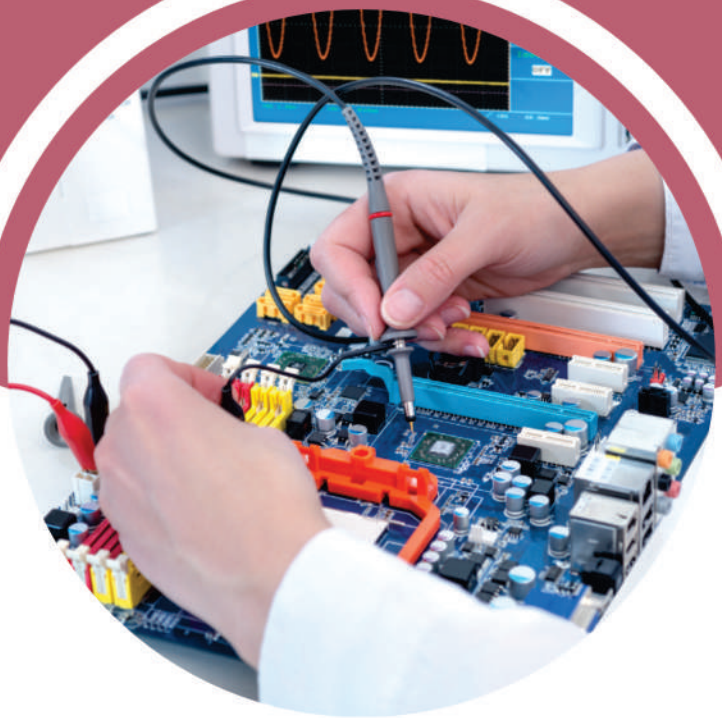
Third Year BE

SCHEME & SYLLABUS

Autonomous Scheme 2021-22

Electronics and Communication Engineering



ST JOSEPH ENGINEERING COLLEGE

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

MOTTO

Service and Excellence

VISION

To be a global premier Institution of professional education and research

MISSION

- Provide opportunities to deserving students of all communities, the Christian students in particular, for quality professional education
- Design and deliver curricula to meet the national and global changing needs through student-centric learning methodologies
- Attract, nurture and retain the best faculty and technical manpower
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities
- Promote all-round personality development of the students through interaction with alumni, academia and industry
- Strengthen the Educational Social Responsibilities (ESR) of the Institution

ST JOSEPH ENGINEERING COLLEGE

An Autonomous Institution
Vamanjoor, Mangaluru - 575028

Affiliated to VTU – Belagavi & Recognized by AICTE New Delhi
NBA – Accredited: B.E.(CSE,ECE,EEE, ME and CIV) & MBA
NAAC – Accredited with A+

B.E. SCHEME & SYLLABUS
(With effect from 2021-22)

Electronics and Communication Engineering

THIRD YEAR

(V and VI Semester)

AUTONOMY AND ACCREDITATION

St Joseph Engineering College (SJEC) is an Autonomous Institute under Visvesvaraya Technological University (VTU), Belagavi, Karnataka State, and is recognized by the All-India Council for Technical Education (AICTE), New Delhi. SJEC is registered under the trust "Diocese of Mangalore, Social Action Department".

The SJEC has been conferred Fresh Autonomous Status from the Academic Year 2021-22. The college was granted autonomy by the University Grants Commission (UGC) under the UGC Scheme for Autonomous Colleges 2018 and conferred by VTU. The UGC Expert Team had visited the college on 28-29 November 2021 and rigorously assessed the college on multiple parameters. The fact that only a handful of engineering colleges in the state have attained Autonomous Status adds to the college's credibility that has been on a constant upswing. Autonomy will make it convenient for the college to design curricula by recognizing the needs of the industry, offering elective courses of choice and conducting the continuous assessment of its students.

At SJEC, the Outcome-Based Education (OBE) system has been implemented since 2011. Owing to OBE practised at the college, SJEC has already been accredited by the National Board of Accreditation (NBA). Five of the UG programs, namely Computer Science & Engineering, Mechanical Engineering, Electronics and Communication Engineering, Electrical & Electronics Engineering and Civil Engineering and MBA programs, have accreditation from the NBA.

Also, SJEC has been awarded the prestigious A+ grade by the National Assessment and Accreditation Council (NAAC) for five years. With a Cumulative Grade Point Average (CGPA) of 3.39 on a 4-point scale, SJEC has joined the elite list of colleges accredited with an A+ grade by NAAC in its first cycle. The fact that only a small percentage of the Higher Education Institutions in India have bagged A+ or higher grades by NAAC adds to the college's credibility that has been on a constant upswing.

The college is committed to offering quality education to all its students, and the accreditation by NAAC and NBA reassures this fact. True to its motto of "Service and Excellence", the college's hard work has resulted in getting this recognition, which has endorsed the academic framework and policies that the college has been practicing since its inception. The college has been leveraging a flexible choice-based academic model that gives students the freedom to undergo learning in respective disciplines and a transparent and continuous evaluation process that helps in their holistic development.

CONTENTS

ABOUT THE DEPARTMENT

The Department of Electronics and Communication Engineering was setup during the inception of the college in 2002. With the effort of well qualified faculty and best infrastructure, the Department has grown from strength to strength in the last decade. Currently, the student intake is 120 at the UG level. VTU has approved the Department to offer M.Sc (Engg.) by research and PhD from 2015. The Department strives to empower students with the skills required to thrive in the field of Digital System Design, VLSI, Wireless Communication, Optical Communication, Embedded Systems, Biomedical Engineering, IoT, Artificial Intelligence and Robotics. Students are encouraged to present papers in symposium and conferences, and to participate in various intercollege technical and nontechnical events.

The Department is well equipped with state-of-art laboratories with the latest tools such as Cadence VLSI Design Suite, Xilinx Vivado-2018, MATLAB 2023a, ARM CORTEX, NI Multisim 14.2, NEXYS 4 DDR Artix-7 FPGA Board, Analog Discovery Kits, Digital Storage Oscilloscopes, Digital Signal Generators, Workstations etc. to skill the students Industry ready. With a large collection of books and materials for students, faculty, and staff, the Department offers a well-organized library. In addition, the Department has Biomedical Electronics Research Lab to encourage students to develop projects in the field of Biomedical Engineering in association with Father Mullers Research Centre and Hospital Mangaluru, Cyclops MedTech Private Limited Bengaluru and DST-Nitte University Technology Enabling Centre.

The Department has MOU with "Karmic Design Pvt Ltd" Manipal to facilitate the students in semiconductor chip design. Also, Department has MoU with College of Electrical & Information Engineering, Asia University, Taiwan to encourage students for Internship in the emerging areas such as Image Processing, Artificial Intelligence, Deep Learning, Computer Networks, Cyber Security etc. The Department actively organizes Industry visits, Conferences, Workshops, Technical talks, Faculty Development Programs from Industry/Academic experts in order to enhance students' learning abilities, creative thinking and also to bridge the gap between the Industry and Academia.

PRODIGY student association and **Samarthya Club** of the Department provides ample opportunities for the students to excel in technical and extra-curricular activities. The Department has well qualified faculty who are specialized in their respective domain and are actively involved in research. The Department has been shaping industry-ready graduates who have carved successful careers in the industry with placements almost nearing 100%.

DEPARTMENT VISION

To Excel in Electronics and Communication Engineering Education and Research, focusing on the needs of Industry and Society, with professional ethics.

DEPARTMENT MISSION

- Provide opportunities to deserving students for quality professional education in the field of Electronics and Communication.
- Design and deliver curricula to meet the changing needs of industry through student centric learning methodologies to excel in their profession.
- Recruit, Nurture and Retain best faculty and technical manpower.
- Consolidate the state-of-art infrastructure and equipment for teaching and research activities.
- Promote all round personality development of the students through interaction with alumni, academia and industry.
- Strengthen the Educational Social Responsibilities of the institution.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide students with the solid foundation in mathematical, scientific, Electronics and Communication engineering to analyze data and technical concepts for application to product design and also to pursue higher education.

2. To train students with good scientific and engineering breadth, including proficiency in software language and use of latest software tools so as to comprehend, analyze, design and create novel products and solutions for the real-life problems.
3. To develop skills in students for successful careers in industry that meet the needs of Indian and multinational companies, through rigorous education.
4. To inculcate in students professional and ethical attitude, effective communication skills and teamwork, multidisciplinary approach, and an ability to relate engineering issues to broader social context.
5. To provide students with an academic environment to become aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

4. Conduct investigations on complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and the synthesis of information to provide valid conclusions.

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

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and a leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will be able to:

PSO1: Analyze and develop solutions in the areas of Signal Processing and Communication Systems.

PSO2: Apply knowledge of Embedded Systems and VLSI to design and develop solutions for societal problems.

V Semester (B.E. – E&C Engineering)														
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
						L	T	P					
1	HSMC	21ECE501	Technological Innovation Management and Entrepreneurship	ECE	ECE	3	-	-	03	50	50	100	3
2	PCC	21ECE502	Digital Signal Processing (Integrated)	ECE	ECE	3	-	2	03	50	50	100	4
3	PCC	21ECE503	Digital Communication	ECE	ECE	2	2	-	03	50	50	100	3
4	PCC	21ECE504	Control Systems	ECE	ECE	2	2	-	03	50	50	100	3
5	PCC	21ECE505	Electromagnetic Waves	ECE	ECE	2	2	-	03	50	50	100	3
6	PCC	21ECL506	Digital Communication Lab	ECE	ECE	-	-	2	03	50	50	100	1
7	HSMC	21RMI507	Research Methodology and Intellectual Property Rights	ECE	ECE	3	-	-	03	50	50	100	3
8	INT	21INT508	Summer Internship - II	ECE	ECE	-	-	-	03	100	-	100	2
9	MNCC	21ETP509	Emerging Technologies: A Primer	COM	COM	-	-	2	02	50	-	50	-
						15	6	6	26	500	350	850	22

Note: BSC: Basic Science Courses; ESC: Engineering Science Courses; HSMC: Humanity, Social Science and Management Courses; MNCC = Mandatory Non-Credit Course. INT: Internship, PCC: Professional Core Course; PEC = Professional Elective Course; OEC = Open Elective Course; UHV: Universal Human Values SDC: Ability Enhancement (Skill Development) Course.

One-hour Lecture (L) per week per semester = 1 Credit; Two-hour Tutorial (T) per week per semester = 1 Credit; Two-hour Practical/Laboratory/Drawing (P) per week per semester = 1 Credit.

VI Semester (B.E. – E&C Engineering)													
SI. No.	**Course and Course Code**		**Course Title**	**Teaching Department**	**Paper Setting Board**	**Teaching Hours/Week**			**Examination**				**Credits**
						Theory Lecture	**Tutorial**	**Practical/ Drawing**	**Duration in hours**	**CIE Marks**	**SEE Marks**	**Total**	
						L	T	P					
1	PCC	21ECE601	Computer Communication Networks (Integrated)	ECE	ECE	2	2	2	03	50	50	100	4
2	PCC	21ECE602	VLSI Design	ECE	ECE	2	2	-	03	50	50	100	3
3	PEC	21ECE603X	Professional Elective - 1	ECE	ECE	2	2	-	03	50	50	100	3
4	OEC	21XXX604X	Open Elective - 1	ECE	ECE	3	-	-	03	50	50	100	3
5	HSMC	21CIV605	Environmental Studies	ECE	ECE	1	-	-	02	50	50	100	1
6	PCC	21ECL606	VLSI Lab	ECE	ECE	-	-	2	03	50	50	100	1
7	PCC	21ECE607	Python Programming	ECE	ECE	3	-	-	03	50	50	100	3
8	SDC	21ECE608	Mini-Project	ECE	ECE	-	-	2	03	100	-	100	2
9	MNCC	21IIP609	Innovation and Intellectual Property	COM	COM	-	-	2	02	50	-	50	-
10	INT	Summer Internship III: Research Internship / Industrial Internship: 24 weeks during the VI to VIII semesters On successful completion, 10 credits will be added in the VIII Semester marks card.											
						13	06	08	25	500	350	850	20

Professional Elective - I: Students can select any one of the Professional Electives offered by the Department.

Professional Elective – 1 21ECE603X					
21ECE6031	Microwave and Antennas	21ECE6033	Artificial Neural Networks	21ECE6035	Operating System
21ECE6032	Analog and Mixed Mode VLSI Design	21ECE6034	Object Oriented Programming using C++		

Open Elective I (21XXX604X)							
Course Code	**CSE**	**AIM**	**CBS**	**ECE**	**EEE**	**MEC**	**CIV**
21XXX6041	Introduction to Database Management System	Neural Networks	Neural Networks	Basics of Analog Circuits	Renewable Energy Sources	Automobile Engineering	Remote Sensing and Geographical Information System
21XXX6042	Introducton to Programming in Java	Introductionto AI and ML	Introductionto AI and ML	Fundamentals of Digital System Design	PLC & SCADA	3D modelling	Numerical Methods and Applications
21XXX6043	Dot Net Programming	ComputerVision	Computer Vision	Microcontroller	Control Systems	Entrepreneurship Development	Sustainability Concepts in Engineering
21XXX6044	Introduction to Python	Predictive Analytics	Predictive Analytics	Programming and Interfacing withArduino	Electrical Safety Practices	Statistical Quality Control	Occupational Health and Safety
21XXX6045	-	Introduction to Data Science	Introductionto Data Science	Communication Theory	Energy Conservation and Audit	Non-Destructive Testing	-

Note: Open Elective – I: Students can select any one of the open electives offered by other Departments except those that are offered by the parent Department (Please refer to the list of open electives). Selection of an open elective shall not be allowed if, (i) the candidate has studied the same course during the previous semesters of the program. (ii) the syllabus content of open elective is similar to that of the Departmental core courses or professional electives. (iii). A similar course, under any category, is prescribed in the higher semesters of the program. Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Research/Industrial Internship - All the students admitted shall have to undergo a mandatory internship of minimum 24 weeks during the VI to VIII semesters. Viva-Voce examination shall be conducted during VIII semester and the prescribed credit shall be included. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements.

Research Internship Students have to take up research internships at Centers of Excellence (CoE) / Study Centers established in the same institute and /or out of the institute at reputed research organizations / Institutes. A research internship is intended to give students the flavour of current research going on a particular topic/s. The internships serve this purpose. They help students to get familiarized with the field, the skill needed, the amount and kind of effort required for carrying out research in that field.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B. Plan day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

V Semester

Technological Innovation Management and Entrepreneurship			
Course Code	**21ECE501**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain the field of management, task of the manager, planning and steps in decision making.
- Discuss the structure of organization, Understand the need for Entrepreneurs and their skills.
- Identify the Management functions and Social responsibilities.
- Distinguish between Management and Administration.
- Understand Project identification and Selection.

Module-1 Management & Planning (8 hours)

Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art &Profession. (Selected topics from Chapter 1, Text 1).

Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making.

(Selected topics from Chapters 4 & 5, Text 1**).**

Module-2 Organization and Staffing (8 hours)

Organizing and Staffing: Organisation-Meaning, Characteristics, Process of Organising, Principles of Organising, Span of Management (meaning and importance only), Departmentalisation, Committees, Difference between Authority and Power, Delegation of Authority, Decentralization of Authority. Coordination- Meaning, Types, Techniques of Coordination. Staffing-Need and Importance, Recruitment and Selection Process

(Selected topics from Chapters 7, 8, 9 & 11, Text 1**).**

Direction and Supervision and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioral Approach of Leadership.

(Selected topics from Chapters 15 to 17 Text 1).

Module-3 Social Responsibilities of Business and SSI (8 hours)

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance. (Selected topics from Chapter 3, Text 1).

Modern Small Business Enterprises: Role of Small Scale Industries, Impact of Globalization and WTO on SSIs in India, Concepts and definitions of SSI, Government policy and development of the Small Scale sector in India, Growth and Performance of Small Scale Industries in India, Problems for Small Scale Industries.

(Selected topics from Chapter1, Text 2).

Module-4 Entrepreneurship and Family Business (8 hours)

Entrepreneurship: Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship.

(Selected topics from Chapter 2, Text 2).

Family Business: Importance of Family Business, Various types of family businesses, History of Family Business, Strategies for improving the capability of a Family business.

(Selected topics from Chapter 6 - Text 2).

Module-5 Business Ideas and Project Design (8 hours)
Projects Management: Search for a Business idea: Introduction, Choosing an Idea, Selection of product, The Adoption process, Product Innovation, Product Planning and Development Strategy, Product Planning and Development Process. (Selected topics from Chapter 16, Text 3). **Concepts of Projects and Classification :** Introduction, Meaning of Projects, Characteristics of a Project, Project Levels, Project Classification, Aspects of a Project, The project Cycle, Features and Phases of Project management, Project Management Processes. **(**Selected topics from Chapter 17, Text 3). **Project Design and Network Analysis**: Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences between PERT and CPM. (Selected topics from Chapters 20, Text 3).

Course Outcomes: At the end of the course the student will be able to:	
21ECE501.1	Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business.
21ECE501.2	Select a best Entrepreneurship model for the required domain of establishment.
21ECE501.3	Describe the functions of Managers, Entrepreneurs and their social responsibilities.
21ECE501.4	Compare various types of Entrepreneur
21ECE501.5	Awareness about various sources of funding and institutions supporting entrepreneurs
21ECE501.6	Analyze the Institutional support by various state and central government agencies.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Principles of Management	P.C Tripathi, P.N Reddy	McGraw Hill Education,	6th Edition, 2017
2	Entrepreneurship Development Small Business Enterprises-	Poornima M Charantimath	Pearson Education	3rd Edition, 2008
3	Dynamics of Entrepreneurial Development and Management	Vasant Desai	Himalaya Publishing House	4th Edition, 2007
Reference Books				
1	Essentials of Management: An International, Innovation and Leadership perspective	Harold Koontz, Heinz Weihrich	McGraw Hill Education,	10th Edition, 2016

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc21_mg63/preview
- https://onlinecourses.swayam2.ac.in/cec23_mg11/preview
- https://onlinecourses.nptel.ac.in/noc23_mg116/preview

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE501.1										1				
21ECE501.2									2					
21ECE501.3									1	1				
21ECE501.4										1				
21ECE501.5										1				
21ECE501.6									1					

1: Low 2: Medium 3: High

Digital Signal Processing			
Course Code	**21ECE502**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Apply DFT as linear transformation
- Study the properties and the development of efficient algorithms for the computation of DFT
- Realize FIR and IIR filters in different structural forms.
- Study the different windows used in the design of FIR filters and design appropriate filters based on the specifications.
- Learn the procedures to design of IIR filters from the analog filters using bilinear transformation.
- Comprehend the architecture and working of DSP processor

Module-1 Discrete Fourier Transform (8 hours)

The DFT as a linear transformation, Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution, Additional DFT properties
Textbook 1: 7.1.3,7.2

Module-2 Fast Fourier Transform (8 hours)

Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long Data Sequences.
Fast-Fourier-Transform (FFT) algorithms: Efficient Computation of the DFT, Direct computation of DFT, Radix-2 FFT algorithms.
Textbook 1: 7.3, 8.1,8.1.1,8.1.3

Module-3 FIR Filter (8 hours)

Characteristics of practical frequency –selective filters, Design of FIR Filters-Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows - Rectangular, Hamming, Hanning, Bartlett windows, Blackman. Structures for FIRSystems: Direct form, Lattice structures**.**
Textbook 1: 10.1.2, 10.2, 10.2.1,10.2.2, 9.2, 9.2.1, 9.2.4

Module-4 IIR Filter (8 hours)

Design of IIR filters from analog filters, IIR filter design by Bilinear Transformation, Characteristics of commonly used analog filter – Butterworth, FrequencyTransformations in analog Domain, Realization of IIR Filters in Direct form I and II.
Textbook 1:10.3, 10.3.3, 10.3.4, 10.4.1,9.3.1

Module-5 Digital Signal Processor (8 hours)

DSP Architecture, DSP Hardware Units, Fixed and floating point formats, FIR and IIR filter implementations in Fixed point systems
Textbook 2: 9.1, 9.2, 9.4, 9.5

PRACTICAL MODULE

A–Exercise (compulsorily to be conducted):

Following Experiments to be done using MATLAB:

1. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).
2. Verification of DFT properties (like Linearity and Parseval's theorem, etc.)
3. Linear Auto and Cross correlation of two sequences and verification of their properties
4. Circular Auto and cross correlation of two sequences and verification of their properties

5. Circular convolution of two given sequences
6. Design and implementation of Low pass and High pass FIR filter to meet the desired specifications (using different window techniques) and test the filter. Plot the spectrum.
7. Design and implementation of a digital IIR Filter-Butterworth (Low pass and Highpass) to meet given specifications and test the filter. Plot the spectrum.

Following Experiments to be done using DSP kit

8. Compute Circular convolution of two sequences.
9. Compute the N-point DFT of a given sequence.
10. Generation of Sine wave and standard test signals.

B–Open Ended Experiments:

1. Design and implementation of filter to remove noise from ECG signal.

Course Outcomes: At the end of the course the student will be able to:	
21ECE502.1	Analyze discrete time signals in the frequency domain using DFT and its properties
21ECE502.2	Apply efficient algorithms for the computation of linear filtering and DFT
21ECE502.3	Design Digital FIR filters using relevant structural forms and implement them for the given specification
21ECE502.4	Design Digital IIR filters from an analog filter and implement their structures.
21ECE502.5	Analyze the architecture details of fixed and floating point DSPs
21ECE502.6	Design a system using DSP concepts to develop solution in the field of Signal Processing

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital Signal Processing –Principles Algorithms & Applications	John G Proakis & Dimitris G Manolakis	Pearson Education,New Delhi	4th Edition, 2007
2	Digital Signal processing – Fundamentals and Applications	Li Tan	Elsevier	2008
Reference Books				
1	Digital Signal Processing	D.Ganesh Rao and Vineeth P Gejji	CengageIndia Private Limited	2017
2	Digital Signal Processing	J. S. Chittode	Technical Publications	First Edition 2008

Web links and Video Lectures (e-Resources):

- **MIT OPEN COURSEWARE:**
  https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
  Author: Prof. Alan V. Oppenheim
- **NPTEL:**
  https://nptel.ac.in/courses/108/105/108105055/
  Digital Signal Processing by Prof. T.K. Basu, Electrical Engineering, IIT Kharagpur

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE502.1	1				2									
21ECE502.2	1				1									
21ECE502.3	1				2									
21ECE502.4	1				2									
21ECE502.5	1				1									
21ECE502.6					1				2	3			2	

1: Low 2: Medium 3: High

Digital Communication			
Course Code	**21ECE503**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(2:2:0)	Exam Hours	03
Total Hours	40	Credits	03

Course Learning Objectives: This Course will enable students to

- Analyze the performance of waveform coding techniques in representing digital data.
- Apply the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver.
- Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions.
- Design different digital modulation techniques and measure their performances.
- Compare the performances of different spread spectrum modulation techniques and identify their applications in communication systems.

Module-1 Digital Communication Basics (8 Hours)

Digital Communications: Block Diagram of Digital Communication System.
Line codes: Unipolar, Polar, Bipolar (AMI) and Manchester code and their power spectral densities Signaling over AWGN Channels: Introduction, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel, Optimum receivers using coherent detection: Maximum Likelihood Decoding, Correlation receiver, matched filter receiver.
Text 1 :1.5, 6.10, 7.1, 7.2, 7.3, 7.4

Module-2 Digital Modulation Techniques (8 Hours)

Phase Shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM, Frequency shift keying techniques using Coherent detection: generation, detection and error probabilities of BFSK and MSK.
Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagram treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation).
Text 1: 7.6, 7.7, 7.8, 7.11, 7.12, 7.13

Module-3 Signalling over Band-Limited Channels (8 Hours)

Introduction, Error Rate Due to Channel Noise in a Matched-Filter Receiver, Intersymbol Interference, Signal Design for Zero ISI, Ideal Nyquist Pulse for Distortionless Baseband Data Transmission, Raised-Cosine Spectrum, Post-Processing Techniques: The Eye Pattern, Adaptive Equalization.
Text 1: 8.1 to 8.6, 8.8, 8.9

Module-4 Principles of Spread Spectrum (8 Hours)

Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), The Interference Margin, Performance of Coded Spread Spectrum Signals, Some applications of DS Spread Spectrum Signals: Code Division Multiple Access, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS-95.
Text 2: 11.3, 11.3.1, 11.3.2, 11.3.3, 11.3.4, 11.3.5, 11.4.2

Module-5 Orthogonal Frequency-Division Multiplexing (8 Hours)

Modulation and Demodulation in an OFDM System, An OFDM System Implemented via the FFT Algorithm, Spectral Characteristics of OFDM signals, Peak-To-Average Power Ratio In OFDM Systems, Applications of OFDM.
(Text 2: 11.2, 11.2.1, 11.2.2, 11.2.3, 11.2.4, 11.2.5)

Course Outcomes: At the end of the course the student will be able to:	
21ECE503.1	Explain merits and demerits of different modulation techniques, line coding techniques, and channel behaviors.
21ECE503.2	Design and demonstrate various digital modulation, line coding and equalization techniques and measure their performance.
21ECE503.3	Analyze the properties of various digital modulation techniques in terms of waveforms, signal constellations and error probabilities.
21ECE503.4	Analyze the effect of ISI and AWGN, recommend appropriate techniques to control the same for different band limited channel conditions.
21ECE503.5	Compare direct sequence and frequency hopped spread spectrum systems and discuss their applications in communication systems.
21ECE503.6	Analyze the working principle of multicarrier modulation scheme such as OFDM and identify the modulation schemes used in wideband digital communication systems.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital Communication Systems	Simon Haykin	Wiley & sons	1st Edition, 2014
2	Fundamentals of Communication Systems	John G Proakis and Masoud Salehi	Pearson Education	1st Edition, 2007
Reference Books				
1	Digital Communications	John G Proakis and Masoud Salehi	McGraw-Hill	5th Edition, 2014
2	Digital Communications - Fundamentals and Applications	Bernard Sklar and Ray	Pearson Education	2nd Edition, 2009

Web links/Video Lectures/MOOCs/papers

- https://onlinecourses.nptel.ac.in/noc21_ee11/preview
- https://nptel.ac.in/courses/117101051

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE503.1										1				
21ECE503.2		2												
21ECE503.3		2		2					2	1				
21ECE503.4				2										
21ECE503.5									2	1				
21ECE503.6										1			1	

1: Low 2: Medium 3: High

Control Systems			
Course Code	**21ECE504**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Comprehend the fundamental principles and mathematical modelling of systems.
- Illustrate block diagrams and perform reductions for a given system.
- Derive transfer functions through reduction and employ signal flow graph techniques.
- Evaluate the system's time and frequency domain response.
- Interpret and devise control systems utilizing state space analysis.

Module-1 (8 hours)

Introduction to Control Systems:
Types of Control Systems, Effect of Feedback Systems, Differential equations of Physical Systems – Mechanical Systems, Electrical Systems, Electromechanical Systems, Analogous Systems.
Block diagrams and signal flow graphs:
Transfer functions, Block diagram algebra and Signal Flow graphs.

Module-2 (8 hours)

Standard test signals, Unit step response of First and Second Order Systems. Time response specifications, Time response specifications of second order systems, steady-state errors, and error constants. Introduction to PI, PD and PID Controllers (excluding design).
Text book 2: Chapter 4

Module-3 (8 hours)

Stability analysis:
Concepts of stability, Necessary conditions for Stability, Routh stability criterion, Relative stability analysis: more on the Routh stability criterion. Introduction to Root-Locus Techniques, The root locus concepts, Construction of root loci.

Module-4 (8 hours)

Frequency domain analysis and stability:
Correlation between time and frequency response, Bode Plots, GM, PM and relative stability.
Introduction to Polar Plots, (Inverse Polar Plots excluded) Mathematical preliminaries, Nyquist Stability criterion, (Systems with transportation lag excluded)

Module-5 (8 hours)

Introduction to State variable analysis:
Concepts of state, state variable and state models for electrical systems, Solution of state equations, obtaining transfer function from state space model.

Course Outcomes: At the end of the course the student will be able to:	
21ECE504.1	Develop the mathematical model of mechanical and electrical systems.
21ECE504.2	Develop transfer function for a given control system using block diagram reduction techniques and signal flow graph method.
21ECE504.3	Determine the time domain specifications for first and second-order systems.
21ECE504.4	Determine the stability of a system in the time domain using the Routh-Hurwitz criterion and the Root-locus technique.
21ECE504.5	Determine the stability of a system in the frequency domain using Nyquist and Bode plots.
21ECE504.6	Develop a state space model for electrical systems

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Control Systems Engineering	J. Nagarath and M.Gopal	New Age International(P) Limited, Publishers	5th Edition- 2005
2	Engineering Control Systems	Norman S. Nise	John Wiley and Sons	5th Edition, 2009
Reference Books				
1	Modern Control Engineering	K.Ogata	Pearson Education Asia/ PHI	4th Edition, 2002
2	Automatic Control Systems	Benjamin C. Kuo	JohnWiley India Pvt. Ltd	8th Edition, 2008
3	Feedback and Control System	Joseph J Distefano III et al.	Schaum's Outlines, TMH	2nd Edition 2007

Web links and Video Lectures (e-Resources):

- Control systems: https://nptel.ac.in/courses/107106081
- Advanced Linear Continuous Control Systems: Applications with MATLAB Programming and Simulink: https://nptel.ac.in/courses/108107115
- Polar Curves: https://www.youtube.com/watch?v=ixDGaEqWuA0

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE504.1	2	2											2	
21ECE504.2	3	2											2	
21ECE504.3	2	2											2	
21ECE504.4	2	2											2	
21ECE504.5	2	2											3	
21ECE504.6	2	2											2	

1: Low 2: Medium 3: High

Electromagnetic Waves			
Course Code	**21ECE505**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Study the application of Coulomb's Law and Gauss Law for electric fields produced by different charge configurations
- Evaluate the energy and potential due to a system of charges.
- Study the behavior of an electric field across a boundary between a conductor and dielectric and between two different dielectrics
- Study the magnetic fields and magnetic materials.

Module-1 Coulomb's Law, Electric Field Intensity and Flux density (8 hours)

Coulomb's Law, Electric Field Intensity and Flux density: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Field due to Sheet of charge, Electric flux density, Numerical Problems. (Text 1: Chapter 2.1 to 2.5, 3.1)

Gauss's law and Divergence: Gauss law, Application of Gauss law to point charge, line charge, Surface charge, and volume charge, Point (differential) form of Gauss law, Divergence. Maxwell's First Equation (Electrostatics), Vector Operator V and divergence theorem, Numerical Problems (Text 1: Chapter 3.2 to 3.7).

Module-2 Energy, Potential and Conductors (8 hours)

Energy, Potential, and Conductors: Energy expended or work done in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of a point charge, Potential gradient, Numerical Problems.
(Text 1: Chapter 4.1 to 4.4 and 4.6).
Current and Current density, Continuity of current. (Text 1: Chapter 5.1, 5.2).

Module-3 Poisson's and Laplace's Equations (8 hours)

Dielectric and capacitance: Dielectric materials, boundary conditions, the capacitance of different configurations. (Text 1: Chapter 5.7 and 5.8).

Poisson's and Laplace's Equations: Derivation of Poisson's and Laplace's Equations, Uniqueness theorem. Examples of the solution of Laplace's equation, Numerical problems on Laplace equation (Text 1: Chapter 6.6 to 6.8).

Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Basic concepts Scalar and Vector Magnetic Potentials, Numerical problems. (Text 1: Chapter 7.1 to 7.6).

Module-4 Magnetic Forces (8 hours)

Magnetic Forces: Force on a moving charge, differential current elements, Force between differential current elements, Numerical problems. (Text 1: Chapter 8.1 to 8.3).

Magnetic Materials: Magnetization and permeability, Magnetic boundary conditions, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance and mutual reactance, and Numerical problems . (Text 1: Chapter 8.6 to 8.10).

Faraday's law of Electromagnetic Induction -Integral form and Point form, Numerical problems. (Text 1: Chapter 9.1).

Module-5 Maxwell's equations & Uniform Plane Wave (8 hours)

Maxwell's equations Continuity equation, Inconsistency of Ampere's law with continuity equation, displacement current, Conduction current, Derivation of Maxwell's equations in point form, and integral form, Maxwell's equations for different media, Numerical problems.
(Text 1: Chapter 9.2 to 9.4).

Uniform Plane Wave: Plane wave, Uniform plane wave, Derivation of plane wave equations from Maxwell's equations, Solution of wave equation for perfect dielectric, Relation between E and H, Wave propagation in free space, Solution of wave equation for sinusoidal excitation.
(Text: Chapter 11.1 to 11.3).

Course Outcomes: At the end of the course the student will be able to:	
21ECE505.1	Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume.
21ECE505.2	Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem.
21ECE505.3	Determine potential and energy with respect to point charge and capacitance using Laplace equation.
21ECE505.4	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations.
21ECE505.5	Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials and voltage induced in electric circuits.
21ECE505.6	Apply Maxwell's equations for time varying fields.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Engineering Electromagnetics	W.H. Hayt and J.A. Buck	Tata McGraw-Hill	8th Edition, 2012
Reference Books				
1	Elements of Electromagnetics	Matthew N.O., Sadiku	Oxford University Press	4th Edition, 2007
2	Electromagnetic Waves and Radiating systems	E. C. Jordan and K.G Balmain	Prentice Hall India	2nd Edition, 2015

Web links and Video Lectures (e-Resources):

- Vector Calculus for Electromagnetism 1 : Vector Components - Electromagnetic Field: https://www.youtube.com/watch?v=0Hv4a2KcXVc
- Differential equations for engineers: https://archive.nptel.ac.in/courses/111/106/111106100/
- Introduction to EM waves and various techniques of communication: https://nptel.ac.in/courses/117101056
- Electromagnetic Theory: https://nptel.ac.in/courses/115101005

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE505.1	2												1	
21ECE505.2	2	1											1	
21ECE505.3	2												1	
21ECE505.4	2												1	
21ECE505.5	2	1											1	
21ECE505.6	2												1	

1: Low 2: Medium 3: High

Digital Communication Lab			
Course Code	**21ECL506**	CIE Marks	50
Course Type	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	10 lab slots	Credits	01

Course Learning Objectives: This Course will enable students to

- Demonstrate Pulse Code Modulation in digitization of the signal.
- Differentiate between different line codes and their power spectral densities.
- Design and implement digital modulation schemes.
- Measure propagation and bending losses of an optical fiber.
- Analyze and study the characteristic features of microwave test bench.

Part A

Using discrete components:

1. Design and implement ASK transmitter and receiver.
2. Design and implement FSK transmitter and receiver.
3. Design and implement PSK transmitter and receiver.
4. Measurement of propagation loss, bending loss and numerical aperture of an optical fiber.
5. Time Division Multiplexing and Demultiplexing of two band limited signals.
6. Measurements of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench.
7. Measurements of directivity and gain of antennas: printed dipole, microstrip patch antenna and printed yagi antennas.

Part B

Using MATLAB/SIMULINK:

8. Design and simulate Pulse Code Modulation and Demodulation system.
9. Simulate NRZ, RZ, Manchester, half-sinusoid and raised cosine pulses and analyze their eye patterns for different noise voltages.
10. Simulate matched filter receiver for improving SNR at the detector.
11. Design DPSK and QPSK transmitter and receiver and observe the modulated and reconstructed signal.
12. Design and simulate QAM and MSK transmitter and receiver.
13. Open ended experiment covering entire syllabus.

Course Outcomes:

At the end of the course the student will be able to:

21ECL506.1	Design and implement pulse code modulation for analog to digital conversion.
21ECL506.2	Analyze the working of microwave devices and antennas and study their operating principles.
21ECL506.3	Analyze the channel losses associated with optical fiber communication system.
21ECL506.4	Design and implement different coherent and non-coherent digital modulation techniques.
21ECL506.5	Demonstrate polar signaling schemes representing digital data and analyze the effect of noise in received symbol.
21ECL506.6	Design multiplexing and demultiplexing scheme for digital communication.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	MATLAB/Simulink for Digital Communication	Won Y. Yang, Yong S. Cho Jeong W. Lee	Hongrung Publishing	2nd Edition, 2012
2	Digital Communication Systems	Simon Haykin	Wiley & sons	1st Edition, 2014
Reference Books				
1	Digital Communications	John G Proakis and Masoud Salehi	McGra w-Hill	5th Edition, 2014
2	Digital Communications - Fundamentals and Applications	Bernard Sklar and Ray	Pearson Education	2nd Edition, 2009

Web links/Video Lectures/MOOCs/papers

- **https://in.mathworks.com/academia/courseware/digital-communication-laboratory.html**
- https://onlinecourses.nptel.ac.in/noc21_ee11/preview
- https://nptel.ac.in/courses/117101051

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECL506.1			2	2	2				2			2		
21ECL506.2			2	2	2				2			2		
21ECL506.3			2	2	2				2			2		
21ECL506.4			2	2	2				2			2		
21ECL506.5			2	2	2				2			2		
21ECL506.6			2	2	2				2			2		

1: Low 2: Medium 3: High

Research Methodology and Intellectual Property Rights			
Course Code	**21RMI507**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives:

1. To understand the basic concepts related to research
2. To learn the concept of literature survey, review and technical writing
3. To discuss the basics of intellectual property
4. To explain the patents, copyrights, trademarks, industrial designs and geographical indications.

Module-1 Research Methodology and Literature Survey (8 hours)

Research Methodology: Meaning, objectives, types, significance of research. Research approaches, method versus methodology, research process, Criteria of good research. Defining the research problem: conditions, components, selection, necessity, techniques and illustrations.

Literature Survey, Literature Review: Introduction, process, databases (Google Scholar, Web of Science, Scopus, Science Direct etc) and management tools. Author Metrics and Journal Metrics, Identifying gap areas from literature review. Ethics in research and publications. Plagiarism: Introduction, tools for detection, avoiding plagiarism. Illustrations.

Textbook 1: Ch 1 and 2, Textbook 2: Ch 7-17.

Module-2 Technical Writing and Presentations (8 hours)

Research Paper Writing: Importance, steps of writing research papers, Contents of a research article, referencing and citations, submission and post-submission. Illustrations.

Thesis Writing: Synopsis, Introduction, Literature review, Aim and objectives, Methodology, Time frame, Results and discussions, Conclusions.

Research Proposal Writing: Types of research projects, Major funding agencies in India, Preliminary requirements for proposal writing, Standard heads in research proposal. Illustrations.

Textbook 2: Ch 20-28, 35.

Module-3 Introduction to IPR and Patents (8 hours)

Introduction to Intellectual Property: Meaning, relevance, Types of IP, Role of International Institutions: The Patent Cooperation Treaty (PCT), TRIPS Agreement, WIPO, IP system in India and National IPR Policy in India.

Patents: Concept, Patents Act 1970 and its amendments, Patentable Subject Matter and Patentability Criteria, Non- Patentable Subject Matter, Procedure for Filing of Patent Application and types of Applications, Patent Search and Databases, Patent Granting Procedure, Rights of Patentee, Patent Infringement, Recent Developments: Patenting of Softwares, Inventions in Biotechnology. Illustrations.

Textbook 3: Lesson 1-10.

Module-4 Copyright and Trademarks (8 hours)

Copyright: Introduction, meaning, nature of copyright protection, Indian copyright law: Classes of work, copyright pertaining to software, Authorship and ownership and rights, Terms of copyright, Assignment, transmission and licensing, Infringement of copyrights: Exceptions and remedies, Copyright societies, Office, board, Registration of copyrights and appeals, Illustrations.

Trademark: Introduction, The Trade Marks Act 1999, Important Definitions, Trade Mark Rules 2017, Procedure of registration of trade mark in India. Duration and renewal, Opposition to registration, Grounds for refusal to registration, Rights conferred by registration, Infringement of registered Trade Mark and Remedies. Illustrations.

Textbook 3: Lesson 11 and 12.

Module-5 Industrial Designs and Geographical Indications (8 hours)
Industrial Designs: Introduction, Need for protection of industrial designs, Registrable and non-registrable designs, Registration of designs, Infringement of Industrial Designs–and Remedies, Illustrations. **Geographical Indications (GIs):** Introduction, Geographical Indications of Goods (Registration & Protection) Act, 1999, Procedure for registration of geographical indications, Infringement of GIs. **Layout – Designs of Integrated Circuits:** Introduction, Procedure for Registration of Layout design under the Semi-Conductor Integrated Circuits Layout-Design Act, 2000, Conditions and Procedures for registration. Infringement and Penalty. **Miscellaneous Topics:** The Protection of Plant Varieties and Farmers' Rights, Protection of Traditional Knowledge and Bio-diversity Act. Textbook 3: Lesson 13-16, Textbook 4: Ch 70.

Course Outcomes: At the end of the course the student will be able :	
21RMI507.1	To conduct literature survey, review and define a research problem.
21RMI507.2	To follow research ethics and develop the art of writing technical papers and reports.
21RMI507.3	To discuss the importance of Intellectual Property Rights in India.
21RMI507.4	To explain the various forms of Intellectual Property and its relevance in Indian context.
21RMI507.5	To explain the legal aspects of patents, copyrights and trademarks in India.
21RMI507.6	To explain the legal aspects of industrial designs, geographical indications and semi-conductor integrated circuits layout-designs in India.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Research Methodology: Methods and Techniques	C R Kothari and Gaurav Garg	New Age International Publishers	4th Edition 2019
2	Academic Writing	Ajay Semalty	B S Publications	2021
3	Intellectual Property Rights – Laws and Practice	The Institute of Company Secretaries of India, New Delhi	Delhi Computer Services, New Delhi	2018
4	Law Relating to Intellectual Property Rights	V K Ahuja	LexisNexis, India	3rd Edition 2017
Reference Books				
1	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	Sage Publications India Pvt Ld New Delhi	4th Edition 2014
2	Intellectual Property: A Primer for Academia	Prof. Rupinder Tewari and Ms. Mamta Bhardwaj	Publication Bureau, Panjab University, India	2021
Additional Resources: Web links/NPTEL Courses https://ipindia.gov.in/ (Official website of Intellectual Property India) https://dpiit.gov.in/policies-rules-and-acts/policies/national-ipr-policy https://www.icsi.edu/media/webmodules/FINAL_IPR&LP_BOOK_10022020.pdf https://corpbiz.io/learning/design-infringement-in-india/				

https://nptel.ac.in/courses/121106007 (Introduction to Research (Research Methodology))
https://nptel.ac.in/courses/109105112 (Introduction on Intellectual Property to Engineers and Technologists)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21RMI507.1	-	**2**	-	-	**1**	-	-	-	-	-	-	**2**	-	-
21RMI507.2	-	-	-	-	**1**	-	-	**3**	-	**2**	-	-	-	-
21RMI507.3	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-
21RMI507.4	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-
21RMI507.5	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-
21RMI507.6	-	-	-	-	-	**2**	-	-	-	**2**	-	-	-	-

1: Low 2: Medium 3: High

Emerging Technologies: A Primer			
Course Code	21ETP509	CIE Marks	50
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE Marks	-
Credits	0	Exam Hours	02

Course Learning Objectives:

1. To develop a strong awareness of the ethical and societal implications associated with emerging technologies.
2. To instil practical skills related to AI (Artificial Intelligence), Blockchain, Digital Twins, RPA (Robotic Process Automation), and Cybersecurity.
3. To enable experiences of working on a team project, allowing students to apply their knowledge and skills to a real-world problem and present their findings effectively.

Module-1: AI and Web 3.0 (06 Hours)

Introduction to Emerging Technologies: Overview of the course, Importance of staying updated with emerging technologies, Ethical and societal considerations.

Artificial Intelligence (AI): Definition and history of AI, Machine learning and deep learning, Applications of AI in various industries, In-Class Assignment: AI in Everyday Life, Homework Assignment: Building a Simple Chatbot.

Web 3.0: Blockchain and Metaverse - Introduction to Blockchain technology, Metaverse and its potential, In-Class Assignment: Creating a Simple Smart Contract, Homework Assignment: Exploring a Metaverse Platform.

Module-2: Smart Manufacturing and Robotic Process Automation (06 Hours)

Smart Manufacturing and Digital Twins: The concept of Smart Manufacturing, Role of IoT and sensors, Digital Twins and their applications, In-Class Assignment: Explore the designs of Digital Twins, Homework Assignment: Analysing a Smart Manufacturing Case Study.

Robotic Process Automation: Understanding Robotic Process Automation (RPA), Types of robots and their applications, Human-robot collaboration, In-Class Assignment: Automating a Task with RPA, Homework Assignment: Researching Advances in Robotics.

Module-3: Cybersecurity and Quantum Computing (06 Hours)

Cybersecurity: Importance of cybersecurity in the digital age, Threats and vulnerabilities, Security best practices, In-Class Assignment: Ethical Hacking Simulation, Homework Assignment: Creating a Cybersecurity Plan.

Quantum Computing: Introduction to Quantum Mechanics, Quantum bits (qubits) and quantum gates, Quantum supremacy and real-world applications. Homework Assignment: Exploring Quantum Computing Research.

Module-4: Project Work (06 Hours)

Team Formation, Synopsis submission, Mid-Term Progress Review, Final Project Presentation.

Course Outcomes: At the end of the course the student will be able to:

21ETP509.1	Assess the ethical and societal impacts of emerging technologies, demonstrating critical thinking skills.
21ETP509.2	Apply AI and Web 3.0 concepts to develop practical solutions and explore real-world applications.
21ETP509.3	Apply RPA principles and tools to automate common tasks to boost productivity.
21ETP509.4	Explain common cybersecurity threats and recommend best practices to safeguard digital assets.
21ETP509.5	Explain the fundamentals of quantum computing and its real-world applications.
21ETP509.6	Develop a solution using emerging technologies for a real-world problem in teams.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	Pearson	Fourth Edition, 2020
2	Blockchain Technology	Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan	Universities Press (India) Pvt. Ltd.	First Edition 2020
3	Metaverse and Web 3: A Beginner's Guide: A Beginner's Guide: A Digital Space Powered with Decentralized Technology	Utpal Chakraborty	BPB Publications	First Edition, 2022
4	Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath	Alok Mani Tripathi	Packt Publishing	First Edition 2018
5	Cybersecurity: The Beginner's Guide: A comprehensive guide to getting started in cybersecurity	Dr. Erdal Ozkaya	Packt Publishing Limited	First Edition 2019
6	Quantum Computing: A Gentle Introduction	Eleanor G. Rieffel, Wolfgang H. Polak.	MIT Press	First Edition 2014
Reference Books				
1	Smart Manufacturing Technologies for Industry 4.0: Integration, Benefits, and Operational Activities	Edited By: Jayakrishna Kandasamy, Kamalakanta Muduli, V. P. Kommula, Purushottam L. Meena	CRC Press	First Edition 2022
2	The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems	Tom Taulli	Apress Berkeley, CA	2020
3	The Cyber Security Handbook: Prepare for, respond to and recover from cyber-attacks with the IT Governance Cyber Resilience Framework (CRF)	Alan Calder	IT Governance Publishing	First Edition 2020

Web links/Video Lectures:

Introduction to Emerging Technologies:

1. https://aiethics.princeton.edu/case-studies/case-study-pdfs/
2. https://research.aimultiple.com/ai-ethics/
3. https://news.harvard.edu/gazette/story/2020/10/ethical-concerns-mount-as-ai-takes-bigger-decision-making-role/
4. https://www.sciencedirect.com/science/article/pii/S0268401223000816
5. https://www.youtube.com/watch?v=G2fqAlgmoPo
6. https://www.youtube.com/watch?v=zizonToFXDs

Web 3.0: Blockchain and Metaverse

1. What is Ethereum? | ethereum.org
2. Navigating Remix — Remix - Ethereum IDE 1 documentation (remix-ide.readthedocs.io)
3. Solidity — Solidity 0.6.8 documentation (soliditylang.org)
4. https://www.youtube.com/watch?v=nalMdCI_pv8&t=765s

5. The Decentralized Autonomous Organization and Governance Issues by Usman W. Chohan :: SSRN
6. Ethereum Smart Contract Best Practices (consensys.github.io)
7. https://hackernoon.com/hack-solidity-reentrancy-attack

Smart Manufacturing and Digital Twins:

1. https://www.youtube.com/watch?v=nwFed03fS_s
2. https://www.youtube.com/watch?v=ScmK-bKJ4MI

RPA and Robotics:

1. https://www.youtube.com/watch?v=9URSbTOE4YI
2. https://www.youtube.com/watch?v=UEbw7dIOg0g
3. https://www.uipath.com/resources/automation-case-studies
4. https://www.ibm.com/products/robotic-process-automation/case-studies

Cybersecurity:

1. https://www.getastra.com/blog/security-audit/what-is-vapt/
2. https://owasp.org/www-project-top-ten/
3. https://owasp.org/www-project-mutillidae-ii/
4. https://www.youtube.com/watch?v=JAtwZoW76-I
5. Threat modelling (STRIDE framework): https://learn.microsoft.com/en-us/azure/security/develop/threat-modeling-tool-threats
6. Cyber Kill Chain:https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html

Quantum Computing:

1. https://www.youtube.com/watch?v=e3fz3dqhN44
2. https://quantumai.google/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
21ETP509.1	-	-	-	-		**3**	-	**2**	-	--	-	-
21ETP509.2	-	**2**	-	-	**3**	-	-	-		-	-	**1**
21ETP509.3	-	-	-	**3**	**2**	-	-	-	--	-	-	-
21ETP509.4	-	-	-	-	**3**	-		-	-	-	-	**1**
21ETP509.5	**2**	-	-	-	**3**	-	-	-	-	-	-	-
21ETP509.6	-	-	**2**	-	**3**	-	--	-	**2**	-	-	**1**

1: Low 2: Medium 3: High

VI Semester

Computer Communication Networks			
Course Code	**21ECE601**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Integrated	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:2	SEE	3 Hours
Total Hours	40 hours Theory + 10 Lab slots	Credits	04

Course Learning Objectives: The objective of the course is to

- Explain the use of computer networking in various walks of life, describe the types of networks, network configurations and network topologies.
- Analyse responsibilities of the data link layer, its implementation and associated protocols,
- Explain the various techniques used to access a shared channel in-network and IEEE specifications for LANs.
- Describe different types of networking devices, backbone networks and Internet Protocol (IP) addressing.
- Illustrate the responsibilities of network, transport and application layers

Module-1 Network Models (8 hours)

Introduction: Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet. (Text 1: 1.1,1.2, 1.3(1.3.1 to 1.3.4).

Network Models: Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.
(Text 1: 2.1, 2.2, 2.3).

Module-2 Data-Link Layer (8 hours)

Data-Link Layer: Introduction: Nodes and Links, Services, Two Categories of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking. (Text 1: 9.1, 9.2(9.2.1, 9.2.2), 11.1, 11.2).

Media Access Control: Random Access: ALOHA**,** CSMA, CSM*A/C*D, CSMA*/* CA**.**
(Text 1: 12.1)**.**

Module-3 Network Layer (8 hours)

Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution, Forwarding of IP Packets: Based on destination Address and Label.
(Text 1: 18.1, 18.2, 18.4, 18.5.1, 18.5.2).

Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation. **Unicast Routing:** Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing**.** (Text 1: 19.1, 20.1,20.2).

Module-4- Transport-Layer Protocols (8 hours)

Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram. (Text 1: 24.2, 24.3.1 to 24.3.5).

Module-5 Application Layer (8 hours)

Application Layer: Standard Client-Server Protocols: World wide web, HyperText Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Web Based Mail, Telnet: Local versus remote logging. Domain Name System: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, and security of DNS. (Text 1: 26.1, *2*6.2, *2*6.3, 26.4, 26.6)**.**

PRACTICAL MODULE

A–Exercise (compulsorily to be conducted):

1. Implement the HLDC frame for i) Bit stuffing ii) Character stuffing.
2. Implement the distance vector algorithm to find a suitable path for transmission of data.
3. Implement Dijkstra's algorithm to compute the shortest routing path.
4. For the given data, use the CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a. Without error b. With error.
5. Implementation of Stop and Wait Protocol and Sliding Window Protocol.
6. Implement congestion control using a leaky bucket algorithm.

B–Open Ended Experiments (any two):

7. FTP protocol for transfer and receive the file using wired shark.
8. Socket programming to configure client and server.

Course Outcomes: At the end of the course the student will be able to:	
21ECE601.1	Identify the components of Data communication, types of Computer Networks, and Layered Architecture.
21ECE601.2	Analyse the services provided by the Data Link Layer.
21ECE601.3	Evaluate the various protocols and services provided by Network Layer.
21ECE601.4	Evaluate various services provided by TCP and UDP.
21ECE601.5	Illustrate various services provided by the Application Layer.
21ECE601.6	Implement concepts of TCP/IP protocol using modern tools.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Data Communications and Networking	Behrouz A Forouzan	McGraw Hill	5th Edition, 2022
Reference Books				
1	Computer Networks	Andrew S Tanenbaum	Prentice Hall	5th Edition, 2020
2	Data and Computer Communications	William Stallings	Prentice Hall	10th Edition, 2022
3	Computer Networks	James J Kurose, Keith W Ross	Pearson Education	6th Edition, 2017
4	Introduction to Data Communication and Networking	Wayne Tomasi	Pearson Education	1st Edition, 2011

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses/106105081/
- http://nptel.ac.in/courses/106105082/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE601.1			1											
21ECE601.2			1		1									
21ECE601.3			1		1									
21ECE601.4			1											
21ECE601.5			1											
21ECE601.6			1											

1: Low 2: Medium 3: High

VLSI Design			
Course Code	**21ECE602**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Impart knowledge of MOS transistor theory and CMOS technologies.
- Show the operation principles and analysis of inverter circuits.
- Analyze the Combinational, sequential and dynamic logic circuits as per the requirements.
- Demonstrate the operation of Semiconductors Memory circuits and verification of digital circuit.
- Solve IC amplifier for the given requirements.

Module-1 MOS Theory (8 hours)

Introduction: A Brief History, MOS Transistors, CMOS Logic.
(Text 1 - 1.1 to 1.4).
MOS Transistor Theory: Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics.
(Text 1 - 2.1, 2.2, 2.4 and 2.5).

Module-2 Fabrication and Delay (8 hours)

Fabrication: CMOS Fabrication and Layout, VLSI Design Flow, Introduction, CMOS Technologies, Layout Design Rules. (Text 1 -1.5 and 3.1 to 3.3).
Scaling: Transistor scaling.
(Text 1 - 4.8.1).
Delay: Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths.
(Text 1 - 4.1 to 4.5, except sub-sections 4.3.7, 4.4.5, 4.4.6, 4.5.5 and 4.5.6).

Module-3 Digital Circuit Design (8 hours)

Combinational Circuit Design: Introduction, Circuit families (Text 1 - 9.1 to 9.2).
Sequential Circuit Design: Introduction, Circuit Design for Latches and Flip-Flops .
(Text 1- 10.1 and 10.3.1 to 10.3.5).
Dynamic Logic Circuits: Introduction, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques.
(Text 2 - 9.1, 9.4 and 9.5).

Module-4 Memories and Verification (8 hours)

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM): DRAM cell types, Operation of one & three transistor cell and Static Random Access Memory (SRAM): Full CMOS SRAM and Operation of SRAM.
(Text 2 -10.1, 10.2 & 10.3).
Testing and Verification: Introduction, Logic Verification Principles, Manufacturing Test Principles, Design for testability.
(Text 1 - 15.1, 15.3, 15.5 15.6.1 to 15.6.3**).**

Module-5 Analog IC Design (8 hours)

IC amplifiers: The Common Source Circuit, CMOS implementation of the Common Source Amplifier.
Differential Amplifier: MOS differential pair, Operation with a common mode input voltage, Operation with Differential input voltage, Large Signal Operation.
A Two Stage CMOS op-amp: The Circuits, input Common-Mode Range and output Swing, Voltage gain, CMRR, Frequency response and slew rate.
(Text 3 - 6.6.1,6.6.2, 8.1.1 ,8.1.2, 8.1.3, 9.1.1, 9.1.1 - 9.1.6).

Course Outcomes: At the end of the course the student will be able to:	
21ECE602.1	Show the knowledge of MOS transistor theory and CMOS logic.
21ECE602.2	Demonstrate the understanding of CMOS fabrication, MOSFET scaling and delay models.
21ECE602.3	Demonstrate the ability to design combinational, sequential and dynamic logic circuits as per requirement.
21ECE602.4	Analyse and draw the layout and stick diagram of the logic gates with the knowledge of layout design rules.
21ECE602.5	Compare the memory elements along with timing consideration and Interpret the testing and testability issues in VLSI design.
21ECE602.6	Demonstrate the ability to design IC amplifier circuit.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	CMOS VLSI Design- A Circuits and Systems Perspective	Neil H. E. Weste, and David Money Harris	Pearson Education	4th Edition, 2015
2	CMOS Digital Integrated Circuits: Analysis and Design	Sung Mo Kang & Yosuf Leblebici	Tata McGraw Hill	3rd Edition, 2003
3	Microelectronics Circuits Theory and Applications	Adel Sedra and K. C. Smith	Oxford University Press	6th Edition, 2009
Reference Books				
1	Basic VLSI Design	Douglas A Pucknell & Kamran Eshragian	Prentice Hall India	3rd Edition, 1994
2	Design of Analog CMOS Integrated Circuits	Behzad Razavi	Tata McGraw-Hill.	2nd Edition, 2007

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108/107/108107129/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE602.1	1													1
21ECE602.2		1												1
21ECE602.3		1												1
21ECE602.4		1	1											1
21ECE602.5	1	1												1
21ECE602.6	1	1												1

1: Low 2: Medium 3: High

Microwave and Antennas			
Course Code	**21ECE6031**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40	Credits	03

Course Learning Objectives: The objective of the course is to

- Analyze and evaluate the electrical properties of microwave transmission lines.
- Apply the concepts of S-parameters to analyze and understand the performance of microwave networks.
- Examine the various microwave passive devices and their practical applications.
- Analyze the radiation pattern of linear arrays of isotropic sources.
- Analyze various antenna parameters and their importance in building RF systems.
- Identify appropriate antenna configurations for various applications.

Module-1 Microwave Transmission Lines (8 hours)

Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient, and Transmission Coefficient. Standing wave and Standing wave ratio, Smith Chart, Impedance Matching - Single Stub Matching.
(Text 2: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6.1).

Module-2 Microwave Network Theory and Passive Devices (8 hours)

Microwave Network Theory: Introduction, Properties of Z and Y Matrices for Reciprocal Networks, Scattering Matrix Representation of Multiport Network.
(Text 1: 6.1, 6.2, 6.3).
Microwave Passive Devices: Coaxial Cables, Coaxial connectors and Adapters, Attenuators, Phase shifters, Waveguide Tees, Magic Tee.
(Text 1: 6.4.1, 6.4.2, 6.4.14, 6.4.15, 6.4.16).

Module-3 Strip Lines and Antenna Basics (8 hours)

Strip Lines: Introduction, Micro Strip lines, Parallel Strip lines, Coplanar Strip lines, Shielded Strip Lines.
(Text 2: 11.0, 11.1, 11.2, 11.3, 11.4).
Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Fields due to an Oscillating Dipole, Antenna Field Zones.
(Text 3: 2.1, 2.2.1, 2.2.2).

Module-4 Antenna Arrays and Electric Dipole (8 hours)

Point Sources and Arrays: Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 isotropic point sources, Linear arrays of n Isotropic sources of equal amplitude and Spacing.
(Text 3: 5.1, 5.2, 5.3).
Electric Dipole: Introduction, Short Electric dipole, Fields of a short dipole. Radiation Resistance of a short dipole. Thin linear antenna (Field Analysis).
(Text 3: 6.1, 6.2).

Module-5 Antenna Types (8 hours)

Loop and Horn Antennas: Introduction: Small loop, Comparison of far fields of small loop and Short dipole, Loop Antenna: General Case, Horn Antennas, Rectangular Horn Antenna.
(Text 3: 7.1.1, 7.1.2, 7.1.3, 7.3.1, 7.3.2).
Antenna Types: The Helix geometry, Helix modes, Practical design consideration for mono-filar axial mode Helical Antenna, Yagi Uda array, Parabolic Reflector.
(Text 3: 8.1.1, 8.1.2, 8.1.3, 8.2.1, 8.2.4, 9.4).

Course Outcomes: At the end of the course the student will be able to:	
21ECE6031.1	Apply the concepts of impedance matching, reflection coefficient, and standing waves to ensure maximum power transfer in microwave transmission lines.
21ECE6031.2	Apply the principles of microwave network theory to analyze microwave devices.
21ECE6031.3	Analyze different types of microstrip lines and identify their applications.
21ECE6031.4	Illustrate and explain the various factors that impact antenna performance, such as radiation pattern, gain, directivity, bandwidth, and efficiency.
21ECE6031.5	Analyze the radiation intensity and power patterns of point sources and arrays.
21ECE6031.6	Evaluate the geometry, performance parameters, and applications of different antennas.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Microwave Engineering	Annapurna Das, Sisir K Das	TMH Publication	3rd Edition, 2010
2	Microwave Devices and Circuits	Samuel Y Liao	Pearson Education	3rd Edition, 2007
3	Antennas and Wave Propagation	John D Krauss, Ronald J Marhefka, Ahmad S Khan	McGraw Hill Education	5th Edition, 2018
Reference Books				
1	Microwave Engineering	David M Pozar	John Wiley India Pvt Ltd	3rd Edition, 2008
2	Microwave Engineering	Sushrut Das	Oxford Higher Education	2nd Edition, 2015
3	Antennas and Wave Propagation	Harish and Sachidananda	Oxford University Press	2007

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108101112
- https://onlinecourses.nptel.ac.in/noc22_ee63

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE6031.1	1											1		
21ECE6031.2		1										1		
21ECE6031.3		1										1		
21ECE6031.4	1	1			1							1		
21ECE6031.5		1										1		
21ECE6031.6	1	1										1		

1: Low 2: Medium 3: High

Analog and Mixed Mode VLSI Design			
Course Code	**21ECE6032**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40	Credits	03

Course Learning Objectives: The objective of the course is to

- Describe basic physics and operation of single stage amplifiers.
- Exemplify differential amplifiers and current mirrors.
- Describe operational amplifiers.
- Learn the design of phase-locked-loops.
- Know the role of Data converters in an ever-increasing digital world.

Module-1 Single Stage amplifiers (8 hours)

Single stage Amplifier (Part 1): General Considerations, Common Source stage. (Sections 3.2 and 3.3 of Text 1).

Single stage Amplifier (Part 2): Source follower, common-gate stage, Cascode Stage, choice of device models. (Sections 3.4, 3.5, 3.6, 3.7 of Text 1).

Self-study topics: Basic MOS Device Physics: General considerations, MOS I/V Characteristics, second order effects, MOS device models. (Sections 2.1, 2.2, 2.3, 2.4 of Text 1).

Module-2 Differential Amplifiers and Current mirrors (8 hours)

Differential Amplifiers: Single ended and differential operation, Basic differential pair, Common mode response, Differential pair with MOS loads, Gilbert cell. (Sections 4.1, 4.2, 4.3, 4.4, 4.5 of Text 1).

Current Mirrors: Basic current mirrors, Cascode Current mirrors, Active Current mirrors (Sections 5.1, 5.2, 5.3 of Text 1).

Module-3 Operational Amplifiers (8 hours)

Operational Amplifiers (part-1): General Considerations, One Stage OP-Amp, Two Stage OP-Amp, Gain boosting.(Sections 9.1, 9.2, 9.3, 9.4 of Text 1).

Operational Amplifiers (part-2): Common Mode Feedback, Slew rate, Power Supply Rejection. (Section 9.7, 9.9, 9.11 of Text 1).

Module-4 Phase Lock Loops (8 hours)

Simple PLL, Charge pump PLLs, Non-ideal effects in PLLs, Delay-Locked Loops, and Applications. (Sections 16.1, 16.2, 16.3, 16.4, 16.5 of Text 1).

Module-5 Data Converter Architectures (8 hours)

DAC & ADC Specifications, Current Steering DAC, Charge Scaling DAC, Cyclic DAC, Pipeline DAC, Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. (Sections 28.4, 28.5, 29.1.4, 29.1.5, 29.1.6, 29.1.7, 29.2.1, 29.2.3, 29.2.4, 29.2.5 of Text 2).

Course Outcomes: At the end of the course the student will be able to:	
21ECE6032.1	Analyze and design various configurations of single stage amplifiers.
21ECE6032.2	Design the analog circuits such as differential amplifiers.
21ECE6032.3	Analyze the working principles of various types of current mirrors like cascode and active mirrors.
21ECE6032.4	Identify the critical parameters that affect the operational amplifiers' performance.
21ECE6032.5	Design and study the behavior of phase-locked-loops for the applications.
21ECE6032.6	Compare data converter characteristics and build data converter architectures.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Design of Analog CMOS Integrated Circuits	Behzad Razavi	Mc Graw Hill	2nd Edition, 2016
2	CMOS Circuit Design, Layout, and Simulation	R. Jacob Baker	Wiley	3rd Edition, 2010
Reference Books				
1	CMOS Analog Circuit Design	Phillip E. Allen, Douglas R. Holberg	Oxford University Press	2nd Edition, 2002
2	Microelectronic Circuits Theory and Applications	Adel S. Sedra, Kenneth C. Smith	Oxford University Press	5th Edition, 2015

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/117103066
- https://archive.nptel.ac.in/courses/117/101/117101105/
- https://www.youtube.com/watch?v=1zns2aaA4Pc
- https://www.techtarget.com/searchnetworking/definition/phase-locked-loop

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE6032.1	1	1			1									2
21ECE6032.2		1			1									2
21ECE6032.3		1												2
21ECE6032.4					1									2
21ECE6032.5	1													2
21ECE6032.6		1												2

1: Low 2: Medium 3: High

Artificial Neural Networks			
Course Code	**21ECE6033**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: This course will enable students to:

- Understand the basics of ANN and compare it with human brain
- Acquire knowledge on various ANN architectures
- Understand statistical learning theory
- Understand principle behind supervised and unsupervised algorithms of ANN
- Understand recurrent neural networks.

Module-1 (8 hours)

Introduction: Fundamentals of neural network, biological neuron, benefits of neural networks, artificial neural model, McCulloch-Pitts neuron model, types of activation functions.
Network Architecture: Feedforward and Feedback – single and multilayered architecture, convex set, convex hull and linear separability, non-linear separable problem - XOR problem, multilayer networks.
Learning Processes: Learning Algorithms - Supervised and Unsupervised learnings.
Chapter 1 and 3 – Textbook 1, Chapter 1 and 2 – Textbook 2.

Module-2 (8 hours)

Supervised Learning I: Perceptron learning algorithm, perceptron convergence theorem, perceptron learning and non-separable sets, α-Least Mean Square learning, MSE error surface, steepest descent search, application of LMS to noise cancelling.
Supervised Learning II: Multilayered Network Architecture - Back propagation learning algorithm - pattern update and batch update, practical consideration of BP algorithm.
Chapter 5 and 6 – Textbook 1, Chapter 3 and 4 – Textbook 2.

Module-3 (8 hours)

Statistical Learning Theory: Bias and Variance dilemma, ERM, SRM, VC dimension
Support Vector Machines: Support vectors, soft margin classifier, non-linear classifier, SVM as feed forward NN.
Radial Basis Function: Radial Basis Function Network (RBFN) and regularization theory, interpolation, solution for XOR problem using RBFN, Generalized RBF Networks.
Chapter 8 – Textbook 1, Chapter 5 and 6 – Textbook 2.

Module-4 (8 hours)

Attractor Neural Networks: Neurodynamical systems, Hebbian learning, Lyapunov stability theorem, Cohen-Grossberg theorem, associative learning and associative memory model, linear associative memory, Hopfield network and its application, spurious attractors, Brain State in a Box neural network, Simulated Annealing, Boltzmann Machine, Bidirectional Associative Memory.
Chapter 9 and 10 – Textbook 1, Chapter 14 – Textbook 2.

Module-5 (8 hours)

Self-organization Feature Map: Oja's rule, Maximal Eigenvector Filtering, Principal Component Analysis, Generalized Learning Laws, Vector Quantization, Self-organization Feature Maps, Application of SOM, Growing Neural Gas.
Chapter 12 – Textbook 1, Chapter 8 and 9 – Textbook 2

Course Outcomes: At the end of the course the student will be able to:	
21ECE6033.1	Analyze building blocks of Artificial Neural Network
21ECE6033.2	Apply supervised learning algorithm

21ECE6033.3	Examine the principles of RBF and SVM
21ECE6033.4	Acquire the knowledge of learning in Artificial Neural Network
21ECE6033.5	Illustrate Artificial Neural Network as a memory model
21ECE6033.6	Illustrate possible application of ANN

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Neural Networks A Classroom Approach	Satish Kumar	McGraw Hill Education Pvt. Ltd.	2nd Edition, 2020
2	Neural Networks: A Comprehensive Foundation	Simon Haykin	Pearson Education	2nd Edition, 1997
Reference Books				
1	Introduction to Artificial Neural Systems	J.M. Zurada	Jaico Publications	1st Edition, 1994
2	Artificial Neural Networks	B.Yegnanarayana	PHI, New Delhi	1998

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/117105084
- https://archive.nptel.ac.in/courses/117/105/117105101/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE6033.1	2	1												
21ECE6033.2	2	1												
21ECE6033.3	2	1												
21ECE6033.4	2	1												
21ECE6033.5	2	1												
21ECE6033.6	2	1												

1: Low 2: Medium 3: High

Object Oriented Programming using C++			
Course Code	**21ECE6034**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 Hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain various advantages of object-oriented programming.
- Implement efficient and flexible code using a wide range of data types and structures, including arrays, strings, classes, and templates.
- Illustrate the characters and behavior of the objects that comprise a system.
- Explain how to achieve reusability using inheritance.
- Illustrate function overloading and operator overloading.
- Solve the problem with an object-oriented approach

Module-1 Beginning with C++ and Features (8 hours)

Introduction to C++, Applications and Structure of C++ Program, Different Data types, Variables, Different Operators, Expressions, Operator Overloading and Control Structures in C++.
(Textbook1, Chapters - 2, 3).

Module-2 Functions, Classes and Objects (8 hours)

Functions, Inline Function, Function Overloading, Friend and Virtual Functions., Specifying a Class, C++ Program with a Class, Arrays within a Class, Memory Allocation to Objects, Array of Objects, Members, Pointers to Members and Member Functions.
(Textbook1, Chapters - 4, 5).

Module-3 Constructors and Operator overloading (8 hours)

Constructors, Multiple Constructors in a class, Copy Constructor, Dynamic Constructor, Destructors, Defining Operator Overloading, Overloading Unary and Binary Operators, Manipulation of Strings using Operators.
(TextBook1, Chapter - 6, 7).

Module-4 Inheritance and Virtual Functions (8 hours)

Derived Classes, Single, Multilevel, Multiple Inheritance, Pointers to Objects and Derived Classes, this Pointer, Virtual and Pure Virtual Functions.
(Textbook1, Chapter – 8, 9).

Module-5 I/O Stream and Files (8 hours)

C++ Streams and Stream Classes, Formatted and Unformatted I/O Operations, Output with Manipulators. Classes for File Stream Operations, Opening and Closing a File, EOF.
(Textbook1, Chapter-10, 11).

Course Outcomes: At the end of the course the student will be able to:	
21ECE6034.1	Identify and explain the principles of object-oriented programming.
21ECE6034.2	Analyze basic building blocks of the C++ language, including variables, data types, operators, control structures, and functions.
21ECE6034.3	Apply the object initialization and destroy concepts using constructors and destructors.
21ECE6034.4	Examine the concept of Function overloading, operator overloading and virtual functions.
21ECE6034.5	Analyze Object Oriented Programs using inheritance, I/O Operation and File Operations.
21ECE6034.6	Implement and debug the C++ program using Object Oriented Concepts to solve problems.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Object-Oriented Programming in C++	E.Balaguruswamy	McGraw Hill	8th Edition, 2020
Reference Books				
1	Object-Oriented Programming in C++	Robert Lafore	Galgotia	4th Edition, 2010
2	C++ Primer	Stanley B. Lippman, Josée Lajoie and Barbara E. Moo	Addison-Wesley Educational Publishers Inc	5th Edition, 2012
3	C++ Programming Language	Bjarne Stroustrup	Addison-Wesley Educational Publishers Inc	4th Edition, 2013

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106105234
- https://nptel.ac.in/courses/106101208
- https://en.cppreference.com/w/cpp/11
- https://www.learncpp.com/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE6034.1	1													
21ECE6034.2		1												
21ECE6034.3		1			1									
21ECE6034.4		1	1		1									
21ECE6034.5		1	1		1									
21ECE6034.6			1		1				1					

1: Low 2: Medium 3: High

Operating System			
Course Code	**21ECE6035**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	2:2:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Tabulate the working of a single user and multiuser operating system.
- Explain how processes are synchronized and scheduled in the system.
- Distinguish the approaches of memory management and virtual memory management.
- Describe the structure and organization of the file systems.
- Interpret the inter process communication and deadlock situations in OS.

Module-1 Introduction to Operating Systems (8 hours)

Basics of Operating Systems, Types of Operating Systems, OS Service, Computational Structures, Resource allocation techniques, Efficiency, OS structure: Layered, Monolithic, Microkernel Operating Systems – Concept of Virtual Machine Resource allocation techniques, Classes operating System.
(Text 1 : Chapter 1, Chapter 2).

Module-2 Process Management (8 hours)

OS View of Processes, process Control Block (PCB), Fundamental State Transitions of a process, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS, Highest Response ratio next and SRN, Preemptive Scheduling- Round Robin (RR) and LCN, Scheduling in Unix and Scheduling in Linux .
(Text 1: Chapter 3).

Module-3 Memory Management (8 hours)

Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, Virtual Memory (VM) handler, FIFO, LRU page replacement policies, Virtual memory in Unix and Linux.
(Text 1: Chapter 5).

Module-4 File Systems (8 hours)

File systems and IOCS, File Operations, File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of disk space, Implementing file access.
(Text 2: Chapter 11).

Module-5 Message Passing and Deadlocks (8 hours)

Overview of Message Passing, implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling deadlocks, Deadlock detection Algorithm, Deadlock Prevention. Introduction to Semaphores.
(Text 2: Chapter 3).

Course Outcomes: At the end of the course the student will be able to:	
21ECE6035.1	Explain the goals, requirements and types of operating systems.
21ECE6035.2	Apply the process management algorithms and analyse with suitable parameters.
21ECE6035.3	Understand the memory management techniques involved in operating systems.
21ECE6035.4	Describe the file management techniques used in the operating system.
21ECE6035.5	Describe message passing, deadlock detection and prevention methods.
21ECE6035.6	Learn the latest operating systems and also can develop the concepts.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Operating Systems – A concept-based approach	Dhamdhere	S Chand Publishing	4tth Edition, 2016
2	Operating systems concepts,	Silberschatz and Galvin	John Wiley India Pvt Ltd	10th Edition, 2018
Reference Books				
1	Operating system– internals and design system	William Stalling	Pearson Education	6th Edition, 2008
2	Design of operating systems	Andrew S Tanenbaum	Pearson	3rd Edition, 2006

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/106/102/106102132/ - Prof. Sorav Bansal, Dept. of Computer science and Engineering, IIT Delhi
- https://www.youtube.com/watch?v=NShBeqTkXnQ (Process Scheduling)
- https://www.youtube.com/watch?v=exlaEOVRWQM (scheduling)
  Prof Chester Rebeiro, Dept of Computer science and Engineering, IIT Madras

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE6035.1	1													
21ECE6035.2			3											
21ECE6035.3		2												
21ECE6035.4		2												
21ECE6035.5									2					
21ECE6035.6												3		

1: Low 2: Medium 3: High

Basics of Analog Circuits			
Course Code	**21ECE6041**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Plot the forward and reverse characteristics of PN diode and design rectifiers, regulators clippers and clampers.
- Analyze the BJT common base, common emitter and common collector characteristics.
- Analyze various biasing schemes for FETs and compare it.
- Design the circuits using op-amps for various applications.
- Draw the frequency response of various types of filters and oscillator circuits.

Module-1 Diode and its Applications (8 hours)

Basics of n-type and p-type semiconductors**,** formation of PN junction, barrier voltage, depletion region, reverse bias junction, forward bias junction, junction temperature effects, pn-junction diode, forward and reverse characteristics of pn-junction diode, Zener diodes-characteristics and parameters, Diode applications: Half wave and full wave rectification, clipping and clamping circuits and Zener diode voltage regulators.

Text 1: 1.4, 1.6, 1.7, 2.1, 2.2, 2.9, 3.1, 3.2, 3.7, 3.8, 3.9 and 3.10.

Module-2 Bipolar Junction Transistor (8 hours)

BJT operation, BJT voltages and currents, BJT amplification, BJT switching, common base characteristics, common emitter characteristics, common collector characteristics, BJT cutoff frequency and capacitances, Miller effect, BJT circuit frequency response and transistor circuit noise.

Text 1: 4.1,4.2 ,4.3,4.4,4.5,4.6,4.7,8.3,8.4 and 8.6.

Module-3 Field Effect Transistors (8 hours)

Introduction to FET, n-channel JFET and its characteristics, p-channel JFET and its characteristics, saturation current and pinch-off voltage, FET amplification and switching, Introduction to MOSFET**,** enhancement MOSFET, depletion MOSFET, depletion-enhancement mode MOSFET, VMOSFET, comparison of n-channel and p-channel FETs, DC load line and Bias point(Q-point), GATE bias, self-bias, voltage divider bias, comparison of basic JFET bias circuits.

Text 1: 9.1, 9.2, 9.3, 9.4, 9.5, 10.1, 10.2, 10.3, 10.4 and 10.5.

Module-4 Introduction to OPAMPS and Negative Feedback (8 hours)

Introduction to the operational amplifiers, block diagram representation of a typical op-amp, schematic symbol, integrated circuits, block diagram representation of feedback configurations voltage series feedback amplifier, voltage shunt feedback amplifier, differential amplifiers.

Text 2: 1.1, 1.2, 1.3, 1.5, 1.6, 3.2, 3.3, 3.4, 3.5.

Module-5 General applications of op-amp (8 hours)

DC and AC amplifiers, summing, scaling and averaging amplifiers, Instrumentation amplifier using transducer bridge, differential input and output amplifier, Integrator, Differentiator, Active filters, first order low pass filter, second order low pass filter, first order high pass filter, second order high pass filter, band pass filters, band reject filters, Oscillators, phase shift oscillator, Wien bridge oscillator.

Text 2: 6.2, 6.5, 6.6.1, 6.7, 6.12, 6.13,7.2,7.3, 7.4, 7.5, 7.6, 7.7, 7.8,7.11,7.12,7.13

Course Outcomes: At the end of the course the student will be able to:	
21ECE6041.1	Explain the working principle of PN junction diode and its applications.
21ECE6041.2	Identify and describe the BJT parameters and write current equations.

21ECE6041.3	Discuss the operation of n channel and p channel FETS and draw the typical drain and transfer characteristics of the device.
21ECE6041.4	Analyze various types of FET bias circuits and draw DC load lines for FET circuits
21ECE6041.5	Discuss the general properties of an operational amplifier (op-amps).
21ECE6041.6	Design the circuits using op-amps for various applications.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Electronic Devices and Circuits	David A Bell	Oxford university Press	5th Edition 2008
2	Op-Amps and Linear Integrated circuits	Ramakanth A Gayakward	Pearson Education	4th Edition 2004
Reference Books				
1	Electronic Devices and Circuit Theory	Robert L Boylestad & Louis Nashelsky	Pearson Education	10th Edition 2009
2	Electronic Devices	Thomas L Floyd	Pearson Education	9th Edition, 2015

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/117/101/117101106/
- https://archive.nptel.ac.in/courses/108/102/108102095/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE6041.1	2				2								2	
21ECE6041.2		2											2	
21ECE6041.3	2												2	
21ECE6041.4		2											2	
21ECE6041.5		2	2											
21ECE6041.6	2	2	2		2									

1: Low 2: Medium 3: High

Fundamentals of Digital System Design			
Course Code	**21ECE6042**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40	Credits	03

Course Learning Objectives: The objective of the course is to

- Apply basic postulates and theorems in Boolean algebra.
- Solve Complex Boolean functions using K-map.
- Construct various Combinational circuits using logic gates.
- Compare different Latches and Flip-flops.
- Explain the working of Shift Registers using Flip-flops.
- Utilize D, JK and T flip-flops for the analysis and design of different Asynchronous and Synchronous Counters.

Module-1 Boolean Algebra (8 hours)

Postulates of Boolean Algebra. Basic theorems and Properties of Boolean Algebra. Boolean Functions - Canonical and Standard forms. Implementation of Boolean functions using basic and universal gates Simplification of Boolean Functions- Using Karnaugh- Map Method (upto four variables), Don't care conditions, Product of sums simplification.
(Text1:4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10).

Module-2 Combinational Circuits(8 hours)

Design Procedure & Implementation of combinational logic circuits- Binary adders and subtractors, Binary Parallel adder, BCD adder, Code converter, Magnitude comparator, Multiplexer, Demultiplexer, Encoder, Decoder. (Text 1: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9).

Module-3 Latches & Flip Flops (8 hours)

Latches, Flip-flops- SR, JK, T, D and Master-Slave Flip-Flop. Triggering of flip-flops- Edge-triggered flip- flops. Excitation table and Characteristic Equation. Conversion of Flip flops, Applications of Flip-Flops.
(Text1:7.1, 7.2, 7.3, 7.4).

Module-4 Shift Registers (8 hours)

Serial In Serial Out, Serial In Parallel Out, Parallel In Serial Out, Parallel In Parallel Out. Shift Register Counters: Ring counter. Johnson counter- timing sequences and state diagrams**,** Shift Register Applications.
(Text1:8.1, 8.2, 8.3, 8.4, 8.5).

Module-5 Asynchronous & Synchronous Counters (8 hours)

Counter design: Asynchronous counters- Binary and BCD counters, timing sequences and state diagrams. Synchronous counters- Binary Up- down counter, BCD counter. Counter Applications. (Text1: 9.1, 9.2, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8).

Course Outcomes: At the end of the course the student will be able to:	
21ECE6042.1	Apply the basic concepts of Boolean algebra for the simplification and implementation of logic functions.
21ECE6042.2	Utilize Karnaugh Map technique to simplify Boolean Expressions.
21ECE6042.3	Design combinational logic circuits for various applications.
21ECE6042.4	Demonstrate the working of different Latches and flip flops.
21ECE6042.5	Contrast the working of Shift Registers on Serial and Parallel inputs.
21ECE6042.6	Construct Asynchronous and Synchronous counters using different flip-flops.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Digital Fundamentals	Thomas L Floyd	Pearson Education	11th Edition, 2017
Reference Books				
1	Digital Design	M Morris Mano	Pearson Education	4th Edition, 2007
2	Digital Logic Applications and Design	John M Yarbrough	Cenage learning	2nd Edition, 2009
3	Digital Principles and Design	Donald D Givone	Tata McGraw Hill	1st Edition, 2017

Web links and Video Lectures (e-Resources):

- Virtual Lab :Digital Electronics IITR.
  https://de-iitr.vlabs.ac.in/
- NPTEL Lecture by Prof Roy Choudary, Department of CSE, IIT Kharagpur.
  https://nptel.ac.in/courses/117/105/117105080/
- NPTEL Lecture by Prof Neeraj Goel, IIT Rourkee
  https://onlinecourses.nptel.ac.in/noc21_ee39/preview

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE6042.1	2													
21ECE6042.2	1													
21ECE6042.3	1													
21ECE6042.4	1													
21ECE6042.5	1													
21ECE6042.6	1													

1: Low 2: Medium 3: High

Microcontroller			
Course Code	**21ECE6043**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 Hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Compare the difference between a Microprocessor and a Microcontroller.
- Familiarize the basic architecture of 8051 microcontroller
- Program 8051 microprocessor using Assembly Level Language.
- Explain the operation and use of inbuilt Timers/Counters and Serial port of 8051.
- Explain the interrupt system of 8051 and the use of interrupts.

Module-1 8051 Microcontroller (8 Hours)

8051 Microcontroller: Microprocessor Vs. Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.
Text 2: Chapter 1 - 1.1 to 1.3, Chapter 3 - 3.1 to 3.3.

Module-2 8051 Instruction Set (8 Hours)

8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, and Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions.
Text 2 : Chapter 5 , Chapter 6, Chapter 7, Chapter 8

Module-3 8051 Jump and Call instructions (8 Hours)

8051 Jump and Call instructions: Jump and Call Instructions, Calls & Subroutine instructions. Assembly language program examples on subroutine and involving loops.
Text 2 : Chapter 8 - 8.1 to 8.4 .

Module-4 8051 Timers and Serial Port (8 Hours)

8051 Timers and Serial Port: 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.
Text1 : Chapter 9 - 9.1 Chapter 10 - 10.1 to 10.5.

Module-5 8051 Interrupts (8 Hours)

8051 Interrupts: 8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a Timer interrupt.
Text 1: Chapter 11 - 11.1 and 11.2 , Chapter 12 -12.1, Chapter 13 -13.1 to 13.2, , Chapter 17 - 17.2.

Course Outcomes: At the end of the course the student will be able to:	
21ECE6043.1	Outline the detailed hardware architecture of the 8051 Microcontroller.
21ECE6043.2	Identify the addressing modes and instruction set of 8051 microcontrollers.
21ECE6043.3	Identify the appropriate 8051 Jump and Call instructions.
21ECE6043.4	Describe the various modes of the 8051 Timers.
21ECE6043.5	Analyze the data transfer through Input/ output ports.
21ECE6043.6	Illustrate the use of 8051 Interrupts to change the flow of program.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	The 8051 Microcontroller and Embedded Systems – using assembly and C	Muhammad Ali Mazidi, Janice Gillespie Mazidi, and Rollin D McKinlay	Pearson	2nd Edition, 2006
2	The 8051 Microcontroller.	Kenneth J Ayala	Thomson/Cengage Learning.	1st Edition, 1991
Reference Books				
1	The 8051 Microcontroller Based Embedded Systems	Manish K Patel	Mc Graw Hill	1st Edition, 2014
2	Microcontrollers: Architecture, Programming, Interfacing and System Design	Raj Kamal	Pearson Education	2nd Edition, 2012

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108105102
- https://www.classcentral.com/classroom/youtube-8051-microcontroller-lecture-series-53060

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE6043.1	1											1		
21ECE6043.2	1				1							1		
21ECE6043.3	1											1		
21ECE6043.4	1											1		
21ECE6043.5	1											1		
21ECE6043.6	1				1							1		

1: Low 2: Medium 3: High

Programming and Interfacing with Arduino			
Course Code	**21ECE6044**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours Theory	Credits	03

Course Learning Objectives: The objective of the course is to

- Explain various hardware features of the Arduino UNO board
- Explain the structure, syntax and various functions in writing the Arduino program
- Describe the working principle and function of Actuators
- Describe the working principle and function of Sensors
- Demonstrate the interfacing and programming of various I/O devices with Arduino UNO Board

Module-1 Arduino UNO Board (8 hours)

Introduction to Arduino UNO Board.
Features of Arduino UNO Board, Arduino IDE Software, Arduino IDE download, Working with Arduino IDE, Introduction to ATmega 328, Serial Peripheral Interface (SPI) Communication Protocol, and Inter-Integrated Circuit (I2C) Communication Protocol.
Text Book 1: Chapter 1.

Module-2 Arduino Programming Constructs (8 hours)

Structure of Arduino Programming, Function: pinMode, digitalwrite(pin, value), digitalread (pin), Analogread (pin), analogwrite(pin, value), delay(value), for loop, If statement.
Text Book 1: Chapter 2.

Module-3 I/O device and Actuators (8 hours)

Light-Emitting Diode (LED), push button switch, Seven-Segment Display, Analog to Digital Converter, Pulse Width Modulation, Motor Driver L293D.
Text Book 1: Chapter 3: 3.1, 3.2, 3.3, 3.6, 3.7, 3.10.

Module-4 Interfacing of Sensors (8 hours)

Relay, Light Dependent Resistor (LDR), Ultrasonic sensor (HC- SR04), Bluetooth Module (HC-05), Temperature Sensor LM35.
Text Book 1: Chapter 3: 3.11, 3.12, 3.18, 3.19.

Module-5 Interfacing and Programming with Arduino (8 hours)

LED Interfacing and Programming, Display in serial monitor**,** Push-Button Interfacing and Programming, Seven-Segment Display Interfacing and Programming, Interfacing and Programming of Arduino UNO with Ultrasonic Sensor (HC-SR04), Interfacing and Programming of Arduino UNO with Bluetooth Module (HC-05).
Text Book 1: Chapter 4: 4.1 – 4.4, 4.19, 4.20.

Course Outcomes: At the end of the course the student will be able to:	
21ECE6044.1	Interpret various hardware features of the Arduino UNO board, ATmega 328 and communication protocols
21ECE6044.2	Analyse the programming constructs to perform interfacing
21ECE6044.3	Analyse the interfacing configurations of I/O devices and actuators
21ECE6044.4	Analyse the working of different sensors with their configurations
21ECE6044.5	Implement the interfacing of sensors and actuators with Arduino UNO
21ECE6044.6	Demonstrate an example to illustrate the programming and Interfacing with Arduino.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Programming and Interfacing with Arduino	Dr. Yogesh Mishra	CRC press	1st Edition, 2021
Reference Books				
1	Getting Started with Arduino	Massimo Banzi	Maker Media, Inc., 1005	3rd Edition, 2014

Web links and Video Lectures (e-Resources):

- **https://www.youtube.com/watch?v=NkZdosZH6Wo (NPTEL video)**
- https://youtu.be/_ItSHuIJAJ8
- https://youtu.be/9cxAjRHdMVY
- https://youtu.be/XI49uFm5HRE

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE6044.1					1							1		
21ECE6044.2					1							1		
21ECE6044.3					1							1		
21ECE6044.4					1							1		
21ECE6044.5					1							1		
21ECE6044.6					1				2	1	1	1		

1: Low 2: Medium 3: High

Communication Theory			
Course Code	**21ECE6045**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40 hours	Credits	03

Course Learning Objectives: The objective of the course is to

- Illustrate essential elements of electronic communications.
- Discuss Amplitude and Angle modulation.
- Explain AM Radio transmitters and Receivers
- Describe the concepts of sampling and quantization.
- Explain the various digital modulation schemes.
- Illustrate the concepts of wireless communication.

Module-1 Electronic Communications (8 hours)

Introduction to Electronic Communications: Historical perspective, Electromagnetic frequency spectrum, Signal and its representation, Elements of electronic communications system, Primary communication resources, Signal transmission concepts, Analog and digital transmission, Modulation, Concept of frequency translation, Signal radiation and propagation.
(Text 1: 1.1 to 1.10).

Module-2 Signal Transmission and Reception (8 hours)

Amplitude Modulation Techniques: Types of analog modulation, Principle of Amplitude Modulation, AM power distribution, Limitations of AM.
(Text 1: 4.1, 4.2, 4.4, 4.6).
Angle Modulation Techniques: Principles of Angle modulation, Theory of FM-basic Concepts, Theory of phase modulation.
(Text 1: 5.1, 5.2, 5.5).
Analog Transmission and Reception: AM Radio transmitters, AM Radio Receivers.
(Text 1:6.1, 6.2).

Module-3 Modulation Techniques (8 hours)

Sampling Theorem and pulse Modulation Techniques:
Digital versus analog Transmissions, Sampling Theorem, Classification of Pulse Modulation Techniques, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Pulse Code Modulation (PCM).
(Text 1: 7.1 to 7.7).

Module-4 Digital Modulation (8 hours)

Digital Modulation Techniques: Types of digital Modulation, Amplitude Shift keying (ASK), FrequencyShift keying (FSK), Phase shift Keying (PSK).
(Text 1: 9.1 to 9.4).
Source and Channel Coding: Objective of source coding, source coding technique, Shannon's sourcecoding theorem, Need of channel coding, Channel coding theorem.
(Text 1: 11.1 to 11.3, 11.8, 11.9).

Module-5 Wireless communication systems (8 hours)

Evolution of wireless communication systems: Brief History of wireless communications, Advantages of wireless communication, Disadvantages of wireless communications, Wireless network generations, Comparison of wireless systems, Evolution of next-generation networks, Applications of wireless communication.
(Text 2: 1.1 to 1.7).
Principles of Cellular Communications: Cellular terminology, Cell structure and Cluster, Frequency reuse concept, Cluster size and system capacity, Method of locating co-channel cells, Frequency reuse distance.
(Text 2: 4.1 to 4.6).

Course Outcomes: At the end of the course the student will be able to:	
21ECE6045.1	Illustrate the fundamentals of electronic communications.
21ECE6045.2	To describe various analog modulation schemes.
21ECE6045.3	Compare the Digital with Analog modulation techniques and classify the various pulse modulation schemes.
21ECE6045.4	Analyze the various digital modulation schemes and discuss the available source coding techniques.
21ECE6045.5	Interpret the concepts of wireless communication.
21ECE6045.6	Analyze the principles of the cellular technology.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Analog and Digital Communications	T L Singal	McGraw Hill Education (India) Private Limited.	1st Edition,2017
2	Wireless Communications	T L Singal	McGraw Hill Education (India) Private Limited.	1st Edition,2017
Reference Books				
1	Modern digital and Analog communication Systems	P B Lathi	Oxford University Press	4th Edition, 2010
2	Communication Systems: Analog and Digital	R.P.Singh and S.Sapre	Tata McGraw Hill	2nd Edition, 2007

Web links and Video Lectures (e-Resources):

- https://youtu.be/KXFF8m4uGDc
- https://youtu.be/QE-GmtXIKGs

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE6045.1	2											1	1	
21ECE6045.2	2												1	
21ECE6045.3	2					2							1	
21ECE6045.4	2					2							1	
21ECE6045.5	2												1	
21ECE6045.6	2					2							1	

1: Low 2: Medium 3: High

Environmental Studies			
Course Code	**21CIV605**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	1:0:0	SEE Hours	02
Total Hours	15 hours Theory	Credits	01

Course Learning Objectives: This course will enable

- To create environmental awareness among the students.
- To gain knowledge on different types of pollution in the environment.

Module-1 Introduction to Ecology **3 hours**

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Module-2 Energy Systems and Natural Resources **3 hours**

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.
Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Module-3 Environmental Pollution and Public Health **3 hours**

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module-4 Environmental Concerns **3 hours**

Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module-5 Environmental Management **3 hours**

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Course Outcomes: At the end of the course the student will be able to:

21CIV605.1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale
21CIV605.2	Develop critical thinking and/or observation skills and apply them to the analysis of a problem or question related to the environment.
21CIV605.3	Demonstrate ecology knowledge of a complex relationship between biotic and abiotic component.
21CIV605.4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.
21CIV605.5	Address problems related to waste management and public health aspects
21CIV605.6	Understand about the Standards and latest tools to mitigate pollution.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Environmental studies	Benny Joseph	Tata McGraw-Hill	Edition 3, 2018
2	Environmental Studies –From Crisis to Cure	R Rajagopalan	Oxford Uni-Press	Edition 3, 2020
Reference Books				
1	A Basic Course in Environmental Studies	Surinder Deswal, Anupama Deswal	DhanpatRai Publishing Co. (P) Ltd	2017
2	Text book of Environmental Studies for Undergraduate Courses	Bharucha Erach	Universities Press	Edition 2, 2017
3	Environmental Studies	Ranjit R. J Daniels, Jagdish Krishnaswamy	John Wiley & Sons Inc.	2010
4	Perspective in Environmental Studies	Anubha Kaushik, C P Kaushik	New Age International Pvt. Ltd	Edition 3, 2009

Web links and Video Lectures (e-Resources):

- Coursera Course: Introduction to Environmental Science Specialization - https://coursera.org/share/e6c3c98f7215fd49f688e7ede71a0dfc
- NPTEL: Environmental Studies - https://onlinecourses.swayam2.ac.in/cec22_ge22/preview
- Directory of Open Access Books (DOAB) -Environmental Leadership Capacity Building in Higher Education: Experience and Lessons from Asian Program for Incubation of Environmental Leaders : http://link.springer.com/openurl?genre=book&isbn=978-4-431-54339-8
- Lec 31: Environmental Management Systems (EMS) - https://youtu.be/BYqLRGawoH0
- ISO 14001:2015 Training - Environmental Management - https://youtu.be/2f4pBIvXkBs

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21CIV605.1	0	0	0	0	0	1	3	0	0	0	0	0	0	0
21CIV605.2	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.3	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.4	0	0	0	0	0	0	3	0	0	0	0	0	0	0
21CIV605.5	0	0	0	0	0	2	3	1	0	0	0	0	0	0
21CIV605.6	0	0	0	0	1	0	0	2	0	0	0	0	0	0

1: Low 2: Medium 3: High

VLSI LAB			
Course Code	**21ECL606**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	0:0:2	SEE	3 Hours
Total Hours	20	Credits	1

Course Learning Objectives: The objective of the course is to

- Design, model, simulate and verify CMOS digital circuits
- Design layouts and perform physical verification of CMOS digital circuits
- Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist
- Perform RTL-GDS II flow and understand the stages in ASIC design

Part A

1) Write Verilog code for 4-bit up/down asynchronous reset counter and carry out the following:
   a) Verify the functionality using test bench
   b) Synthesize the design by setting area and timing constraint. Obtain the gate level netlist, find the critical path and maximum frequency of operation. Record the area requirement in terms of number of cells required and properties of each cell in terms of driving strength, power and area requirement
2) Write Verilog code for 32-bit ALU supporting four logical and four arithmetic operations, use case statement and if statement for ALU behavioural modelling
   a) Perform functional verification using test bench
   b) Synthesize the design targeting suitable library by setting area and timing constraints
   c) For various constrains set, tabulate the area, power and delay for the synthesized netlist
   d) Identify the critical path and set the constraints to obtain optimum gate level netlist with suitable constraints

Part B

1) Design an Inverter with given specifications, completing the design flow mentioned below
   a) Draw the schematic and verify the following: i) DC Analysis ii) Transient Analysis
   b) Draw the Layout and verify the DRC, ERC
   c) Check for LVS
2) Design NAND the following circuits with the given specifications, completing the design flow mentioned below:
   a) Draw the schematic and verify the following: i) DC Analysis ii) Transient Analysis
   b) Draw the Layout and verify the DRC, ERC
   c) Check for LVS
3) Design a Common source amplifier with the given specification completing the design flow as mentioned below
   a) Draw the schematic and verify the following: i) DC Analysis ii) AC Analysis iii) Transient Analysis
   b) Design Layout for Common source amplifier with given design parameters
   c) Draw the Layout and verify the DRC, ERC
   d) Check for LVS
   e) Extract RC and back annotate the same and verify the Design
4) Design a Two stage amplifier with the given specification completing the design flow as mentioned below
   a) Draw the schematic and verify the following: i) DC Analysis ii) AC Analysis iii) Transient Analysis and Design Layout for Two stage amplifier with given design parameters
   b) Draw the Layout and verify the DRC, ERC
   c) Check for LVS
   d) Extract RC and back annotate the same and verify the Design

Course Outcomes: At the end of the course the student will be able to:	
21ECL606.1	Design and simulate combinational and sequential digital circuits using Verilog HDL
21ECL606.2	Design and simulate basic CMOS circuits like inverter, NAND and common source amplifier
21ECL606.3	Demonstrate the understanding of schematic and layout for the circuit
21ECL606.4	Design and analyze the op-amp with given constraints
21ECL606.5	Demonstrate the understanding of ASIC design by performing RTL-GDS II flow
21ECL606.6	Demonstrate the ability to utilize the EDA tools for a given problem

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	CMOS VLSI Design- A Circuits and Systems Perspective	Neil H. E. Weste, and David Money Harris	Pearson Education	4th Edition, 2015
2	CMOS Digital Integrated Circuits: Analysis and Design	Sung Mo Kang & Yosuf Leblebici	Tata McGraw Hill	3rd Edition, 2003
3	Microelectronics Circuits Theory and Applications	Adel Sedra and K. C. Smith	Oxford University Press	6th Edition, 2009
Reference Books				
1	Basic VLSI Design	Douglas A Pucknell & Kamran Eshragian	Prentice Hall India	3rd Edition, 1994
2	Design of Analog CMOS Integrated Circuits	Behzad Razavi	Tata McGraw Hill.	2nd Edition 2007

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECL606.1				1	1					1				2
21ECL606.2				1	1					1				2
21ECL606.3				1	1					1				2
21ECL606.4				1	1					1				2
21ECL606.5				1	1					1				2
21ECL606.6				1	1					1				2

1: Low 2: Medium 3: High

Python Programming			
Course Code	**21ECE607**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	3:0:0	SEE	3 Hours
Total Hours	40	Credits	03

Course Learning Objectives: The objective of the course is to

- Learn the syntax and semantics of the Python programming language and learn to create conditional statements and functions in Python.
- Implement looping constructs and handle strings and files in Python.
- Illustrate the process of structuring the data using lists, tuples and dictionaries and learn regular expressions.
- Develop, Run and manipulate python programs for searching patterns using Regular expressions.
- Implement the Object Oriented Programming concepts in Python.
- Build Web services, Network and Database programs in Python.

Module-1 Introduction, Conditional Execution and Functions (8 hours)

Introduction: Computer hardware architecture, Understanding programming, Words and sentences, Conversing with Python, Interpreter and compiler, Writing a program, What is a program, Building blocks of a program. (Text 1: Chapter1).

Variables, expressions and statements: Values and types, Variables, Variable names and Keywords, Statements, Operators and Operands, Expressions, Order of Operations, Modulus Operator, String Operations, Asking the user for input, Comments, Choosing Mnemonic variable names. (Text 1: Chapter 2).

Conditional execution: Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Catching expressions using try and except, Short- circuit evaluation of logical expressions. (Text 1: Chapter 3).

Functions: Function calls, Built-in functions, Type conversion functions, Math functions, Random numbers, Adding new functions, Definitions and uses, Flow of execution, Parameters and arguments, Fruitful functions and void functions. (Text 1: Chapter 4).

Module-2 Iteration, Strings and Files (8 hours)

Iteration: Updating Variables, The *while* statement, Infinite loops, Finishing iteration with continue, Definite loops using *for*, Loop patterns**.** (Text 1: Chapter 5).

Strings: A string is a sequence, Getting the length of a string using '*len',* Traversal through a string with loop, String slices, Strings are immutable, Looping and counting, The in operator, string comparison, String methods, Parsing strings, Format operator. (Text 1: Chapter 6).

Files: Persistence, Opening files, Text files and lines, Reading files, Searching through a file, Letting the user choose the file name, Using try except and open, Writing files.
(Text 1: Chapter 7).

Module-3 Lists, Dictionaries, Tuples and Regular Expressions (8 hours)

Lists: A list is a sequence, Lists are mutable, Traversing a list, List Operations, List slices, List methods, Deleting elements, Lists and functions, Lists and strings, Parsing lines, Objects and values, Aliasing, Lists arguments. (Text 1: Chapter 8).

Dictionaries: Dictionary as set of counters, Dictionaries and files, Looping and dictionaries, Advanced text parsing. (Text 1: Chapter 9).

Tuples: Tuples are immutable, Comparing tuples, Tuple assignment, Dictionaries and Tuples, Multiple assignment with dictionaries, The most common words, Using tuples as keys in dictionary, Sequence: strings, lists and tuples, List comprehension. (Text 1: Chapter 10).

Regular Expressions: Character matching in Regular expressions, Extracting data using regular expressions, Combining searching and extracting, Escape character. (Text 1: Chapter 11).

Module-4 Classes (8 hours)
Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying. (Text 2: Chapter 15). **Classes and functions:** Time, Pure functions, Modifiers, Prototyping Vs planning. (Text 2: Chapter 16). **Classes and methods:** Object-oriented features, Printing objects, examples, The init method, The _ _str_ _ method**,** Operator overloading, Type-based dispatch, polymorphism. (Text 2: Chapter 17).
Module-5 Networking and Web services (8 hours)
Network Programs: HTTP, The world's simplest web browser, Retrieving an image over HTTP, Retrieving webpages with urllib, Reading binary files using urllib, Parsing HTML and scraping the web, Parsing HTML using regular expressions, Parsing HTML using BeautifulSoup. (Text 1: Chapter 12). **Using web services:** XML, Parsing XML, Looping through nodes, JSON, Parsing JSON, Application Programming Interfaces, Security and API usage. (Text 1: Chapter 13). **Using Databases and SQL:** Database concepts, Database browser for SQLite, Creating a Database table. (Text 1: 14.13,14.14,14.15,14.16).

Course Outcomes: At the end of the course the student will be able to:	
21ECE607.1	Examine Python Syntax and semantics and be fluent in the use of Python flow control and Functions.
21ECE607.2	Demonstrate proficiency in handling Python strings and File system.
21ECE607.3	Design, Create and execute Python programs using core data types like List, Dictionary and Tuple.
21ECE607.4	Implement Regular expressions for patterns recognition.
21ECE607.5	Interpret the concepts of Object-Oriented programming in Python.
21ECE607.6	Implement applications related to Network programming, Web services and Databases in Python.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Python for everybody: Exploring Data Using Python3.	Charles R. Severance	Create Space Independent Publishing Platform	1st Edition , 2016
2	Think Python: How to Think Like a Computer Scientist.	Allen B. Downey	Green Tea Press	2nd Edition , 2015
Reference Books				
1	Python Programming Using Problem Solving Approach.	Reema Thareja	Oxford University Press	1st Edition , 2017
2	Learning Python.	Mark Lutz	O'Reilly Media	5th Edition, 2013
3	Introduction to Python Programming.	Gowrishankar S, Veena A	CRC Press	1st Edition, 2019

Web links and Video Lectures (e-Resources):

- https://www.learnbyexample.org/python/
- https://www.learnpython.org/
- https://pythontutor.com/visualize.html#mode=edit
- https://developers.google.com/edu/python

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE607.1	1				1									
21ECE607.2	1				1									
21ECE607.3	1				1									
21ECE607.4	1				1									
21ECE607.5	1				1									
21ECE607.6	1	1			1									

1: Low 2: Medium 3: High

Innovation and Intellectual Property			
Course Code	**21IIP609**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	50
Teaching Hours/Week (L:T:P)	0:0:2	SEE	2 Hours
Total Hours	20 Hrs	Credits	-

Course Learning Objectives:

1. Learn how to use online databases and search tools for conducting patent searches.
2. Develop skills in analyzing patent documents and identifying relevant prior art.
3. Gain proficiency in evaluating the patentability criteria for engineering inventions.
4. Understand the principles of technology gap analysis and patentability search.
5. Understand the patent drafting and patent prosecution.

Module-1 Basics of Intellectual Property Rights (4 Hours)

Creativity, Invention, and Innovation – Introduction to Intellectual Property Rights-types and Importance – Overview of Patent Law – Intellectual Property Management and Commercialization – Emerging Issues in Intellectual Property – Case Studies and Practical Examples – Ethical and Social Considerations.

Activity: Trademark Design Challenge – IP Case Study Analysis

Module-2 Patent Landscape Analysis – Technology Gap Analysis (4 Hours)

Overview of Patent Databases and Search Tools – Keyword Searching, Classification Searching, and Citation Searching – Methods for Analyzing Patent Data: Patent Counts, Citation Analysis, and Patent Mapping – Technology Gap Analysis – Patent Portfolios – Portfolio Strength Assessment – Identification of Key Players – Competitive Intelligence and Market Analysis.

Activity: Conduct Patent Landscape Analysis for the Proposed Capstone Project.

Module-3 Patentability Assessment (6 Hours)

Significance of Patentability Assessment – Patentability Criteria: Novelty, Non-obviousness (Inventive Step), and Industrial Applicability/Utility – Prior Art Searching and Analysis (Keyword Searching, Classification Searching, and Citation Searching) – Non-Patent Literature Search and Other sources of Prior Art – Patentability Reports and Assessments – Case Studies and Practical Examples.

Activity: Conduct a Patentability Search for the Proposed Capstone Project.

Module-4 Patent Drafting and Prosecution (6 Hours)

Significance of Patent Drafting and Prosecution – Structure and Components of a Patent Application – Drafting of Patent Specifications, Claims, and Drawings – Overview of Patent Prosecution Process

Activity: Prepare a Patent Draft for the Proposed Capstone Project.

Course Outcomes: At the end of the course, the student will be able to:	
21IIP609.1	Demonstrate proficiency in utilizing various online databases and search tools for conducting patent searches.
21IIP609.2	Develop advanced skills in analyzing patent documents to identify relevant prior art, including patents, patent applications, and non-patent literature.
21IIP609.3	Demonstrate a comprehensive understanding of the patentability criteria, including novelty, non-obviousness, and utility.

21IIP609.4	Explain the principles and methodologies of technology gap analysis and its relevance to patentability searches.
21IIP609.5	Gain insight into the patent drafting process, including the structure and components of patent applications, and patent prosecution.
21IIP609.6	Apply the acquired knowledge and skills in conducting practical activities, such as conducting patent landscape analysis, patentability searches, and drafting patent applications, to solve real-world problems and challenges in the field of intellectual property rights.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Reference Books/Sources				
1	Intellectual Property- A Primer for Academia (For Module 1)	Rupinder Tewari Mamtha Bhardway	Publication Bureau, Panjab University Chandigarh India	2021
2	Patent Landscape Reports (For Module 2)	WIPO - World Intellectual Property Organization		https://www.wipo.int/patentscope/en/programs/patent_landscapes/
3	Guidelines for Preparing Patent Landscape Reports (For Module 2)	Anthony Trippe, Patinformatics, LLC	World Intellectual Property Organization (WIPO)	2015
4	Patent Searching - Tools and Techniques (For Module 3)	David Hunt	John Wiley & Sons Inc	First edition 2007
5	The Complete Patent Book_ Everything You Need to Obtain Your Patent (For Module 4)	James L. Rogers	Sphinx Publishing	First Edition 2003

Additional Resources:

1. WIPO Patent Drafting Manual - Second Edition 2023, https://www.wipo.int/edocs/pubdocs/en/wipo-pub-867-23-en-wipo-patent-drafting-manual.pdf
2. Patent Drafting for Beginners - https://elearn.nptel.ac.in/shop/nptel/patent-drafting-for-beginners/?v=c86ee0d9d7ed
3. The Office of the Controller General of Patents, Designs and Trade Marks, Government of India - https://www.ipindia.gov.in/
4. Copyright Office, Government of India - https://copyright.gov.in/
5. United States Patent and Trademark Office - https://www.uspto.gov/
6. Espacenet – patent search - https://worldwide.espacenet.com/
7. The Lens - Free & Open Patent and Scholarly Search - https://www.lens.org/
8. WIPO PATENTSCOPE - https://patentscope.wipo.int/search/en/search.jsf

Course Articulation Matrix

Course Outcomes (Cos)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21IIP609.1	2	-	-	-	3	-	-	-	-	-	-	1	-	-
21IIP609.2	2	-	-	3	-	-	-	-	-	-	-	1	-	-
21IIP609.3	3	-	-	-	-	-	-	-	-	-	1	-	-	-
21IIP609.4	2	-	3	-	-	-	-	-	-	-	-	-	-	-
21IIP609.5	1	3	-	-	-	-	-	-	-	-	-	2	-	-
21IIP609.6	-	-	-	-	2	-	-	-	-	-	-	3	-	-

1: Low 2: Medium 3: High

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Core Values of the Institution

SERVICE

A Josephite will keep service as the prime goal in everything that is undertaken. Meeting the needs of the stakeholders will be the prime focus of all our endeavors.

EXCELLENCE

A Josephite will not only endeavor to serve, but serve with excellence. Preparing rigorously to excel in whatever we do will be our hallmark.

ACCOUNTABILITY

Every member of the SJEC Family will be guided to deliver on assurances given within the constraints set. A Josephite will always keep budgets and deadlines in mind when delivering a service.

CONTINUOUS ADAPTATION

Every member of the SJEC Family will strive to provide reliable and continuous service by adapting to the changing environment.

COLLABORATION

A Josephite will always seek to collaborate with others and be a team-player in the service of the stakeholders.

Objectives

- Provide Quality Technical Education facilities to every student admitted to the College and facilitate the development of all round personality of the students.
- Provide most competent staff and excellent support facilities like laboratory, library and internet required for good education on a continuous basis.
- Encourage organizing and participation of staff and students in in-house and outside Training programmes, seminars, conferences and workshops on continuous basis.
- Provide incentives and encouragement to motivate staff and students to actively involve in research-innovative projects in collaboration with industry and R &D centres on continuous basis
- Invite more and more number of persons from industry from India and abroad for collaboration and promote Industry-Institute Partnership.
- Encourage consultancy and testing and respond to the needs of the immediate neighbourhood.

St Joseph Engineering College

AN AUTONOMOUS INSTITUTION

Affiliated to VTU, Belagavi | Recognised by AICTE, New Delhi
Accredited by NAAC with A+ Grade
B.E. (CSE, ECE, EEE, ME, CIV), MBA & MCA Accredited by NBA, New Delhi

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