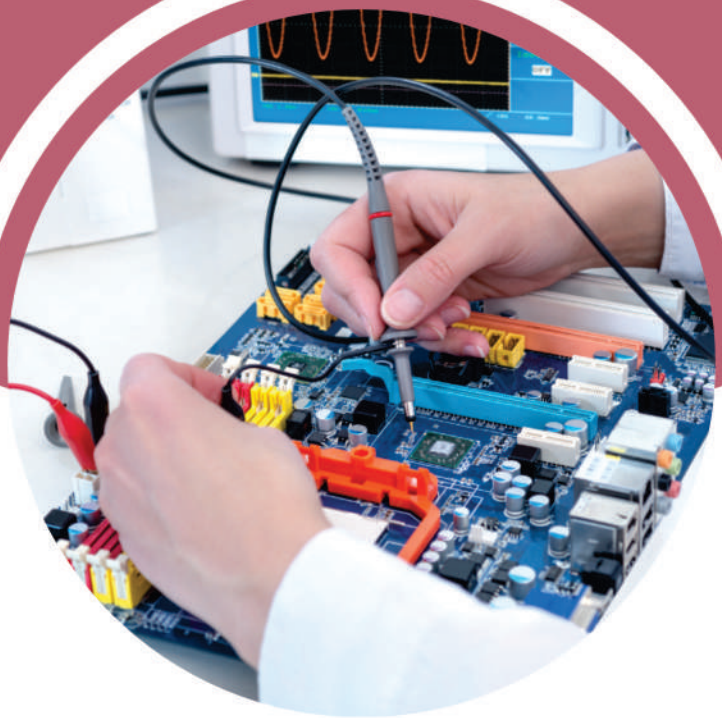
Fourth Year BE

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) & PG (MBA and MCA)
NAAC – Accredited with A+

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

Electronics and Communication Engineering

FOURTH YEAR

(VII and VIII 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 two of the PG programs, namely, MBA and MCA 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

Sl No	SUBJECTS	Page No
1	Department Vision, Mission, Program Educational Objectives (PEOs)	04
2	Program Outcomes POs and Program Specific Outcomes PSOs	05
3	Scheme – VII Semester Electronics and Communication Engineering	06
4	Scheme – VIII Semester Electronics and Communication Engineering	07
	VII Semester	
5	21ECE701 - Wireless Communication	09
6	21ECE702 – Digital Image Processing	11
7	21ECE7031 - Information Theory and Coding	13
8	21ECE7032 - VLSI Design Tools	15
9	21ECE7033 - Machine Learning	17
10	21ECE7034 - Data Structures using C++	19
11	21ECE7035 – Embedded Systems Design	21
12	21ECE7041 - Biomedical Signal Processing	23
13	21ECE7042– Advanced VLSI design	25
14	21ECE7043 - Artificial Intelligence and Deep Learning	27
15	21ECE7044 - Database Management System	29
16	21ECE7045 - IOT & Wireless Sensor Networks	31
17	21ECE7051 – Internet of Things (IoT)	33
18	21ECE7052 - Sensors and Signal Conditioning	35
19	21ECE7053 – Real Time Systems	37
20	21ECE7054 - Cyber Security	39
21	21ECE7055 - ARM Embedded Systems	41
22	21ECS706 - Technical Seminar	43
23	21ECP707 - Major Project Work	46
	VIII Semester	
24	21AEC801 - Massive Open Online Course (MOOC)	50
25	21ECP802 – Major Project Work	53
26	21INT803 - Research/Industry Internship	56

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.

VII Semester (B.E. – Electronics and Communication 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 Marks**	
						L	**T**	**P**					
1	PCC	21ECE701	Wireless Communication	ECE	ECE	3	-	-	03	50	50	100	3
2	PCC	21ECE702	Digital Image Processing	ECE	ECE	3	-	-	03	50	50	100	3
2	PEC	21ECE703X	Professional Elective - 2	ECE	ECE	3	-	-	03	50	50	100	3
3	PEC	21ECE704X	Professional Elective - 3	ECE	ECE	3	-	-	03	50	50	100	3
4	OEC	21ECE705X	Open Elective - 2	ECE	ECE	3	-	-	03	50	50	100	3
5	SDC	21ECS706	Technical Seminar	ECE	ECE	--	--	2	-	100	--	100	1
6	SDC	21ECP707	Major Project Work (Phase I & II)	ECE	ECE	--	--	6	03	50	50	100	5
					Total	**15**	**-**	**8**	**18**	**400**	**300**	**700**	**21**

21ECE703X : Professional Elective II					
21ECE7031	Information Theory and Coding	21ECE7033	Machine Learning	21ECE7035	Embedded Systems Design
21ECE7032	VLSI Design Tools	21ECE7034	Data Structures using C++		
21ECE704X : Professional Elective III					
21ECE7041	Biomedical Signal Processing	21ECE7043	Artificial Intelligence and Deep Learning	21ECE7045	IOT & Wireless Sensor Networks
21ECE7042	Advanced VLSI design	22ECE7044	Database Management System		

21ECE705X : Open Elective II					
21ECE7051	Internet of Things (IoT)	21ECE7053	Real Time Systems	21ECE7055	ARM Embedded Systems
21ECE7052	Sensors and Signal Conditioning	21ECE7054	Cyber Security		

VIII Semester (B.E. – Electronics and Communication Engineering)														
Sl. 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	SDC	21AEC801	MOOC	Any MOOC topic (Choices are given by respective Department) with minimum 8 weeks to be completed between III Sem to VIII Sem								100	2
2	SDC	21ECP802	Major Project Work (Final Presentation and Report Submission)	ECE		-	-	-	03	50	50	100	5
3	INT	21INT803	Research / Industry Internship			-	-	-	03	50	50	100	10
					Total	-	-	-	**06**	**100**	**100**	**300**	**17**

Research Internship / Industry Internship is to be carried out during the 8th semester for 15 weeks.

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.

VII Semester

Wireless Communication			
Course Code	**21ECE701**	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

- Understand the concepts of propagation over wireless channels from a physics standpoint.
- Apply communication theory to comprehend GSM systems managing mobile telephony, incorporating both physical and networking aspect.
- Utilize communication theory, encompassing physical and networking aspects, to grasp CDMA systems managing mobile telephony.
- Apply communication theory, covering physical and networking aspects, to comprehend LTE-4G systems thoroughly.
- Understand the basics of optical wireless communication.

Module-1 Wireless Fundamentals (8 hours)

Communication system building blocks, The broadband wireless channel: Path loss and shadowing, Cellular systems: Cellular Concept, Analysis of Cellular Systems, Sectoring, The broadband wireless channel: Fading - Delay Spread and Coherence Bandwidth, Doppler Spread and Coherence Time, Angular spread and Coherence Distance, Modeling broadband fading channels - Statistical channel models. **Textbook 1: 2-2.5.1**

Module-2 GSM and TDMA Technology (8 hours)

GSM System overview: Introduction, GSM Network and System Architecture, GSM Channel Concept. **GSM System Operations:** GSM Identities, System Operations –Traffic cases, GSM Infrastructure Communications (Um Interface). **Textbook 2: Part 1 and Part 2 of Chapter 5**

Module-3 CDMA Technology (8 hours)

CDMA System Overview: Introduction, CDMA Network and system Architecture.
CDMA Basics: CDMA Channel concepts, CDMA System (Layer3) operations, 3G CDMA.
Textbook 2-Part 1, Part2 and Part 3 of Chapter 6

Module-4 LTE – 4G (8 hours)

Key Enablers for LTE 4G: OFDM, SC-FDE, SC-FDMA, Channel Dependent Multiuser Resource Scheduling, Multi-Antenna Techniques, Flat IP Architecture, LTE Network Architecture.
Multi-Carrier Modulation: Multicarrier concepts, OFDM Basics, OFDM in LTE, Timing and Frequency Synchronization, Peak to Average Ratio, SC-Frequency Domain Equalization, Computational Complexity Advantage of OFDM and SC-FDE. **Textbook 1: 1.4, 3.1 – 3.7**

Module-5 Optical Wireless Communication (8 hours)

Introduction: Optical Wireless Communication, Wireless Access Schemes, A Brief History of OWC, OWC/Radio Comparison, Link Configuration, OWC Application Areas, Safety and Regulations, Maximum Permissible Exposures, OWC Challenges.
Textbook 3 – 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.6.1, 1.7

Course Outcomes: At the end of the course the student will be able to	
21ECE701.1	Utilize the concepts of mobile Radio propagation and fading to model statistical and empirical channels.
21ECE701.2	Analyse the architecture of GSM and TDMA technologies to understand their functionality and design principles.

21ECE701.3	Examine the architecture of CDMA technologies and the channel concept of Layer 3 Operations.
21ECE701.4	Elaborate on LTE standardization, OFDMA, SC-FDE, and SC-FDMA techniques for wireless communication.
21ECE701.5	Explore multicarrier concepts, including OFDM basics, LTE integration, and synchronization.
21ECE701.6	Analyse optical systems: components, atmospheric signal propagation, FSO performance, and understanding VLC technology.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Fundamentals of LTE	Arunabha Ghosh, Jan Zhang, Jefferey Andrews, Riaz Mohammed	Pearson education	1st Edition, 2018
2	Introduction to Wireless Telecommunications Systems and Networks	Gary Mullet	Cengage Learning India Pvt Ltd	1st Edition, 2006
3	Optical Wireless Communications: System and Channel Modelling with MATLAB	Z. Ghassemlooy, W. Popoola, S. Rajbhandari	CRC Press	1st Edition, 2012
Reference Books				
1	Wireless Communications: Principles and Practice	Theodore Rappaport	Prentice Hall	1st Edition, 2002
2	LTE for UMTS Evolution to LTE-Advanced	Harri Holma and Antti Toskala	John Wiley & Sons, Ltd	1st Edition, 2011

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/117/102/117102062/
https://archive.nptel.ac.in/courses/108/106/106106167/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE701.1	2					1		1					1	
21ECE701.2	2	1											1	
21ECE701.3	2												1	
21ECE701.4	2					1		1					1	
21ECE701.5	3	1											1	
21ECE701.6	2	1											1	

1: Low 2: Medium 3: High

Digital Image Processing			
Course Code	**21ECE702**	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 Objectives: This course will enable students to

- Understand the fundamental concepts of digital image processing.
- Learn the techniques for enhancing images in digital image processing.
- Explore the methods and techniques for image restoration in digital image processing.
- Comprehend the basics of color image processing.
- Understand and apply morphological operations in digital image processing.

Module-1 Fundamentals of Digital Image Processing (8 hours)

Digital Image Fundamentals, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System.
Text Book: Chapter 1: Sections 1.1 to 1.5
Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.
Text Book: Chapter 2: Sections 2.1 to 2.5 and 2.6.2.

Module-2: **Image Enhancement in Spatial Domain (8 hours)**

Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.
Text Book: Chapter 3: Sections 3.1 to 3.6.

Module-3: **Image Enhancement in Frequency Domain (8 hours)**

The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. **Text Book: Chapter 4: Sections 4.5 to 4. 10**

Module-4 Image Restoration (8 hours)

Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.
Text Book: Chapter 5: Sections 5.2 to 5. 9

Module-5 Color and Morphological Image Processing (8 hours)

Color Image Processing: Color Fundamentals, Color Models, Pseudo color Image Processing.
Text Book: Chapter 6: Sections 6.1 to 6.3
Morphological Image Processing: Preliminaries, Basic Morphological Operations: Erosion, Dilation, Opening and Closing. Morphological Algorithms: Boundary extraction, region filling, skeletonization.
Text Book: Chapter 9: Sections 9.1 to 9.6.3

Course Outcomes: At the end of the course the student will be able to:	
21ECE702.1	Analyze the fundamental concepts and components involved in digital image processing and explain their significance in various application fields.
21ECE702.2	Apply spatial domain techniques to enhance digital images using intensity transformation functions, histogram processing, and spatial filters.
21ECE702.3	Analyze the process of image enhancement in the frequency domain, including the application of the Discrete Fourier Transform (DFT) and filtering techniques for image smoothing and sharpening.

21ECE702.4	Analyze various noise models and apply restoration techniques, using both spatial and frequency domain filtering methods, to restore degraded images.
21ECE702.5	Apply concepts of color image processing techniques to perform enhancements and transformations on color images.
21ECE702.6	Implement morphological image processing techniques on real-time images.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition &Year
Textbooks				
1	Digital Image Processing	Rafael C. Gonzalez & Richard E. Woods et al.	Pearson	3rd Edition, 2010
Reference Books				
1	Digital Image Processing	S Jayaraman, S Esakkirajan, T Veerakumar	Tata McGraw Hill	1st Edition, 2014
2	Fundamentals of Digital Image Processing	Anil K Jain	Pearson	1st Edition, 2004
3	Digital Image Processing with MATLAB	R.C. Gonzalez & R.E. Woods	Gatesmark	1st Edition, 2009

Web links and Video Lectures (e-Resources)	
1	NPTEL Video Lecture **Speaker: Prof Prabir Kumar Biswas** Professor Electronics and Electrical Communication Engg. IIT Khargpur Link: https://onlinecourses.nptel.ac.in/noc21_ee78/preview
2	NPTEL Video Lecture **Speaker: Prof Gaurav Harit** Associate Professor Department of Computer Science and Engineering IIT, Jodhpur **Link:** https://nptel.ac.in/courses/106/105/106105032/
3	**Course Materials:** PPTs from NEW MEXICO TECH (Science Engineering and Research University) Link: https://www.cs.nmt.edu/~ip/lectures.html

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE702.1	2	2	1									1	2	
21ECE702.2	2	2	2	1	2						1	1	2	
21ECE702.3	2	2	1	1	2						1	1	2	
21ECE702.4	2	2	1	1	2						1	1	2	
21ECE702.5	2	2	1	1	1						1	1	2	
21ECE702.6	2	2	1	1	2			1	1		1	1	2	

1: Low, 2: Medium, 3: High

Information Theory and Coding			
Course Code	**21ECE7031**	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

- Understand the concept of entropy, Rate of information, and order of the source about dependent and independent sources.
- Study various source encoding algorithms.
- Model discrete and continuous communication channels.
- Study various error control coding algorithms.

Module-1 Introduction to Information (8 hours)

Information Theory: Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model of Information Sources, Entropy and Information rate of Markoff Sources .
Textbook 1: 4.1, 4.2

Module-2 Source Coding (8 hours)

Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fano Encoding Algorithm, Source coding theorem, Huffman.
Textbook 1: 4.3, 4.3.1
Reference Book 4: 2.15
Textbook 2: 2.2

Module-3 Information Channels (8 hours)

Information Channels: Communication Channels, Discrete Communication channels Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies. Mutual Information, Channel Capacity, Channel Capacity of Binary Symmetric Channel, Binary Erasure Channel, Muroga,s Theorem.
Textbook 1: 4.4, 4.5, 4.5.1, 4.5.2
Textbook 2: 2.5, 2.6
Reference Book 4: 2.27, 2.28

Module-4 Error Control Coding (8 hours)

Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Binary Cyclic Codes: Algebraic Structure of Cyclic Codes.
Textbook 1: 9.1, 9.2, 9.3, 9.3.1, 9.3.2, 9.3.3

Module-5 Convolution Codes (8 hours)

Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm
Textbook 2: 8.5 – Articles 1,2 and 3, 8.6 - Article 1

Course Outcomes: At the end of the course the student will be able to:	
21ECE7031.1	Illustrate the fundamental parameters relevant to information theory.
21ECE7031.2	Apply source coding and decoding techniques to solve engineering problems.
21ECE7031.3	Categorize different types of channels and channel models.

21ECE7031.4	Apply various error detection and correction techniques to address communication engineering problems.
21ECE7031.5	Generate and represent cyclic codes and understand their operation.
21ECE7031.6	Develop and analyze the encoding and decoding process of convolutional codes.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Digital and analog communication systems	K. Sam Shanmugam	John Wiley & Sons	2nd Edition, 2006
2	Digital communication	Simon Haykin	John Wiley & Sons	2nd Edition, 2008
Reference Books				
1	ITC and Cryptography	Ranjan Bose	TMH	2nd Edition, 2007
2	Principles of digital communication	J. Das, S. K. Mullick, P. K. Chatterjee	Wiley	2nd Edition, 2008
3	Digital Communications Fundamentals and Applications	Bernard Sklar	Pearson Education	2nd Edition, 2016
4	Information Theory and Coding	Hari Bhat, Ganesh Rao,	Cengage India Private Limited	1st Edition, 2017
5	Error Correction Coding	Todd K Moon	Wiley	1st Edition, 2006

Web links and video Lecturers

- https://nptelvideos.com/course.php?id=555 (NPTEL)
- https://www.coursera.org/learn/information-theory (Coursera)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7031.1	1													
21ECE7031.2	2	2	2	1										
21ECE7031.3	2	2		1								1		
21ECE7031.4	1	1	2									1		
21ECE7031.5	1	1			1									
21ECE7031.6	1				1									

1: Low 2: Medium 3: High

VLSI DESIGN TOOLS			
Course Code	**21ECE7032**	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

- Understand the fundamental concepts and methodologies of VLSI design automation tools.
- Develop proficiency in data structures and algorithms relevant to VLSI design.
- Acquire skills in partitioning, placement, and floor planning algorithms for VLSI layout design.
- Master routing algorithms for local and global routing challenges in VLSI design.
- Develop expertise in modeling, simulation, and synthesis techniques for VLSI design.

Module-1 Introduction (8 hours)

Introduction to Design Methodologies: The VLSI Design Problem, The Design Domains, Design Actions, and Design Methods and Technologies.
VLSI Design Automation Tools: Algorithmic and System Design, Structural and Logic Design, Transistor-level Design, Layout Design, Verification Methods and Design Management Tools.
Textbook 1:1.1 to 1.4, 2.1 to 2.6

Module-2 Data Structures And Basic Algorithms (8 hours)

Data Structures for the Representation of Graphs, Computational Complexity, Examples of Graph Algorithms, Combinatorial Optimization Problems, Decision problems, NP-completeness and NP-hardness.
Textbook 1: 3.2 to 3.4 , 4.1,4.2, 4.4

Module-3 Algorithms For Partitioning And Placement (8 hours)

Layout Compaction: Design Rules, Symbolic Layout, Problem Formulation, Algorithms for Constraint-graph Compaction
Placement and Partitioning: Placement Algorithms and Partitioning.
Textbook 1: 6.1 to 6.4, 7.4, 7.5

Module-4 Algorithms For Floor Planning And Routing (8 hours)

Floor planning Concepts: Shape Functions and Floor plan Sizing
Routing: Types of Local Routing Problems, Channel Routing, Introduction to Global Routing and Algorithms for Global Routing
Textbook 1: 8.1, 8.2, 9.1, 9.3 to 9.5

Module-5 Modelling, Simulation And Synthesis (8 hours)

Simulation: Gate-level Modeling and Simulation and Switch-level Modeling and Simulation
Logic Synthesis and Verification: Binary-decision Diagrams and Two-level Logic Synthesis
Textbook 1: 10.2, 10.3, 11.2, 11.3

Course Outcomes: At the end of the course the student will be able to:	
21ECE7032.1	Analyze and evaluate various design methodologies and automation tools used in VLSI design, distinguishing between algorithmic, structural, transistor-level, and layout design approaches.
21ECE7032.2	Apply advanced data structures and algorithms to solve complex VLSI design problems, including graph representation, computational complexity analysis, and optimization techniques.

21ECE7032.3	Implement and evaluate partitioning and placement algorithms and applying floor planning techniques to efficiently organize chip components.
21ECE7032.4	Design and analyze routing algorithms for local and global routing problems.
21ECE7032.5	Create gate-level and switch-level models for VLSI components and simulate their behavior accurately, as well as utilize logic synthesis techniques such as binary-decision diagrams for efficient logic optimization and verification.
21ECE7032.6	Independently identifying, analyzing, and solving complex VLSI design problems using CAD tools.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Algorithms for VLSI Design Automation	Sabih H. Gerez	Wiley-India	1st Edition, 1998
Reference Books				
1	Algorithms for VLSI Physical Design Automation	Naveed A. Sherwani	Springer	3rd Edition, 2017

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/106/106/106106088/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE7032.1	2				3									
21ECE7032.2	2	1			3									
21ECE7032.3	2	1												
21ECE7032.4	2	1	2	2										
21ECE7032.5	2	1	1	2										
21ECE7032.6	2	1	1						1			1		

1: Low 2: Medium 3: High

Machine Learning			
Course Code	**21ECE7033**	CIE Marks	50
Course Type	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L: T: P)	3:0:0	SEE	03 Hours
Total Hours	40 Hours Theory	Credits	03

Course Learning Objectives: This course will enable students to:

- Understand the basics of machine learning and different types of it.
- Understand principle behind supervised and unsupervised machine learning algorithms.
- Understand principles and importance of clustering and dimensional reduction in machine learning.
- Understand advanced machine learning concepts – Deep learning, Recurrent Neural Networks and Natural Language Processing.

Module-1 Introduction to Machine Learning (8 Hours)

Introduction: Designing a Learning System, Well Posed Learning, Perspective and Issues in Machine Learning, Hypothesis Space, Inductive Bias.
Types of Machine Learning: Supervised, Unsupervised, Reinforcement Learning.
Textbook 1: 1.1, 1.2, 1.3, 2.1, 2.2, 2.7, Textbook 2: 1.2

Module-2 Supervised Learning (8 Hours)

Regression & **Classification:** Linear Regression, Logistic Regression, Polynomial Regression, Underfitting and Overfitting, Generalization, Bias and Variance, Regularization Techniques**,** Decision Tree, Bayesian Learning.
Textbook 1: 5.1, 5.2, 6.1,6.2,6.3, 8.3, Textbook 2: 2.7, 3.1, 3.2, 3.3, 3.4, 4.6, 4.8

Module-3 Unsupervised Learning (8 Hours)

Clustering: Hierarchical, k - mean Clustering, Gaussian Mixture Model
Dimensionality Reduction: Principal Component Analysis (PCA), Singular Value Decomposition (SVD), Linear Discriminant Analysis (LDA).
Textbook 1: 8.2, Textbook 2: 6.3, 6.6, 6.8, 7.2, 7.3

Module-4 Neural Network (8 Hours)

Introduction: Biological Neuron, McCulloch-Pitts neuron model, Activation Function, Perceptron Learning, Gradient Descent Rule.
Network Architecture: Feed forward and Feedback Neural Networks - Single and Multilayered Architecture, Summary of Back Propagation Algorithm.
Textbook 3: 2.2, 3.1, 3.2, 3.5, 5.9, 5.16, 6.1, 6.2

Module-5 Advanced Machine Learning Techniques (8 Hours)

Support Vector Machines: SVM Design Objectives, Linear and Nonlinear SVM
Natural Language Processing: Word Vectors, Co-occurrence Matrix
Deep Learning: Auto encoders and its applications, Convolutional Neural Network, Recurrent Neural Network.
Textbook 3 : 8.3, Textbook 4: 9.1, 9.2, 9.3, 10.2, 12.4, 14.1, 14.9

Course Outcomes: At the end of the course the student will be able to:	
21ECE7033.1	Discuss the different learning methods in machine learning.
21ECE7033.2	Apply supervised learning algorithm for machine learning applications.
21ECE7033.3	Apply the principles of clustering and dimension reduction for machine learning applications.
21ECE7033.4	Illustrate Artificial Neural Network architecture.

21ECE7033.5	Analyze advanced machine learning algorithms and their application.
21ECE7033.6	Differentiate among different types of machine learning algorithms.

Sl No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Machine Learning	Tom M Mitchell	McGraw Hill	1st Edition 2017
2	Introduction to Machine Learning	Ethem Alpaydin	PHI Learning Pvt. Ltd	3rd Edition, 2015
3	Neural Networks A Classroom Approach	Satish Kumar	McGraw Hill Education Pvt. Ltd.	2nd Edition 2020
4	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press	1st Edition, 2017
Reference Books				
1	Pattern recognition & Machine Learning	Christopher M. Bishop	Springer	1st Edition, 2009
2	Neural Network & Statistical Learning	Ke-Lin Du · M. N. S. Swamy	Springer	1st Edition, 2013
3	Machine Learning with Neural Network: An Introduction for Scientists and Engineers	Bernhard Mehlig	Cambridge University Press	1st Edition, 2021

Web links/Video Lectures/MOOCs/papers

https://archive.nptel.ac.in/courses/106/105/106105152/
https://nptel.ac.in/courses/106106139
https://nptel.ac.in/courses/106106184

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7033.1	3													
21ECE7033.2	2	3		2	2									
21ECE7033.3	3	2		1										
21ECE7033.4	2	3												
21ECE7033.5				2	3									
21ECE7033.6				2										

1: Low 2: Medium 3: High

Data Structure using C++			
Course Code	**21ECE7034**	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:

- Explain the fundamentals of data structures and their applications essential for programming.
- Analyze linear data structures: lists, stacks, and queues.
- Analyze non-linear data structures: trees.
- Assess appropriate data structure during program development/Problem-Solving.
- Apply algorithm for solving problems like sorting, searching, insertion, and deletion of data.

Module-1 (8 hours)

Introduction: Functions and Parameters, Dynamic memory allocation, and Recursion.

Linear Lists: Data objects and structures, The Linear list data structures, Array Representation, Vector Representation, Singly Linked lists and chains

Textbook 1: Chapters 1, 5, 6

Module-2 (8 hours)

Arrays And Matrices: Arrays, Matrices, Special matrices, Sparse matrices.

Stacks: The abstract data types, Array Representation, Linked Representation, Applications-Parenthesis Matching & Towers of Hanoi.

Textbook 1: Chapters 7, 8

Module-3 (8 hours)

Queues: The abstract data types, Array Representation, Linked Representation, and Applications-Railroad car arrangement.

Hashing: Dictionaries, Linear representation, Hash table representation.

Textbook 1: Chapters 9, 10

Module-4 (8 hours)

Trees: Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, ADT binary tree, and Class-linked binary tree.

Textbook 1: Chapter 11

Module-5 (8 hours)

Priority Queues: Linear lists, Heaps, Applications-Heap Sorting.

Binary Search Trees: Binary search tree operations and implementation, Binary Search trees with duplicates.

Textbook 1: Chapters 12, 14

Course Outcomes: At the end of the course the student will be able to:	
21ECE7034.1	Apply Object Oriented Programming approaches to solve the problem.
21ECE7034.2	Illustrate dynamic memory allocation and special matrices.
21ECE7034.3	Analyze the operations linear list data structure and its representation.
21ECE7034.4	Analyze the various operations of Stack and Queue.
21ECE7034.5	Illustrate the operations of non-linear binary data structure.
21ECE7034.6	Implement linked list, stacks, queues, hash tables and search trees to solve various computing problems

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Data structures, Algorithms, and applications in C++	Sartaj Sahni	Universities Press	2nd Edition 2005
Reference Books				
1	Data structures, Algorithms, and applications in C++	Sartaj Sahni	Mc. Graw Hill	1st Edition, 2000
2	Schaum's Outline of Data Structures with C++	John Hubbard, J. R. Hubbard	McGraw-Hil	2nd Edition, 2000
3	Object Oriented Programming with C++	E.Balaguruswamy	TMH	6th Edition, 2013

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/106102064
https://www.udemy.com/course/data-structures-algorithms-using-c-zero-to-mastery/
https://www.tutorialspoint.com/cplusplus/cpp_data_structures.htm
https://www.edx.org/course/data-structures-algorithms-using-c
https://www.youtube.com/user/mycodeschool

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE7034.1	1		1		3									
21ECE7034.2	1		1		3									
21ECE7034.3	1		1		3									
21ECE7034.4	1		1		3									
21ECE7034.5	1		1		3									
21ECE7034.6	1		1	1	3							2		

1: Low 2: Medium 3: High

Embedded System Design			
Course Code	**21ECE7035**	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

- Describe embedded systems and differentiate them from general computing systems.
- Explain the core components of embedded systems, including processors, ASICs, PLDs, and memory types.
- Outline essential elements of embedded firmware such as reset circuits, oscillators, and real-time clocks.
- Summarize the basics of operating systems and their relevance to embedded systems.
- Explain mechanisms for task communication and synchronization in embedded systems.

Module-1 Introduction to Embedded Systems (8 hours)

Definition of Embedded System: Embedded Systems Vs. General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems. Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off- The-Shelf Components (COTS).

Textbook 1: 1.2 to 1.6, 3.1, 3.2, 2.1

Module-2 Typical Embedded System (8 hours)

Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: On board and External Communication Interfaces.

Textbook 1: 2.2 to 2.4

Module-3 Embedded Firmware (8 hours)

Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

Textbook 1: 2.5, 2.6, 9.1, 9.2

Module-4 RTOS Based Embedded System Design (8 hours)

Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

Textbook 1: 10.1 to 10.5

Module-5 Task Communication (8 hours)

Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/ Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

Textbook 1: 10.7 to 10.10

Course Outcomes: At the end of the course the student will be able to:	
21ECE7035.1	Describe the concepts of embedded systems and distinguish them from general computing systems.
21ECE7035.2	Identify and analyze the core components of embedded systems, including processors.
21ECE7035.3	Identify and analyse the memory types, sensors, actuators, and communication interfaces.
21ECE7035.4	Develop practical skills in designing and programming embedded firmware, utilizing various development languages and design approaches.

21ECE7035.5	Demonstrate a solid understanding of operating system basics and the role of real-time operating systems in embedded system design.
21ECE7035.6	Describe task communication and synchronization mechanisms in embedded systems.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Introduction to Embedded systems	Shibu.K.V	Mc Graw Hill	9th Reprint 2022
Reference Books				
1	Embedded Systems	Rajkamal	TMH	3rd Edition 2017
2	Embedded System Design	Frank Vahid, Tony Givargis	John Wiley publication	1st Edition 2006

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/108102045

http://books.google.co.in - An embedded software premier- Volume 1- David E. Simon

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7035.1	2													
21ECE7035.2	2	2												
21ECE7035.3	2					2								
21ECE7035.4	2				3									
21ECE7035.5	2					2								
21ECE7035.6	2				3									

1: Low 2: Medium 3: High

Biomedical Signal Processing			
Course Code	**21ECE7041**	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

- Illustrate the origin and properties of biological signals.
- Describe the basic signal processing techniques in analyzing biological signals.
- Apply signal processing techniques for estimating characteristics of ECG signal.
- Apply signal processing methods to analyze the properties of EEG signal.

Module-1 Introduction to Biomedical Signals (8 hours)

Introduction to Biomedical Signals: The nature of biomedical Signals, Examples of biomedical signals, Objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, Computer-aided diagnosis. **Textbook1: 1.1-1.5**

Module-2 Signal Averaging and Data Compression Techniques (8 hours)

Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.
Data Compression Techniques: Turning point algorithm, AZTEC algorithm, Fan algorithm, Huffman coding.
Textbook 2: 9.1, 9.2, 9.3, 9.4, 9.5, 10.1, 10.2, 10.3, 10.4

Module-3 Filtering for Removal of Artifacts (8 hours)

Problem Statement: Random noise, Structured noise, and Physiological interference. **Illustration of the Problem with Case-studies:** Noise in event related potentials, High frequency noise in the ECG, Motion artifacts in the ECG, Power-line interference in ECG signals, Maternal interference in the fetal ECG.
Applications: Removal of Artifacts in the ECG, Maternal-Fetal ECG.
Textbook 1: 3.1, 3.1.1, 3.2, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.8, 3.9

Module-4 ECG QRS Detection and Analysis (8 hours)

Power Spectrum of ECG, Bandpass filtering techniques, Differentiation techniques, Template matching technique, A QRS detection algorithm.
ECG interpretation, ST-segment analyzer, Portable arrhythmia monitor, Simulation of ECG signals using MATLAB.
Textbook 2: 12.1, 12.2, 12.3, 12.4, 12.5, 13.1, 13.2,13.3

Module-5 EEG Signal Analysis (8 hours)

EEG rhythms, waves and transients, Correlation Analysis of EEG channels, Detection of EEG rhythms, Template matching for EEG spike - and - wave detection, Cross - spectral techniques, Coherence analysis of EEG channels, The matched filter: Detection of EEG spike-and wave complexes. Application: Adaptive segmentation of EEG signals, Simulation of EEG signals using MATLAB.
Textbook 1: 4.2.4, 4.4, 4.4.1, 4.4.2, 4.5, 4.5.1, 4.6, 4.6.1, 8.7

Course Outcomes: At the end of the course the student will be able to:	
21ECE7041.1	Describe the origin, properties and suitable models of important biological signals such as ECG and EEG.
21ECE7041.2	Apply the basic signal processing techniques in analyzing biomedical signals.
21ECE7041.3	Discuss different types of noise interference and removal techniques in ECG signals.

21ECE7041.4	Discuss the detection of events in ECG and apply it in the detection of QRS.
21ECE7041.5	Apply ECG signal acquisition and signal processing methods for extraction of QRS cycle.
21ECE7041.6	Apply different algorithms for the detection of EEG spike, wave and transients and analyze extracted features.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Biomedical Signal Analysis: A Case Study Approach	Rangaraj M. Rangayyan	John Wiley & Sons	1st Edition, 2011
2	Biomedical Digital Signal Processing	Willis J. Tompkins	PHI	1st Edition, 2011
Reference Books				
1	Biomedical Signal Processing: Principles and Techniques	D C Reddy	McGraw-Hill Education Pvt Limited	1st Edition, 2005

Web links and Video Lectures (e-Resources):

NPTEL Video on Biomedical Signal Processing by Prof.Sudipta Mukhopyay by IIT Kharagpur: https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-ee17/

MIT Courseware on Biomedical Signal and Image Processing: https://ocw.mit.edu/courses/hst-582j-biomedical-signal-and-image-processing-spring-2007/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7041.1	2	0	0	0	0	0	0	0	1	1	0	0	0	0
21ECE7041.2	2	1	0	0	0	0	0	0	0	1	0	0	0	0
21ECE7041.3	2	2	0	1	0	0	0	0	0	1	0	0	0	0
21ECE7041.4	2	0	0	1	1	0	0	0	0	1	0	0	0	0
21ECE7041.5	2	0	1	1	1	0	0	0	0	1	0	0	0	0
21ECE7041.6	2	0	1	1	1	0	0	0	0	1	0	0	0	0

1: Low 2: Medium 3: High

Advanced VLSI Design			
Course Code	**21ECE7042**	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

- Comprehend the impact of delays in digital circuits.
- Gain insights into power consumption and optimization techniques in VLSI design.
- Explore the design and implementation of data path subsystems in VLSI systems.
- Understand the architecture and operation of array subsystems in VLSI systems.
- Learn the principles and techniques of testing, debugging, and verification in VLSI design.

Module-1 Delays (8 hours)

Delays: Introduction, RC Delay Model and Linear Delay Model.

Textbook 1: 4.1, 4.2, 4.3

Module-2 Power (8 hours)

Powers: Introduction, Dynamic Power, Static Power , Energy-Delay Optimization and Low Power Architectures.

Textbook 1: 5.1, 5.2, 5.3, 5.4, 5.5

Module-3 Datapath Subsystems (8 hours)

Addition/Subtraction, One/Zero Detectors, Comparators, Coding, Shifters, Unsigned Array Multiplication, Two's Complement Array Multiplication, and Booth Encoding.

Textbook 1:11.2,11.3,11.4.11.7, 11.8, 11.9.1, 11.9.2, 11.9.3

Module-4 Array Subsystems (8 hours)

SRAM, DRAM, NAND ROMS, Flash, and Robust Memory.

Textbook 1: 12.2, 12.3, 12.4.2, 12.4.3, 12.7

Module-5 Testing, Debugging, and Verification (8 hours)

Logic Verification Principles, Manufacturing Test Principles, Design for Testability, Boundary Scan

Textbook 1: 15.3,15.4, 15.6, 15.7, 15.8

Course Outcomes: At the end of the course the student will be able to:	
21ECE7042.1	Differentiate between RC Delay Model and Linear Delay Model and analyze their impact on circuit performance.
21ECE7042.2	Identify and quantify dynamic and static power components, and apply energy-delay optimization techniques to minimize power consumption in digital circuits.
21ECE7042.3	Design and analyze various data path components such as addition/subtraction units, comparators, and shifters using different coding techniques, including unsigned and two's complement array multiplication.
21ECE7042.4	Describe the characteristics and functionalities of different memory technologies such as SRAM, DRAM, NAND ROMs, Flash, and Robust Memory, and analyze their suitability for specific applications.
21ECE7042.5	Apply logic verification principles, manufacturing test principles, and design for testability.
21ECE7042.6	Apply the theoretical concepts learned in the course to design, simulate, and validate VLSI systems using industry-standard design tools, enhancing their readiness for real-world applications in VLSI design and engineering.

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, David Money Harris	Addison-Wesley	4th Edition, 2015
Reference Books				
1	Digital Integrated Circuits-A Design Perspective	Jan M Rabey, Anantha Chandrakasan, Borivoje	PHI	2nd Edition, 2016
2	VLSI Test Principles and Architectures	Wang, Wu and Wen	Morgan Kaufmann	1st Edition, 2006

Web links and Video Lectures (e-Resources):

https://archive.nptel.ac.in/courses/117/101/117101004/

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECE7042.1	2		1											
21ECE7042.2	2	1	1											
21ECE7042.3	2		2											
21ECE7042.4	2		1											
21ECE7042.5	2	1	1			1		1						
21ECE7042.6	2	1			3							1		

1: Low 2: Medium 3: High

Artificial Intelligence and Deep learning			
Course Code	**21ECE7043**	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

- Understand the fundamental principles of AI and its significance in various domains.
- Gain knowledge of neural network basics and deep learning architectures.
- Develop proficiency in implementing and deploying deep learning models for real-world applications.
- Analyse and discuss ethical and societal implications of AI and deep learning

Prerequisites- Proficiency in programming, preferably Python, and a solid understanding of mathematics, particularly calculus, linear algebra, and probability theory.

Hands-on/ Simulation: Explore and visualize data trends, preprocess datasets for model readiness, build and evaluate models, tune hyperparameters, engineer features, reduce dimensionality, employ ensemble methods, utilize unsupervised learning, and deploy models for real-world applications.

Module-1 Introduction to Artificial Intelligence (8 hours)

Overview of Artificial Intelligence -Definition of AI, History and evolution, Applications and importance.
Foundations of AI- Problem-solving methods, Knowledge representation, Search algorithms- Divide and Conquer, Greedy, Branch and Bound.
(Self-study –Introduction to Machine Learning- Basic concepts and types of learning- Supervised, unsupervised, and reinforcement learning, Examples and applications). **Textbook 1: Chapter 1, 2, 3**

Module-2 Neural Network Basics (8 hours)

Introduction to Neural Networks-Biological inspiration, Neuron model
Perceptron and Multi-Layer Perceptron (MLP)-Single-layer perceptron, Activation functions, multi-layer perceptron architecture
Feedforward Neural Networks (FFN)-Structure and components, Forward pass computation, Applications. **Textbook 2: Chapter 2, 3, 4**

Module-3 Deep Learning Fundamentals & CNN (8 hours)

Backpropagation- Chain rule and gradient descent, Training neural networks, Optimization techniques and algorithms.
Convolutional Neural Networks (CNNs)- Architecture and components, Convolutional layers, Pooling layers, Applications in image processing and computer vision. **Textbook 3: Chapter 6, 8, 9**

Module-4 Recurrent Neural Networks & Representation Learning (8 hours)

Recurrent Neural Networks (RNNs)- Architecture and components, Long Short-Term Memory (LSTM) networks, Applications in sequence modelling and natural language processing.
Representation Learning- Feature learning vs. task-specific representation, Transfer learning, Unsupervised pre-training.
(Self-Study-Overview of Advanced Architectures -Autoencoders, Generative Adversarial Networks (GANs), reinforcement Learning architectures). **Textbook 3: Chapter 10,15**

Module-5 Applications and Case studies (8 hours)

Deep Learning Applications-Image classification and object detection, Natural language processing, Healthcare, finance, and other industry applications.
Ethical and Social Implications- Bias and fairness in AI, Privacy concerns, Ethical considerations in AI development and deployment, Real-world examples of AI and deep learning applications. **Reference Book 1: Chapter 5, 6, 7**

Course Outcomes: At the end of the course the student will be able to:	
21ECE7043.1	Apply foundational principles of AI to solve real-world problems.
21ECE7043.2	Design and implement neural network architectures, train them using various optimization techniques.
21ECE7043.3	Implementing neural networks and deep learning algorithms using Python and popular deep learning frameworks.
21ECE7043.4	Demonstrate the applications of various architectures in diverse domains such as computer vision, natural language processing, and reinforcement learning.
21ECE7043.5	Engage in informed discussions on AI ethics and governance.
21ECE7043.6	Evaluate model performance using appropriate metrics.

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 and Peter Norvig	Pearson	1st Edition,, 2021
2	Neural Networks and Deep Learning: A Textbook	Charu C. Aggarwal	Springer	1st Edition, 2020
3	Deep Learning	Ian Goodfellow, Yoshua Bengio, and Aaron Courville	MIT Press	1st Edition, 2016
Reference Books				
1	Deep Learning for Computer Vision	Rajalingappaa Shanmugamani	Packt	1st Edition, 2018

Web links and Video Lectures (e-Resources):

https://www.coursera.org/specializations/deep-learning
https://www.youtube.com/playlist?list=PLZHQObOWTQDNU6R1_67000Dx_ZCJB-3pi
https://www.youtube.com/watch?v=XCPZBD9lbVo&list=PLbMVogVj5nJQu5qw m- HmJgjmeGhsErvXD
https://www.kaggle.com/code/kanncaa1/deep-learning-tutorial-for-beginners
https://www.kaggle.com/datasets
https://www.kaggle.com/c/house-prices-advanced-regression-techniques/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7043.1	3													
21ECE7043.2	2	2	2		2									
21ECE7043.3	3				3									
21ECE7043.4	2	2	3		2									
21ECE7043.5	2	3						3						
21ECE7043.6	2				3									

1: Low 2: Medium 3: High

DATABASE MANAGEMENT SYSTEM			
Course Code	**21ECE7044**	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

- Provide a strong foundation in database concepts, technology, and practice.
- Practice SQL programming through a variety of database problems.
- Demonstrate the use of concurrency and transactions in the database.
- Design and build database applications for real world problems.
- Develop applications to interact with databases.

Module-1 Introduction to Databases (8 hours)

Introduction to Databases: Introduction, Characteristics of database approach, Actors on the scene, Workers behind the scene, Advantages of using the DBMS approach.
Database Concepts and Architectures: Data Models, Schemas and Instances, Three schema architecture and data independence, database languages and interfaces, DBMS Component modules
Data Model: Main phases of a Database Design Process, Entity Types, Entity Sets, Attributes, Keys, Relationship Types, Sets, Roles and Structural Constraints, ER diagram Notations and examples.
Text book1: 1.1, 1.3 to 1.6, 2.1 to 2.4.1, 3.1, 3.3.1, 3.3.2, 3.4, 3.7

Module-2 Relational Model (8 hours)

Relational Model: Relational Model Concepts, Relational Model Constraints and Relational Database schemas, Update Operations, Transactions and Dealing with Constraint violations.
SQL: SQL data definition and data types, Specifying Constraints in SQL, Basic Retrieval Queries in SQL, INSERT, DELETE, and UPDATE statements in SQL, More Complex SQL Retrieval Queries, Specifying Constraints as Assertions and Triggers, Views in SQL, Schema Change Statements in SQL
Textbook 1: 5.1 to 5.3, 6.1 to 6.4, 7.1 to 7.4

Module-3 SQL and JDBC (8 hours)

Relational Algebra & Design: Unary relational operations, Relational Algebra Operations, Binary Relational Operations, Additional Relational Operations, Examples of Queries in Relational Algebra
Database Application Development: Embedded SQL, Dynamic SQL, SQLJ, Database Programming with Function calls: SQL and JDBC, Database Stored Procedures. **Textbook 1: 8.1 to 8.5, 10.2 to 10.4**

Module-4 Normalization and its Algorithms (8 hours)

Normalization and its Algorithms: Informal design guidelines for relation schema, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form, Multivalued Dependency and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Nulls, Dangling Tuples, and Alternative Relational Designs
Textbook 1: 14.1 to 14.7, 15.4

Module-5 Transaction Processing & Database Recovery (8 hours)

Transaction Processing: Introduction to Transaction Processing, Transaction and System concepts, Desirable properties of Transactions, Characterizing schedules based on recoverability, Characterizing schedules based on Serializability, Two-phase locking techniques for Concurrency control
Database Security: Database security issues-Types of security and control measures, SQL Injection, Challenges to Maintaining Database Security. **Textbook 1:20.1 to 20.5, 21.1, 30.1.1,30.1.2, 30.4, 30.9**

Course Outcomes: At the end of the course the student will be able to:	
21ECE7044.1	Identify various elements of Database Management Systems and to draw an Entity Relationship diagram.
21ECE7044.2	Apply relational database schema for the given application and develop queries in relational algebraic expressions.

21ECE7044.3	Implement basic and complex queries using SQL to retrieve the required information from database.
21ECE7044.4	Apply normalization steps in database design using the design guidelines and functional dependencies
21ECE7044.5	Analyse the issues associated with Transaction Processing and relate the concept of query optimization.
21ECE7044.6	Design and develop a database application system using advanced SQL tools.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Fundamentals of Database Systems	Ramez Elmasri, Shamkant B. Navathe	Pearson	7th Edition 2017
Reference Books				
1	Database System Concepts	Abraham Silberschatz, Henry F. Korth and S. Sudharshan	McGraw Hill	6th Edition 2011
2	Database management systems	Raghu Ramakrishnan, Johannes Gehrke	McGraw Hill	3rd Edition 2014
3	Database Principles: Fundamentals of Design, Implementation and Management	Carlos Coronel, Peter Rob, and Steven Morris	Cengage Learning	9th Edition 2012

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/106/106/106106095/
https://nptel.ac.in/courses/106/106/106106220/
https://www.tutorialspoint.com/dbms/
https://www.w3schools.com/sql/
https://www.codecademy.com/learn/learn-sql
https://www.geeksforgeeks.org/dbms/

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7044.1	1	2			1									
21ECE7044.2	1		3		1									
21ECE7044.3	1		1		2									
21ECE7044.4	1	2	3		1									
21ECE7044.5	1		1	2	1									
21ECE7044.6	1		1	2	2	2			2	1				

: Low 2: Medium 3: High

IoT & Wireless Sensor Networks			
Course Code	**21ECE7045**	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

- Understand the fundamentals of IoT and its communication techniques.
  Understand the recent application domains of IoT in everyday life.
- To impart necessary and practical knowledge of components of Internet of Things
- To develop skills required to build real-life IoT based projects.
- To study the features and protocols of wireless sensor networks

Module-1 Overview of Internet of Things (8 hours)

IoT Conceptual Framework, IoT Architectural View, Technology Behind IoT, Sources of IoT,M2M communication, Examples of IoT. Modified OSI Model for the IoT/M2M Systems, data enrichment, data consolidation and device management at IoT/M2M Gateway, web communication protocols used by connected IoT/M2M devices, Message communication protocols (CoAP-SMS, CoAPMQ, MQTT,XMPP) for IoT/M2M devices.

Textbook 1:Chapters 1,2

Module-2 Architecture and Design Principles for IoT (8 hours)

Internet connectivity, Internet-based communication, IPv4, IPv6,6LoWPAN protocol, IP Addressing in the IoT, Application layer protocols: HTTP, HTTPS, FTP, TELNET and ports. Data Collection, Storage and Computing using a Cloud Platform: Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud- based data collection, storage and computing services using Nimbits.

Textbook 1: Chapters 4, 6

Module-3 Prototyping and Designing Software for IoT Applications (8 hours)

Introduction, Prototyping Embedded device software, Programming Embedded Device Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. Programming MQTT clients and MQTT server.

Textbook 1: Chapter 9

Module-4 Overview of Wireless Sensor Networks (8 hours)

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. Architectures: Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture-Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts.

Textbook 2: 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 3.5

Module-5 Communication Protocols (8 hours)

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols (CSMA,PAMAS), Schedule based protocols (LEACH, SMACS, TRAMA) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering.

Textbook 2: 4.3, 5.1.3, 5.2.2, 5.2.3, 5.2.4, 5.3.1, 5.3.2, 5.4

Textbook 2:7.2, 7.3, 11.3, 11.5

Course Outcomes: At the end of the course the student will be able to:	
21ECE7045.1	Describe the OSI Model for the IoT/M2M Systems.

21ECE7045.2	Outline the architecture and design principles for IoT.
21ECE7045.3	Compile the program for IoT Applications.
21ECE7045.4	Describe the prototyping of programs for embedded devices and analyze the issues of data privacy, security, vulnerability solutions.
21ECE7045.5	Illustrate the overview of wireless sensor networks and architecture, design principles of WSN.
21ECE7045.6	Evaluate the functioning of medium access and routing protocols of WSN.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Internet of Things- Architecture and design principles	Raj Kamal	McGraw Hill Education	1st Edition, 2017
2	Protocols And Architectures for Wireless Sensor Networks	Holger Karl & Andreas Willig	John Wiley	1st Edition, 2005
Reference Books				
1	Wireless Sensor Networks- An Information Processing Approach	Feng Zhao & Leonidas J. Guibas	Elsevier	1st Edition, 2007
2	Wireless Sensor Networks- Technology, Protocols and Applications	Kazem Sohraby, Daniel Minoli & TaiebZnati	John Wiley	1st Edition, 2007

Web links and Video Lectures (e-Resources):

Introduction to Internet of Things - Course (nptel.ac.in)

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7045.1	3	3	2											
21ECE7045.2		3	3	2		3								
21ECE7045.3		3	2	2										
21ECE7045.4	3	3	3		2									
21ECE7045.5		3	3	3										
21ECE7045.6		3	3											

1: Low 2: Medium 3: High

Internet of Things (IoT)			
Course Code	**21ECE7051**	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

- Understand the fundamentals of IoT and its building blocks along with their characteristics
- Understand the recent application domains of IoT in everyday life
- Gain insights about the current trends of associated IoT technologies and IoT analytics.
- Apply the knowledge to solve real time problems
- Make use of the IoT concepts for innovative ideas

Module-1 (8 hours)

Predecessors of IoT: Introduction, Wireless Sensor Networks, Machine-to-Machine Communications.
Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT.
Textbook 1: Chapter 3(3.1 - 3.4), Chapter 4(4.1 - 4.5)

Module-2 (8 hours)

IoT Sensing and Actuation:Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics
Textbook 1: Chapter 5(5.1 - 5.9)

Module-3 (8 hours)

IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Thread, WirelessHART, RFID , NFC, DASH7 ,Z-Wave, LoRa, NB-IoT, Wi-Fi, Bluetooth.
Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service.
Textbook 1: Chapters 7(7.1 - 7.16), Chapter 10(10.1 - 10.6)

Module-4 (8 hours)

IoT Case studies & Future trends: Agricultural IoT, Vehicular IoT, Healthcare IoT.
Textbook 1: Chapters 12(12.1 - 12.2), Chapter 13(13.1), Chapter 14(14.1 - 14.2)

Module-5 (8 hours)

IoT Hands-ON: Beginning IoT Hardware Projects: Introduction to Arduino Boards, Writing an Arduino Sketch, Hands-on Experiments with Arduino, Introduction to Raspberry Pi Boards, Hands-on Experiments with Raspberry Pi.
Textbook 1: Chapter 16(16.1 - 16.5)

Course Outcomes: At the end of the course the student will be able to:	
21EC7051.1	Describe the evolution of IoT, IoT networking components and addressing strategies in IoT.
21EC7051.2	Classify various sensing devices and actuator types.
21EC7051.3	Analyze various communication technologies & cloud computing technologies.
21EC7051.4	Identify, formulate and solve engineering problems by using Industrial IoT.
21EC7051.5	Illustrate the architecture of IoT applications.
21EC7051.6	Implement real field problem by gained knowledge of Industrial applications with IoT analytics.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Introduction to IoT	Sudip Misra, Anandarup Mukherjee & Arijit Roy	Cambridge University Press	1st Edition 2021
Reference Books				
1	Internet of Things- A Hands-On Approach	Arshdeep Bahga, Vijay Madisetti	Universities Press	1st Edition 2015
2	Internet of Things- Architecture and Design Principles	Raj Kamal	McGraw Hill Education	1st Edition 2017
3	Designing the Internet Of Things	Adrian McEwen, Hakim Cassimally	John Wiley and Sons, Ltd	1st Edition 2014

Web links and Video Lectures (e-Resources):

Introduction to Internet of Things - Course (nptel.ac.in)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7051.1	2	2	2			2								
21ECE7051.2	2													
21ECE7051.3	2	2	2	2										
21ECE7051.4		2	2	2										
21ECE7051.5		3			3	3								
21ECE7051.6		3					3		3			3		

1: Low 2: Medium 3: High

Sensors and Signal Conditioning			
Course Code	**21ECE7052**	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

- Provide the fundamental knowledge of basic sensors.
- Acquire knowledge about types of sensors used in modern digital systems.
- Get acquainted about material properties required to make sensors.
- Understand the operations of Signal Conditioning and Data Acquisition System.

Module-1 Introduction to Sensors and Restive Sensors (8 hours)

General concepts and terminology, sensor classification, primary sensors, material for sensors, microsensor technology, Thermistors, Magneto resistors, Light dependent resistors, Resistive hygrometers, Resistive gas sensors.
Text Book 1: 1.1, 1.2, 1.7, 1.8, 1.9, 2.4, 2.5, 2.6, 2.7, 2.8

Module-2 Self Generating Sensors (8 hours)

Thermoelectric sensors, Piezoelectric sensors, Pyroelectric sensors, Photovoltaic sensors
Text Book 1: 6.1, 6.2, 6.3, 6.4

Module-3 Digital and Intelligent Sensors (8 hours)

Resonant sensors, Sensors based on quartz resonators, SAW sensors, Vibrating wire strain gages, Vibrating cylinder sensors, Digital flow meters
Text Book 1: 8.2, 8.2.1, 8.2.2, 8.2.3, 8.2.4, 8.2.5

Module-4 Signal Conditioning (8 hours)

Introduction, Operational Amplifier, Basic Instrumentation Amplifier, Instrumentation Amplifier, Applications of Instrumentation Amplifiers (Specific Bridge)
Text Book 2: 14.1, 14.2, 14.3, 14.4

Module-5 Data Acquisition and Data Transmission System (8 hours)

Introduction, Objective of a DAS, Signal Conditioning of the Inputs, Single Channel Data Acquisition System, Multi-Channel DAS, Computer Based DAS, Data Loggers
Data Transmission, Introduction, Data Transmission Systems, Advantages and Disadvantages of **Digital Transmission Over Analog.**
Text Book 2: 17.1, 17.2, 17.3, 17.4, 17.5, 17.6, 17.8, 18.1, 18.2, 18.3

Course Outcomes: At the end of the course the student will be able to:	
21ECE7052.1	Distinguish various types of resistive sensors and their construction.
21ECE7052.2	Illustrate various types of self-generating sensors and their construction.
21ECE7052.3	Interpret the modern and intelligent sensors.
21ECE7052.4	Discuss the working of Operational Amplifier based signal conditioning systems.
21ECE7052.5	Outline the working of data transmission systems and distinguish between analog and digital transmission.
21ECE7052.6	Illustrate the use of appropriate circuits for signal conditioning of DAS.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Sensors and Signal Conditioning	Ramon Pallás Areny, John G. Webster	John Wiley and Sons	2nd Edition 2000
2	Electronic Instrumentation	H. S. Kalsi	Tata McGraw Hill Education Pvt. Ltd.	3rd Edition 2010
Reference Books				
1	Sensors and Transducers	D. Patranabis	PHI Learning Pvt Ltd	2nd Edition 2013
2	Electrical & Electronic Measurements & Instrumentation	A. K. Sawhney	Dhanpat Rai & Co. Pvt. Ltd	17th Edition 2004

Web links and Video Lectures (e-Resources):

https://nptel.ac.in/courses/108105064

https://www.youtube.com/watch?v=3eYmFjHnQjY&list=PLbRMhDVUMngcoKrA4s H- zvbNVSE6IpEio

https://www.youtube.com/watch?v=NuQqDFkhIlU&list=PLC7B26029C4E955FA

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7052.1	2	2	1			2	2		2	2				
21ECE7052.2	2	2	1			2	2		2	2				
21ECE7052.3	2	2	1			2	2		2	2				
21ECE7052.4	2	2	1	1										
21ECE7052.5	2	2	1	1										
21ECE7052.6	2	2	1	1										

1: Low 2: Medium 3: High

Real Time Systems			
Course Code	**21ECE7053**	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

- Discuss the historical background of Real-time systems and its classifications.
- Describe the concepts of computer control and hardware components for Real-Time Application
- Discuss the languages to develop software for Real-Time Applications.
- Discuss the importance of Linux in embedded systems and its relevance in various industries.
- Acquire practical skills in obtaining and customizing the Linux kernel for embedded applications.
- Explain the concepts of operating system and RTS development methodologies.

Module-1 Introduction to Real-Time Systems(8 hours)

Introduction to Real-Time Systems: Historical background, Elements of a Computer Control System, RTS- Definition, Classification of Real-time Systems, Time Constraints, Classification of Programs.

Concepts of Computer Control: Introduction, Sequence Control, Loop Control, Supervisory Control, Centralized Computer Control.

Textbook 1:1.1 to 1.6, 2.1 to 2.5

Module-2 Computer Hardware Requirements for Real-Time Applications(8 hours)

Computer Hardware Requirements for Real-Time Applications: Introduction, General Purpose Computer, Single Chip Microcomputers and Microcontrollers, Specialized Processors, Process-Related Interfaces, Data Transfer Techniques, Communications, Standard Interface.

Textbook 1: 3.1 to 3.8

Module-3 Languages for Real-Time Applications(8 hours)

Languages for Real-Time Applications: Introduction, Syntax Layout and Readability, Declaration and Initialization of Variables and Constants, Modularity and Variables, Compilation of Modular Programs, Data types, Control Structures, Exception Handling, Low-level facilities, Co-routines, Interrupts and Device Handling, Concurrency, Real-Time Support, Overview of Real-Time Languages.

Textbook 1:5.1 to 5.14

Module-4: **Linux Operating Systems (8 hours)**

Introduction: Why Linux, Embedded Linux Today, Standards and Relevant.
(Text2: Chapter 1.1 to 1.5)
Anatomy of an Embedded System, Storage Considerations, Embedded Linux Distributions.
(Text2: Chapter 2.1 to 2.4)
The Linux Kernel-A Different Perspective: Background, Linux Kernel Construction, Kernel Build System, Obtaining a Linux Kernel.

Textbook 2: 4.1 to 4.4

Module-5 RTS Design and Development Methodologies (8 hours)

Design of RTS – General Introduction: Introduction, Specification Document, Preliminary Design, Single Program Approach, Foreground/Background System.
(Text 1: Chapter 7.1 to 7.5)
RTS Development Methodologies: Introduction, Yourdon Methodology, Ward and Mellor Method, Hately and Pirbhai Method.

Textbook 1: 8.1, 8.2, 8.4,8.5

Course Outcomes: At the end of the course the student will be able to:	
21ECE7053.1	Interpret the fundamentals of Real time systems and its classifications
21ECE7053.2	Apply the concepts of computer control, operating system and the suitable computer hardware requirements for real-time applications
21ECE7053.3	Develop the software languages to meet Real time applications
21ECE7053.4	Discuss the embedded Linux concepts, including its architecture, components, and storage considerations
21ECE7053.5	Demonstrate proficiency in working with embedded Linux distributions, development tools, and kernel customization
21ECE7053.6	Apply structured approaches to the design and development of real-time applications

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	Real Time Computer Control	Stuart Bennett	Pearson Education	2nd Edition 2008
2	Embedded Linux Primer- A practical Real –World Approach	Christopher Hallinan	Pearson Education	1st Edition 2008
Reference Books				
1	Real Time Systems	Jane W.S. Liu	Pearson	1st Edition 2000
2	Real Time Systems	C.M. Krishna, Kang G Shin	McGraw-Hill International Editions	1st Edition 2017

Web links and Video Lectures (e-Resources):

Introduction to Real time Systems: https://www.youtube.com/watch?v=BxYwjdrdnQg&t=360s
Real time systems: http://nptel.vtu.ac.in/econtent/courses/NPTEL/CSE/106105036/index.php

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7053.1	1		1											
21ECE7053.2		1	2											
21ECE7053.3	1	1			2					1				
21ECE7053.4		2	1											
21ECE7053.5	1		2											
21ECE7053.6	1		2		2							1		

1: Low 2: Medium 3: High

Cyber Security			
Course Code	**21ECE7054**	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

- To familiarize cybercrime terminologies and perspectives.
- Understand the fundamentals of cybercrime and forensics and assess the security policies of organizations.
- Demonstrate and investigate the use of tools used in digital forensics for investigations.
- Analyse the different types of forensics and describe its legal challenges.
- Investigate both criminal and civil matters using evolving digital technology.

Module-1 Introduction to Cybercrime (8 hours)

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals? Classifications of Cyber Crimes
Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens.
Textbook 1: 1.1 to 1.5, 1.7-1.9

Module-2 Cyber offenses Cybercrime (8 hours)

Cyber offenses: Categories of cybercrime: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices.
Textbook 1: 2.1 to 2.7, 3.1 to 3.6

Module-3 Tools and Methods used in Cybercrime (8 hours)

Tools and Methods used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Key Loggers and Spyware, Virus and Worms, Trojan Horses and Backdoors, DoS and DDOS Attacks, Attacks on Wireless networks.
Textbook 1:4.1 to 4.7, 4.9, 4.12

Module-4 Digital Forensics (8 hours)

Computer Forensics: Introduction, Historical Background of Cyber Forensics, Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Digital Forensic Life cycle, Chain of Custody Concepts, Challenges in Computer Forensics.
Textbook 1: 7.1. to 7.5, 7.7 ,7.8, 7.16

Module-5 Forensics of Handheld Devices (8 hours)

Introduction, Understanding Cell Phone working Characteristics, Hand held device and Digital forensics, Toolkits for Hand-Held device Forensics
Textbook 1: 8.1, 8.2, 8.3.1 to 8.3.5, 8.4

Course Outcomes: At the end of the course the student will be able to:	
21ECE7054.1	Illustrate the legal perspectives and frameworks related to cybercrime, including relevant laws, regulations, and enforcement mechanisms.
21ECE7054.2	Discuss the proliferation of mobile and wireless devices and the associated trends in mobility.

21ECE7054.3	Evaluate the vulnerabilities and security challenges associated with wireless networks, and the potential attack vectors that cybercriminals may exploit.
21ECE7054.4	Identify the challenges and limitations associated with computer forensics
21ECE7054.5	Analyse the working characteristics and internal components of cell phones and other hand-held devices.
21ECE7054.6	Apply necessity and relevance of computer forensics in modern digital investigations.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives	Sunit Belapure and Nina Godbole	Wiley India Pvt Ltd	1st Edition (Reprinted 2018)
Reference Books				
1	Cybersecurity: Managing Systems, Conducting Testing, and Investigating Intrusions	Thomas J. Mowbray	John Wiley & Sons	1st Edition 2014
2	Principles of Information Security	Michael E. Whitman, Herbert J. Mattord	Cengage Learning Pub	2nd Edition 2012

Web links and Video Lectures (e-Resources):
https://www.youtube.com/watch?v=nzZkKoREEGo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7054.1	2			2										
21ECE7054.2	2			2										
21ECE7054.3	2			2										
21ECE7054.4	2			2										
21ECE7054.5	2			3										
21ECE7054.6	2			3										

1: Low 2: Medium 3: High

ARM EMBEDDED SYSTEMS			
Course Code	**21ECE7055**	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

- Analyze the significance and diverse applications of ARM Design.
- Comprehend the architecture of the ARM processor.
- Apply the instruction sets of the ARM processor.
- Analyze the adaptation of C code, firmware, OS, Interrupts, caches, etc. in ARM embedded systems.

Module-1 Embedded Systems (8 hours)

ARM Embedded Systems

Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals.

ARM Processor Fundamentals

ARM core dataflow model, registers, current program status register, Pipeline, Exceptions.

Textbook 1: 1.1 to 1.4, 2.1 to 2.4

Module-2 ARM Instruction Set (8 hours)

Introduction to the ARM Instruction set

Introduction, Data processing instructions, Load - Store instruction, Program status register instructions, Loading constants, Conditional Execution. ALP programming.

Textbook 1: 3.1 to 3.3, 3.5, 3.6, 3.8

Module-3 THUMB Instruction Set (8 hours)

Introduction to the THUMB instruction set

Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, ALP programming.

Textbook 1: 4.1 to 4.7

Module-4 C Programming (8 hours)

Efficient C Programming: Overview of C Compilers and optimization, Basic C data types, C Looping Structures, Register Allocation, Function Calls, Pointer Aliasing, Local Variable Types, Portability issues, Structure Arrangement, Bit Fields, Unaligned Data and Endianness, Division, Floating Point Inline Functions and Inline Assembly, Portability Issues.

Textbook 1: 5.1 to 5.13

Module-5 Embedded Operating Systems (8 hours)

Embedded Operating Systems: Fundamental Components.

Caches: The memory Hierarchy and caches memory-caches and memory management units, Cache architecture basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.

Textbook 1: 11.1, 11.2, 12.1 to 12.7

Course Outcomes: At the end of the course the student will be able to:	
21ECE7055.1	Depict the organization, architecture, bus technology, memory and operation of the ARM processors.
21ECE7055.2	Employ the knowledge of the Instruction set of ARM processors to develop basic Assembly Language Programs.
21ECE7055.3	Analyze the importance of the Thumb mode of operation of ARM processors

21ECE7055.4	Describe the techniques involved in writing C code for ARM processors and Exceptions.
21ECE7055.5	Describe the importance and use of Firmware, OS and Cache in ARM Embedded Systems.
21ECE7055.6	Illustrate the organization, architecture, bus technology, memory and operation of the ARM processors.

Sl. No.	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
Textbooks				
1	ARM System Developer's Guide	Andrew N Sloss, Dominic System and Chris Wright	Elsevier, Morgan Kaufman Publisher	1st Edition, 2008
Reference Books				
1	ARM System on chip Architecture	Furber S, Addison Wiley	Oxford University Press	2nd Edition, 2008
2	Embedded System	Rajkamal	Tata McGraw-Hill Publishers	2nd Edition, 2008

Web links and Video Lectures (e-Resources):

Embedded System Design With ARM: https://nptel.ac.in/courses/106105193

Embedded Software and Hardware Architecture.: https://www.coursera.org/lecture/embedded-https://tinyurl.com/Arm-embedded

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECE7055.1	2	2							2					
21ECE7055.2	2	2		3					2	2				
21ECE7055.3	2	2		2					2	2				
21ECE7055.4	2	2		2					2	3				
21ECE7055.5	2	2		3					2	3				
21ECE7055.6	2	1							2	3				

1: Low 2: Medium 3: High

Technical Seminar			
Course Code	**21ECS706**	CIE Marks	100
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	-
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:2)	SEE	-
Total Hours	20 hours	Credits	01

Course Learning Objectives:

1. To equip students with the ability to conduct in-depth research, analyze technical literature, and explore contemporary advancements in their field of study.
2. To effectively organize, design, and deliver technical presentations that convey complex information clearly to a diverse audience.
3. To encourage students to critically analyse and evaluate emerging trends, technologies, or methodologies relevant to their chosen seminar topic.
4. To enable students to improve their written and oral communication by preparing well-structured seminar reports and articulating ideas confidently during presentations.
5. To stimulate independent learning and problem-solving abilities by allowing students to explore specific topics of interest, enhancing self-directed research and learning.
6. To prepare students to effectively discuss and defend their technical knowledge in a professional setting, such as viva-voce, aligning with future industry or academic pursuits.

1. Selection of Technical Seminar Topic

- Students should select a technical topic related to their field of study, preferably focusing on recent advancements or emerging technologies. Inter-disciplinary/Multi-disciplinary topics are appreciated.
- Topics must be approved by the seminar coordinator within the first few weeks of the semester.

2 Research and Preparation

- Extensive research should be carried out using credible sources such as research papers, technical journals, books, and online databases.
- A minimum of 10-20 references is recommended, ensuring a mix of primary and secondary sources.

3. Seminar Report

- A detailed report (approximately 20-30 pages) must be prepared, summarizing the research findings and organized in a structured manner.
- The report should include sections like introduction, literature review, methodology, results, discussion, conclusion, and references.
- The report should follow a standard format as prescribed by the Department (font, spacing, citation style, etc.).

4. Oral Presentation

- Students must deliver an oral presentation lasting 15-20 minutes, followed by a question-and-answer session.
- Presentations should be well-structured, with appropriate use of visuals (slides, graphs, diagrams) to clearly convey technical content.
- All presentations must be conducted on scheduled dates, and attendance is mandatory for both presenters and all other students.

5. Question and Answer Session

- After the presentation, students will face a viva-voce where they are required to answer questions posed by the Departmental Seminar Evaluation Committee regarding their seminar topic.
- The viva will test the student's depth of understanding, research analysis, and ability to think critically about the subject matter.

6. Evaluation Criteria
• Seminar Report: Clarity, technical depth, comprehensiveness, quality of research, organization, and adherence to format (50 marks). • Oral Presentation: Communication skills, visual aids, clarity of content, timing, etc. (25 marks). • Viva-Voce: Ability to answer questions effectively, depth of understanding, and analytical skills (25 marks).
7. Submission Deadlines
• The report should be submitted at least one week prior to the scheduled presentation date. • Late submissions will be penalized as per department rules.
8. Plagiarism Check
• All seminar reports must be subjected to plagiarism checking, and the similarity index should be within acceptable limits specified by the Department. • Instances of plagiarism will result in penalties, which could include rejection of the report or a reduction in marks.
9. Mentorship and Feedback
• Students are required to consult with their faculty mentors regularly throughout the preparation phase to seek guidance and feedback. • At least three mentorship meetings should be recorded before the final presentation.
10. Attendance
• Students must attend all seminar sessions conducted by their peers, as it promotes collaborative learning and constructive feedback. • Attendance could be considered for internal evaluation.

Course Outcomes: At the end of the course the student will be able to :	
21ECS706.1	Demonstrate a thorough understanding of a specialized topic by conducting extensive research and presenting technical content effectively.
21ECS706.2	Exhibit proficiency in delivering well-organized and visually supported oral presentations, clearly articulating complex technical ideas to an audience.
21ECS706.3	Apply critical thinking and research methodologies to explore, analyze, and synthesize information from various sources, leading to sound conclusions.
21ECS706.4	Prepare a detailed and well-structured seminar report that adheres to technical writing standards, showcasing the ability to document research findings comprehensively.
21ECS706.5	Respond confidently and competently to questions during the viva-voce, defending the technical work and demonstrating an in-depth understanding of the topic.
21ECS706.6	Engage actively in peer seminars, providing constructive feedback, and reflecting on insights gained from discussions with fellow students and faculty.

Useful Links:
• **https://homes.cs.washington.edu/~mernst/advice/giving-talk.html** (How to give a technical presentation) • **https://learnerbits.com/essential-tips-for-engineering-presentations** • **https://onlinecourses.nptel.ac.in/noc24_hs175/preview** (Technical English for Engineers)

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECS706.1	-	1	-	3	-	-	-	-	-	2	-	-	-	-
21ECS706.2	-	-	-	-	2	-	-	-	-	3	-	1	-	-
21ECS706.3	-	2	-	3	-	-	-	-	-	-	-	-	-	-
21ECS706.4	-	-	-	-	-	1	-	2	-	3	-	-	-	-
21ECS706.5	-	-	-	-	-	-	-	-	-	3	-	-	-	-
21ECS706.6	-	-	-	-	-	1	-	-	-	3	-	2	-	-

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21ECP707**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(0:0:6)	SEE	3 Hrs
Total Hours	60 hours	Credits	05

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Selection

- **Relevance**: Projects should align with the students' specialization and current industry trends.
- **Innovation**: Projects that offer innovative solutions to existing problems or explore new ideas are encouraged.
- **Feasibility**: The project should be achievable within the given timeframe and resources.
- **Team Composition**: Students can work in teams, typically comprising maximum 4 members.

2. Project Proposal

- **Submission**: Students must submit a detailed project proposal (project synopsis) outlining the problem statement, objectives, methodology, expected outcomes, and a work plan.
- **Approval**: The proposal should be reviewed and approved by the Department Project Evaluation Committee (DPEC).

3. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

4. Mid-term Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

5. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

6. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.

- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

7. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the final report, presentation, and the ability to answer questions.

8. Plagiarism Check

- **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources.
- **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).

9. Mentorship and Feedback

- **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback.
- **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.

10. Post Submission

- **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field.
- **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Project Synopsis Evaluation (Phase I)	Beginning of the 7th Semester	10 marks
2. Project Progress Evaluation	Middle of the 7th Semester	20 marks
3. Project Report Evaluation (Phase II)	End of the 7th Semester	20 marks
Semester End Examinations (SEE)		
4. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		
• When all the Project Objectives are met and the Project Work is successfully completed and final Project Report is submitted as reported by the Department Project Evaluation Committee (DPEC), the CIE and SEE performance of the 7th semester will be carried forward to the 8th semester. There will not be any separate CIE and SEE for such project batches in the 8th semester.		

- In case of any Project Objectives not met, Project Work not completed or final Project Report not submitted, as reported by the DPEC, the CIE and SEE will be conducted in the 7th semester for the completed portion of the Project Work. In such cases, the submission of the Draft Copy of the Project Report is mandatory for evaluation. The remaining part of the project shall be completed during the 8th semester and there will be a CIE and SEE for the Project Work in the 8th semester.

Students are advised to complete the Project Work during the 7th semester and devote the 8th semester for Industry Internship/Research Internship.

Course Outcomes: At the end of the course the student will be able to :	
21ECP707.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21ECP707.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21ECP707.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21ECP707.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21ECP707.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21ECP707.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21ECP707.1	**2**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21ECP707.2	**-**	**-**	**3**	**-**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21ECP707.3	**1**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21ECP707.4	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**
21ECP707.5	**-**	**-**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
21ECP707.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**

1: Low 2: Medium 3: High

VIII Semester

Massive Open Online Course (MOOC)			
Course Code	**21AEC801**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Theory	SEE Marks	50
		Total Marks	100
Teaching Hours/Week (L:T:P)	(2:0:0)	SEE	3 Hrs
Total Hours	20 hours	Credits	02

Course Learning Objectives:

1. Enable students to acquire a strong foundation in core engineering subjects through high-quality, accessible online resources.
2. Facilitate skill development in specific engineering domains using practical exercises, simulations, and projects offered through the MOOC platform.
3. Encourage students to develop autonomy in learning by navigating and managing their course content, assignments, and assessments independently.
4. Expose students to interdisciplinary concepts and applications, fostering an understanding of how engineering principles integrate with other fields.
5. Provide exposure to global best practices and trends in engineering, allowing students to learn from international faculty and peer collaboration.
6. Develop essential soft skills by participating in discussion forums, group projects, and peer assessments, enhancing communication and teamwork skills.

1. Selection of MOOCs

1.1 Accredited Platforms: Students shall select MOOCs from accredited platforms such as Coursera, edX, SWAYAM/NPTEL, Udacity, or any online learning platform recognized by the respective Engineering Department / Board of Studies (BoS). Engineering Departments with the approval of BoS shall publish a list of MOOCs courses in the beginning of every semester.

1.2 Prerequisites: Students shall ensure that he/she has completed any foundational courses or prerequisites required for the chosen MOOCs.

1.3 Relevant Courses: Students shall choose courses that are relevant to the Student's Engineering discipline and career goals. Students shall NOT opt for the course which is part of their curriculum (I to VIII semester B.E program) and Honors Degree/Minor Degree courses. In case of any overlapping in the contents of the MOOC Course with that in the curriculum or other courses, the maximum permitted overlapping in the course contents (syllabus) is 20-25%.

1.4 Credit Value: Students shall ensure that the selected MOOCs collectively account for 2 credits. Typically, a 2-credit MOOC will require around 20-25 hours of study and a 1-credit MOOC will require 10-12 hours of study.

1.5 Duration of Course: A 4-weeks MOOCs is eligible for 1-credit. Students are advised to enrol for one 8-weeks MOOCs course to earn 2 credits. However, Students can also take two 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied.

2. Approval Process

2.1 Pre-Approval: Students must seek pre-approval from the Department MOOCs Coordinator before enrolling in MOOCs.

2.2 Submission of Proposal: Students can submit a detailed proposal to Department MOOCs Coordinator including the name of the MOOCs, the platforms, course duration, credit value, and relevance to their field of study.

If a Student has already completed any MOOCs course/s from the beginning of the III semester B.E, that satisfies the criteria mentioned in the clause 1. Selection of MOOCs, such course/s can be considered by the Department for credit transfer, provided the student has NOT already claimed the benefit of completing the MOOCs under any assessment in any of the subject.

2.3 Evaluation: The Department will evaluate the proposal for relevance, academic rigor, and credit equivalence and will communicate the decision to the Students.

3. Registration and Enrollment
3.1 Official Enrollment: Students shall register for the approved MOOCs on the respective platforms. **3.2 Documentation:** Students shall keep documentation of registration and course details for future reference and provide the same when asked by the Department.
4. Course Completion
4.1 Active Participation: Students shall engage actively in all course activities including lectures, assignments, quizzes, and discussion forums. **4.2 Completion Certificate:** Students shall obtain a verified certificate of completion for MOOC Course. Free versions without certificates are NOT eligible for credit.
5. Assessment and Evaluation
5.1 Performance Tracking: Students shall maintain records of performance in all assessments throughout the course. **5.2 Final Assessment:** The Department may conduct a final assessment (proctored exam) to ensure that the knowledge gained aligns with the academic standards. This summative assessment (proctored exam) by the Engineering Department is mandatory in the absence of such assessment in the MOOC course/s by the online platform.
6. Credit Transfer
6.1 Submission of Certificates: Students shall submit the completion certificate/s and performance records to the Department MOOCs Coordinator. **6.2 Credit Evaluation:** The Department will evaluate the certificates and performance records to approve the credit transfer. **6.3 Grade Conversion:** College will take care to convert the grades from the MOOCs into the grading system as per established Academic Rules and Regulations.
7. Integration into Academic Record
7.1 Transcript Update: Upon approval, the credits and grades will be integrated into the student's academic transcript. **7.2 Grade Point Average (GPA) Calculation:** The MOOC grades are included in the calculation of the student's GPA.
8. Support and Resources
8.1 Academic Advising: The Department MOOCs Coordinator shall provide guidance and support to the students throughout the process. **8. 2 Technical Support:** The Department MOOCs Coordinator shall ensure that students have access to the necessary technical resources to complete MOOCs courses.
9. Feedback and Improvement
9.1 Student Feedback: Department MOOCs Coordinator shall collect feedback from students on their MOOC experiences to improve future implementations. **9.2 Continuous Improvement:** MOOCs guidelines and processes will be updated based on student feedback, Department feedback and evolving educational standards.

Course Outcomes: At the end of the course the student will be able to :	
21AEC801.1	Students will demonstrate a strong grasp of essential engineering concepts and methodologies relevant to their chosen field.
21AEC801.2	Students will apply engineering knowledge to solve real-world problems through projects and case studies presented in the course.
21AEC801.3	Students will proficiently use online tools and resources, including simulations, interactive modules, and digital libraries, to enhance their learning experience.
21AEC801.4	Students will gain insights into new technologies and innovations within engineering, preparing them to adapt to technological advancements.
21AEC801.5	Students will exhibit improved teamwork and communication skills by engaging in online discussions, group projects, and peer assessments.

21AEC801.6	Students will develop a broader understanding of how engineering intersects with other disciplines and cultural contexts, informed by national/global perspectives gained through the MOOC.

Course Articulation Matrix

Course Outcomes (COs)	**Program Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21AEC801.1	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21AEC801.2	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
21AEC801.3	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**
21AEC801.4	**3**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21AEC801.5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**1**	**-**	**-**
21AEC801.6	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**

1: Low 2: Medium 3: High

Major Project Work			
Course Code	**21ECP802**	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 Hrs
Total Hours	20 hours	Credits	05

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyse, and solve complex problems in the project domain.
2. Develop and execute a comprehensive project plan that includes designing, prototyping, testing, and evaluating a system, component, or process to meet specific needs and constraints.
3. Conduct in-depth research, critically review literature, and integrate innovative solutions or techniques within the project framework.
4. Demonstrate effective teamwork, communication, and collaboration skills in a multidisciplinary environment to achieve project objectives.
5. Incorporate ethical considerations, societal impact, and sustainable practices in the project development, while adhering to professional engineering standards.
6. Prepare and present a well-structured project report, supported by technical documentation and visual aids, and confidently defend the work during project viva-voce or presentations.

1. Project Execution

- **Regular Meetings**: Students should meet regularly with their project-guide to discuss progress, challenges, and next steps.
- **Documentation**: Maintain detailed documentation throughout the project in a project work-dairy, including design decisions, experiments, and testing results.
- **Milestones**: Set clear milestones and deadlines to ensure steady progress. These could include design completion, initial prototype, testing, etc.

2. Progress Review

- **Progress Presentation**: DPEC shall conduct a mid-term review where students present their progress to a panel of faculty members.
- **Feedback**: Provide constructive feedback and guidance to help students refine their projects.

3. Final Submission

- **Report**: The final project report should include an abstract, introduction, literature review, methodology, implementation, results, discussion, conclusion, and references.
- **Code and Data**: If applicable, students should submit their code, datasets, and any other relevant materials.

4. Project Presentations

- **Oral Presentation**: Students should present their projects to a panel, explaining their work, findings, and contributions.
- **Demonstration**: If possible, include a live demonstration of the project or show relevant simulations and results.
- **Q&A**: Be prepared to answer questions from the panel and justify the project's methodology and conclusions.

5. Evaluation Criteria

- **Originality and Innovation**: Assess the novelty and creativity of the project.
- **Technical Competence**: Evaluate the depth of technical knowledge and problem-solving ability demonstrated.
- **Project Execution**: Consider the effectiveness of project planning, adherence to timelines, and quality of implementation.
- **Presentation and Communication**: Judge the clarity and coherence of the final report, presentation, and the ability to answer questions.

6. Plagiarism Check
• **Academic Integrity**: Ensure that the work submitted is original and properly cites all references and sources. • **Plagiarism Check**: Run all reports through plagiarism detection software and ensure that similarity index is less than the threshold value (25%).
7. Mentorship and Feedback
• **Feedback:** Students are required to consult with their project guide regularly throughout the project work to seek guidance and feedback. • **Weekly Meetings:** At least one mentorship meeting every week shall be held and recorded in the project work-dairy.
8. Post Submission
• **Publication**: DPEC shall encourage students to publish their work in conferences or journals, especially if it contributes significantly to their field. • **Project Archive**: Store all projects in the department's digital archive for future reference.

Continuous Internal Evaluation (CIE)		
Description	**Proposed Dates**	**CIE Weightage (Max 50 marks)**
1. Progress Review	During the 8th semester	25 marks
2. Project Report Evaluation	End of the 8th Semester	25 marks
Semester End Examinations (SEE)		
3. SEE will be conducted for 100 marks (after the last working day of the 7th semester) in the presence of the external examiner with the weightage as **Project Report: 50 marks, Project Presentation: 25 marks and Question & Answer Session: 25 marks**. Marks awarded for Project Report is same for all batch-mates.		

Course Outcomes: At the end of the course the student will be able to :	
21ECP802.1	Demonstrate the ability to identify, define, and solve complex engineering problems using appropriate methodologies and modern tools.
21ECP802.2	Successfully design, develop, and test an engineering solution that meets specified requirements, addressing technical, economic, environmental, and social constraints.
21ECP802.3	Apply research skills to review existing literature, gather and analyze data, and incorporate innovative or state-of-the-art technologies in the project
21ECP802.4	Collaborate effectively within a team, taking on leadership or supportive roles as needed, while ensuring clear communication and efficient project management.
21ECP802.5	Demonstrate awareness of professional ethics, societal impact, and sustainability in the design and implementation of engineering solutions.
21ECP802.6	Exhibit strong written and oral communication skills by preparing technical reports, project documentation, and delivering persuasive project presentations.

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
21ECP802.1	2	3	-	-	1	-	-	-	-	-	-	-	-	-
21ECP802.2	-	-	3	-	-	2	1	-	-	-	-	-	-	-
21ECP802.3	1	2	-	3	-	-	-	-	-	-	-	-	-	-
21ECP802.4	-	-	-	-	-	1	-	-	3	2	2	-	-	-
21ECP802.5	-	-	1	-	-	-	2	3	-	-	-	-	-	-
21ECP802.6	-	-	-	-	-	-	-	-	-	3	2	1	-	-

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Research Internship

Course Learning Objectives:

1. To equip students with the knowledge of fundamental research principles, methodologies, and techniques applicable to their engineering discipline.
2. To enable students to formulate research questions, design experiments or studies, and use appropriate data collection and analysis tools.
3. To foster the ability to think critically and innovatively while solving complex engineering problems during the research process.
4. To guide students in developing the skills necessary for writing clear and well-structured research reports, papers, and presentations.
5. To instill an understanding of ethical practices in research, including integrity, responsible data handling, and respect for intellectual property.
6. To prepare students to work effectively in research teams, communicate their ideas clearly, and present their findings to both technical and non-technical audiences.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) and the Research Supervisor to understand the research goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, research agreements and confidentiality agreements, if applicable.
3. **Research Proposal:** Develop a research proposal in consultation with the Research Supervisor and academic mentor outlining the objectives, methodology, and expected outcomes.

During the Internship

1. **Work Plan:** Follow a structured research plan provided by the supervising researcher or mentor.
2. **Literature Review:** Conduct a comprehensive literature review to understand the current state of research in the chosen area.
3. **Regular Meetings:** Participate in regular meetings with academic and research mentors to discuss progress, challenges, and next steps.
4. **Lab Work/Field Work:** Engage in experimental work, simulations, or field studies as required by the research project.
5. **Data Collection and Analysis:** Collect, analyze, and interpret data using appropriate tools and techniques.
6. **Documentation:** Maintain detailed records of research activities, experiments, and findings.

Deliverables

1. **Weekly Reports:** Submit weekly progress reports to academic and research mentors.
2. **Monthly Reports:** Submit monthly progress reports to academic and research mentors.
3. **Mid-Term Review:** Participate in a mid-term review meeting to assess progress and realign research goals if necessary.
4. **Report and Research Paper:** Prepare a draft report and a research paper detailing the research problem, methodology, results and discussions, and conclusions.
5. **Presentation:** Deliver a presentation summarizing the research work to faculty, peers, and other stakeholders upon completion of the internship.

Assessment Criteria
1. **Research Quality:** Evaluate the quality and rigor of the research conducted. 2. **Report Quality:** Assess the clarity, organization, and thoroughness of the report and the research paper. 3. **Presentation:** Evaluate the effectiveness and clarity of the final presentation. 4. **Innovation and Creativity:** Consider the originality and innovative aspects of the research. 5. **Self-Reflection:** Review the student's ability to critically reflect on their research experience and identify areas for future growth.
Post-Internship
1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the research experience and areas of improvement. 2. **Publication:** Explore opportunities to publish the research findings in academic journals or conferences. 3. **Networking:** Maintain professional relationships established during the internship for future research collaborations.
Additional Tips
• **Curiosity:** Cultivate a curious mindset and a willingness to explore new ideas. • **Collaboration:** Work collaboratively with other researchers and team members. • **Adaptability:** Be open to modifying research approaches based on findings and feedback. • **Communication:** Develop strong written and oral communication skills to effectively present research findings. • **Time Management:** Prioritize tasks and manage time efficiently to meet research deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (Only OFFLINE)	Will be conducted during the 7th semester BE. Students shall submit the Research Internship Proposal and make a presentation and answer questions raised by the Departmental Internship Evaluation Committee (DIEC). Marks split-up: Research Internship Proposal – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): II (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on progress done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
Continuous Internal Evaluation (CIE): III (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final internship report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.
CIE Marks (Max 100)	Average of the CIE:I , CIE-II and CIE:III marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation-25 marks + Question and Answer-25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply appropriate research methodologies and tools to design and conduct experiments, analyze data, and draw conclusions.
21INT803.2	Demonstrate the ability to identify and solve complex engineering problems through innovative and systematic research approaches.
21INT803.3	Acquire proficiency in using advanced technologies, tools, and techniques relevant to their field of research.
21INT803.4	Develop skills in writing comprehensive research reports, documentation, and effectively presenting research findings.
21INT803.5	Understand and apply ethical standards in research, including plagiarism avoidance, proper citations, and data integrity.
21INT803.6	Gain experience in working collaboratively within a research team and contributing effectively to the shared goals of the project.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at **https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf**

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at **https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf**

3. VTU Mandatory Internship Guidelines 2021.
Available at **https://vtu.ac.in/pdf/regulations2021/anex4.pdf**

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21INT803.1	**1**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.2	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.3	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.4	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**1**	**-**	**-**
21INT803.5	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**1**	**-**	**-**	**-**

1: Low 2: Medium 3: High

Research/Industry Internship			
Course Code	**21INT803**	CIE Marks	50
Course Type (Theory/Practical/Integrated)	Practical	SEE Marks	50
		Total Marks	100
Number of Weeks	15 Weeks	SEE	3 Hours
		Credits	10

Industry Internship

Course Learning Objectives:

1. To develop practical engineering skills through hands-on experience in a real-world industrial environment.
2. To enhance the ability to identify, analyze, and solve complex engineering problems encountered during the internship.
3. To gain an understanding of the functioning of the industry, including exposure to its standards, practices, and emerging technologies.
4. To improve communication, collaboration, and teamwork skills by working with professionals in a multidisciplinary team setting.
5. To foster adaptability by learning to work in dynamic and fast-paced industrial environments while embracing lifelong learning.
6. To instill a sense of professional ethics, responsibility, and accountability in engineering practice by adhering to industry-specific codes of conduct.

Pre-Internship Preparation

1. **Orientation Session:** Attend an orientation session with the academic mentor (allotted from the Department) to understand the internship goals, expectations, and assessment criteria.
2. **Documentation:** Complete necessary documentation, including the approval from the Department, processing of the internship request application, internship agreements if applicable etc.
3. **Goal Setting:** Define specific, measurable, achievable, relevant, and time-bound (SMART) goals in consultation with academic and industry mentors.

During the Internship

1. **Work Plan:** Follow a structured work plan provided by the host organization.
2. **Mentorship:** Regularly meet with assigned industry and academic mentors to review progress and seek guidance.
3. **Work Diary/Daily Report/Learning Diary:** Maintain a diary/logbook documenting daily activities, learnings, challenges, and reflections.
4. **Professional Conduct:** Adhere to the professional and ethical standards of the host organization, including dress code, punctuality, and communication protocols.
5. **Skill Application:** Actively participate in projects and tasks assigned, applying theoretical knowledge to practical situations.

Deliverables

1. **Weekly Reports:** Submit the weekly progress reports to academic and industry mentors.
2. **Monthly Reports:** Submit the monthly progress reports to academic and industry mentors.
3. **Mid-Term Review/Evaluation:** Participate in a mid-term review meeting/evaluation to assess progress and realign goals if necessary.
4. **Final Report:** Prepare a comprehensive final report in the specified format detailing the projects undertaken, skills acquired, challenges faced, and overall learning experience.
5. **Presentation:** Deliver a presentation summarizing the internship experience to faculty evaluators and peers upon completion of the internship.

Assessment Criteria

1. **Performance Evaluation:** Receive feedback from the industry mentor based on work performance, technical skills, and professional behaviour.

2. **Report Quality:** Evaluate the quality, clarity, and comprehensiveness of the final report.
3. **Presentation:** Assess the effectiveness and clarity of the final presentation.
4. **Self-Reflection:** Review the student's ability to critically reflect on their learning experience and identify areas for future growth.

Post-Internship

1. **Feedback Session:** Attend a feedback session with academic mentors to discuss the internship experience and areas of improvement.
2. **Certification:** Obtain an internship completion certificate from the host organization.
3. **Networking:** Maintain professional relationships established during the internship for future opportunities.

Additional Tips

- **Professionalism:** Demonstrate a professional attitude and work ethic at all times.
- **Adaptability:** Be open to learning and adapting to new environments and technologies.
- **Communication:** Develop strong communication skills to effectively collaborate with colleagues and mentors.
- **Time Management:** Prioritize tasks and manage time efficiently to meet deadlines.

Evaluation Scheme	
Continuous Internal Evaluation (CIE): I (ONLINE/OFFLINE)	Will be conducted during the middle of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports), make a presentation on work done so far and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
Continuous Internal Evaluation (CIE): II (Only OFFLINE)	Will be conducted at the end of the 8th semester BE. Students shall submit the Reports (daily/weekly/monthly reports) and the final report, make a presentation on work completed and answer questions raised by the Departmental Internship Evaluation Committee. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.
CIE Marks (Max 100)	Average of the CIE:I and CIE:II marks
Semester-End-Examinations (SEE) (Only OFFLINE)	Will be conducted within a week of the last working day of the 8th semester BE. Student shall submit the internship report approved by all the concerned, make a presentation and answer the questions raised by the internal and external examiners. Marks split-up: Reports – 50 marks + Oral Presentation 25 marks + Question and Answer 25 marks.

Course Outcomes: At the end of the course the student will be able to:	
21INT803.1	Apply engineering concepts and theoretical knowledge to solve real-world industry problems.
21INT803.2	Enhance their problem-solving abilities by identifying, analyzing, and providing innovative solutions to engineering challenges in the industry.
21INT803.3	Develop key professional skills such as teamwork, communication, and time management in a corporate or industrial environment.
21INT803.4	Gain exposure to industry-standard tools, technologies, methodologies, and regulatory standards relevant to their field of study.

21INT803.5	Demonstrate understanding and adherence to professional ethics, safety regulations, and responsibilities in an industrial setting.
21INT803.6	Build a network of industry professionals and gain insights into career opportunities, preparing them for future employment in the engineering sector.

References

1. AICTE Internship Policy : Guidelines and Procedures 2019.
Available at **https://aicte-india.org/sites/default/files/AICTE%20Internship%20Policy.pdf**

2. UGC Guidelines for Internship/Research Internship for Under Graduate Students 2023.
Available at **https://www.ugc.gov.in/pdfnews/0063650_Draft-Guidelines-for-Internship-and-Research-Internship-for-Under-Graduate-Students.pdf**

3. VTU Mandatory Internship Guidelines 2021.
Available at **https://vtu.ac.in/pdf/regulations2021/anex4.pdf**

Course Articulation Matrix

Course Outcomes (COs)	Program Outcomes (POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
21INT803.1	**3**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
21INT803.2	**-**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
21INT803.3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**
21INT803.4	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
21INT803.5	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**
21INT803.6	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**1**	**-**	**-**

1: Low 2: Medium 3: High

***

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

Vamanjoor, Mangaluru - 575 028, Karnataka, India
Ph: 91-824-2868100 / 2263753 / 54 / 55
E-mail: sjec@sjec.ac.in | Website: www.sjec.ac.in