1	2	3

CO1	2	-	2
CO2	2	-	2
CO3	3	-	2
CO4	3	-	-
CO5	2	-	-

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	**Continuous Internal Examination**		**End Semester Examination**
	1	**2**	
Remember	20	20	20

	Understand	20	20	20
	Apply	60	60	60
	Analyze	0	0	0
End	**Evaluate**	0	0	0
	Create	0	0	0

semester

Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

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

Course Code:	24CM104	**Course Title:**	**ADVANCED WIRELESS NETWORKS**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

The students should be made to:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Blended Mode of Learning
4. Project based Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – INTRODUCTION	[9 hours]
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	

UNIT II – WIRELESS IP NETWORK ARCHITECTURES	[9 hours]
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	

UNIT III – ADAPTIVE LINK AND NETWORK LAYER	[9 hours]
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	

UNIT IV – MOBILITY MANAGEMENT	[9 hours]
Cellular Networks-Cellular Systems with Prioritized Handoff-Cell Residing Time Distribution Mobility Prediction in Pico- and Micro-Cellular Networks	

UNIT V – QUALITY OF SERVICE	[9 hours]
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.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
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

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	3	1	2
CO2	3	-	2
CO3	2	-	2
CO4	2	-	2
CO5	2	-	2

Level 3- Highly Map1ped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	**2**	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0

Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

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.

Course Code:	**24CM105**	**Course Title:**	**RADIATING SYSTEMS**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

- To understand Antenna basics
- To learn about Antenna arrays and their characteristics
- To study about operating Antennas
- To familiarize with modern Antennas and Measurement Techniques
- To learn about recent trends in Antenna Design

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT I – Antenna Fundamentals & Wire Antennas	**[9 hours]**
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	
UNIT II – Antenna Arrays	**[9 Hours]**
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	
UNIT III – Aperture Antennas	**[9 hours]**
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	

UNIT IV – Modern Antennas & Measurement Techniques	**[9 hours]**
Base station antennas, PIFA – Antennas for WBAN – RFID Antennas -Automotive antennas, MIMO Antennas, Diversity techniques – Antenna impedance and radiation pattern measurements	

UNIT V – Recent Trends in Antenna Design	[9 hours]
UWB antenna arrays – Smart antennas- Vivaldi antenna arrays – Artificial magnetic conductors/High impedance surfaces – Antennas in medicine – Plasma antennas – Antennas for millimeter wave communication - optimization techniques – Numerical methods	

Course outcomes: On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
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	K3
CO5	Understand the need for optimizing in antenna design and the methodologies for the same.	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	1	-	1
CO2	3	-	2
CO3	2	-	2
CO4	3	-	3
CO5	2	3	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not

Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	20	20
Apply	60	60	60
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

REFERENCE BOOKS

1. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 3rdEdition,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. W.L.Stutzman and G.A.Thiele, "Antenna Theory and Design", John Wiley& Sons Inc., 2ndEdition, 1998.
7. Jim R. James,P.S.Hall ,"Handbook of Microstrip Antennas" IEE Electromagnetic wave seriesVolume 2,1989.

Course Code:	**24CM131**	**Course Title**	**Digital communication systems laboratory**
Credits:	**1.5**	**L – T – P**	**0-0-3**

Course objectives:

To impart knowledge on the

- To study & measure the performance of digital communication systems.
- To provide a comprehensive knowledge of Wireless Communication
- To learn about the design of digital filter and its adaptive filtering algorithms.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. PowerPoint presentation
2. Interactive Simulations
3. Lab experiment videos
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room

[45 hours]

S.No.	Name of the Experiment
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 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).

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Summarize the adaptive filtering algorithms	K2
CO2	Generate and detect digital communication signals of various modulation techniques using MATLAB.	K3
CO3	Explain cellular mobile communication technology and propagation model.	K2
CO4	Apply mathematical formulation to analyse spectrum estimation of a signal and bit ratedetermination of a transmission link.	K3
CO5	Analyse the performance of optimization algorithms for equalizing the channel ornoise/echo cancellation	K4
CO6	Design synchronization algorithm for Digital Communication systems.	K4

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	2	1	2
CO2	2	1	2
CO3	2	1	2
CO4	2	1	3
CO5	2	1	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	40
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	60	60	60
				Total	100

Course Code:	**24CM132**	**Course Title**	**Advanced Digital Signal Processing Laboratory**
Credits:	**1.5**	**L – T – P**	**0-0-3**

Course objectives:

To impart knowledge on the

- To enable the student to verify the basic principles of random signal processing, spectral estimation methods and additive white Gaussian noise (AWGN) channel characterization
- To design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. PowerPoint presentation
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Experiential Learning
6. NPTEL and Other Videos

Sl.No.	Name of the Experiment
1	Study of SDR
2	Estimation of power spectrum of the given random sequence using Nonparametric methods (Welch Tukey/ Bartlett)
3	Upsampling the discrete time sequence by L times and plot the spectrum of both the given sequence and upsampled sequence
4	Downsampling the discrete time sequence by M times and plot the spectrum of both the given sequence and down sampled sequence
5	Design an adaptive filter to extract a desired signal from the given noisy signal by cancelling the noise using LMS & RLS Algorithm
6	Implementation of Digital Filter Banks

[45 hours]

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Explain deterministic/Random sequences using simulation tool	K2
CO2	Analyze the frequency response of FIR/IIR digital filters for the given specifications	K4
CO3	Analyze power spectrum of the given random sequence using parametric/nonparametric estimation methods	K4
CO4	Apply LMS/RLS algorithm for adaptive filters	K3
CO5	Analyse the discrete time systems at various sampling rates	K4

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	3	1	3
CO2	3	2	3

CO3	3	2	3
CO4	3	1	3
CO5	3	1	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	40
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	60	60	60
				Total	100

Course Code:	24CM201	Course Title:	RF System Design
Credits:	3	L – T – P	3-0-0

Course objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT-I Basics of Radio Frequency System Design	[9 hours]

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

UNIT II – Radio Architectures and Design Considerations	[9 hours]

Super heterodyne 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.

UNIT III – Amplifier Modeling and Analysis	[9 hours]
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.	
UNIT IV – Mixer and Oscillator Modeling and Analysis	**[9 hours]**
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.	

UNIT V – Applications of Systems Design	[9 hours]
Multimode and multiband Super heterodyne transceiver: selection of frequency plan, receiver system and transmitter system design – Direct conversion transceiver: receiver system and transmitter system design.	

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
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 andalso 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	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	3	--	3
CO2	2	--	2
CO3	2	--	3
CO4	2	--	2
CO5	2	--	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	**2**	
Remember	**20**	**20**	**20**
Understand	**20**	**20**	**20**
Apply	**60**	**60**	**60**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.

- All the sixteen questions have to be answered.

References:

1. The Design of CMOS Radio-Frequency Integrated Circuits by Thomas H. Lee. Cambridge UniversityPress, 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, 2nd Edition, 2000.

Course Code:	**24CM202**	**Course Title:**	**Microwave Integrated Circuits**
Credits:	**4**	**L – T – P**	**3-0-2**

Course objectives:

- To familiarize different transmission lines used at Microwave frequencies
- To design impedance matching networks using lumped and distributed elements
- To design and analyze different microwave components
- To use SMITH chart to analyze the region of stability and instability for designingamplifiers and oscillators
- To simulate and to test the microwave components under laboratory conditions

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Blended Mode of Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – Planar Transmission Lines and Components	**[9 hours]**

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	
Practical Topics: 1. Study of transmission line parameters – Impedance analysis	
UNIT II – Impedance Matching Networks	**[9 hours]**
Circuit Representation of two port RF/Microwave Networks: Low Frequency Parameters, High Frequency Parameters, Transmission Matrix, ZY Smith Chart, Design of Matching Circuits using Lumped Elements, Matching Network Design using Distributed Elements	
Practical Topics: 1. Design of impedance matching networks 2. Design of low pass and high pass filter 3. Design of band-pass and band-stop filters	
UNIT III – Microwave Amplifier and Oscillator Design	**[9 hours]**
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.	
Practical Topics: 1. Design of branch line couplers	
UNIT IV – Mixers and Control Circuits	**[9 hours]**
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	
Practical Topics: 1. Design of phase shifters 2. Design of Mixers	
UNIT V – Microwave IC Design and Measurement Techniques	**[9 hours]**
Microwave Integrated Circuits – MIC Materials- Hybrid versus Monolithic MICs – Multichip Module Technology – Fabrication Techniques, Miniaturization techniques, Introduction to SOC, SOP, Test fixture measurements, probe station measurements, thermal and cryogenic measurements, experimental field probing techniques.	
Practical Topics: 1. Design of Power dividers	

Laboratory Component: **[30 hours]**

S.No.	Name of the Experiment
1	Study of transmission line parameters – Impedance analysis using ANSYS Software
2	Design of impedance matching networks using ANSYS Software
3	Design of low pass and high pass filter using ANSYS Software
4	Design of band-pass and band-stop filters using ANSYS Software
5	Design of branch line couplers using ANSYS Software
6	Design of phase shifters
7	Design of Mixers
8	Design of Power dividers

Course outcomes:

On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Understand the concepts of planar transmission line	K2
CO2	Analyze impedance matching circuits using LC components and stubs.	K4
CO3	Analyze microwave components.	K4
CO4	Perform stability analysis and be able to design amplifiers and oscillators at microwave frequencies.	K3
CO5	Perform simulations, fabricate and test microwave devices.	K3

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	2	3	2
CO2	2	3	2
CO3	3	3	3
CO4	2	2	2
CO5	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	25
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	25
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Theory Exam	100	35	50	50
	Lab Exam	100	15		
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**20**	**20**
Apply	**60**	**60**	**60**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

REFERENCES:

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", PearsonEducation, 2002.

Course Code:	**24CM203**	**Course Title:**	**Optical Communication and Networking**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

- 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.
- 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.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT I – Optical System Components and Network Design	**[9 hours]**

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.

UNIT II – Coherent Systems	**[9 hours]**

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 inCoherent detection

UNIT III – Optical Network Architectures	**[9 hours]**

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.

UNIT IV – Network Connections	**[9 hours]**

Connection Management and Control; Static Networks, Wavelength Routed Networks; Linear Lightwave networks; Logically Routed Networks; Routing and Wavelength Assignment, Traffic Grooming in Optical Networks	
UNIT V – Optical Network Survivability	**[9 hours]**
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	

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Demonstrate an understanding of the differences and challenges involved in the design ofoptical systems and networks.	K2
CO2	Apply his knowledge for designing a fiber optic system addressing the channelimpairments.	K3
CO3	Summarize the architectures and the protocol stack in use in optical networks andwould be able to identify a suitable backbone infrastructure for our present and future communication needs.	K2
CO4	Explain how connections are managed in the network and the pros and cons of thedifferent approaches	K2
CO5	Summarize the need for network survivability and the methodologies used.	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	**3**	**1**	2
CO2	**3**	**1**	2

CO3	**3**	**1**	2
CO4	**2**	**-**	3
CO5	**3**	**-**	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- NotMapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**20**	**20**
Apply	**60**	**60**	**60**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

REFERENCES:

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.

Course Code:	**24CM204**	**Course Title:**	**Machine Learning**
Credits:	**4**	**L – T – P**	**3-0-2**

Course objectives:

- To understand the concepts and mathematical foundations of machine learning and types ofproblems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT I – Introduction and Mathematical Foundations	**[9 hours]**

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

UNIT II – Supervised Learning	**[9 hours]**

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

Practical Topics:

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in buildinga 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 KNNclassifer 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

UNIT III – Unsupervised Learning and Reinforcement Learning	**[9 hours]**

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

Practical Topics:

1. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split atraining 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. 2. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset.

UNIT IV – Probabilistic Methods for Learning	**[9 hours]**
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	
1. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset	

UNIT V – Neural Networks and Deep Learning	**[9 hours]**
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	

Laboratory Component: **[30 hours]**

SL.No.	**Name of the Experiment**
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 neighbourhood above a certain price?"(use data from exercise 1). Modify theclassification 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 classifier 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 atraining 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) project must implement one or more machine learning algorithms andapply them to some data. a. 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. 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. a.Your project may be a comparison of several existing algorithms, or it may propose a newalgorithm 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. 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.

Course outcomes:

On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Explain the outline problems for each type of machine learning	K2
CO2	Model a Decision tree and Random Forest for an application	K3
CO3	Develop Probabilistic Discriminative and Generative algorithms for an application and analyze the results.	K3
CO4	Apply typical Clustering algorithms for different types of applications.	K3
CO5	Develop an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.	K3

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	3	-	3
CO2	3	2	3
CO3	3	1	3
CO4	3	1	2
CO5	3	-	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	25
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	25
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Theory Exam	100	35	50	50
	Lab Exam	100	15		
				Total	**100**

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**20**	**20**
Apply	**60**	**60**	**60**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

References:

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 Computationand 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 Theoryto 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)

Course Code:	**24CM231**	**Course Title:**	**Wireless Communication Laboratory**
Credits:	**1.5**	**L – T – P**	**0-0-3**

Course objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. PowerPoint presentation
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room

Laboratory Component **[45hours]**

Sl.No.	Name of the Experiment
1	Spectral Characterisation of communication signals (using Spectrum Analyzer)
2	Design and analysis of digital modulation techniques on an SDR platform
3	Carrier and Symbol timing Synchronization using SDR platform
4	CDMA signal generation and RAKE receiver design using DSP/MATLAB/ SIMULINK
5	Design and performance analysis of error control encoder and decoder (Blockand Convolutional Codes)
6	Wireless Channel equalizer design using DSP (ZF / LMS / RLS)
7	Wireless Channel Estimation and Diversity Combining

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Develop the physical models of wireless channels.	K3
CO2	Analyze the digital modulation techniques	K4
CO3	Measure capacity of AWGN channel, LTI Gaussian channels and various fading channels	K3
CO4	Illustrate the uplink and downlink model of AWGN channel, fading channels and multiuser diversity	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	3	1	1
CO2	3	1	3
CO3	1	2	3
CO4	1	3	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	40
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	60	60	60
				Total	100

Course Code:	24CM211	Course Title:	Electromagnetic Interference and Compatibility
Credits:	3	L – T – P	3-0-0

Course Objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT-I Introduction & Sources of EM Interference	[9 hours]
Introduction - Classification of sources - Natural sources - Man-made sources - Survey of the electromagnetic environment.	

UNIT-II EM Shielding	[9 hours]
Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures	

UNIT-III Interference Control Techniques	[9 hours]
Equipment screening - Cable screening - grounding - Power-line filters - Isolation - Balancing - Signal-line filters - Nonlinear protective devices.	

UNIT-IV EMC Standards, Measurements And Testing	[9 hours]
Need for standards - The international framework - Human exposure limits to EM fields -EMC measurement techniques - Measurement tools - Test environments.	

UNIT-V EMC Considerations in Wireless And Broadband Technologies	[9 hours]
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.	

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Demonstrate knowledge of the various sources of electromagnetic interference	K2
CO2	Explain the effect of electromagnetic fields couple through apertures, and solve simple problems based on that understanding	K2
CO3	Explain the EMI mitigation techniques of shielding and grounding	K2
CO4	Explain the need for standards and EMC measurement methods	K2
CO5	Summarize the impact of EMC on wireless and broadband technologies	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	2	1	3
CO2	2	1	3
CO3	3	-	3
CO4	3	-	2
CO5	3	-	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) -Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**60**	**40**
Apply	**60**	**20**	**40**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End Semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

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.

Course Code:	**24CM212**	**Course Title:**	**Advanced Satellite Communication and Navigation Systems**
Credits:	**3**	**L – T – P**	**3-0-0**

Course Objectives:

- Learn M2M developments and satellite applications
- Understand Satellite Communication in IPv6 Environment

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT-I Overview of Satellite Communication	**[9 hours]**
Overview of satellite communication and orbital mechanics Link budget Parameters, Link budget calculations, Auxiliary Equations, Performance Calculations.	

UNIT-II M2M Developments and Satellite Applications	**[9 hours]**
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.	

UNIT-III Satellite Communication in Ipv6 Environment	**[9 hours]**
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

UNIT-IV Satellite Navigation and Global Positioning System	**[9 hours]**
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.	

UNIT-V Deep Space Networks and Inter Planetary Missions	**[9 hours]**
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	

Course outcomes: On completion of the course, the student will have the ability to:

COs	**Course Outcome**	**Cognitive domain**
CO1	Explain the Satellite navigation and global positioning system	K2
CO2	Summarize the deep space networks and inter planetary missions	K2
CO3	Summarize the different interferences and attenuation mechanisms affecting the satellite link design.	K2
CO4	Explain the different communication, sensing and navigational applications of satellite	K2
CO5	Summarize the implementation aspects of existing satellite-based systems.	K2

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	**2**	**1**	**3**
CO2	**2**	**1**	**3**
CO3	**3**	**-**	**3**
CO4	**3**	**-**	**2**

CO5	**3**	**-**	**2**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
Total					100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**60**	**40**
Apply	**60**	**20**	**40**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

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.

Course Code:	**24CM213**	**Course Title:**	**High Speed Switching and Networking**
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – Switching Architectures	[9 hours]
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	

UNIT II – Network Performance Analysis	[9 hours]
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	

UNIT III – Multimedia Networking Applications	[9 hours]
Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, RSVP-differentiated services.	

UNIT IV – Packet Queues And Delay Analysis	[9 hours]
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	

UNIT V – Network Security And Management	[9 hours]
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.	

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Explain the fundamental concepts of the switching architecture involved in various switching types	K2
CO2	Describe the basics of various protocols and QOS in the network performance	K2
CO3	Summarize the various types of multimedia networking application	K2
CO4	Illustrate the concepts of various analysis method involved in the processing	K2
CO5	Explain fundamental issues involved in providing the security as well as the management	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	**1**	**-**	2
CO2	2	**-**	2
CO3	2	**-**	2
CO4	2	**-**	2
CO5	2	**-**	**-**

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

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

Course Code:	24CM214	Course Title:	Signal Integrity For High Speed Design
Credits:	3	L – T – P	3-0-0

Course objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – Signal Propagation on Transmission Lines	[9 hours]

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

UNIT II – Multi-Conductor Transmission Lines and Cross-Talk	[9 hours]

Multi-conductor transmission-lines, coupling physics, per unit length parameters ,Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signaling, termination, balanced circuits ,S-parameters, Lossy and Lossless models**.**

UNIT III – Non-Ideal Effects	[9 hours]

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

UNIT IV – Power Considerations and System Design	[9 hours]
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	

UNIT V – Clock Distribution and Clock Oscillators	[9 hours]
Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.	

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Identify the sources affecting the speed of digital circuits.	K2
CO2	Identify the methods to improve the signal transmission characteristics	K2
CO3	Summarize the Characterize and model multi conductor transmission line	K2
CO4	Analyse the clock distribution system and its parameters	K4
CO5	Analyze the non-ideal effects of transmission line	K4

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	1	-	1
CO2	2	-	1
CO3	1	-	1
CO4	2	2	2
CO5	2	2	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- NotMapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) -	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II				

Theory		40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**60**	**40**
Apply	**60**	**20**	**40**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (OP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

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.

Course Code:	24CM215	Course Title:	Wavelets and Sub band Coding
Credits:	3	L – T – P	3-0-0

Course objectives:

To impart knowledge on the

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – Introduction to Wavelets	[9 hours]

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

UNIT II – Multiresolution Concept And Discrete Wavelet Transform	[9 hours]

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

UNIT III – Wavelet System Design	[9 hours]

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV – Wavelet Families	**[9 hours]**
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.	

Course outcomes: On completion of the course, the student will have the ability to:

COs	**Course Outcome**	**Cognitive domain**
CO1	Explain the fundamental concepts of wavelet transforms	K2
CO2	Describe the detailed knowledge about wavelet transform	K2
CO3	Summarize the system design using wavelets.	K2
CO4	Compare different wavelet families.	K2
CO5	Analyze the signal compression techniques and sub-band coding	K4

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	2	-	2
CO2	1	1	2
CO3	2	1	3
CO4	3	1	2
CO5	3	1	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	**20**	**20**	**20**
Understand	**20**	**60**	**40**
Apply	**60**	**20**	**40**
Analyze	**0**	**0**	**0**
Evaluate	**0**	**0**	**0**
Create	**0**	**0**	**0**

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

REFERENCE

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.

Course Code:	24CM221	Course Title:	Multimedia Compression Techniques
Credits:	3	L – T – P	3-0-0

Course Objectives:

To impart knowledge on the

- To understand the basic ideas of compression algorithms related to multimedia components-Text, speech, audio, image and Video.
- To understand the principles and standards and their applications with an emphasis onunderlying technologies, algorithms, and performance.
- To appreciate the use of compression in multimedia processing applications
- To understand and implement compression standards in detail.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT I - Fundamentals of Compression	[9 hours]

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

UNIT II - Text Compression	[9 hours]
Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms	

UNIT III - Image Compression	[9 hours]
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.	

UNIT IV- Audio Compression	[9 hours]
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.	

UNIT V-Video Compression	[9 hours]
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.	

Course Outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Summarize the basic compression algorithms familiar with the use of MATLAB and its equivalent open source environments	K2
CO2	Explain the basic compression standards	K2

CO3	Analyze the different approaches of compression algorithms in multimedia related mini projects.	K2
CO4	Explain the various audio, speech compression techniques	K2
CO5	Summarize the MPEG video coding techniques.	K2

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	2	-	2
CO2	1	1	2
CO3	2	1	3
CO4	3	1	2
CO5	3	1	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of Assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE)	CIE – I	100	60	100	40
	CIE – II	100			
	Skill Assessment – I	40	40		
	Skill Assessment - II	40			

End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End Semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered

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

Course Code:	24CM222	Course Title:	Cognitive Radio Networks
Credits:	3	L – T – P	3-0-0

Course Objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – Introduction to Cognitive Radio	[9 hours]
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	
UNIT II – Spectrum Sensing And Trading	**[9 hours]**

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)

UNIT III – MAC Protocols and Network Layer Design	**[9 hours]**
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	
UNIT IV – Dynamic Spectrum Access and Management	**[9 hours]**
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	
UNIT V – Trusted Cognitive Radio Networks and Research Challenges	**[9 hours]**
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.	

Course Outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Explain the fundamental concepts of cognitive radio networks	K2
CO2	Summarize the basics of various spectrum sensing techniques and algorithms.	K2
CO3	Explain the functions of MAC layer and Network layer and its various	K2

	protocols	
CO4	Explain the concepts of cooperative spectrum sensing and handoff process	K2
CO5	Summarize the 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

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	3	2	1
CO2	2	1	1
CO3	2	1	1
CO4	3	2	1
CO5	3	2	1

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of Assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE)	CIE – I	100	60	100	40
	CIE – II	100			
	Skill Assessment – I	40	40		
	Skill Assessment - II	40			

End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	**Continuous Internal Examination**		**End Semester Examination**
	1	**2**	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End Semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions.
- One 16 marks question (either or) will be from any one of the five units.
- All the fifteen questions have to be answered.

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 Communicationsand Networks - Principles and Practice", Elsevier Inc., 2010.

CourseCode:	24CM223	Course Title	SPEECH PROCESSING
Credits:	3	L – T – P	3-0-0

Course Objectives:

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

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT I – Fundamentals of Speech Processing	[9 hours]
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.	

UNIT II - Speech Signal Representations and Coding	[9 hours]
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.	

UNIT III – Speech Recognition	[9 hours]
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – PhoneticModeling – Adaptive Techniques – Confidence Measures – Other Techniques.	

UNIT IV – Text Analysis	[9 hours]
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.	

UNIT V – Speech Synthesis	[9 hours]
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Model speech production system and describe the fundamentals of speech.	K2
CO2	Compare the different speech parameters.	K2
CO3	Summarize an appropriate statistical speech model for a given application.	K2

CO4	Summarize the speech recognition system	K2
CO5	Illustrate the different text analysis and speech synthesis techniques	K2

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	3	-	2
CO2	3	-	2
CO3	3	-	2
CO4	3	-	2
CO5	3	-	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	50	50	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End Semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions.
- One 16 marks question (either or) will be from any one of the five units.
- All the fifteen questions have to be answered.

REFERENCE BOOKS

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception ofSpeech 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", PearsonEducation, 2003.
6. Steven W. Smith, "The Scientist and Engineer"s Guide to Digital Signal Processing", CaliforniaTechnical Publishing, 1997.
7. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", PearsonEducation, 2004.

Course Code:	24CM224	Course Title	mm Wave Communication
Credits:	3	L – T – P	3-0-0

Course Objectives:

- To understand the fundamentals of Millimeter wave devices and circuits.
- To understand the various components of Millimeter wave Communications system.
- To know the antenna design at Millimeter wave frequencies.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Lab experiment videos
4. Blended Mode of Learning
5. Project based Learning
6. Experiential Learning
7. NPTEL and Other Videos
8. Smart Class Room
9. Flipped Class

UNIT I – Introduction	[9 hours]

Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wavepropagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

UNIT II – mm Wave Devices and Circuits	[9 hours]

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.

UNIT III – mm Wave Communication Systems	[9 hours]
Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeterwave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator,Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.	

UNIT IV – mm Wave Mimo Systems	[9 hours]
Massive MIMO Communications, Spatial diversity of Antenna Arrays, Multiple Antennas, MultipleTransceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial,Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.	
UNIT V – Antennas for mm Wave Systems	**[9 hours]**
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.	

Course Outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Explain the millimeter wave characteristics and implementation challenges faced.	K2
CO2	Summarize the millimeter devices and circuits.	K2
CO3	Apply the knowledge on the Modulation techniques for millimeter wave communications.	K3
CO4	Develop an antenna for millimeter wave frequencies.	K3
CO5	Summarize the millimeter wave technology.	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	**2**	**-**	2
CO2	**2**	**-**	2
CO3	**2**	**-**	2
CO4	**2**	**-**	3
CO5	**2-**	**-**	3

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End Semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

REFERENCES:

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.

Course Code:	24CM225	Course Title:	Analog and Mixed Signal VLSI Design
Credits:	3	L – T – P	3-0-0

Course Objectives:

To impart knowledge on the

- To study the concepts of MOS large signal model and small signal model
- To understand the concepts of D/A conversion methods and their architectures.
- To learn filters for ADC.
- To study about the switched capacitor circuits.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. Interactive Simulations
3. Blended Mode of Learning
4. Project based Learning
5. Experiential Learning
6. NPTEL and Other Videos
7. Smart Class Room
8. Flipped Class

UNIT I – Introduction and Basic MOS Devices	[9 hours]

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.

UNIT II – Submicron Circuit Design	[9 hours]
Submicron CMOS process flow, Capacitors and resistors, Current mirrors, Digital Circuit Design, Delay Elements – Adders- OP Amp parameters and Design	

UNIT III – Data Converters	[9 hours]
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 DACand sigma delta DAC. ADC – Flash ADC, pipelined ADC, successive approximation ADC, sigma delta ADC.	

UNIT IV – SNR in Data Converters	[9 hours]
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	

UNIT V – Switched Capacitor Circuits	[9 hours]
Resistors, First order low pass Circuit, Switched capacitor Amplifier, Switched Capacitor Integrator – Design of flip around sample and hold circuit – pipelined ADC.	

Course Outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Summarize the Basic MOS devices characteristics their frequency responses	K2
CO2	Explain the submicron circuit.	K2
CO3	Apply the knowledge on the DAC & ADC conversions.	K3
CO4	Analyze the SNR in Data converters.	K3

CO5	Illustrate the switched capacitor circuits	K2

COs and POs Mapping:

COs	**POs**		
	1	**2**	**3**
CO1	3	-	3
CO2	3	-	3
CO3	3	-	3
CO4	3	1	2
CO5	3	1	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern

Bloom's Category	Continuous Internal Examination		End Semester Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyze	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.
- All the sixteen questions have to be answered.

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"

Course Code:	24CM251	Course Title:	Term Paper Writing and Seminar
Credits:	1	L – T – P	0-0-2

Course objectives:

- To develop their scientific and technical reading and writing skills that they need tounderstand and construct research articles.
- To obtain information from a variety of sources (i.e., Journals, dictionaries, referencebooks) and then place it in logically developed ideas.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Blended Mode of Learning
4. NPTEL and Other Videos
5. Smart Class Room

The work involves the following steps:

- Selecting a subject, narrowing the subject into a topic
- Stating an objective
- Collecting the relevant bibliography (at least 15 journal papers)
- Preparing a working outline
- Studying the papers and understanding the authors contributions and critically analyzing each paper.
- Preparing a working outline
- Linking the papers and preparing a draft of the paper.
- Preparing conclusions based on the reading of all the papers.
- Writing the Final Paper and giving final Presentation

Activity	Instructions	Submissionweek	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an areaof 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 Groupsor professional society 2. List 2 journals 3. List 2 conferences, symposiaor workshops 4. List 1 thesis title 5. List 3 web presences (mailinglists, forums, news sites) 6. List 3 authors who publishregularly in your area 7. Attach a call for papers (CFP)from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
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 onyour objective -Search various digital libraries andGoogle 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” papers in the	4th week	**6%** (the list of standard papers and reason for selection)

	field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gainan overview, • Find relationships with respect to each other and toyour topic area (classification scheme/categorization) • Mark in the hard copy of papers 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 other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were 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 important directions for future	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	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
Draft outline 1 and Linking papers	Prepare a draft Outline, your surveygoals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classificationamong the papers)
Abstract	Prepare a draft abstract and give apresentation	9th week	**6%** (Clarity, purpose andconclusion) **6%** Presentation & VivaVoce
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 keepingwith the goals of your survey	11th week	**10%** (this component will be evaluated based on the linking and classificationamong the papers)
Your conclusions	Write your conclusions and futurework	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of yourpaper	13th week	**10%** (formatting, English, Clarity andlinking) **4%** Plagiarism CheckReport
Seminar	A brief 15 slides on your paper	14th & 15thweek	**10%** (based on presentationand Viva-voce)

Course outcomes: On completion of the course, the student will have the ability to:

COs	Course Outcome	Cognitive domain
CO1	Analyze and evaluate theoretical literature.	K4
CO2	Select and use research methods depends on research problem and goals.	K3
CO3	Analyze empirical data and interpret research results and make conclusions	K4
CO4	Develop the final text of the term paper	K3

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	**3**	**3**	2
CO2	**3**	**3**	2
CO3	**3**	**3**	2

CO4	**3**	**3**	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0- NotMapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Laboratory	Continuous Assessment	75	75	100	40
	Model Lab Exam	25	25		
End Semester Examination (ESE)	Lab Exam	100	60	60	60
				Total	100

Course Code:	24AC201	Course Title:	ENGLISH FOR RESEARCH PAPER WRITING
Credits:	2	L – T – P	2-0-0

Course objectives:

- To Develop how to improve writing skills and level of readability
- To plan what to write in each section
- To Apply the skills needed when writing a Title
- To develop the skills needed when writing the Conclusion
- Make use of the use of the quality of paper at very first-time submission

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. NPTEL and Other Videos
3. Smart Class Room
4. Field visit
5. Project based learning
6. Industrial Visit

UNIT I - Introduction to Research Paper Writing	[6 hours]
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	

UNIT II - Presentation Skills	[6 hours]
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	

UNIT III - Title Writing Skills	[6 hours]
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	

UNIT IV- Result Writing Skills	[6 hours]
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	

UNIT V- Verification Skills	[6 hours]
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Develop the writing skills and level of readability	K3
CO2	Develop the presentation skills.	K3
CO3	Apply the skills needed when writing a title	K3
CO4	Develop the skills needed when writing the Conclusion	K3
CO5	Analyze the quality of good paper.	K4

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	1	3	3
CO2	1	3	2
CO3	1	3	2
CO4	1	3	2
CO5	1	3	2

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped, Level 0-Not Mapped

Scheme of Evaluation:

Component	**Type of assessment**	**Max Marks**	**Reduced Marks**	**Total**	**Final marks**
Continuous Internal Examination (CIE)	CIE – I	100	60	100	40
	CIE – II	100			
	Skill Assessment – I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	60	60	60
				Total	100

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyse	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 16 marks question (either or).
- All the fifteen questions have to be answered.

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.

Course Code:	24AC202	Course Title:	DISASTER MANAGEMENT
Credits:	**3**	**L – T – P**	**3-0-0**

Course objectives:

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and

humanitarianresponse

- Illustrate disaster risk reduction and humanitarian response policy and practice from multipleperspectives.
- Describe an understanding of standards of humanitarian response and practical relevance inspecific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. NPTEL and Other Videos
3. Smart Class Room
4. Field visit

UNIT I – INTRODUCTION	**[6 hours]**
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude	

UNIT II – REPERCUSSIONS OF DISASTERS AND HAZARDS	**[6 hours]**
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.	

UNIT III – DISASTER PRONE AREAS IN INDIA	**[6 hours]**
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	

UNIT IV – DISASTER PREPAREDNESS AND MANAGEMENT	[9 hours]
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.	

UNIT V – RISK ASSESSMENT	[9 hours]
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	

Course outcomes:

On completion of the course, the student will have the ability to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Summarize the basics of disaster	K2
CO2	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response	K2
CO3	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives	K2
CO4	Describe the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations	K2
CO5	Summarize the strengths and weaknesses of disaster management approaches	K2

COs and POs Mapping:

COs	POs		
	1	**2**	**3**
CO1	2	--	2
CO2	2	--	2

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

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped,Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	60	60
				Total	100

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	**2**	
Remember	20	20	20
Understand	20	60	40
Apply	60	20	40
Analyse	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions and one 13 marks question (either or).
- One 16 marks question (either or) will be from any one of the five units.

- All the sixteen questions have to be answered.

References:

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", PrenticeHall OfIndia, New Delhi,2001

Course Code:	**24AC203**	**Course Title:**	**Constitution of India**
Credits:	**3**	**L – T – P**	**2-0-0**

COURSE OBJECTIES:

- Understand the premises informing the twin themes of liberty and freedom from a civil rightsperspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in theearly years of Indian nationalism.
- To address the role of socialism in India after the commencement of the BolshevikRevolutionin1917and its impact on the initial drafting of the Indian Constitution.

Teaching-Learning Process:

Suggested strategies that teachers may use to effectively achieve the course outcomes:

1. Chalk and Talk
2. PowerPoint presentation
3. Project based Learning
4. Experiential Learning
5. NPTEL and Other Videos
6. Smart Class Room
7. Flipped Class

UNIT I – HISTORY OF MAKING OF THE INDIAN CONSTITUTION	[4 hours]
History, Drafting Committee, (Composition & Working)	

UNIT II – PHILOSOPHY OF THE INDIAN CONSTITUTION	[4 hours]
Preamble, Salient Features	

UNIT III – CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	[6 hours]
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.	

UNIT IV – ORGANS OF GOVERNANCE	[6 hours]
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.	

UNIT V – LOCAL ADMINISTRATION	[6 hours]

District's Administration head: Role and importance, Municipalities: Introduction , Mayor 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.

UNIT VI – ELECTION COMMISSION	**[4 hours]**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women	

Course outcomes:

At the end of this course the students will be able to:

CO No.	Course Outcomes	Cognitive Domain
CO1	Summarize 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	Summarize the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	K2
CO3	Summarize the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of theproposal of direct elections through adult suffrage in the Indian Constitution.	K2
CO4	Explain the concepts of cooperative spectrum sensing and handoff process	K2

COs and POs Mapping:

COs	POs

	1	2	3
CO1	1	2	-
CO2	1	1	-
CO3	1	-	-
CO4	1	-	-

Level 3- Highly Mapped, Level 2- Moderately Mapped, Level 1- Low Mapped,Level 0- Not Mapped

Scheme of Evaluation:

Component	Type of assessment	Max Marks	Reduced Marks	Total	Final marks
Continuous Internal Examination (CIE) - Theory	CIE – I	100	50	100	40
	CIE – II	100			
	MCQ	20	10		
	Skill Assessment - I	40	40		
	Skill Assessment - II	40			
End Semester Examination (ESE)	Theory Exam	100	40	60	60
				Total	100

Assessment Pattern:

Bloom's Category	Continuous Assessment Tests		Terminal Examination
	1	2	
Remember	20	20	20
Understand	20	60	40

Apply	60	20	40
Analyse	0	0	0
Evaluate	0	0	0
Create	0	0	0

End semester Examination: (QP PATTERN)

- Each unit consists of two 2 marks questions.
- One 16 marks question (either or) will be from any one of the five units.
- All the fifteen questions have to be answered.

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.