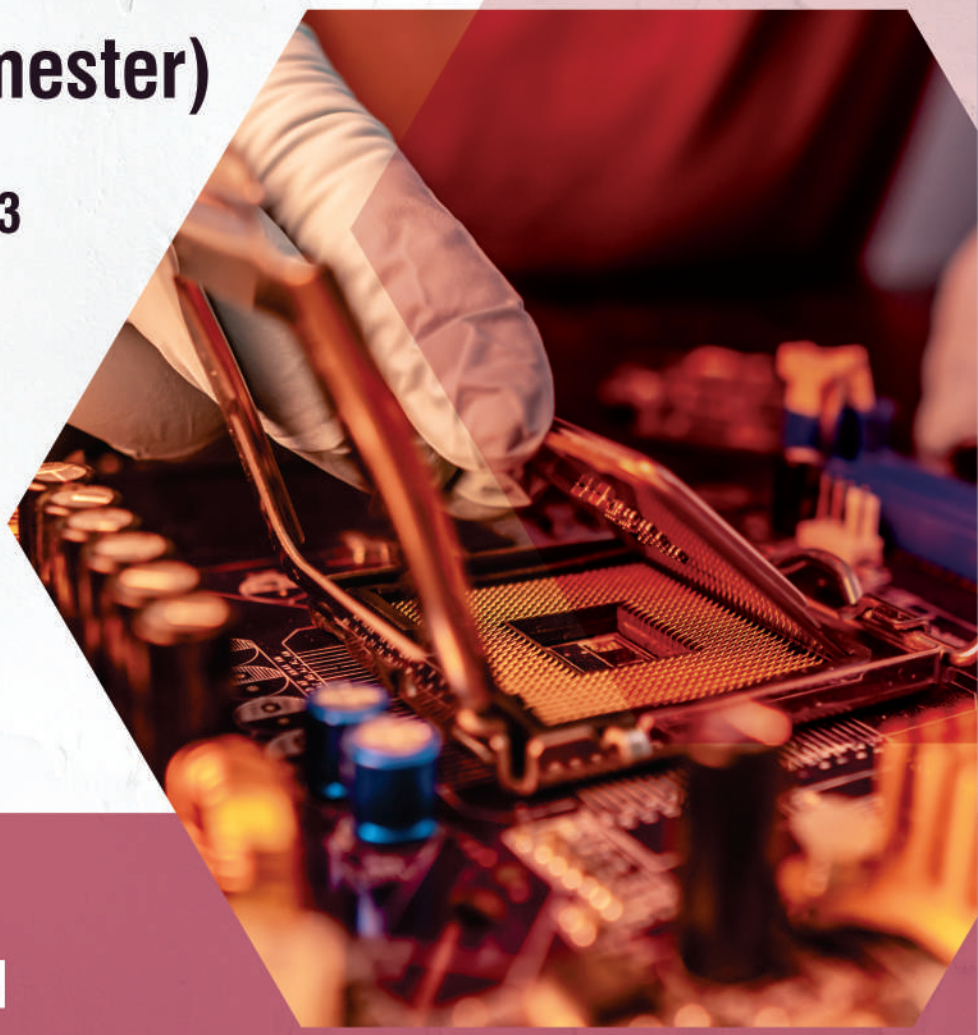
# BE SCHEME & SYLLABUS

## Fourth Year
## (VII and VIII Semester)

**With effect from 2022-23**



## Electronics and Communication Engineering


**ST JOSEPH ENGINEERING COLLEGE**

AN AUTONOMOUS INSTITUTION

Vamanjoor, Mangaluru - 575028

## MOTTO

**Service & 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. (ECE, EEE, ME and CIV) & PG (MBA and MCA)
NAAC – Accredited with A+

## B.E. SCHEME & SYLLABUS

## (With effect from 2022-23)

## 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). Four of the UG programs, namely 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

# 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. Also, the VTU has approved the department to offer PhD / M.Sc. (Engg) by research from 2015. The faculty of the department are actively involved in teaching and research with specializations in Communication, Signal Processing, Embedded Systems, and VLSI. The department encourages students to present papers in symposiums and conferences, and to participate in various intercollege technical and nontechnical events.

The department is well equipped with state-of-the-art laboratories with the latest tools such as Cadence VLSI Design Suite, Xilinx Vivado-2018, MATLAB 2025a, ARM CORTEX, Multisim, and NEXYS 4 DDR Artix-7 FPGA Board, to make students industry-ready.

The department has MOU with “Karmic Design Pvt Ltd” Manipal to facilitate the students in semiconductor chip design. The department actively organizes Industry visits, National Level Conference, Workshops, Technical talks from Industry/Academic experts in order to enhance their learning abilities, creative thinking and also to bridge the gap between the Industry and Academia.

Prodigi Student Association and Samarthya Club of the department provide ample opportunities for the students to excel in technical and extracurricular 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)

I. Develop a strong foundation in science and engineering, gain proficiency in modern tools and technologies, and apply analytical and design skills to create innovative solutions for real-world problems.

II. Demonstrate professionalism, ethics, and effective communication while demonstrating leadership, excelling in teamwork and multidisciplinary collaboration.

III. Cultivate strong interpersonal skills, adaptability to evolving technologies, and a commitment to lifelong learning.

## PROGRAM OUTCOMES (POs)

**PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.

**PO2: Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).

**PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5).

**PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

**PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

**PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

**PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

**PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

**PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

**PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

**PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

## PROGRAMME SPECIFIC OUTCOMES (PSOs)

**PSO-1**. Analyze and develop solutions in the areas of Signal Processing and Communication Systems.

**PSO-2**. 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 | IPCC | 22ECE71 | Digital Image Processing (Integrated) | ECE | ECE | 3 | - | 2 | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | 22ECE72 | Advanced Embedded System (Integrated) | ECE | ECE | 3 | - | 2 | 03 | 50 | 50 | 100 | 4 |
| 3 | PCC | 22ECE73 | Cellular Communication | ECE | ECE | 3 | - | - | 03 | 50 | 50 | 100 | 3 |
| 4 | PEC | 22ECE74X | Professional Elective -III | ECE | ECE | 3 | - | - | 03 | 50 | 50 | 100 | 3 |
| 5 | PRJ | 22ECE75 | Major Project - Phase II | ECE | ECE | - | - | 6 | 03 | 50 | 50 | 100 | 6 |
| | | | | | **Total** | **12** | **-** | **10** | **15** | **250** | **250** | **500** | **20** |

| **22ECE74X : Professional Elective III** | | | |
|---|---|---|---|
| 22ECE741 | Satellite Communication | 22ECE743 | Analog IC Design |
| 22ECE742 | Fiber Optic Networks | 22ECE744 | Network Security |

| VIII 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 | PEC | 22ECE81 | Professional Elective IV (Online Course) | Any MOOC topic (Choices are given by respective Department) with minimum 12 weeks to be completed before the end of 8th semester. | | | | | | | | 100 | 3 |
| 2 | OEC | 22ECE82 | Open Elective -II (Online Course) | Any MOOC topic (Choices are given by respective Department) with minimum 12 weeks to be completed before the end of 8th semester. | | | | | | | | 100 | 3 |
| 3 | INT | 22ECE83 | Research / Industry Internship (14 to 16 weeks) | | | - | - | - | 03 | 50 | 50 | 100 | 10 |
| | | | **Total** | | | **-** | **-** | **-** | **03** | **50** | **50** | **300** | **16** |

**Note:**

**a. Professional Elective IV:** These are ONLINE courses suggested by the respective Board of Studies (Department).

**b. Open Elective -II:** These are ONLINE courses suggested by the respective Board of Studies (Department).

**c. Research Internship /Industrial Internship:** During 4th year of the program i.e., after VII semester, students shall take up the Research Internship /Industrial Internship for 14-16 weeks. Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation centre, Incubation centre, Start-up, Centre of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

# VII Semester

| Digital Image Processing (Integrated) | | | |
|---|---|---|---|
| Course Code | 22ECE71 | CIE Marks | 50 |
| Course Type (Theory/Practical/Integrated) | Integrated | SEE Marks | 50 |
| | | Total Marks | 100 |
| Teaching Hours/Week (L:T:P) | 3:0:2 | SEE | 3 Hours |
| Total Hours | 40 hours Theory + 10 Lab slots | Credits | 04 |

Course Learning Objectives:

1. Provide basic understanding of digital image representation and processing concepts.
2. Introduce various techniques for image enhancement in spatial and frequency domains.
3. Enable students to learn image restoration and noise reduction methods.
4. Familiarize students with color image processing and morphological operations.
5. Develop practical skills through the implementation of image processing techniques using MATLAB or Python.

**Module-1 Digital Image Fundamentals (8 hours)**

Introduction to Digital Image Processing (DIP), Examples in the field DIP, Fundamental Steps in DIP, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels.
(Text 1: Chapter 1 and Chapter 2: Sections 1.1-1.4, 2.1, 2.3-2.5)

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

Basic Gray Level Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters.
(Text 1: Chapter 3: Sections 3.1-3.6).

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

The 2D Discrete Fourier Transform (DFT) and its' Properties (Statements only), Fourier Spectra and Phase Angle, Basics of Filtering in the Frequency Domain, Smoothing and Sharpening using Frequency Domain Filters.
(Text 1: Chapter 4 : Sections 4.5.5, 4.6-4.9)

**Module-4 Image Restoration (8 hours)**

Model of Image degradation/Restoration, Noise models, Restoration in the Presence of Noise only using Spatial Filtering, Periodic Noise reduction by Frequency Domain Filtering, Linear, Position-Invariant degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.
(Text 1: Chapter 5: Sections 5.1 - 5.8)

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

Color Fundamentals, Color Models, Pseudo Color Image Processing. Basic Morphological Operations: Dilation, Erosion, Closing and Opening
(Text 1: Chapter 6, 9: Sections 6.1 to 6.3, 9.1 to 9.3)

**PRACTICAL MODULE**

**Exercise (MATLAB/Python)**

1. To perform basic image, I/O operations and fundamental manipulations such as reading, writing, displaying, grayscale conversion, binary conversion, image complement, rotation, indexed image conversion, and data type handling.
2. To resize images using various interpolation techniques and demonstrate false contouring by reducing gray levels.
3. To implement pixel-wise arithmetic (addition, subtraction, multiplication, division) and logical (AND, OR, NOT, XOR) operations.

4. Implement and analyze gray-level (intensity) transformations for image enhancement in the spatial domain: 1) Contrast stretching (piece-wise linear) & thresholding, 2) Logarithmic transformation, 3) Power-law (gamma) transformation, 4) Gray Level slicing with and without background, 5) Bit plane slicing.
5. Histogram Analysis and Enhancement Techniques in Digital Image Processing
6. To understand and implement spatial low-pass filters (mean/average, median) and spatial sharpening filters (first-order derivative, second-order derivative, Laplacian, and unsharp masking) for image enhancement.
7. To understand and implement frequency domain low-pass filters (Ideal, Butterworth, Gaussian filters) and frequency domain sharpening filters (Ideal, Butterworth, Gaussian filters) for image enhancement.
8. Implement various morphological operations in digital image processing and to study the effect of structuring element shape and size.
9. To implement colour space conversions between RGB, HSI, YCbCr, and CMY, visualize individual channels and evaluate conversion accuracy.
10. To restore a motion-blurred and noise-corrupted image using i) Inverse Filtering ii) Wiener Filtering and compare their performance.
11. Open Ended Experiments.

| **Course Outcomes:** At the end of the course the student will be able to: | |
|---|---|
| 22ECE71.1 | Analyze the fundamentals of Digital Image Processing |
| 22ECE71.2 | Design and implement programs in MATLAB or Python to explore and understand fundamental concepts in Digital Image Processing |
| 22ECE71.3 | Investigate image enhancement techniques |
| 22ECE71.4 | Analyze the occurrence of noise in digital image processing and discuss the application of suitable filtering techniques for noise reduction. |
| 22ECE71.5 | Develop colour model conversions and basic morphological operations |
| 22ECE71.6 | Implement colour model conversions and perform basic morphological operations to enhance understanding of digital image processing techniques. |

| **Sl. No.** | **Title of the Book** | **Name of the Author/s** | **Name of the Publisher** | **Edition and Year** |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Digital Image Processing | Rafel C Gonzalez and Richard E. Woods | Prentice-Hall of India | 3rd Edition 2008 |
| 2 | Digital Image Processing using MATLAB | Rafel C Gonzalez Richard E.Woods and Steven L | Tata Mc Graw Hill | 3rd Edition, 2008 |
| **Reference Books** | | | | |
| 1 | Digital Image Processing | S.Jayaraman, S. Esakkirajan,T. Veerakumar, | Tata Mc GrawHill | 2nd Edition, 2014 |

| | | | | |
|---|---|---|---|---|
| 2 | Fundamentals of Digital Image Processing | A K. Jain | Pearson | 1st Edition, 2004. |

**Web links and Video Lectures (e-Resources):**

- https://www.youtube.com/watch?v=CVV0TvNK6pk
- https://www.youtube.com/watch?v=uvXTZxSzdMk

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE71.1 | 3 | - | - | - | 2 | - | - | - | - | - | - | 3 | - |
| 22ECE71.2 | 2 | - | 2 | 2 | 3 | - | - | | - | 1 | - | 3 | - |
| 22ECE71.3 | 3 | - | 2 | 2 | 2 | - | - | - | - | - | - | 3 | - |
| 22ECE71.4 | 3 | - | 2 | 2 | 2 | - | - | - | - | - | - | 3 | - |
| 22ECE71.5 | 2 | - | 2 | - | 2 | - | - | - | - | - | - | 2 | - |
| 22ECE71.6 | 2 | - | 2 | - | 3 | - | - | - | - | 1 | - | 2 | - |

1: Low 2: Medium 3: High

| Advanced Embedded System (Integrated) | | | |
|---|---|---|---|
| Course Code | 22ECE72 | CIE Marks | 50 |
| Course Type (Theory/Practical/Integrated) | Integrated | SEE Marks | 50 |
| | | Total Marks | 100 |
| Teaching Hours/Week (L:T:P) | 3:0:2 | SEE | 3 Hours |
| Total Hours | 40 hours Theory + 10 Lab slots | Credits | 04 |

Course Learning Objectives:

1. Understand fundamental characteristics, operation, and applications of various power semiconductor devices
2. Gain knowledge of different types of sensors and actuators, the principles of Analog-to-Digital (A/D) and Digital-to-Analog (D/A) conversion, and various interfacing techniques relevant to embedded systems
3. Acquire a strong understanding of embedded system design principles
4. Develop practical skills in utilizing an RTOS (specifically FreeRTOS) for managing tasks
5. Understand the concepts of hardware/software co-design, partitioning strategies

**Module 1 Power Electronics (8 Hours)**

Power Transistor, Power MOSFET, IGBT, Thyristor, GTO, Phase controlled Rectifiers full wave rectifier, SMPS

(Text 1: 2.3,2.4,2.5 4.1 - 4.4 , 4.11 , 6.1.1,6.1.2, 6.3.1,6.3.2 , 11.1)

**Module 2 Sensors and Actuators (8 Hours)**

Sensors, A/D-D/A converters and actuators, interfacing techniques, Network Embedded System, Interfacing SRAM, DRAM and Flash Memory, Internet-Enabled System

(Text 2 : 4.1-4.5)

**Module 3 Embedded System (8 hours)**

ARM Microcontrollers: ARM processor Based System Design, Real-time Operating system and task scheduling: RTOS important concepts, Types of real-time tasks and their characteristics, Task scheduling and features of RTOS

(Text 2 : 3.4 , 7.1 - 7.4 ,8.1)

**Module 4 Programming using RTOS, freeRTOS (8 hours)**

Task Management: Task Functions, Top Level Task States, Task Creation, Task Priorities, The Idle Task and the Idle Task Hook, Expanding the Not Running State, Changing the Priority of a Task

Queue: Using a Queue, Receiving Data from Multiple Sources, Creating and Starting a Software Timer, Mutexes (and Binary Semaphores)

(Text 3: 4.2-4.9, 5.3 - 5.4, 6.5 and 8.3)

**Module 5 Hardware/ Software co-design (8 hours)**

Hardware/software co-design, hardware/software Partitioning, Testing embedded system, Design for Testability and self-test (Self-study)

Case Study: Robotics, Embedded Systems in Automobile and Adaptive cruise control system in a car

(Text 2 : 13.1-13.4, 14.1-14.3)

**PRACTICAL MODULE**

**Part -A (Power Electronics)**

1. Characteristics of Power MOSFET, IGBT and SCR
2. Phase-Controlled Rectifier (Single-Phase, Half-Wave with Resistive Load)
3. Buck Converter (Step-Down SMPS)
4. Boost Converter (Step-Up SMPS)

**Part- B (RTOS)**

Tools: Keil or equivalents with free RTOS

1. Task Management Fundamentals - LED Blinking with Different Priorities
2. Idle Task and Priority Change - Observing System Load
3. Inter-Task Communication using Queues - Controlling a DC Motor
4. Timers and Mutexes - Controlling a Stepper Motor with Synchronization

| **Course Outcomes:** At the end of the course, the student will be able to: | |
|---|---|
| 22ECE72.1 | Analyze and Design Basic Power Electronic Converter Circuits |
| 22ECE72.2 | Design and implement interfacing circuits for various sensors, actuators, and external memory |
| 22ECE72.3 | Design and develop embedded systems utilizing ARM microcontrollers and apply RTOS concepts for efficient task management and resource utilization |
| 22ECE72.4 | Implement inter-task communication mechanisms using queues and synchronization primitives |
| 22ECE72.5 | Illustrate the principles of hardware/software co-design and employ appropriate testing strategies |
| 22ECE72.6 | Verify the reliability and functionality of a given design |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Power Electronics | P S Bimbhra | Khanna Publishing House | 7th Edition, 2022 |
| 2 | Embedded Systems | Raj Kamal | McGraw Hill | 4th Edition 2023 |
| 3 | Mastering-the-FreeRTOS-Real-Time-Kernel.v1.1.0 | Richard Barry | NA | 1st Edition, 2024 |
| **Reference Books** | | | | |
| 1 | Hands On RTOS with Microcontrollers | Brian Amos | Packt Publishing Limited | 1st Edition, 2020 |
| 2 | Switching Power Supply Design & Optimization | Sanjaya Maniktala | McGraw-Hill Professional | 1st Edition, 2004 |
| 3 | The Art of Designing Embedded Systems | Jack Ganssle | Newnes | 2nd Edition, 2009 |

**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc20_ee98/
- https://onlinecourses.nptel.ac.in/noc20_cs16/
- https://onlinecourses.nptel.ac.in/noc25_ee37/

## Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE72.1 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | 2 | - |
| 22ECE72.2 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | 2 | - |
| 22ECE72.3 | 2 | 1 | - | - | - | - | - | - | - | - | - | 2 | - |
| 22ECE72.4 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | 2 | - |
| 22ECE72.5 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | 2 | - |
| 22ECE72.6 | 2 | 1 | - | - | 3 | - | - | - | - | - | - | 2 | - |

1: Low 2: Medium 3: High

| Cellular Communication | | | |
|---|---|---|---|
| Course Code | 22ECE73 | 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:

1. To provide with an understanding of the basic cellular communication building blocks
2. To develop a thorough understanding of cellular system design fundamentals
3. Apply communication theory, covering physical and networking aspects, to comprehend LTE-4G systems thoroughly
4. To comprehend the basics of 5G technology.

**Module-1 Cellular Systems (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, Modelling broadband fading channels - Statistical channel models

(Text 1: 2-2.5.1)

**Module-2 The Cellular Concept- System Design Fundamentals (8 hours)**

Introduction, frequency reuse, channel assignment strategies, handoff strategies, inference and system capacity – Co-channel interference and system capacity, adjacent channel interference, power control for reducing interference, trunking and grade of service. Improving capacity in cellular systems – cell splitting, sectoring, a novel microcell zone concept.

(Text 2: 2-2.7)

**Module-3 LTE – 4G (PART I) (8 hours)**

Key Enablers for LTE 4G: OFDM, SC-FDE, SC-FDMA, Channel Dependant 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.

(Text 1: 1.4, 3.1 – 3.7)

**Module - 4 LTE – 4G (PART II) (8 hours)**

OFDMA and SC-FDMA – Multiple Access for OFDM Systems, OFDMA, SCFDMA, Multiuser Diversity and Opportunistic Scheduling, OFDMA and SC-FDMA in LTE, OFDMA system design considerations. (Text 1: 4.1 – 4.6)

The LTE Standard – Introduction to LTE and Hierarchical Channel Structure of LTE, Downlink OFDMA Radio Resources, Uplink SC-FDMA Radio Resources. (Text 1: 6.1 – 6.4)

**Module-5 5G and Beyond (8 hours)**

5G system concept: Concept overview, Extreme mobile broadband, Massive machine-type communication, Ultra-reliable machine-type communication, Dynamic radio access network

The 5G architecture: Introduction, NFV and SDN, Basics about RAN architecture, High-level requirements for the 5G architecture, Functional architecture and 5G flexibility, Functional split criteria, Functional split alternatives, Functional optimization for specific applications, Integration of LTE and new air interface to fulfil 5G Requirements, Enhanced Multi-RAT coordination features, Physical architecture and 5G deployment.

(Text 3: 2.1-2.5 , 3.1-3.4)

| **Course Outcomes:** At the end of the course the student will be able to: | |
|---|---|
| 22ECE73.1 | Analyze the fundamental building blocks of communication systems and evaluate the impact of wireless channel characteristics on system performance. |
| 22ECE73.2 | Evaluate and design cellular systems considering frequency reuse, co-channel and non-co-channel interference, and apply diversity techniques for improved system performance. |
| 22ECE73.3 | Apply and analyze key enabling technologies for LTE such as OFDM, SC-FDMA, and flat IP architecture, and understand their role in LTE network and system performance. |
| 22ECE73.4 | Design and evaluate LTE radio access techniques using OFDMA and SC-FDMA, and explain the LTE hierarchical channel structure with downlink and uplink resource allocation strategies. |
| 22ECE73.5 | Explain the evolution to 5G, including system concepts, architecture and integration with LTE for next-generation wireless communication. |
| 22ECE73.6 | Design, simulate, and analyze wireless communication systems and protocols (4G/5G) using modern tools to evaluate the impact of channel impairments, interference, and multi-access techniques. |

| 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 (Formerly Prentice Hall, Communications Engg and Emerging Technologies) | 1st Edition 2018 |
| 2 | Wireless Communications | Theodore. S. Rapport | Pearson education | 2nd Edition 2002 |
| 3 | 5G Mobile and Wireless Communications Technology | Afif Osseiran, Jose F. Monserrat, Patrick Marsch | Cambridge University Press | 2nd Edition 2011 |
| **Reference Books** | | | | |
| 1 | Introduction to Wireless Telecommunications Systems and Networks | Gary Mullet | Cengage Learning India Pvt Ltd | 1st Edition 2006 |
| 2 | LTE for UMTS Evolution to LTE-Advanced | Harri Holma and Antti Toskala | John Wiley & Sons, Ltd | 2nd 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** | **PSO1** | **PSO2** |
| 22ECE73.1 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 22ECE73.2 | - | 3 | - | - | - | - | - | - | - | - | - | 1 | - |
| 22ECE73.3 | - | - | 3 | - | - | - | - | - | - | - | - | 1 | - |
| 22ECE73.4 | 2 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 22ECE73.5 | 2 | 1 | - | - | - | - | - | - | - | - | - | 1 | - |
| 22ECE73.6 | 2 | 2 | 2 | - | 3 | - | - | 2 | - | - | - | 1 | - |

1: Low 2: Medium 3: High

| Satellite Communication | | | |
|---|---|---|---|
| Course Code | 2ECE741 | 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:

1. Illustrate the basic principle of satellite orbits and trajectories.
2. Study of electronic systems associated with a satellite and the Earth station.
3. Focus on satellite access techniques for communication.
4. Study of satellite applications focusing on various domains of services such as Direct Broadcast Satellite (DBS) Television and Mobile Services

**Module-1 Satellite Orbits and Trajectories (8 hours)**

Overview of Satellite Communication, Orbital Mechanics, Look Angle Determination, Orbital Perturbations, Orbit Determination, Launches and Launch Vehicles, Orbital Effects in Communication System Performance.
(Text 1: 1.4, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6)

**Module-2 Satellite Subsystems (8 hours)**

Satellite Subsystems, Attitude and Orbit Control Systems, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, A Maritime Satellite Communication System, Satellite Antennas. (Text 1: 3.1, 3.2, 3.3, 3.4, 3.4, 3.5, 3.6)

**Module-3 Satellite Link Design and Multiple Access (8 hours)**

Introduction, Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Downlinks, Satellite Systems using Small Earth Stations, Uplink Design.
(Text 1: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6)
Single Access, Preassigned FDMA, Demand Assigned FDMA, Spade System, Satellite Switched TDMA.
(Text 2: 14.1, 14.2, 14.3, 14.4, 14.5, 14.9)

**Module-4 Application in Direct Broadcast Satellite (DBS) Television (8 hours)**

Orbital Spacing, Power Rating and Number of Transponders, Frequencies and Polarization, Transponder Capacity, Bit Rates for Digital Television, The Home Receiver Outdoor Unit (ODU), The Home Receiver Indoor Unit (IDU), Downlink Analysis, Uplink, High-Definition Television (HDTV), Video Frequency Bandwidth.
(Text 2:16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.9, 16.10, 16.11, 16.12, 16.13, 16.14)

**Module-5 Satellite Mobile and Specialized Services (8 hours)**

Satellite Mobile Services, VSATs, Radarsat, Global Positioning Satellite System (GPS) Orbcomm, Irdium, Problems and Exercises
(Text 2: 17.1,17.2, 17.3, 17.4, 17.5, 17.6, 17.7, 17.8)

| **Course Outcomes:** At the end of the course the student will be able to: | |
|---|---|
| 22ECE741.1 | Analyze the fundamentals of satellite orbits, trajectories, and their impact on communication system performance. |
| 22ECE741.2 | Design satellite communication links considering transmission parameters, system noise, and G/T ratio. |
| 22ECE741.3 | Implement analog and digital technologies within satellite communication networks, understanding their respective applications and limitations |
| 22ECE741.4 | Illustrate the architecture and operation of Earth stations and satellite subsystems for efficient communication. |
| 22ECE741.5 | Compare and evaluate multiple access techniques (FDMA, TDMA, CDMA) used in satellite communication systems. |

| | |
|---|---|
| 22ECE741.6 | Analyze the use of satellites in various applications, such as Direct Broadcast Satellite (DBS) television, mobile services, and specialized services. |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Satellite Communications | Thimothy Pratt, Charles Bostian, Jeremy Allnutt | John Wiley & Sons | 2nd Edition, 2007 |
| 2 | Satellite Communications | Dennis Roddy | Tata McGraw-Hill | 4th Edition, 2009 |
| **Reference Books** | | | | |
| 1 | Satellite Communication Systems Engineering | Wilbur L. Pritchard, Hendri G. Suyderhoud, Robert A. Nelson | Pearson Education India | 2nd Edition, 2003 |
| 2 | Satellite Communication | Sapna Katiyar | Kataria, S. K., & Sons | 3rd Edition, 2007 |

**Web links and Video Lectures (e-Resources):**

- https://archive.nptel.ac.in/courses/117/105/117105131/ - NPTEL course on Satellite Communication Systems by Prof Kalyan Kumar Bandopadhyay, Dept of Electronics and Electrical Communication Engineering, IIT Kharagpur
- http://www.digimat.in/nptel/courses/video/105107194/L01.html - NPTEL course on Global Navigation Satellite Systems and Applications by Prof. Arun K Saraf, Dept of Earth Science, IIT, Roorkee

## Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22ECE741.1 | 3 | 2 | - | 1 | - | - | 1 | - | - | 1 | - | 1 | - |
| 22ECE741.2 | 3 | 2 | - | 1 | - | - | 1 | - | - | 1 | - | 1 | - |
| 22ECE741.3 | 2 | 2 | - | 1 | - | - | 1 | - | - | 1 | - | 1 | - |
| 22ECE741.4 | 2 | 2 | - | 1 | - | - | 1 | - | - | 1 | - | 1 | - |
| 22ECE741.5 | 3 | 2 | - | 1 | - | - | 1 | - | - | 1 | - | 1 | - |
| 22ECE741.6 | 2 | 2 | | 1 | - | - | 1 | - | - | 1 | - | 1 | - |

1: Low 2: Medium 3: High

| Fiber Optic Networks | | | |
|---|---|---|---|
| Course Code | 22ECE742 | CIE Marks | 50 |
| Course Type (Theory/Practical/Integrated) | Theory | SEE Marks | 50 |
| | | Total Marks | 100 |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours |
| Total Hours | 40 Hours | Credits | 03 |

Course Learning Objectives:

1. To study the various optical fiber modes, configurations, and transmission characteristics of optical fibers.
2. To learn about the various optical sources, detectors, and transmission techniques.
3. To explore various ideas about optical fiber measurements and various coupling techniques.
4. To enrich the knowledge about optical communication systems and networks.

**Module-1 Optical Fiber Communications (8 hours)**

Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave-guides, Ray theory transmission, Modes in planar guide, Phase and group velocity (quantitative analysis only), Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength.
(Text 2: 1.1, 1.2, 1.3, 2.1, 2.2, 2.3,2.4.3,2.4.4, 2.5,2.5.1)

**Module-2 Transmission Characteristics of Optical Fiber (8 hours)**

Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber.
Textbook 2: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.8
Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices: Fusion Splices, Mechanical splices, Fiber couplers, Star couplers, Optical Isolators and Circulators
(Text 2: 5.1, 5.2, 5.3, 5.6, 5.7)

**Module-3 Optical Sources (8 hours)**

Optical sources: Light Emitting diodes: LED Structures, Light Source Materials, Laser Diodes, Modes and Threshold conditions.
Textbook 1: 4.2- 4.2.2, 4.3.1
Photodetectors: Physical principles of Photodiodes, Photo detector noise.
(Text 1: 6.1, 6.2.)
Optical Receiver: Optical Receiver Operation, Error sources. Front End Amplifiers.
(Text 1: 7.1)

**Module-4 WDM Concepts and Components (8 hours)**

Optical network evolution and concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, Public telecommunication network overview. Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, OSI reference model, Optical transport network, Internet protocol.
(Text 2: 15.1- 15.3)

**Module-5 Optical Networks (8 hours)**

Wavelength routing networks: Routing and wavelength assignment.
Switching networks: Optical circuit switched networks, packet switched networks, Multiprotocol Label Switching, Optical burst switching networks
(Text 2: 15.4 -15.5)

| **Course Outcomes:** At the end of the course the student will be able to: | |
|---|---|
| 22ECE742.1 | Explain the fundamental principles of optical fiber communication with different modes of signal propagation. |
| 22ECE742.2 | Analyze the transmission characteristics associated with dispersion and polarization techniques. |

| | |
|---|---|
| 22ECE742.3 | Evaluate the performance of optical sources, detectors and different losses in optical fiber communication. |
| 22ECE742.4 | Apply the concepts of Wavelength Division Multiplexing (WDM) and optical amplifiers to enhance communication system efficiency |
| 22ECE742.5 | Design and optimize optical fiber communication systems, considering signal losses, and network protocols. |
| 22ECE742.6 | Develop innovative optical network solutions using advanced multiplexing, switching, and routing techniques for high-speed data transmission |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Optical Fiber Communication | Gerd Keiser | Mc Graw Hill Education (India) Private Limited | 5th Edition, 2015 |
| 2 | Optical Fiber Communications, Principles and Practice | John M Senior | Pearson Education | 3rd Edition, 2010 |
| **Reference Books** | | | | |
| 1 | Fiber Optic Communication | Joseph C Palais | Pearson Education | 4th Edition, 2005 |
| 2 | Optical Networks | Rajiv Ramaswami | Elsevier | 2nd Edition, 2004 |
| 3 | Optical Fiber Communication | P Chakrabarti | McGraw Hill Education (India)Private Limited | 1st Edition, 2016 |

**Web links and Video Lectures (e-Resources):**

- NPTEL : Electrical Engineering - NOC: Fiber Optic Communication Technology
- Fiber-Optic Communication Systems and Techniques - Course

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22ECE742.1 | 2 | - | - | 1 | - | 1 | - | - | - | - | - | 2 | - |
| 22ECE742.2 | 2 | 2 | - | - | - | 1 | - | - | - | - | - | 2 | - |
| 22ECE742.3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | 2 | - |
| 22ECE742.4 | 2 | 2 | 2 | 2 | - | 2 | - | - | - | - | - | 2 | - |
| 22ECE742.5 | - | - | 3 | 2 | 2 | 2 | - | - | - | - | - | 2 | - |
| 22ECE742.6 | - | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | - |

1: Low 2: Medium 3: High

| Analog IC Design | | | |
|---|---|---|---|
| Course Code | **22ECE743** | CIE Marks | 50 |
| Course Type | Theory | SEE Marks | 50 |
| | | Total Marks | 100 |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE | 3 Hours |
| Total Hours | 40 hours | Credits | 03 |

Course Learning Objectives:

1. Understand the physics and characteristics of MOS devices
2. Analyze and design single-stage MOS amplifier configurations
3. Apply current mirror and differential amplifier concepts in analog circuit design
4. Evaluate the frequency response of MOS amplifier stages

**Module 1 – MOS Device Physics (8 hours)**

General Considerations, MOS I/V Characteristics, Second Order Effects, MOS Device Capacitance, MOS Models
(Text 1: 2.1 – 2.4)

**Module 2 – Single Stage Amplifier – I (8 hours)**

General Considerations, Common Source Stage – Resistive Load, Diode Connected Load, Current source Load, Source Degeneration,
(Text 1: 3.2-3.3)

**Module 3 – Single Stage Amplifier - II (8 hours)**

Source Follower, Common Source Stage, Cascode Stage, Basic Current Mirror, Cascode Current Mirror
(Text 1: 3.4-3.6, 5.1-5.2)

**Module 4 – Differential Amplifier (8 hours)**

Single-Ended and Differential Operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS Loads
(Text 1: 4.1-4.4)

**Module 5 – Frequency Response of Amplifiers (8 hours)**

Active Current Mirrors, Biasing Techniques, General Considerations, Common Source Stage, Source Follower, Differential Pair, Gain-Bandwidth Trade-Offs
(Text 1: 5.3, 6.1-6.3, 6.6-6.7)

| **Course Outcomes:** At the end of the course the student will be able to: | |
|---|---|
| 22EC743.1 | Explain MOS device physics, including I/V characteristics, second-order effects, and capacitance models |
| 22EC743.2 | Design and analyze single/multistage amplifiers using small-signal models and trade-offs in gain/bandwidth. |
| 22EC743.3 | Evaluate differential amplifier performance for differential vs. single-ended operation. |
| 22EC743.4 | Analyze the frequency response of analog circuits |
| 22EC743.5 | Synthesize biasing circuits to mitigate non-idealities |
| 22EC743.6 | Demonstrate analog circuit simulation (e.g., SPICE) for design validation aligned with industry practices. |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Design of Analog CMOS Integrated Circuits | Behzad Razavi | McGraw Hill Education | 2nd Edition, 2015 |
| **Reference Books** | | | | |
| 1 | Microelectronic Circuits Theory and Applications. | Adel S Sedra and Kenneth C. Smith | Oxford University Press | 7th Edition, 2017 |
| 2 | CMOS Analog Circuit Design | Phillip E. Allen and Douglas R. Holberg | Oxford University Press | 3rd Edition, 2013 |
| 3 | Analysis and Design of Analog Integrated Circuits | Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer | Wiley | 5th Edition, 2009 |

**Web links and Video Lectures (e-Resources):**

- NPTEL: https://onlinecourses.nptel.ac.in/noc22_ee37/preview
  Analog IC Design by Prof. Aniruddhan.S, Dept. of Electrical Engineering, IIT Madras

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22EC743.1 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | 3 |
| 22EC743.2 | - | 2 | 2 | - | - | - | - | - | - | - | - | - | 2 |
| 22EC743.3 | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - |
| 22EC743.4 | - | 2 | - | 2 | - | - | - | - | - | - | - | - | - |
| 22EC743.5 | - | - | 2 | - | 2 | - | - | - | - | - | - | - | - |
| 22EC743.6 | - | - | - | - | 2 | 2 | - | - | - | - | - | - | 2 |

1: Low 2: Medium 3: High

| Network Security | | | |
|---|---|---|---|
| Course Code | 22ECE744 | 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:

1. Gain a fundamental understanding of information security and its significance in real-world applications.
2. Explore and analyze various cryptographic algorithms.
3. Understand the critical role of internet security and the protocols used for ensuring IP security.
4. Learn about different types of viruses, intrusion detection systems, and firewall mechanisms.
5. Familiarize with various techniques used for generating authentication codes.

**Module-1 Introduction to Network Security (8 hours)**

Security Concepts: Introduction, The OSI security architecture, Security attacks, Security services, Security Mechanisms, A model for Network Security

Classical Encryption Techniques: Symmetric Cipher Model, Substitution techniques, Transposition techniques, Stenography.

(Text 1: Chapter 1 (1.2-1.6), Chapter 2 (2.1- 2.3, 2.5))

**Module-2 Block Cipher and Data Encryption Standard (8 hours)**

Block Cipher principles, DES, Strength of DES, Block cipher Design Principles AES, Block cipher modes of operation, Stream ciphers, RC4.

Asymmetric key Ciphers: Principles of public key cryptosystems, RSA algorithm, Key Management, Diffie-Hellman Key Exchange.

(Text 1: Chapter 3 (3.1-3.3, 3.5), Chapter 5 (5.2), Chapter 6(6.2-6.3), Chapter 9 (9.1,9.2) Chapter 10(10.1,10.2))

**Module-3 Key Management and Distribution (8 hours)**

Authentication requirements, Authentication functions, Message Authentication Codes, Hash functions, Security of Hash functions and MACs, HMAC, CMAC, Digital Signatures

(Text 1: Chapter 11 (11.1-11.5), Chapter 12 (12.3.12.4), Chapter 13(13.1))

**Module-4 Email Security & Web Security (8 hours)**

E-Mail Security: Pretty Good Privacy, S/MIME Web Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transactions.

(Text 1: Chapter 15(15.1,15.2), Chapter 17(17.1-17.3))

**Module-5 Firewalls and Virtual Private Network (VPN) (8 hours)**

Introduction, Brief Introduction to TCP/IP, Firewalls, IP Security, Virtual Private Networks, Intrusion, Case Studies on Cryptography and Security: Secure Multiparty Calculation, Virtual Elections, Single sign On, Secure Inter-Branch Payment Transactions, Cross site Scripting Vulnerability.

(Text 2: Chapter 9, Chapter 10)

| **Course Outcomes:** At the end of the course the student will be able to: | |
|---|---|
| 22ECE744.1 | Outline the significance of information security and various security mechanisms in real-world applications |
| 22ECE744.2 | Analyze different conventional and public key encryption algorithms to assess their effectiveness. |
| 22ECE744.2 | Apply various methods to compute authentication codes using Message Authentication Code. |

| | |
|---|---|
| 22ECE744.4 | Apply different techniques to generate authentication codes using Hash Functions. |
| 22ECE744.5 | Describe security implementations across different network layers, email, and web communications. |
| 22ECE744.6 | Apply the concepts of network security and mechanisms used for intrusion detection. |

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Cryptography and Network Security | William Stallings, | Pearson Education | 4th Edition, 2005 |
| 2 | Cryptography and Network Security | Atul Kahate | McGraw-Hill Edition | 2nd Edition, 2008. |
| **Reference Books** | | | | |
| 1 | Cryptography and Network Security | Behrouz A Forouzan, Debdep Mukhopadhyay | McGraw-Hill | 2nd Edition, 2010 |
| 2 | Introduction to Network Security | Neal Krawetz | Cengage Learning | 1st Edition, 2006 |

**Web links and Video Lectures (e-Resources):**

- https://onlinecourses.nptel.ac.in/noc22_cs90/preview
- https://archive.nptel.ac.in/courses/106/105/106105031/

## Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 22ECE744.1 | 3 | - | - | - | - | - | - | - | - | - | - | 1 | - |
| 22ECE744.2 | - | 2 | - | - | - | - | - | - | - | - | - | 2 | - |
| 22ECE744.2 | - | - | 3 | - | - | - | - | - | - | - | - | - | - |
| 22ECE744.4 | - | - | - | 3 | - | - | - | - | - | - | - | - | - |
| 22ECE744.5 | - | - | - | - | 2 | - | - | 2 | - | - | - | 1 | - |
| 22ECE744.6 | - | - | - | - | 2 | - | - | 2 | 2 | - | - | - | - |

1: Low 2: Medium 3: High

| Major Project Phase II | | | |
|---|---|---|---|
| Course Code | 22ECE75 | 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 | 72 hours | Credits | 06 |

Course Learning Objectives:

1. Utilize fundamental principles of engineering and interdisciplinary knowledge to identify, analyze, 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. 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.

**3. Final Submission**

- Report: The 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.<br>● 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.<br>● 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.<br>● Project Archive: Store all projects in the department's digital archive for future reference. |

| **Continuous Internal Evaluation (CIE)** | | |
|---|---|---|
| **Description** | **Proposed Dates** | **CIE Weightage (Max 100 marks)** |
| 1. Project Progress Evaluation -I | Beginning of the 7th Semester | 20 marks |
| 2. Project Progress Evaluation -II | Middle of the 7th Semester | 30 marks |
| 3. Project Report Evaluation (Phase II) | End of the 7th Semester | 50 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. | | |

| **Course Outcomes:** At the end of the course the student will be able to : | |
|---|---|
| 22ECE75.1 | Outline the current state of knowledge in their field of interest and identify key research gaps for further investigation |
| 22ECE75.2 | Explain the theoretical concepts and practical applications relevant to their field of study and critically assess how they can be applied to solve real-world problems. |
| 22ECE75.3 | Identify, analyze, and solve complex problems that arise during the course of research and development, and propose innovative solutions based on evidence. |
| 22ECE75.4 | Apply hands-on experience and technical proficiency in the chosen area of specialization by designing and building a functional model or prototype to solve a real-world problem |
| 22ECE75.5 | Interpret project findings through reports, presentations, and demonstrations, and effectively communicate complex ideas to diverse audiences while responding to feedback and questions with clarity and confidence |

| | |
|---|---|
| 22ECE75.6 | Demonstrate effective team coordination by articulating ideas clearly, delegating tasks based on team members' strengths, resolving conflicts, and ensuring collective goal achievement |

**Course Articulation Matrix**

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE75.1 | - | 2 | 2 | 1 | - | 2 | 1 | 1 | 3 | 2 | 3 | 3 | 3 |
| 22ECE75.2 | - | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 3 |
| 22ECE75.3 | 3 | 3 | 2 | 3 | 2 | 3 | 2 | 3 | 1 | 2 | 1 | 3 | 3 |
| 22ECE75.4 | - | - | - | - | 2 | 3 | 2 | 1 | 2 | 2 | 1 | 3 | 3 |
| 22ECE75.5 | - | - | - | - | - | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 |
| 22ECE75.6 | - | - | - | - | - | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 |

1: Low 2: Medium 3: High

# VIII Semester

| Professional Elective – IV (Online Course) | | | |
|---|---|---|---|
| Course Code | 22ECE81 | 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 Hrs |
| Total Hours | 36 hours | Credits | 03 |

Course Learning Objectives:

1. Understand and apply foundational concepts and principles of the chosen elective domain to real-world engineering problems.
2. Develop the ability to learn independently and navigate MOOC platforms effectively to acquire domain-specific knowledge and skills.
3. Demonstrate analytical and problem-solving abilities by engaging in course assessments, simulations, case studies, or project-based activities.
4. Interpret and evaluate course content critically from multiple sources including video lectures, reading materials, and peer discussions.
5. Integrate interdisciplinary knowledge gained from the MOOC into core engineering subjects for innovative applications or design thinking.
6. Communicate technical ideas and solutions effectively, both in written and oral form, based on the knowledge acquired through the online course.

*Note: In case of MOOCs certificates submitted by the students, the marks/grade shall be awarded based on the percentage of marks/grade reflected in the certificates.

**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/academic session.

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 3 credits. Typically, a 3-credit MOOC will require around 35-40 hours of study, 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 enroll for one 12-weeks MOOCs course to earn 3 credits. However, Students can also take one 8-weeks MOOCs + one 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied. The total performance in the MOOCs will be average of performances considering both MOOCs courses

**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 : | |
|---|---|
| 22ECE81.1 | Identify a relevant and approved course that aligns with individual interests or career goals beyond the existing curriculum |
| 22ECE81.2 | Demonstrate self-directed learning by engaging with video lectures, assignments, and quizzes in the chosen online course. |
| 22ECE81.3 | Develop time management and digital learning skills by systematically completing the course within the prescribed timeframe. |
| 22ECE81.4 | Evaluate and reflect on the learning process and outcomes through participation in assessments and online discussions. |
| 22ECE81.5 | Apply the knowledge gained from the MOOC to real-world scenarios, interdisciplinary projects, or advanced academic pursuits. |
| 22ECE81.6 | Obtain certification upon successful completion of the chosen MOOC, demonstrating consistent effort and commitment to continuous learning |

**Course Articulation Matrix**

| **Course Outcomes (COs)** | **Program Outcomes (POs)** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE81.1 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 22ECE81.2 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 22ECE81.3 | 2 | - | - | - | 2 | - | - | - | - | - | 3 | 2 | 2 |
| 22ECE81.4 | - | - | - | - | - | - | - | - | 2 | - | 3 | - | - |
| 22ECE81.5 | - | - | - | - | - | 3 | - | - | - | - | 3 | - | - |
| 22ECE81.6 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

1: Low 2: Medium 3: High

| Open Elective – II (Online Course) | | | |
|---|---|---|---|
| Course Code | 22ECE82 | 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 Hrs |
| Total Hours | 36 hours | Credits | 03 |

Course Learning Objectives:

1. Gain foundational and interdisciplinary knowledge in a subject outside the core engineering specialization to promote broader intellectual development.
2. Understand key theories, models, and practices related to the open elective topic, as delivered through MOOC lectures, readings, and assessments.
3. Develop the ability to learn independently and manage learning schedules, leveraging the flexibility of the MOOC platform.
4. Apply the acquired knowledge to real-world contexts, demonstrating the relevance of interdisciplinary learning to personal, professional, or societal challenges.
5. Enhance digital learning competencies, including navigating online resources, participating in online discussions, and completing online assessments effectively.
6. Foster critical thinking, creativity, and lifelong learning mind-set by exploring new domains and expanding personal and professional interests.

*Note: In case of MOOCs certificates submitted by the students, the marks/grade shall be awarded based on the percentage of marks/grade reflected in the certificates.

**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 3 credits. Typically, a 3-credit MOOC will require around 35-40 hours of study, 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 enroll for one 12-weeks MOOCs course to earn 3 credits. However, Students can also take one 8-weeks MOOCs + one 4-weeks MOOCs instead of one course. In each case, the number of hours of study mentioned shall be satisfied. The total performance in the MOOCs will be average of performances considering both MOOCs course.

**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 Enrolment**

3.1 Official Enrolment: 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 : | |
|---|---|
| 22ECE82.1 | Identify a relevant and approved course that aligns with individual interests or career goals beyond the existing curriculum |
| 22ECE82.2 | Demonstrate self-directed learning by engaging with video lectures, assignments, and quizzes in the chosen online course. |
| 22ECE82.3 | Develop time management and digital learning skills by systematically completing the course within the prescribed timeframe. |
| 22ECE82.4 | Evaluate and reflect on the learning process and outcomes through participation in assessments and online discussions. |
| 22ECE82.5 | Apply the knowledge gained from the MOOC to real-world scenarios, interdisciplinary projects, or advanced academic pursuits. |
| 22ECE82.6 | Obtain certification upon successful completion of the chosen MOOC, demonstrating consistent effort and commitment to continuous learning |

**Course Articulation Matrix**

| **Course Outcomes (COs)** | **Program Outcomes (POs)** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE82.1 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 22ECE82.2 | 2 | - | - | - | - | - | - | - | - | - | 3 | 2 | 2 |
| 22ECE82.3 | 2 | - | - | - | 2 | - | - | - | - | - | 3 | 2 | 2 |
| 22ECE82.4 | - | - | - | - | - | - | - | - | 2 | - | 3 | - | - |
| 22ECE82.5 | - | - | - | - | - | 3 | - | - | - | - | 3 | - | - |
| 22ECE82.6 | - | - | - | - | - | - | - | - | - | - | 2 | - | - |

1: Low 2: Medium 3: High

| Research/Industry Internship | | | |
|---|---|---|---|
| Course Code | 22ECE83 | CIE Marks | 50 |
| Course Type (Theory/Practical/Integrated) | Practical | SEE Marks | 50 |
| | | Total Marks | 100 |
| Number of Weeks | 14-16 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 instil 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 mind-set 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 7$^{th}$ semester BE. Students shall submit the Research Internship Proposal and make a presentation and answer questions raised by the Departmental Internship Evaluation Committee (DIEC).<br>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 8$^{th}$ 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.<br>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 8$^{th}$ 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.<br>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 8$^{th}$ 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.<br>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: | |
|---|---|
| 22ECE83.1 | Apply research methodologies and modern engineering tools to design, test, and analyze systems in Engineering Domain |
| 22ECE83.2 | Identify and solve complex problems in circuits, VLSI, signal processing, communication networks, algorithms, and computing systems through systematic and innovative research. |
| 22ECE83.3 | Acquire proficiency in advanced tools and technologies including simulation software, hardware prototyping platforms, programming frameworks, and testing instruments. |
| 22ECE83.4 | Develop skills to write technical reports, research papers, and effectively present findings. |
| 22ECE83.5 | Apply ethical practices in research by ensuring data integrity, proper citations, avoidance of plagiarism, and responsible use of technology. |
| 22ECE83.6 | Collaborate effectively in interdisciplinary research teams to achieve shared goals in areas such as IoT, embedded systems, wireless communication, data science, and AI. |

**References**


1. AICTE Internship Policy: Guidelines and Procedures 2019. Available at https://aicteindia.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 2025 Available at https://vtu.ac.in/wp-content/uploads/2025/07/Mandetory-Guidelines-for-Internship-V3_watermark-1.pdf


## Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE83.1 | 1 | - | 2 | 3 | - | - | - | - | - | - | - | - | - |
| 22ECE83.2 | 3 | 2 | - | - | - | - | - | - | - | - | - | 2 | 2 |
| 22ECE83.3 | - | - | - | - | 3 | 2 | - | - | - | - | 1 | - | - |
| 22ECE83.4 | - | - | - | - | - | - | - | - | 3 | - | 1 | - | - |
| 22ECE83.5 | - | - | - | - | - | 2 | 3 | - | - | - | 1 | - | - |
| 22ECE83.6 | - | - | - | - | - | - | - | 3 | 2 | 1 | - | - | - |

1: Low 2: Medium 3: High

| Research/Industry Internship | | | |
|---|---|---|---|
| Course Code | 22ECE83 | CIE Marks | 50 |
| Course Type (Theory/Practical/Integrated) | Practical | SEE Marks | 50 |
| | | Total Marks | 100 |
| Number of Weeks | 14-16 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 instil 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 8$^{th}$ 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.<br>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 8$^{th}$ 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.<br>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 8$^{th}$ 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.<br>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: | |
|---|---|
| 22ECE83.1 | Apply core engineering concepts and domain-specific knowledge to solve real-world industrial problems. |
| 22ECE83.2 | Enhance problem-solving abilities by identifying, analyzing, and delivering innovative solutions to complex engineering challenges. |
| 22ECE83.3 | Develop key professional skills such as teamwork, effective communication, adaptability, and time management in corporate, industrial, or research environments. |
| 22ECE83.4 | Gain exposure to industry-standard tools, technologies, and methodologies, including software platforms, hardware systems, design frameworks, and regulatory standards relevant to their field of study. |

| | |
|---|---|
| 22ECE83.5 | Demonstrate adherence to professional ethics, data integrity, safety regulations, and social responsibilities while working in industrial or organizational settings. |
| 22ECE83.6 | Build professional networks and gain insights into career pathways, fostering preparedness for employment and lifelong learning in diverse engineering sectors. |

**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 2025 Available at https://vtu.ac.in/wp-content/uploads/2025/07/Mandetory-Guidelines-for-Internship-V3_watermark-1.pdf


## Course Articulation Matrix

| Course Outcomes (COs) | Program Outcomes (POs) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PSO1** | **PSO2** |
| 22ECE83.1 | 3 | 2 | - | - | - | 1 | - | - | - | 1 | - | 1 | 1 |
| 22ECE83.2 | - | 3 | 2 | 1 | - | - | - | - | - | 1 | - | 2 | 2 |
| 22ECE83.3 | - | - | - | - | - | - | - | 3 | 2 | - | - | - | - |
| 22ECE83.4 | - | - | - | - | 3 | 2 | - | - | - | - | 1 | - | - |
| 22ECE83.5 | - | - | - | - | - | 2 | 3 | - | - | - | - | - | - |
| 22ECE83.6 | - | - | - | - | - | - | - | 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. (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