# Electronics and Communication Engineering

## FACULTY OF ENGINEERING & TECHNOLOGY
## 2023 Scheme & Syllabus

Scheme of
Teaching & Evaluation for
**B.Tech. – III & IV YEAR**

## VISION

- To develop an ethical and a competent global workforce with an inquisitive mind.

## MISSION

- To equip the students with professional skills, ethical values and competency.
- To offer state of the art programs by collaborating with industry, academia and society.
- To undertake collaborative & inter disciplinary research for overall development.
- To develop leaders and entrepreneurs for the real and sustainable world

## VALUES

### EQUITY
The University will ensure the education imparted will be fair and impartial.

### EMPATHY
The University will imbibe a culture to understand and share the feelings of another.

### EXCELLENCE
The University in its true spirit will deliver quality education and chase perfection.

### EXPEDITIOUS
The University will carry out the day-to-day work with speed and efficiency and adapt quickly to the changes.

### ETHICS
The University will govern and instill stakeholders with moral principles.

# Program Outcomes

PO1: **Engineering Knowledge:** Apply principles of mathematics, natural sciences, computing, engineering fundamentals, and specialized engineering knowledge to develop solutions for complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, and Analyse complex engineering problems by reviewing research literature and drawing well-founded conclusions, while considering sustainable development.

PO3: **Design/Development of Solutions:** Design innovative solutions for complex engineering problems and develop systems, components, or processes that address identified needs, considering public health and safety, whole-life cost, net-zero carbon goals, culture, society, and environmental impact.

PO4: **Conduct Investigations of Complex Problems:** Utilize research-based knowledge to investigate complex engineering problems, incorporating experiment design, modelling, data analysis, and interpretation to derive valid conclusions.

PO5: **Engineering Tool Usage:** Develop, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, while recognizing their limitations in solving complex engineering problems.

**PO6: The Engineer and the World:** Assess and evaluate societal and environmental factors when addressing complex engineering problems, considering their impact on sustainability in relation to the economy, health, safety, legal frameworks, culture, and the environment.

PO7: **Ethics**: Uphold ethical principles, demonstrate commitment to professional integrity, respect human values, and promote diversity and inclusion while adhering to national and international laws.

PO8: **Individual and Team Collaboration:** Work effectively both independently and as a member or leader in diverse, multidisciplinary teams.

PO9: **Communication:** Communicate clearly and inclusively within the engineering community and society, demonstrating the ability to write effective reports, develop design documentation, and deliver impactful presentations while considering cultural, language, and learning differences.

PO10: **Project Management and Finance:** Apply engineering management principles and economic decision-making to one's work, effectively managing projects and contributing as both a team member and leader in multidisciplinary environments.

PO11: **Life-Long Learning:** Acknowledge the importance of continuous learning and cultivate the skills necessary for:

i) Independent and sustained self-improvement,
ii) Adaptability to evolving and emerging technologies, and
iii) Critical thinking in the broader landscape of technological advancements

# DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

## VISION

To be a leading department in electronics and communication engineering, fostering innovation and excellence in technology, and empowering students to become visionary leaders and problem solvers in a dynamic global landscape.

## MISSION

**M1:** Provide a cutting-edge education that integrates theoretical knowledge with practical application.

**M2:** Conduct pioneering research that advances the field of electronics and communication.

**M3:** Collaborate with industry and academia to address real-world challenges and drive technological progress.

## PROGRAMME SPECIFIC OUTCOME (PSO'S)

**PSO1:** To understand the principles, processes, techniques and design aspects of electronic devices, circuits and communication systems.
**PSO2:** To apply, analyze and design electronic circuits, communication systems, embedded systems by using higher engineering mathematical foundations, computational principles and network modelling skills.
**PSO3:** To develop electronic hardware and software systems for universal requirements using sensors, embedded controllers, signal processors, analog and digitally integrated chips.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S)

**PEO 1:** To acquire strong knowledge in Basic Science, Mathematics and ability to apply this knowledge in the relevant fields of Electronics & Communication Engineering.
**PEO 2:** To develop technical competence and uplift research ability to solve real time problems.
**PEO 3:** To obtain professional Excellency through lifelong learning and produce graduates with professional values.

## V - Semester

| S.No | Course | Course Code | Course Title | Teaching Department (TD) and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | IPCC | **23ECE510** | CMOS IC Design | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | **23ECE520** | Microprocessors and Microcontrollers | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 3 | IPCC | **23ECE530** | Digital Communication | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 4 | PCC | **23ECE540** | Sensors and Actuators | ECE | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 5 | PEC | **23ECE551/ 23ECE552/ 23ECE553/** | 1. Linear IC Applications 2. Smart and Virtual Instrumentation 3. ASIC Design and Verification | ECE | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 6 | SEC | **23ECE561/ 23ECE562/ 23ECE563** | 1. IoT and its Applications 2. Python Programming for Machine Learning Applications 3. DEVOPS | ECE | If course is theory: 1 / If course is lab: 0 | 0 | 0 / 2 | 0 | 01 / 02 | 50 | 50 | 100 | 1 |
| 7 | AEC | **23AAE570** | Advanced Aptitude | Any Dept. | 1 | 0 | 0 | 0 | 02 | 50 | 50 | 100 | 1 |
| 8 | MC | **23NSE580** | National Service Scheme (NSS) | NSS Coordinator | 0 | 0 | 2 | 0 | 0 | 100 | - | 100 | |
| | | **23PEE580** | Physical Education (PE) (Sports and Athletics) | Physical Education Director | | | | | | | | | |
| | | **23YOE580** | Yoga | Yoga Teacher | | | | | | | | | |
| | | | | | | | | | | **450** | **350** | **800** | **20** |

## VI - Semester

| SN | Course | Course Code | Course Title | Teaching Department (TD) and Question Paper Board Setting (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | IPCC | **23ECE610** | Digital Signal Processing | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | **23ECE620** | ARM Controllers and Embedded Systems | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 3 | IPCC | **23ECE630** | Data Communication and Computer networks | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 4 | AEC | **23MEE640** | Management and Entrepreneurship | Any Dept. | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 5 | PEC | **23ECE651/ 23ECE652/ 23ECE653** | 1. Antenna & Wave Propagation<br>2. Power Electronics<br>3. System on Chip | ECE | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 6 | OE | **23ECE661/ 23ECE662/ 23ECE663** | 1. Model Based Development using Simulink<br>2. FPGA System Design using Verilog<br>3. Network Security | ECE | If course is theory: 1 | 0 | 0 | 0 | 01 | 50 | 50 | 100 | 1 |
| | | | | | If course is lab: 0 | 0 | 2 | 0 | 02 | | | | |
| 7 | PROJ | **23ECE670** | Mini Project | ECE | 0 | 0 | 2 | 1 | 03 | 100 | - | 100 | 1 |
| 8 | MC | **23IKS680** | Indian Knowledge System | Any Dept | 1 | 0 | 0 | 0 | - | 100 | -- | 100 | 0 |
| | | | | | | | | | | **500** | **300** | **800** | **20** |

## VII - Semester

| SN | Course | Course Code | Course Title | Teaching Department (TD)and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | IPCC | **23ECE710** | Low Power VLSI Design | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 2 | IPCC | **23ECE720** | Microwave and Optical Communication | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 3 | IPCC | **23ECE730** | Data Structures using Python | ECE | 3 | 0 | 2 | 0 | 03 | 50 | 50 | 100 | 4 |
| 4 | PEC | **23ECE741/**<br>**23ECE742/**<br>**23ECE743/** | 1. RADAR Engineering<br>2. ADHOC and Sensor Networks<br>3. Satellite Communication | ECE | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 5 | PROJ | **23ECE750** | Major Project | ECE | 0 | 0 | 6 | 0 | 03 | 50 | 50 | 100 | 6 |
| 6 | OE (CERT) | **23ECE760**** | Credit Transfer Certification Courses | ECE | 2 | 0 | 0 | 2 | 03 | 30 | 70 | 100 | 2 |
| | | | | | | | | | | **280** | **320** | **600** | **23** |

**PCC**: Professional Core Course, **OE**-Open Elective**, CERT**- Certification Course, **PEC**: Professional Elective Course, **PROJ**: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD**- Teaching Department, **PSB**: Paper Setting Board (Department), **PEC**: Professional Elective Course, **SEC**: Skill Enhancement Course. **CERT:** Credit Transfer Certification Courses. **INT:** Internship

****Credit Transfer Certification Courses:** The Credit Transfer Certification Course is a UGC initiative offered through the SWAYAM platform/Credible MOOCS, providing online credit-eligible courses across various engineering domains. Students must enroll in an equivalent credit course, as decided by the departments which is to be in nature, ensure it is a subject not studied in previous semesters and it may be inter-disciplinary also.

Universities must register with SWAYAM or establish a local chapter to enable participation. SWAYAM provides all learning materials and evaluates assignments, which carry 30 marks as part of the Continuous Internal Evaluation (CIE). The Semester End Examination (SEE) is conducted by the university under the Controller of Examinations for 70 marks.

**VIII - Semester**

| SN | Course | Course Code | Course Title | Teaching Department (TD)and Question Paper Setting Board (PSB) | Teaching Hours /Week | | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | SDA | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | S | | | | | |
| 1 | PCC | **23ECE810** | Wireless Communication | ECE | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 2 | PEC | **23RMI821/**<br>**23ECE822/**<br>**23ECE823** | 1.Research Methodology and IPR<br>2.Artifical Intelligence & Machine learning (AI &ML)<br>3.Micro-Electro Mechanical Systems (MEMS) | ECE | 3 | 0 | 0 | 0 | 03 | 50 | 50 | 100 | 3 |
| 3 | INT | **23ECE830** | Internship | ECE | -- | -- | - | - | 03 | 100 | 100 | 200 | 8 |
| 4 | OE (CERT) | **23ECE840**** | Credit Transfer Certification Courses | ECE | 3 | 0 | 0 | 3 | 03 | 30 | 70 | 100 | 3 |
| | | | | | | | | | | **230** | **270** | **500** | **17** |

**Professional Elective Courses (PEC):** A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

**Open Elective (OE):** Students may choose open electives offered by other departments. They are also allowed to take open electives offered by their own department, subject to eligibility. If a student opts to take an equivalent credit course from another department, they must forgo a corresponding course from their parent department. Any course selected as an open elective must not duplicate a course the student has already completed or is currently enrolled in.

**Internship:** Internship must be completed during intervening vacations of $6^{Th}$ and $7^{Th}$ semesters or $7^{Th}$ and $8^{Th}$ semester with minimum 6 to 8 weeks

**Mini-project work:** Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc.

Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:**

I. **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.
**No SEE component for Mini-Project**

**PROJECT:** The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.
(ii) To develop interactive attitude, communication skills, organization, time management, and presentation skills.
(iii) To impart flexibility and adaptability.
(iv) To inspire team working.
(v) To expand intellectual capacity, credibility, judgment and intuition.
(vi) To adhere to punctuality, setting and meeting deadlines.
(vii) To install responsibilities to oneself and others.
(viii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

**CIE procedure for Project Work:**

(1) **Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work, shall be based on the evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) **Interdisciplinary:** Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

**SEE procedure for Project Work:** SEE for project work will be conducted by the two examiners appointed by the University. The SEE marks awarded for the project work

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# CMOS IC DESIGN

| | | | |
|---|---|---|---|
| Course Code | **23ECE510** | CIE Marks | **50** |
| Teaching Hours/Week (L:T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **03** |
| Examination Type (SEE) | **IPCC** | | |

**Prerequisites:** Analog Electronics Circuits and Digital Circuit Design

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Give exposure to different steps involved in the fabrication of ICs and know the basic electrical properties of MOS.*
*COB-2: Understand the VLSI Design flow, Design rules, MOS Layers, and to draw stick diagrams and layouts for NMOS and CMOS Inverters.*
*COB-3: Understand the logic gates and alternative Gates and to Evaluate the time delays, wiring capacitance, fan-in and fan-out in the digital circuit performance.*
*COB-4: Study MOS-based current sources, mirrors, and voltage references for efficient analog circuit performance*
*COB-5: Understand basic programmable logic devices and testing of CMOS circuits.*

**Module-I**

**Introduction to MOS Technology:** MOS: PMOS, NMOS, CMOS & Bi-CMOS
**Basic Electrical Properties:** Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds; Pass transistor, Various pull ups.

**Module-II**

**VLSI Circuit Design Processes**: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits.

**Module-III**

**Gate Level Design**: Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Time delays, driving large capacitive loads, Wiring capacitance, Fan – in, Fan – out.

**Module-IV**

**Analog CMOS Sub-Circuits:** MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors-Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Bandgap Reference.

**Module-V**

**Programmable Logic Devices and CMOS Testing**: **Design Approach** – PLA, PAL, Standard Cells FPGAs, CPLDs.
**CMOS Testing**: CMOS Testing, Test Principles, Design Strategies for test, Chip level Test Techniques

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Acquire qualitative knowledge about the fabrication process of integrated circuits using MOS transistors.*
*CO-2: Understand VLSI design flow, Draw the layout of any logic circuit which helps to understand and estimate Parasitic effect of any logic circuit.*

*CO-3: Design various logic gates and should be able to Evaluate the time delays, wiring capacitance, fan-in and fan-out effects for optimized digital circuit performance.*

*CO-4: Analyze and design MOS-based current sources, mirrors, and voltage references for efficient analog circuit performance.*

*CO-5: Design the PLAs, PALs, FPGAs and CPLDs for digital circuit Implementation. Explore different types of faults that can occur in a system and learn the concept of testing and adding extra hardware to improve testability of system.*

**PRACTICAL COMPONENT:**

**LIST OF EXPERIMENTS**

**A. CYCLE1**

1. Draw a CMOS circuit of inverter and buffer for specified length and width using schematic and draw the layout for the same using a specified technology.
2. Realize a two input NAND gate using CMOS logic and verify its truth table in both schematic and layout for specified technology.
3. Realize a two input NOR gate using CMOS logic and verify its truth table in both schematic and the layout for specified technology.
4. Implement a full adder circuit with minimum length and width and verify its timing diagram. Make a Verilog file of the schematic and generate the layout. Verify the timing diagram in the layout.
5. Implement a 4-bit parallel adder circuit with minimum length and width and verify its timing diagram. Make a Verilog file of the schematic and generate the layout. Verify the timing diagram in the layout.
6. Implement a 4:1 Multiplexer using Transmission Gate (TG). Verify the truth table in the schematic editor. Make a Verilog file of the schematic and generate the layout. Show the 2D and 3D view for the layout.

**B. CYCLE 2**

7. Implement D flip flop with Clock, Preset and Clear. Make a verilog file of the schematic and generate the layout. Verify its timing diagram in both schematic and layout.
8. Implement a JK flip flop with Clock, Preset and Clear. Make a verilog file of the schematic and generate the layout. Verify its timing diagram in both schematic and layout.
9. Implement a T flip flop with Clock, Preset and Clear. Make a verilog file of the schematic and generate the layout. Verify its timing diagram in both schematic and layout.
10. Implement a serial register capable of holding and shifting 4-bit words. Make a verilog file of the schematic and generate the layout. Verify its timing diagram in both schematic and layout. Show the 3Dand 2D view for the layout.
11. Implement a serial adder circuit with minimum length and width and verify its timing diagram. Make verilog file of the schematic and generate the layout. Verify the timing diagram in the layout.
12. Design a 4-bit Asynchronous Counter using D flip flop in schematic editor. Make a verilog file of the Schematic and generate the layout. Verify the timing diagram in the schematic and layout.

**Text Books:**

1. K. Eshraghian, E. Dougles, and A. Pucknell, Essentials of VLSI Circuits and Systems. PHI, 2005, ISBN 978-8120327221.
2. N. H. E. Weste, D. Harris, and A. Banerjee, CMOS VLSI Design – A Circuits and Systems Perspective, 3rd ed. Pearson, 2009, ISBN 978-8131717037.
3. B. Razavi, Design of Analog CMOS Integrated Circuits. Tata McGraw Hill, ISBN 978-0072380323.

**Reference Books:**

1. P. E. Allen and D. R. Holberg, CMOS Analog Circuit Design, International Second Edition/Indian Edition. Oxford University Press, 2010, ISBN 978-0195691954.
2. M.-B. Lin, Introduction to VLSI Systems: A Logic, Circuit and System Perspective. CRC Press, 2011, ISBN 978-1439868591.
3. J. P. Uyemura, CMOS Logic Circuit Design. Springer, 2007, ISBN 978-0387717391.
4. W. Wolf, Modern VLSI Design, 3rd ed. Pearson Education, 1997, ISBN 978-0130619708

# MICROPROCESSORS AND MICROCONTROLLERS

| | | | |
|---|---|---|---|
| Course Code | **23ECE520** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Computer Organization and Architecture and C- Programming basics

***COURSE OBJECTIVES*:**

***The objectives of the course are to enable students to:***

*COB-1: Understand the 8086 microprocessor's architecture, to distinguish microprocessors from micro-controllers, RISC, CISC, Harvard, and Von Neumann CPU architectures*

*COB-2: Understand the architecture, memory organization, and instruction set of the 8051 microcontroller and develop basic application programs using assembly language*

*COB-3: Understand and program serial communication and interrupt handling in the 8051 microcontroller, including interfacing with RS-232 and managing external hardware interrupts.*

*COB-4: Learn real-time control using the 8051 microcontrollers by programming timers, counters, and handling various interrupts including timer, external hardware, and serial communication interrupts*

*COB-5: Understand the interfacing of I/O devices and memory with the 8051 microcontroller, and to explore various serial communication protocols and bus interfaces for embedded system applications*

## Module-I

**8086 Architecture:** 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086. Difference between Microprocessors and Microcontrollers, RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture.

## Module-II

**8051 Microcontroller:** Introduction, Architecture of 8051, Pin diagram of 8051, Memory organization, Stacks, Addressing Modes.

**Instruction Set:** Introduction, Instruction set of 8051: Data transfer instructions, Arithmetic Instructions, Logical Instructions, Branch control instructions, Bit oriented instructions. Application Programs: Incrementing, Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic, sorting programs.

## Module-III

**8051 Serial communication and Interrupts Programming:** Introduction, Basics of Serial Data Communication, 8051 Serial Communication, connections to RS-232, Serial Communication Programming in assembly.

**Basics of interrupts:** 8051 interrupt structures, Priority of interrupts and Programming External Hardware Interrupts.

## Module-IV

**8051 Real Time Control:** Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters.

**Module-V**

**I/O And Memory Interface:** LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

**Serial Communication and Bus Interface:** Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232, USB.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

***CO-1****: Analyze the working of the 8086 microprocessor and differentiate between microprocessors, microcontrollers, and various CPU architectures.*

***CO-2:*** *Write and execute assembly-level programs for the 8051-microcontroller involving arithmetic operations, data manipulation, and control instructions.*

***CO-3****: Implement serial communication and interrupt-based applications using assembly language on the 8051 microcontrollers.*

***CO-4:*** *Design and implement real-time embedded applications using timers, counters, and interrupt programming on the 8051 microcontrollers.*

***CO-5****: Interface peripherals like LCDs, keyboards, ADC/DAC, and implement serial communication using I2C, SPI, UART, RS232, and USB with the 8051 microcontrollers*

**PRACTICAL COMPONENTS**

**LIST OF THE EXPERIMENTS**

**Part A: Assembly Language Programming using 8086 and 8051**

1. Write an ALP to perform 16-bit Addition, Subtraction using 8086.
2. Write an ALP to perform Multiplication and Division using 8086.
3. Write an ALP to arrange the given numbers in ascending and descending order using bubble sorting method using 8086.
4. Write a program to move and interchange data from source to destination.
5. Write Program to Add and Subtract multi byte numbers.
6. Write a Program to find square and Cube of a number.
7. Write a Program to convert BCD to ASCII and ASCII to BCD.

**Part B: C-Language Programming using 8051**

1. Write a C program for LED Blinking and to turn on Buzzer.
2. Write a C program to display the characters in touch screen LCD.
3. Write a C program to interface ADC.
4. Write a C program to interface Keypad using Seven Segment Display.
5. Write a C program to interface Stepper Motor.
6. Write a C program to interface UART.
7. Write a C program to interface DAC.

**Text Books:**

1. Advanced Microprocessors and Peripherals A. K. Ray and K. M. Bhurchandani TMH 2nd Edition 2006
2. The 8051 Micro controller and Embedded Systems – using assembly and C Muhammad Ali Mazidi and Janice Gillespie Mazidi and RollinD. McKinl ay PHI, Pearson Publication 2014.

**Reference Books:**

1. The 8051 Micro controller Architecture, Programming and Application Kenneth J Ayala Pen ram international publication 3rd Edition 2016.
2. Microcontrollers Architecture, programming, Interfacing and System Design Raj Kamal Dorling Kindersley (India) publication 2011.

**E-References:**

1. https://www.amazon.com/The-8051-Microcontroller-Embedded-Systems/dp/0131194055,
2. Online Resource - Embedded Systems and Microcontrollers by Dr. S. K. Singh (NPTEL Course)

**DIGITAL COMMUNICATION**

| | | | |
|---|---|---|---|
| Course Code | **23ECE530** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Analog Communications

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand and analyze various digital modulation techniques, including coherent and non-coherent modulation methods, and their respective error probabilities.*
*COB-2: Understand the digital signals and process the signal over AWGN Channel and Detect the probability error for Digital PAM*
*COB-3: Know the Principles of Spread Spectrum Communication Systems and to combat the Effect of De-spreading on a narrowband Interference and Probability of error.*
*COB-4: Understand the Measure of information, encoding techniques and its error encoding.*
*COB-5: Analyze the Matrix description of Linear Block Codes and methods of Controlling Errors, Types of Errors, types of Codes.*

**Module-I**

**Digital Modulation Techniques:** Amplitude Phase shift keying,Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, 16-QAM Modulation and QAM constellation, M- aryPSK. M-aryQAM.

**Frequency shift keying techniques using Coherent detection:** BFSK generation, detection and error probability. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation).

**Module-II**

**Signaling Communication through Band Limited AWGN Channels:**

**Signaling over AWGN Channel-** Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver.

**Signal design for Band limited Channels:** Design of band limited signals for zero lSI-The Nyquist Criterion (statement only), Design of band limited signals with controlled lSI-Partial Response signals, Probability of error for detection of Digital PAM: Symbol-by-Symbol detection of data with controlled ISI.

**Module-III**

**Principles of Spread Spectrum:**
Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum, TDMA, FDMA, CDMA based on IS95.

**Module-IV**

**Introduction to Information Theory:** Measure of information, Average information content of symbols in long independent sequences.

**Source Coding:** Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding.

**Module-V**

**Convolution codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram.

**Linear Block Codes:** Matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Single error correction and detection of Hamming code, Table lookup Decoding using Standard Array.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications.*
*CO-2: Process the signal over AWGN Channel, design the band limited signals for zero ISI and Detect the probability error for Digital PAM.*
*CO-3: Differentiate various spread spectrum schemes and compute the performance parameters of communication system.*
*CO-4: Apply the fundamentals of information theory and perform source coding for given message signal.*
*CO-5: Apply different encoding and decoding techniques with error Detection and Correction.*

**PRACTICAL COMPONENTS:**

**PART-A: LIST OF THE EXPERIMENTS (Hardware)**

1. Generation and demodulation of the Amplitude Shift Keying signal.
2. Generation and demodulation of the Phase Shift Keying signal.
3. Generation and demodulation of the Frequency Shift Keying signal.
4. Generation of DPSK signal and detection of data using DPSK transmitter and receiver.

**PART-B: Simulation Experiments using MATLAB/SCILAB**

1. Generate 16-QAM Modulation and obtain the QAM constellation.
2. Simulation of binary baseband signals using a rectangular pulse and estimate the BER for AWGN channel using matched filter receiver.
3. Perform the QPSK Modulation and demodulation. Display the signal and its constellation.
4. Encoding and Decoding of Huffman code.
5. Encoding and decoding of binary data using a Hamming code.
6. For a given data, use the CRC-CCITT polynomial to obtain the CRC code. Verify for the cases, a) Without error b) With error
7. Encoding and Decoding of Convolution code.

**Text Books:**

1. Digital Communication Systems Simon Haykin John Wiley & sons First Edition, 2014
2. Fundamentals of Communication Systems John G Proakis and Masoud Salehi Pearson Education 2014 Edition.

**Reference Books:**

1. Modern Digital and Analog communication Systems B.P.Lathi and Zhi Ding Oxford University Press 4th Edition, 2010
2. Digital Communications Ian A Glover and Peter M Grant Pearson Education Third Edition, 2010.

# SENSORS AND ACTUATORS

| | | | |
|---|---|---|---|
| Course Code | **23ECE540** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Analog Electronic Circuits

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand fundamental concepts and characteristics of sensors, transmitters, transducers and signal transmission*
*COB-2: Explore and study the various types of actuators and Electrical Actuating Systems like electric motors, D.C. Motors and stepper Motors.*
*COB-3: Study the principles, construction, and applications of temperature, strain and pressure sensors.*
*COB-4: Explore and study the various types of Displacement, liquid level and flow sensors.*
*COB-5: Gain the knowledge on sensor materials and advanced processing techniques to fabricate the sensors.*

## Module-I

**Sensors:** Difference between sensor, transmitter and transducer - Primary measuring elements - selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signals: Pneumatic signal; Hydraulic signal; Electronic Signal, photo-resistive sensor.

## Module-II

**Actuators:** Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators.
**Electrical actuating systems:** Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

## Module-III

**Temperature sensors**: Principle of operation, construction details, characteristics and applications of Bimetallic thermometer, Resistance thermometer, Thermistor, Thermocouples and Total radiation Pyrometers.
**Strain and Pressure Sensors**: Strain gauges, strain gauge beam force sensor, piezoelectric force sensor, load cell, Piezoresistive and capacitive pressure sensor, Manometer, vacuum sensors, Pirani gauge.

## Module-IV

**Displacement, level and flow sensors**: Displacement Sensors: LVDT, RVDT, eddy current, transverse inductive, Hall Effect, magneto resistive, magneto strictive sensors. Liquid level sensor: Ultrasonic sensor, capacitive liquid level sensor. Flow sensors: pressure gradient technique, ultrasonic, electromagnetic sensors, Micro flow sensor.

## Module-V

**Sensor materials and processing techniques:** Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining, Bulk silicon micro machining, Surface silicon micro machining, LIGA process.

## *COURSE OUTCOMES:*

***After studying this course, students will be able to:***

*CO-1: Know the concepts and characteristics of sensors, transmitters, transducers and signal transmission.*

*CO-2: Study the various types of actuators and Electrical Actuating Systems like electric motors, D.C. Motors and stepper Motors*
*CO-3: Know the principles, construction, and applications of temperature, strain and pressure sensors*
*CO-4: Understand the various types of Displacement, liquid level and flow sensors.*
*CO-5: Have the knowledge on sensor materials and advanced processing techniques to fabricate the sensors*

**Text Books**:

1. Patranabis.D, Sensors and Transducers, Wheeler publisher, 1994.
2. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010.

**Reference Books**:

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2. Thomas. G. Bekwith and Lewis Buck.N, "Mechanical Measurements", Oxford and IBH publishing Co. Pvt. Ltd.,
3. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1999.
4. Manfred Kohl, Shape Memory Actuators, first edition, Springer.
5. Sergej Fatikow and Ulrich Rembold, "Microsystem Technology and Microbotics" First edition, Springer – Verlag NEwyork, Inc, 1997.

**E-References:**

1. https://onlinecourses.nptel.ac.in/noc21_ee32/preview

# LINEAR IC APPLICATIONS

| | | | |
|---|---|---|---|
| Course Code | **23ECE551** | CIE Marks | **50** |
| Teaching Hours / Week (L: T: P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Basic Electronic Circuits, Analog Electronics Circuits.

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand the operational principles of both ideal and practical Op-Amps, and to analyze various Op-Amp configurations and their frequency response characteristics.*
*COB-2: Explore and design signal conditioning circuits such as precision rectifiers, peak detectors, and active filters, while understanding the concepts of various filter designs and oscillators.*
*COB-3: Learn and apply non-linear Op-Amp circuits such as comparators, waveform generators, and voltage regulators in real-world electronic applications.*
*COB-4: Study and learn the various specialized IC's, PLL's and its applications and Analog Multipliers.*
*COB-5: Study advanced data conversion techniques, including DACs and ADCs, and understand the working principles of instrumentation amplifiers and current feedback Op-Amps.*

## Module-I

**Operational Amplifiers (Op-Amps):** Introduction to Op-Amps Ideal and practical op- amp characteristics. Op-amp parameters: Input offset voltage, input bias current, CMRR, slew rate, gain-bandwidth product. Op- Amp Configurations Inverting and non- inverting amplifiers. Summing amplifier, difference amplifier, and instrumentation amplifier Frequency Response of Op-Amps Open-loop and closed-loop frequency response. Stability and compensation techniques.

## Module-II

**Linear Applications of Op-Amps:** Signal Conditioning Circuits: Precision rectifiers, peak detectors, and clippers. Log and Antilog Amplifiers. Active Filters: First-order and second-order filters: Low-pass, high-pass, band-pass, and band-stop filters. Butterworth, Chebyshev, and Bessel filters. Oscillators: RC phase shift oscillator, Wien bridge oscillator. Square wave and triangular wave generators.

## Module-III

**Non-Linear Applications of Op-Amps: Comparators:** Zero-crossing detector, Schmitt trigger. Applications of comparators in waveform generation.
**Waveform Generators:** Astable and Monostable Multivibrators. Pulse and ramp generators.
**Voltage Regulators:** Linear voltage regulators using op-amps. Series and shunt regulator

**Module-IV**

**Specialized ICs: Timers:** Introduction to 555 timers IC. Applications of 555 timer in mono stable and astable modes.
**Phase-Locked Loops (PLL):** Basic principles and block diagram of PLL. Applications of PLL in frequency synthesis and demodulation.
**Analog Multipliers:** Four-quadrant analog multiplier. Applications in modulation and demodulation.

**Module-V**

**Advanced Topics: Data Converters:** Digital-to-Analog Converters (DAC): Weighted resistor and R-2R ladder DAC. Analog-to-Digital Converters (ADC): Successive approximation, flash, and dual-slope ADC. **Instrumentation Amplifiers:** Three-op-amp instrumentation amplifier. Applications in sensor signal conditioning.
**Current Feedback Op-Amps:** Characteristics and applications of current feedback op- amps.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Characterize and design circuits using Op-Amps, including inverting, non-inverting, summing, difference, and instrumentation amplifiers, and analyze the Op-Amp frequency response for stability and compensation.*
*CO-2: Design and implement precision rectifiers, peak detectors, various active filters, and oscillators for use in signal processing applications.*
*CO-3: Design and analyze comparator circuits, waveform generators, and linear voltage regulators using Op-Amps.*
*CO-4: Design circuits using 555 timer ICs, apply PLLs in frequency synthesis and demodulation, implement analog multipliers for communication system applications.*
*CO-5: Design and implement digital-to-analog converters, analog-to-digital converters, instrumentation amplifiers for sensor signal conditioning, and apply current feedback Op-Amps in high-performance applications.*

**Text Books:**

1. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad.

**Reference Books:**

1. Operational Amplifiers and Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll.
2. Design with Operational Amplifiers and Analog Integrated Circuits by Sergio Franco.
3. Linear Integrated Circuits by D. Roy Choudhury and Shail B. Jain.
4. Analog Integrated Circuit Design by David Johns and Ken Martin.

**E-References:**
**https://onlinecourses.nptel.ac.in/noc24_ee73/preview**

# SMART AND VIRTUAL INSTRUMENTATION

| | | | |
|---|---|---|---|
| Course Code | **23ECE552** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Basics of C, Computer Organization and Architecture, Microcontroller Interfacing

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

***C**OB-1: Impart the concepts of virtual instrumentation and introduction to the Lab VIEW.*
***C**OB-2: Provide with the necessary skills to build efficient, reusable, and maintainable code through the use of Virtual Instruments (VIs)*
***C**OB-3: Equip with the skills to efficiently manage and manipulate data using arrays and control program flow using structures in Lab VIEW.*
***C**OB-4: Learn to configure DAQ hardware for analog inputs, outputs, and counters, while understanding signal conditioning techniques and motion control.*
***C**OB-5: Understand the overview on NI my DAQ data acquisition device, Operating Systems and the hardware required to make analog and digital interface for real world applications.*

## Module-I

**Virtual instrumentation:** Virtual instrument and traditional instrument, hardware and software in VI, VI for test, control and design, VI in engineering process, virtual instruments beyond personal computer, graphical system design using LabVIEW.

**Introduction to LabVIEW:** Advantages, software environment, creating and saving VI, front panel and block diagram toll bar, palettes, controls and indicators, block diagram, data types, data flow program

## Module-II

**Modular programming:** Build a VI front panel and block diagram, building a connector pane, displaying sub VIs and express VIs, creating sub VIs.
**Repetition and loops:** For loops, while loops, structure tunnels, terminal inside or outside loops, shift registers, feedback nodes, control timing, communication among multiple loops, local and global variables.

## Module-III

**Arrays:** Creating one dimensional, two dimensional, multi-dimensional arrays, array initialization, deleting, inserting, replacing elements within an array, array function, auto indexing.
**Structures:** Case, sequence, customizing, timed structures, formula nodes, event structures.

## Module-IV

**Data acquisition:** Signals, signal conditioning, DAQ hardware configuration, DAQ hardware, analog inputs, outputs, counters.
**Motion control:** Components, software for configuration, prototyping and development, motion controller, move types, motor amplifiers and drives, feedback devices and motion I/O.

**Module-V**

**Operating system and hardware overview**: Operating system requirements, current trends on PC based instrumentation, analog and digital interfaces, Modular Instruments, Overview on NI my DAQ Data Acquisition Device for Real-world applications

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

***C****O-1: Understand the principles of smart and virtual instrumentation and LabVIEW.*
***C****O-2: Learn the concepts of modular programming and the concept of Repetition and loops using the LabVIEW.*
***C****O-3: Write the LabVIEW programs using Arrays and Structures.*
***C****O-4: Learn the concepts of data acquisition and motion control while using the LabVIEW.*
***C****O-5: Understand the Operating Systems and the hardware required to make analog and digital interface for real world applications.*

**Text Books:**

1. Data Acquisition and Signal Processing for Smart Sensors by Nikolay V. Kirianaki, Sergey Y. Yurish, and Nadezhda O. Shpak.
2. LabVIEW for Everyone: Graphical Programming Made Easy and Fun by Jeffrey Travis and Jim Kring.

**Reference Books:**

1. Virtual Instrumentation Using LabVIEW by Jovitha Jerome.
2. LabVIEW: Advanced Programming Techniques by Rick Bitter, Taqi Mohiuddin, and Matt Nawrocki
3. Introduction to Instrumentation and Measurements by Robert B. Northrop.

# ASIC DESIGN AND VERIFICATION

| | | | |
|---|---|---|---|
| Course Code | **23ECE553** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **3** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Digital Circuit Design, CMOS IC Design

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

***C**OB-1: Understand the types of ASICs, their design flow and to design the applications of the CMOS Logic circuits.*
***C**OB-2: Design and optimize CMOS logic circuits for data paths, adders, and multipliers and Programmable ASIC Logic Cells.*
***C**OB-3: Understand Low-level design entry, ASIC Construction and constructive partitioning.*
***C**OB-4: Implement floor planning and placement techniques for efficient ASIC Designs.*
***C**OB-5: Understand the routing techniques for efficient ASIC designs.*

## Module-I

**Introduction to ASICs:** Full custom, Semi-custom and Programmable ASICs, ASIC Design flow, ASIC cell libraries.
**CMOS Logic:** Data path Logic Cells: Data Path Elements, Adders: Carry skip, carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers.

## Module-II

**ASIC Library Design:** Logical effort: Predicting Delay, Logical area and logical efficiency, Logical paths, Multi stage cells, Optimum delay and number of stages, library cell design.
**Programmable ASIC Logic Cells:**
MUX as Boolean function generators, Acted ACT: ACT 1, ACT 2 and ACT 3 Logic Modules, Xilinx LCA: XC3000 CLB, Altera FLEX and MAX, Programmable ASIC I/O Cells: Xilinx and Altera I/O Block.

## Module-III

**Low-level design entry:** Schematic entry: Hierarchical design, The cell library, Names, Schematic Icons & Symbols, Nets, Schematic Entry for ASICs, Connections, vectored instances & buses, Edit in place, attributes, Netlist screener.
**ASIC Construction:** Physical Design, CAD Tools System partitioning, Estimating ASIC size. **Partitioning:** Goals and objectives, Constructive Partitioning, Iterative Partitioning Improvement, KL, FM and Look Ahead algorithms.

## Module-IV:

**Floor planning and placement:** Goals and objectives, Measurement of delay in Floor planning, Floor planning tools, Channel definition, I/O and Power planning and Clock planning.
**Placement:** Goals and Objectives, Min-cut Placement algorithm, Iterative Placement Improvement, Time driven placement methods, Physical Design Flow.

**Module-V:**

**Routing**: Global Routing: Goals and objectives, Global Routing Methods, Global routing between blocks, Back annotation. Detailed Routing: Goals and objectives, Measurement of Channel Density, Left-Edge Algorithm, Area-Routing Algorithms, Multilevel routing, Timing –Driven detailed routing, Final routing steps, Special Routing, Circuit extraction and DRC.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

***C****O-1: Understand the types of ASICs, their design flow and to design the applications of the CMOS Logic circuits.*
***C****O-2: Design and optimize CMOS logic circuits for data paths, adders, and multipliers and Programmable ASIC Logic Cells.*
***C****O-3: Understand Low-level design entry, ASIC Construction and constructive partitioning.*
***C****O-4: Implement floor planning, placement, and routing techniques for efficient ASIC Designs*
***C****O-5: Understand the concept of Routing in the ASIC Design.*

**Text Books:**

1. Michael John Sebastian Smith, "Application - Specific Integrated Circuits", Addison- Wesley Professional, 2005

**Reference Books:**

1. Neil H.E. Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Addison Wesley/ Pearson education 3rdedition, 2011
2. Vikram Arkalgud Chandrasetty, "VLSI Design: A Practical Guide for FPGA and ASIC Implementations" Springer, ISBN: 978-1-4614-1119-2. 2011

**E-References:**

- https://www.youtube.com/watch?v=oZSv68esbgI
- https://www.youtube.com/watch?v=4cPkr1VHu7Q
- https://nptel.ac.in/courses/106105161

# IOT AND ITS APPLICATIONS

| | | | |
|---|---|---|---|
| Course Code | **23ECE561** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **1:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **20** | Total Marks | **100** |
| Credits | **1** | Exam Hours | **1** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Knowledge of microcontrollers and interfacing techniques, Knowledge on Sensors and Actuators

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

***C**OB-1: Understand the fundamental concepts and architecture of the Internet of Things (IoT).*
***C**OB-2: Explore key hardware and software platforms used in IoT applications.*
***C**OB-3: Learn techniques for IoT data collection, processing, and security management.*
***C**OB-4: Examine real-world applications of IoT across various domains.*
***C**OB-5: Gain knowledge on deploying IoT solutions using cloud platforms and protocols.*

## Module-I

**Introduction to IoT:**
Fundamentals of IoT, Characteristics and Architecture of IoT, IoT vs Traditional Embedded Systems, Key Enabling Technologies (Cloud Computing, AI, Big Data), IoT Communication Technologies, Wired and Wireless Protocols (Wi-Fi, Bluetooth, Zigbee, LoRa, NB-IoT).

## Module-II:

**IoT Hardware and Software Platforms:**
IoT Hardware: Sensors and Actuators for IoT Applications, Arduino, Raspberry Pi, ESP8266, ESP32), Power Management in IoT Devices, IoT Software & Programming, Embedded C, Python for IoT.

## Module-III

**IoT Data Management and Security:**
IoT Data Collection & Processing, Data Acquisition and Storage, Data Analytics and Visualization (Node-RED, Grafana), IoT Authentication and Encryption Methods, Block chain for IoT Security.

## Module-IV

**IoT Applications in Various Domains:**
Smart Home & Smart Cities Home Automation Systems, Smart Grids and Smart Transportation, Industrial IoT (IIoT) & Healthcare, Remote Monitoring, Wearable Devices, Agriculture and Environmental Monitoring, Smart Irrigation Systems, Air Quality and Weather Monitoring Sensors.

## Module-V

**IoT Deployment and Future Trends**: IoT Cloud Platforms and Deployment IoT with AWS, Google Cloud IoT, Microsoft Azure IoT, API Integration and MQTT Protocol, IoT Project Development, End- to-End IoT

System Design

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Describe IoT architecture, characteristics, key enabling technologies and wired and wireless protocols.*
*CO-2: Select appropriate hardware and programming tools for IoT systems.*
*CO-3: Analyze and manage IoT data securely using modern tools and techniques.*
*CO-4: Apply IoT solutions to real-world problems in sectors like healthcare, Environment and agriculture.*
*CO-5: Design and implement an end-to-end IoT system with cloud deployment.*

**Text Books:**

1. "Internet of Things: A Hands-on Approach" – Arshdeep Bahga & Vijay Madisetti, Universities Press, 2015.
2. "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases" – David Hanes et al., Cisco Press, 2017.

**Reference Books:**

1. "Building the Internet of Things" – Maciej Kranz, Wiley, 2016.
2. "Mastering IoT" – Colin Dow, Packt Publishing, 2019.

**E - References:**

1. **MIT Open CourseWare – IoT Systems**
   https://ocw.mit.edu/courses/
2. **Google Cloud IoT Developer Learning Path**
   https://cloud.google.com/training/

# PYTHON PROGRAMMING FOR MACHINE LEARNING APPLICATIONS

| | | | |
|---|---|---|---|
| Course Code | **23ECE562** | CIE Marks | **50** |
| Teaching Hours/Week (L:T:P) | **0:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **25** | Total Marks | **100** |
| Credits | **01** | Exam Hours | **2** |
| Examination type (SEE) | **Practical** | | |

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

***C**OB-1: Impart necessary and practical knowledge on Machine Learning Algorithms*
***C**OB-2: Develop skills required to build real-life ML Algorithm projects.*
***C**OB-3: Equip learners with proficiency in Python libraries and tools.*
***C**OB-4: Enable learners to implement and optimize machine learning models.*
***C**OB-5: Provide hands-on experience with advanced machine learning algorithms.*

| Sl. No. | Experiments |
|---|---|
| 1 | Solve the Tic-Tac-Toe problem using the Depth First Search technique. |
| 2 | Show that the 8-puzzle states are divided into two disjoint sets, such that any state is reachable from any other state in the same set, while no state is reachable from any state in the other set. |
| 3 | To represent and evaluate different scenarios using predicate logic and knowledge rules. |
| 4 | To apply the Find-S and Candidate Elimination algorithms to a concept learning task and compare their inductive biases and outputs. |
| 5 | To construct a decision tree using the ID3 algorithm on a simple classification dataset |
| 6 | To assess how the ID3 algorithm performs on datasets with varying characteristics and complexity, examining overfitting, underfitting, and decision tree depth. |
| 7 | To examine different types of machine learning approaches (Supervised, Unsupervised, Semi-supervised, and Reinforcement Learning) by setting up a basic classification problem and exploring how each type applies differently |
| 8 | To understand how Find-S and Candidate Elimination algorithms search through the hypothesis space in concept learning tasks, and to observe the role of inductive bias in shaping the learned concept. |
| 9 | To go through all stages of a real-life machine learning project, from data collection to model fine-tuning, using a regression dataset like the "California Housing Prices." |
| 10 | To perform binary and multiclass classification on the MNIST dataset, analyze performance metrics, and perform error analysis. |
| 11 | **Demo experiments** |
| 12 | Demo experiments |

**COURSE OUTCOMES:**

**After studying *this course, the student will be able to:***

***C**O-1: Apply machine learning algorithms to real life problems.*
***C**O-2: Able to make use of different machine learning approaches.*
***C**O-3: Demonstrate proficiency in using Python libraries*
***C**O-4: Evaluate and optimize machine learning models*
***C**O-5: Implement end-to-end machine learning work flows and provide hands-on experience with advanced machine learning algorithms*

**Text Books:**

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015

**Reference Books:**

1. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd Edition,Tata McGraw Hill,2013. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013
2. AurelienGeron, Hands-on Machine Learning with Scikit-Learn &Tensor Flow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019.

**DEVOPS**

| | | | |
|---|---|---|---|
| Course Code | **23ECE563** | CIE Marks | **50** |
| Teaching Hours/Week (L:T:P) | **0:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **25** | Total Marks | **100** |
| Credits | **01** | Exam Hours | **2** |
| Examination type (SEE) | **Practical** | | |

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

***C**OB-1: Understand DevOps terminology, definition & concepts.*
***C**OB-2: Understand the different Version control tools like Git, Mercurial.*
***C**OB-3: Understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment.*
***C**OB-4: Understand Configuration management using Ansible.*
***C**OB-5: Understand the benefits and drive the adoption of cloud-based Devops tools to solve real world problems.*

| Sl. No. | Experiments |
|---|---|
| 1 | **Introduction to Maven and Gradle:** Overview of Build Automation Tools, Key Differences Between Maven and Gradle, Installation and Setup |
| 2 | **Working with Maven:** Creating a Maven Project, Understanding the POM File, Dependency Management and Plugins |
| 3 | **Working with Gradle:** Setting Up a Gradle Project, Understanding Build Scripts (Groovy and Kotlin DSL), Dependency Management and Task Automation |
| 4 | **Practical Exercise:** Build and Run a Java Application with Maven**,** Migrate the Same Application to Gradle |
| 5 | **Introduction to Jenkins:** What is Jenkins? Installing Jenkins on Local or Cloud Environment, Configuring Jenkins for First Use |
| 6 | **Continuous Integration with Jenkins:** Setting Up a CI Pipeline**,** Integrating Jenkins with Maven/Gradle**,** Running Automated Builds and Tests |
| 7 | **Configuration Management with Ansible:** Basics of Ansible: Inventory, Playbooks, and Modules, Automating Server Configurations with Playbooks, Hands-On: Writing and Running a Basic Playbook |
| 8 | **Practical Exercise:** Set Up a Jenkins CI Pipeline for a Maven Project, Use Ansible to Deploy Artifacts Generated by Jenkins |
| 9 | **Introduction to Azure DevOps:** Overview of Azure DevOps Services, Setting Up an Azure DevOps Account and Project |
| 10 | **Creating Build Pipelines:** Building a Maven/Gradle Project with Azure Pipelines, Integrating Code Repositories (e.g., GitHub, Azure Repos), Running Unit Tests and Generating Reports |
| 11 | **Creating Release Pipelines:** Deploying Applications to Azure App Services, Managing Secrets and Configuration with Azure Key Vault, Hands-On: Continuous Deployment with Azure Pipelines |
| 12 | **Practical Exercise and Wrap-Up:** Build and Deploy a Complete DevOps Pipeline, Discussion on Best Practices and Q&A. |

***COURSE OUTCOMES**:*

***After studying this course, the student will be able to:***

*CO-1: Demonstrate different actions performed through Version control tools like Git.*
*CO-2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.*
*CO-3: Experiment with configuration management using Ansible.*
*CO-4: Demonstrate Cloud-based DevOps tools using Azure DevOps.*
*CO-5: Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems.*

**Text Books:**

1. Learning DevOps: Mikael Krief, October 2019, Packt Publishing Ltd, ISBN: 978-1-83864-273-0.

**Reference Books:**

1. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Jez Humble and David Farley, 2010, AddisonWesley Professional, ISBN: 9780321670250.
2. The DevOPS Handbook: How to Create World, Gene Kim & Jez Humble, 2016, It Revolution Press, ISBN: 9781942788003.

**E-References:**

**1.** DevOps.com
**2.** GitLab DevOps Tutorials
**3.** HashiCorp Learn

# ADVANCED APTITUDE

| | | | |
|---|---|---|---|
| Course Code | **23AAE570** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **1:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **20** | Total Marks | **100** |
| Credits | **01** | Exam Hours | **2** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Fundamentals of Mathematics, Basic knowledge of Reasoning

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Develop numerical ability skills through foundational topics like simplifications, LCM, HCF, and root calculations.*
*COB-2: Enhance understanding of percentage-based problems including profit, loss, and interest calculations.*
*COB-3: Build time-based problem-solving abilities involving work, distance, and motion.*
*COB-4: Strengthen conceptual clarity in ratio, proportion, averages, and age-based problems.*
*COB-5: Cultivate logical and analytical reasoning skills through pattern recognition and relational analysis.*

**Module-I**

**Numerical Ability Based:** Simplifications, Squares and Square Roots, Cubes and Cube roots, BODMAS Rule, LCM, HCF, Fractions and Decimals

**Module-II**

**Percentage Based:** Percentages, Profit and Loss, Discounts, Simple Interest and Compound Interest

**Module-III**

**Time Based:** Time and Work, Pipes and Cisterns, Time and Distance, Trains, Boats and Streams

**Module-IV:**

**Ratio Based:** Ratio-proportion, Partnership, Averages and Ages

**Module-V:**

**Logical and Analytical Based:** Seating Arrangement, Series, Analogy, Odd man out and Blood Relations

**COURSE OUTCOMES:**

***After studying this course, students will be able to:***

*CO-1: Solve arithmetic and numerical problems efficiently using shortcut techniques and basic operations.*
*CO-2: Apply concepts of percentage, profit & loss, and interest in real-life quantitative scenarios.*
*CO-3: Analyze and compute time, work, and distance problems with accuracy.*
*CO-4: Interpret and solve problems based on ratios, averages, partnerships, and age relations.*
*CO-5: Demonstrate logical reasoning through analytical questions like series, blood relations, and seating arrangements.*

**Text Books:**

1. R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Publications.
2. Arun Sharma, How to Prepare for Quantitative Aptitude for the CAT, McGraw Hill Education.
3. R.V. Praveen, Quantitative Aptitude and Reasoning, PHI Learning Pvt. Ltd.

**Reference Books:**

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Tata McGraw Hill.
2. Nishit K. Sinha, Quantitative Aptitude for CAT, Pearson Education.
3. Kiran Prakashan, Kiran's SSC Mathematics Chapterwise Solutions – Useful for problem-based learning.

**E-References:**

1. IndiaBIX – Quantitative Aptitude Section - https://www.indiabix.com/aptitude/questions-and-answers/
2. GeeksforGeeks Aptitude Section - https://www.geeksforgeeks.org/aptitude/

# NATIONAL SERVICE SCHEME (NSS)

| | | | |
|---|---|---|---|
| Course Code | **23NSE580** | CIE Marks | **100** |
| Teaching Hours / Week (L:T:P) | **0:0:2** | SEE Marks | **-** |
| Total Hours of Pedagogy | **40-hour Practical Session + 15 hour Planning** | Total Marks | **100** |
| Credits | **NMC** | Exam Hours | **0** |
| Examination type (SEE) | Activities Report Evaluation by College NSS Officer at the end of the semester. | | |

***COURSE OBJECTIVES:***

***National Service Scheme (NSS) will enable the students to:***

*COB-1: Understand the community in general in which they work.*
*COB-2: Identify the needs and problems of the community and involve them in problem –solving.*
*COB-3: Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.*
*COB-4: Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.*
*COB-5: Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.*

**General Instructions - Pedagogy:**

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

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so thatthe activities will develop students' theoretical and applied social and cultural skills.
2. State the need for NSS activities and its present relevance in the society and provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documentingstudents' progress in real activities in the field.

| Sl. No. | TOPIC/ ACTIVITIES TO BE COVERED |
|---|---|
| 1. | Developing Sustainable Water management system for rural areas and implementation approaches. |
| 2. | Contribution to any national level initiative of Government of India. For eg. Digital India, Skill India, Swatch Bharat, Atmanirbhar Bharath, Make in India, Mudra scheme, Skill development programs etc., |
| 3. | Spreading public awareness under rural outreach programs. (minimum5 programs). |
| 4. | Social connect and responsibilities. |
| 5. | Plantation and adoption of plants. Know your plants. |
| 6. | Organize National integration and social harmony events / workshops / seminars. (Minimum 02 programs). |
| 7. | Govt. school Rejuvenation and helping them to achieve good infrastructure. |

***COURSE OUTCOMES:***

***By National Service Scheme (NSS), students will be able to:***

*CO1: Understand the importance of his / her responsibilities towards society.*
*CO2: Analyse the environmental and societal problems / issues and will be able to design solutions for the same.*
*CO3: Evaluate the existing system and to propose practical solutions for the same for sustainable development.*
*CO4: Implement government or self-driven projects effectively in the field.*
*CO5: Develop capacity to meet emergencies and natural disasters & practice national integration and social*

*harmony in general.*

**SUGGESTED LEARNING RESOURCES:**

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi. Government of Karnataka, NSS cell, activities reports and its manual. Government of India, NSS cell, Activities reports and its manual.

# PHYSICAL EDUCATION (PE) (SPORTS & ATHLETICS)

| | | | |
|---|---|---|---|
| Course Code | **23PEE580** | CIE Marks | **100** |
| Teaching Hours / Week (L:T:P) | **0:0:2** | SEE Marks | **-** |
| Total Hours of Pedagogy | **30-hour Practical Session** | Total Marks | **100** |
| Credits | **NMC** | Exam Hours | **0** |

**Module-I**

**Orientation**

a. Lifestyle
b. Fitness
c. Food & Nutrition
d. Health & Wellness
e. Pre-Fitness test.

**Module-II**

**General Fitness & Components of Fitness**

a. Warming up (Free Hand exercises)
b. Strength – Push-up / Pull-ups
c. Speed – 30 Mtr Dash
d. Agility – Shuttle Run
e. Flexibility – Sit and Reach
f. Cardiovascular Endurance – Harvard step Test

**Module-III**

**Recreational Activities**

a. Postural deformities.
b. Stress management.
c. Aerobics.
d. Traditional Games.

**Module-IV**

**Ethics and Moral Values**

a. Ethics in Sports
b. Moral Values in Sports and Games

**Module-V**

**Specific Games (Any one to be selected by the student)**

a. Volleyball – Attack, Block, Service, Upper Hand Pass and Lower hand Pass.
b. Throwball – Service, Receive, Spin attack, Net Drop & Jump throw.
c. Kabaddi – Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.
d. Kho-Kho – Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.
e. Table Tennis – Service (Fore Hand & Back Hand), Receive (Fore Hand & Back Hand), Smash.
f. Athletics (Track / Field Events) – Any event as per availability of Ground.

# YOGA

| | | | |
|---|---|---|---|
| Course Code | **23YOE580** | CIE Marks | **100** |
| Teaching Hours / Week (L:T:P) | **0:0:2** | SEE Marks | **-** |
| Total Hours of Pedagogy | **24 - 28 hours (Theory + practical)** | Total Marks | **100** |
| Credits | **NMC** | Exam Hours | **0** |

***COURSE OBJECTIVES:***

***Yoga will enable the students to:***

*COB-1: Maintain a good health*
*COB-2: Practice mental hygiene.*
*COB-3: Possess emotional stability.*
*COB-4: Integrate moral values.*
*COB-5: attain higher level of consciousness.*

## The Health Benefits of Yoga

The benefits of various yoga techniques have been supposed to improve

- body flexibility,
- performance,
- stress reduction,
- attainment of inner peace, and
- self-realization.

The system has been advocated as a complementary treatment to aid the healing of several ailments such as

- coronary heart disease,
- depression,
- anxiety disorders,
- asthma, and
- extensive rehabilitation for disorders including musculoskeletal problems and traumatic brain injury.

The system has also been suggested as behavioral therapy for smoking cessation and substance abuse (including alcoholabuse).If you practice yoga, you may receive these physical, mental, and spiritual benefits:

- **Physical**
  1. Improved body flexibility and balance
  2. Improved cardiovascular endurance (stronger heart)
  3. Improved digestion
  4. Improved abdominal strength
  5. Enhanced overall muscular strength
  6. Relaxation of muscular strains
  7. Weight control
  8. Increased energy levels
  9. Enhanced immune system
- **Mental**
  1. Relief of stress resulting from the control of emotions
  2. Prevention and relief from stress-related disorders
  3. Intellectual enhancement, leading to improved decision-making skills
- **Spiritual**
  1. Life with meaning, purpose, and direction
  2. Inner peace and tranquility
  3. Contentment

## SEMESTER V

Patanjali's Ashtanga Yoga its need and importance. Ashtanga Yoga

1. Asana
2. Pranayama
3. Pratyahara

Asana its meaning by name, technique, precautionary measures and benefits of each asana

**Different types of Asanas**

a. Sitting: 1. Ardha Ushtrasana, 2.Vakrasana, 3.Yogamudra in Padmasana
b. Standing: 1. UrdhvaHastothanasana, 2.Hastapadasana, 3.ParivrittaTrikonasana, 4.Utkatasana
c. Prone line: 1 . Padangushtha Dhanurasana, 2.Poorna Bhujangasana / Rajakapotasana
d. Supine line: 1. Sarvangasana, 2.Chakraasana, 3.Navasana / Noukasana, 4.Pavanamuktasana

Revision of practice 60 strokes / min 3 rounds

Meaning by name, technique, precautionary measures and benefits of each Pranayama

1. Ujjayi 2. Sheetali 3. Sheektari

## SEMESTER VI

Ashtanga Yoga 1. Dharana 2. Dhyana (Meditation) 3. Samadhi

Asana by name, technique, precautionary measures and benefits of each asana

**Different types of Asanas**

a. Sitting: 1. Bakasana, 2.Hanumanasana, 3.Ekapada Rajakapotasana, 4.Yogamudra in Vajrasana
b. Standing: 1. Vatayanasana, 2.Garudasana, 3.
c. Balancing: 1. Veerabhadrasana, 2.Sheershasana
d. Supine line: 1. Sarvangasana, 2.Setubandha Sarvangasana, 3.Shavasanaa (Relaxation posture).

Revision of Kapalabhati practice 80 strokes / min - 3 rounds

Different types. Meaning by name, technique, precautionary measures and benefits of each Pranayama 1. Bhastrika 2. Bhramari Meaning, Need, importance of Shatkriya. Different types. Meaning by name, technique, precautionary measures and benefits ofeach Kriya 1. Jalaneti & sutraneti 2. Nouli (only for men) 3. Sheetkarma Kapalabhati

***COURSE OUTCOMES:***

***By Yoga, the student will be able to:***

*CO-1: Understand the meaning, aim and objectives of Yoga.*
*CO-2: Perform Surya namaskar and able to Teach its benefits.*
*CO-3: Understand and teach different Asanas by name, its importance, methods and benefits.*
*CO-4: Instruct Kapalabhati and its need and importance.*
*CO-5: Teach different types of Pranayama by its name, precautions, procedure and uses*

*CO-6: Coach different types of Kriyas, method to follow and usefulness.*

**Suggested Learning Resources:**

1. Yogapravesha in Kannada by Ajitkumar
2. Light on Yoga by BKS Iyengar
3. Teaching Methods for Yogic practices by Dr. M L Gharote & Dr. S K Ganguly
4. Yoga Instructor Course hand book published by SVYASA University, Bengaluru
5. Yoga for Children –step by step – by Yamini Muthanna

**E-References:**
https: //youtu.be/KB-TYlgd1wE
https: //youtu.be/aa-TG0Wg1Ls

*****

# Electronics and Communication Engineering

## FACULTY OF ENGINEERING & TECHNOLOGY

## 2023 Scheme & Syllabus

Scheme of
Teaching & Evaluation for

# VI Semester

**DIGITAL SIGNAL PROCESSING**

| | | | |
|---|---|---|---|
| Course Code | **23ECE610** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Signals and Systems, Fourier series and Fourier Transforms

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Provide a strong foundation in Discrete Fourier Transform (DFT) and its properties.*
*COB-2: Develop an understanding of Fast Fourier Transform (FFT) algorithms and their computational efficiency.*
*COB-3: Understand the design of IIR analog and digital filters using various transformations.*
*COB-4: Understand the design of FIR filters using windowing techniques.*
*COB-5: Implement the DFT and digital filters in practical applications.*

**Module-I**

**Discrete Fourier Transform (DFT):** Definitions and properties: Linearity, shift, Symmetry Circular Convolution – Periodic Convolution, tabular arrays, Stockham's method Linear Convolution – Finite-duration sequences, overlap-add, and overlap- save methods.

**Module-II**

**Fast Fourier Transform (FFT) Algorithms:** Decimation-in-time (DIT) FFT algorithm – First decomposition, Computational Complexity Decimation-in- frequency (DIF) FFT algorithm – Number of computations Inverse Radix-2 FFT algorithms.

**Module-III**

**IIR Filter Design:** Analog Filters using Lowpass prototype transformation. Normalized Butterworth Functions and Chebyshev functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design. Digital Butterworth Filter Design using BLT

**Module-IV:**

**Design of FIR Filters:** Characteristics of practical frequency -selective filters, Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows- Rectangular, Hamming, Hanning, Bartlett windows. Design of FIR filters using frequency sampling method.

**Module-V:**

**Realization of IIR and FIR Filters:** Realization of IIR Filters in Direct form I and II, Cascade Form and Parallel Form. Structure for FIR Systems: Direct form, Cascade form and Lattice structures.

***COURSE OUTCOMES:***

***After studying the course, students will be able to:***

*CO-1: Apply DFT and its properties for analyzing discrete-time signals.*
*CO-2: Implement FFT algorithms to efficiently compute the DFT.*
*CO-3: Design IIR digital filters using Butterworth and Chebyshev filter techniques.*
*CO-4: Design FIR digital filters using windowing methods.*
*CO-5: Implementation of IIR and FIR filters using direct and cascade forms.*

**PRACTICAL COMPONENTS**

**LIST OF EXPERIMENTS**

1. Computation of Discrete Fourier Transform (DFT) and Inverse DFT (IDFT)
2. Implementation of Fast Fourier Transform (FFT) and Inverse FFT
3. Linear Convolution of Two Sequences.
4. Circular Convolution of Two Sequences.
5. Implementation of Overlap-Add and Overlap-Save Methods.
6. Design and Implementation of FIR Filter using Rectangular Window.
7. Design and Implementation of FIR Filter using Hamming Window.
8. Design and Implementation of FIR Filter using Hanning Window.
9. Design and Implementation of FIR Filter using Blackman Window.
10. Design and Implementation of IIR Butterworth Filter.
11. Design and Implementation of IIR Filter (Butterworth) using Bilinear Transformation.
12. Design and Implementation of IIR Filter (Chebyshev) using Bilinear Transformation.

**Text Books:**

1. John G. Proakis and Dimitris G. Manolakis, Digital Signal Processing: Principles, Algorithms, and Applications, Pearson.
2. Sanjit K. Mitra, Digital Signal Processing: A Computer-Based Approach, McGraw-Hill

**Reference Books:**

1. Alan V. Oppenheim and Ronald W. Schafer, *Discrete-Time Signal Processing*, Pearson.
2. P. Ramesh Babu, *Digital Signal Processing*, SciTech Publications

**E-References:**

1. MIT Open Course Ware – https://ocw.mit.edu/courses/electrical-engineering- and-computer-science/
2. NPTEL Course on Digital Signal Processing – https://nptel.ac.in/courses/

## ARM CONTROLLERS AND EMBEDDED SYSTEMS

| | | | |
|---|---|---|---|
| Course Code | **23ECE620** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination Type (SEE) | **IPCC** | | |

**Prerequisites:** Digital Electronics, Computer Organization & Architecture, Microcontrollers & Microprocessors.

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand the structure and components of embedded systems.*
*COB-2: Learn ARM Cortex-M3 architecture, its functional units, registers and Interrupts*
*COB-3: Develop programming skills in ARM assembly and C language.*
*COB-4: Explore embedded system design concepts and firmware development.*
*COB-5: Understand RTOS concepts and embedded development tools.*

**Module-I**

**Embedded System Components:** Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES, Core of an Embedded System including all types of processor/controllers, Memory, Sensors, Actuators, LED, 7 segment LED display, Optocoupler, Relay, Piezo buzzer, Push button switch, Communication Interface (onboard and external types).

**Module-II**

**ARM 32-bit Microcontroller:** Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence.

**Module-III**

**ARM Cortex M3 Instruction Sets and Programming:** Assembly basics, Instruction list and description, Useful instructions, Memory mapping, Bit-band operations and CMSIS, Assembly and C language Programming.

**Module-IV**

**Embedded System Design Concepts:** Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling (excluding UML), Embedded firmware design and development (excluding C language).

**Module-V**

**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Preemptive Task scheduling techniques, Task Communication, Embedded system Development Environment–Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Understand the structure, components and applications of embedded systems.*
*CO-2: Describe the architecture and features of ARM Cortex-M3 microcontrollers.*
*CO-3: Write and debug embedded programs using ARM instruction set and C Language.*
*CO-4: Apply design principles and quality attributes in embedded system development.*
*CO-5: Use RTOS concepts and development tools for efficient embedded system design.*

**PRACTICAL COMPONENT:**

**LIST OF EXPERIMENTS**

**Part A: Assembly Language Programming using LPC2148**

1. Write a program to add, subtract and multiply two 16-bit binary numbers.
2. Write a program to find the sum of first 10 integer numbers.
3. Write a program to add an array of 16-bit numbers and store the 32-bit result in internal RAM
4. Write a program to find the square of a number (1 to 10) using look-up table.

**Part B: C-Language Programming using LPC2148**

1. Write a C program for LED Blinking and to turn on Buzzer.
2. Write a C program to display the characters in Touch screen LCD.
3. Write a C program to interface ADC.
4. Write a C program to interface Keypad using Seven Segment Display.
5. Write a C program to interface Stepper Motor.
6. Write a C program to interface UART.
7. Write a C program to interface DAC.

**Text Books:**

1. J. Yiu, The Definitive Guide to the ARM Cortex-M3, 2nd ed. Newnes (Elsevier), 2010, ISBN 978-1856179638.
2. K. V. Shibu, Introduction to Embedded Systems, 2nd ed. Tata McGraw Hill Education Private Limited, ISBN 978-0070145893.

**Reference Books:**

1. A. N. Sloss, ARM System Developer's Guide. ELSEVIER Publications, 2016, ISBN 978-81-8147-646-3.
2. J. W. Valvano, Embedded Systems: Introduction to ARM Cortex-M Microcontrollers, 5th ed. Create Space Independent Publishing Platform, 2018, ISBN 978-1477508992.
3. A. N. Sloss, D. Symes, and C. Wright, ARM System Developer's Guide: Designing and Optimizing System Software, 1st ed. Morgan Kaufmann, 2004, ISBN 978-1558608740.

# DATA COMMUNICATION AND COMPUTER NETWORKS

| | | | |
|---|---|---|---|
| Course Code | **23ECE630** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20()** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Basic Computer Science Concept.

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the fundamentals of data communication, network models, and protocols*
*COB-2: Explore media access control methods and LAN technologies, including Ethernet and wireless networks.*
*COB-3: Learn about networking devices and the functionality of the network layer, including IP addressing.*
*COB-4: Study network layer protocols including IPv4, IPv6, and routing algorithms.*
*COB-5: Understand transport layer protocols and mechanisms for reliable data transfer.*

## Module-I

**Data Communications:** Introduction, Components, Representations, Data Flow, Networks: Physical Structures, Network Types: LAN, WAN, Switching, The Internet.

**Network Models:** Protocol Layering: Scenarios, Principles of protocol layering, TCP/IP Protocol Suite: Layered Architecture, Encapsulation and De-capsulation, Addressing, Multiplexing and De- multiplexing. The OSI Model: OSI versus TCP/IP.

**Data-Link Layer:** Introduction, Nodes and Links, Services, Categories of link, sub layers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple protocol, Stop and wait protocol.

## Module-II

**Media Access Control:** Introduction. Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing. Channelization: FDMA, TDMA, CDMA.

**Wired and Wireless LANs:** Ethernet: Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Efficiency.

**Wireless LANs:** Introduction: Characteristics, IEEE802.11: Architecture, MAC Sub layer, Bluetooth: Architecture.

## Module-III

**Connecting Devices:** Introduction, Hubs, link layer Switches, Virtual LANs: Membership, Configuration.

**Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Packet Switching: Datagram Approach, Virtual Circuit Approach.

**IPV4Addresses:** Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution.

## Module-IV

**Network Layer Protocols:** Introduction, Internet Protocol (IP): Datagram Format, Fragmentation, Security of IPv4 Datagram, Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP. **Next Generation IP:** IPV6 Addressing, Address Space, IPV6 Protocol- packet format, Transition fromIPv4 To IPv6.

**Uni-cast Routing:** Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing.

## Module-V

**Transport Layer:** Introduction, Transport Layer Services, Connection less and Connection oriented Protocols, Transport Layer Protocols: Go-Back-N Protocol, Selective Repeat protocol.
**Transport Layer Protocols in the Internet:** User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram**.**

## *COURSE OUTCOMES:*

***After studying this course, students will be able to:***

*CO-1: Explain data communication principles and the structure of network models like OSI and TCP/IP.*
*CO-2: Analyze media access control techniques and the design of wired and wireless LANs.*
*CO-3: Identify and configure networking devices and IP addressing schemes.*
*CO-4: Compare IPv4 and IPv6 protocols and apply routing algorithms.*
*CO-5: Evaluate transport layer protocols and their role in reliable communication.*

## PRACTICAL COMPONENTS:

### LIST OF THE EXPERIMENTS

**Part A: Implement the following in C/ python Programming:**

1. Write a program to bit stuff and Destuff the frame.
2. Write a program to Character stuff and Destuff the frame
3. Write a program to Simulate Data Encryption and Decryption using Substitution Method
4. For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases: a. without error b. With error
5. Implementation of Stop and Wait Protocol and Sliding Window Protocol

**Part B: Simulation Experiments using Network simulator tools: NS2/ NS3/ Cisco Packet Tracer:**

1. Simulate a four-node point to point network with duplex links between them and set the queue size to vary bandwidth and to find the number of packets dropped.
2. Simulate different types of internet traffic such as FTP and TELNET over a network to analyze the throughput.
3. Simulate Ethernet LAN using n nodes and set multiple traffic nodes to determine collision across different node.
4. Implementation of Link State Routing algorithm for a given graph.
5. Performing an initial Switch configuration Cisco Packet Tracer.

**Text Books:**

1. Data Communication and Networking Author: B Forouzan Publisher: McGraw Hill Edition and Year: 5th Edition, 2013.

**Reference Books:**

1. Computer Networks Author: Andrew S. Tenenbaum Publisher: Pearson Prentice Hall Edition and Year: 4th Edition, 2010.
2. Computer Networks Author: James F. Kurose, Keith W. Ross Publisher: Pearson Edu Edition and Year: 2nd Edition, 2003.

**E-References:**
https://archive.nptel.ac.in/courses/106/105/106105082/

# MANAGEMENT AND ENTREPRENEURSHIP

| | | | |
|---|---|---|---|
| Course Code | **23MEE640** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination Type (SEE) | **Theory** | | |

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to*:**

*COB-1: Introduce to the core principles of management, including the roles and responsibilities of managers in engineering projects.*
*COB-2: Equip with the knowledge and tools needed for effective planning, organizing, staffing, directing, and controlling engineering projects.*
*COB-3: Understand the entrepreneurship, its evolution, and the role of entrepreneurs in driving innovation and economic growth, with a focus on engineering sectors.*
*COB-4: Examine the characteristics and importance of small-scale industries (SSI), exploring the opportunities and challenges they represent for engineers and entrepreneurs.*
*COB-5: Understand practical skills in preparing project reports, conducting feasibility studies, and understanding ownership structures relevant to engineering projects and business ventures.*

## Module-I

**Management:** Introduction - Meaning - nature and characteristics of Management, Scope and functional areas of management, Roles of Manager, Levels of Management, Modem management approaches.

**Planning:** Nature, importance and purpose of planning process objectives - Types of plans (meaning only) - Decision making.

## Module-II

**Organizing and staffing:** Nature and purpose of organization, Principles of organization-Centralization Vs Decentralization of authority and responsibility -Nature and importance of staffing-: Process of Selection & Recruitment (in brief).

**Directing:** Meaning and nature of directing Leadership styles, Motivation, Theories, Communication
**Controlling:** Meaning and steps in controlling, Methods of establishing control (in brief).

## Module-III

**Entrepreneur:** Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of Entrepreneurs, Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship-its Barriers.

## Module-IV

**Small scale industries:** Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5-year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI.

**Module-V**

**Preparation of project:** Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Network Analysis; Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

**Industrial ownership:** Definition and meaning of Partnership, Characteristics of Partnership, Kinds of Partners, Partnership Agreement or Partnership Deed, Registration of Partnership Firm, Rights, Duties and Liabilities of Partners, Advantages and Disadvantages of Partnership, Sole proprietorship, Features, Scope Advantages and Disadvantages of Sole Proprietorship.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Understand of key management functions and managerial roles, and apply these concepts effectively to engineering project management.*

*CO-2: Develop the skills to organize, staff, direct, and control engineering projects, ensuring optimal project execution and team performance.*

*CO-3: Gain insight into the concept, evolution, and significance of entrepreneurship, preparing them for innovation and leadership in engineering ventures.*

*CO-4: Understand the role of small-scale industries (SSI) in economic development and will be equipped to navigate challenges and identify opportunities within this sector.*

*CO-5: Learn how to prepare detailed project reports and understand various industrial ownership Structures, enabling them to make informed decisions in engineering projects and business ventures.*

**Text Books:**

1. P. C. Tripathi and P. N. Reddy, Principles of Management. Tata McGraw Hill, ISBN 978-0071333336.
2. V. Desai, Dynamics of Entrepreneurial Development & Management. Himalaya Publishing House, ISBN 978-8178669562.
3. P. M. Charantimath, Entrepreneurship Development: Small Business Enterprises. Pearson Education, 2006, ISBN 978-8131706956.

**Reference Books:**

1. R. Lusier, Management Fundamentals: Concepts, Application, Skill Development. Thomson, ISBN 978-0324421405.
2. S. S. Khanka, Entrepreneurship Development. S. Chand & Co., New Delhi, ISBN 978-8121904124.
3. S. Robbins, Management, 17th ed. Pearson Education/PHI, 2003, ISBN 978-0131019644.

# ANTENNA & WAVE PROPAGATION

| | | | |
|---|---|---|---|
| Course Code | **23ECE651** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40 (T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination Type (SEE) | **Theory** | | |

**Prerequisites:** Engineering Electromagnetics

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand the basic antennas, their parameters like radiation intensity, beamwidth, directivity, gain, and effective aperture.*

*COB-2: Apply the knowledge of antenna arrays in designing and analyzing Broadside and End fire arrays, folded dipole, Slot antenna and its radiation phenomenon, Horn, Yagi-uda antenna, Parabolic and Helical antenna.*

*COB-3: Equip students with the necessary skills to measure important antenna parameters and understand the methods of measurements.*

*COB-4: Provide a clear understanding of wave propagation concepts, ground wave and implications for communication systems.*

*COB-5: Understand the advanced concepts of space wave propagation, Sky Wave Propagation*

.

## Module-I

**Antenna Fundamentals:** Introduction to antenna, advantages, Parameters of antenna: -Radiation Pattern, Radiation intensity, Solid angle, Beam width, directivity and gain, Relationship b/w directivity and beam area and effective aperture, Effective length, Bandwidth and polarization, efficiency and radiation, Antenna temperature and field zone, Friss free space equation.

## Module-II

**Antenna Array and Point Source:** Array of two isotropic point sources and its types, n-element broadside array and end fire array, short dipole (no field derivation required), radiation resistance of short dipole and half wave dipole with derivation, folded dipole, Slot antenna and its radiation phenomenon. Horn, Yagi-uda antenna, Parabolic and Helical antenna.

## Module-III

**Antenna Measurements:** Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System, Sources of Errors. Patterns to be Measured, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3-Antenna Methods).

## Module-IV

**Wave Propagation:** Definitions, Categorizations and General Classifications, Different Modes of Wave Propagation, Ray/Mode Concepts,

**Ground Wave Propagation:**

Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections.

## Module-V

**Space Wave Propagation:** Field Strength Variation with Distance and Height, Effect of Earth's Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Troposphere Propagation.

**Sky Wave Propagation:** Structure of Ionosphere, Refraction and Reflection of Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multi-hop Propagation.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Analyze and design basic antennas, their parameters like radiation intensity, beamwidth, directivity, gain, and effective aperture.*
*CO-2: Differentiate the types of antenna arrays and types of Antennas for RF.*
*CO-3: Perform antenna measurements, including directivity and gain assessments and other various techniques.*
*CO-4: Gain expertise in different modes of wave propagation and will be able to predict their behavior under different environmental and geographic conditions.*
*CO-5: Acquire advanced knowledge of the physical phenomena influencing Space & Sky wave propagation and will be able to analyze their impact on real-world communication systems.*

**Text Books:**

1. C. Balanis A., Antenna Theory: Analysis and Design, 3rd ed. John Wiley and Sons, 2012, ISBN 978-0471667827.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd ed., 2000.

**Reference Books:**

1. Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.
3. J. D. Krauss, Antennas and Wave Propagation, 4th ed. McGraw-Hill International, 2010, ISBN 978-0070671552.
4. Harish and Sachidananda, Antennas and Wave Propagation. Oxford Press, ISBN 978-0195676869.

# POWER ELECTRONICS

| | | | |
|---|---|---|---|
| Course Code | **23ECE652** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40 (T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination Type (SEE) | **Theory** | | |

**Prerequisites:** Basic Electronic circuits and Semiconductors

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand the characteristics and applications of power diodes and rectifier circuits.*
*COB-2: Learn the operation and switching characteristics of power transistors like BJT, MOSFET, and IGBT.*
*COB-3: Explore thyristor operation, protection methods, and firing circuits.*
*COB-4: Study controlled rectifiers and AC voltage controllers for various load types.*
*COB-5: Understand the principles and control of DC-DC converters (choppers) and inverters.*

## Module-I

**Power Diodes:** Applications of Power Electronics, Power Diode Types, Silicon Carbide Diodes, Silicon Carbide Schottky Diodes, Freewheeling diodes**,** Freewheeling diodes with RL load.
**Diode Rectifiers:** Introduction, Diode Circuits with DC Source connected to R and RL load, Single-Phase Full-Wave Rectifiers with R load, Single-Phase Full-Wave Rectifier with RL Load.

## Module-II

**Power Transistors:** Introduction, Bipolar Junction Transistors – Steady State Characteristics, Switching Characteristics, Switching Limits, Power MOSFETs – Steady State Characteristics, Switching Characteristics, IGBTs; BJT Base Drive, MOSFET Gate Drive, Isolation of Gate and Base Drives.

## Module-III

**Thyristors:** Introduction, Thyristor Characteristics, Two-Transistor Model of Thyristor, Thyristor Turn- On, Thyristor Turn-Off, A brief study on Thyristor Types, Series Operation of Thyristors, Parallel Operation of Thyristors, di/dt Protection, dv/dt Protection, Thyristor Firing Circuits, Unijunction Transistor.

## Module-IV

**Controlled Rectifiers:** Introduction, Single phase half wave circuit with RL Load, Single phase half wave circuit with RL Load and Freewheeling Diode, Single phase half wave circuit with RLE Load, Single-Phase Full Converters with RLE Load, Single-Phase Dual Converters, Principle of operation of Three- Phase dual Converters.

**AC Voltage Controllers**: Introduction, Principle of phase control & Integral cycle control, Single-Phase Full-Wave Controllers with Resistive Loads, Single- Phase Full-Wave Controllers with Inductive Loads, Three-Phase Full-Wave Controllers.

## Module-V

**Choppers:** Introduction, principle of step-down chopper with R and RL load; principle of step-up chopper with R load, Control strategies, performance parameters, DC-DC converter classification.
**Inverters:** Introduction, principle of operation single phase bridge inverters, performance parameters, three phase bridge inverters, voltage control of single-phase inverters, Harmonic reductions, Current source inverters.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

CO-1: Analyze power diode types and rectifier performance for resistive and inductive loads.
CO-2: Compare power transistors based on steady-state and switching characteristics.
CO-3: Explain thyristor operation, triggering methods, and protection mechanisms.
CO-4: Design controlled rectifier and AC voltage controller circuits for power control.
CO-5: Evaluate chopper and inverter circuits, their control strategies, and performance.

**Text Books:**

1. Power Electronics: Circuits Devices and Applications Mohammad H Rashid, Pearson 4th Edition, 2014.

**Reference Books:**

1. Power Electronics P.S. Bimbhra Khanna Publishers 5th Edition, 2012.
2. Power Electronics: Converters, Applications and Design Ned Mohan et al Wiley 3rd Edition, 2014.
3. Power Electronics Daniel W Hart McGraw Hill 1st Edition, 2011.
4. Elements of Power Electronics Philip T Krein Oxford Indian Edition, 2008.

# SYSTEM ON CHIP

| | | | |
|---|---|---|---|
| Course Code | **23ECE653** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **3** | Exam Hours | **3** |
| Examination Type (SEE) | **Theory** | | |

**Prerequisites:** Embedded System, CMOS

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Learn the principles of System-on-Chip (SoC) architectures and their applications.*
*COB-2: Learn the system design with model of computation and co-design and Hardware /software Codesign.*
*COB-3: Gain knowledge on Computation–Communication partitioning and network on chip based SoC.*
*COB-4: Learn the principles of Network-on-Chip (NoC) Design, architectures and their applications.*
*COB-5: Learn the various computation models of SOCs, Academic Implementations-FAUST, RAW and to design case study of SoC –digital camera.*

**Module-I**

**INTRODUCTION:** Introduction to SoC Design, Platform-Based SoC Design, Multiprocessor SoC and Network on Chip, Low Power SoC Design

**Module-II**

**SYSTEM DESIGN WITH MODEL OF COMPUTATION AND CO-DESIGN**: System Models, Validation and Verification, Hardware/Software Codesign Application Analysis, Synthesis

**Module-III**

**COMPUTATION–COMMUNICATION PARTITIONING AND NETWORK ON CHIPBASED SOC:** Communication System - Current Trend, Separation of Communication and Computation. Communication-Centric SoC Design, Communication Synthesis, Network-Based Design, Network on Chip, Architecture of NoC

**Module-IV**

**NOC DESIGN:** Practical Design of NoC, NoC Topology-Analysis Methodology, Energy Exploration, NoC Protocol Design, Low-Power Design for NoC: Low-Power Signaling, On-Chip Serialization, Low-Power Clocking, Low-Power Channel Coding, Low-Power Switch, Low-Power Network on Chip Protocol

**Module-V**

**NOC/SOC CASE STUDIES:** Real Chip Implementation-BONE Series-BONE 1-4, Industrial Implementations, Intel's Tera-FLOP 80- Core NoC, Intel's Scalable Communication Architecture, Academic Implementations-FAUST, RAW; design case study of SoC –digital camera.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Understand foundational concepts and architectures of SoC and Network on Chip (NoC) design.*
*CO-2: Apply system design methodologies, models of computation and hardware/software co-design.*
*CO-3: Analyze and partition computation and communication in communication-centric SoC and NoC architectures.*
*CO-4: Design energy-efficient and low-power NoC protocols, topologies, and signaling methods.*
*CO-5: Evaluate real-world SoC and NoC implementations through case studies and industry examples.*

**Text Books:**

1. W. Wolf, Modern VLSI Design: System-on-Chip Design, 4th ed. Pearson, 2009, ISBN 978-0137145002.
2. S. Pasricha and N. Dutt, On-Chip Communication Architectures: System on Chip Interconnect. Morgan Kaufmann, 2008, ISBN 978-0123738929.
3. A. Jantsch and H. Tenhunen, Networks on Chip. Springer, 2003, ISBN 978-1402075597.

**Reference Books:**

1. G. De Micheli and L. Benini, Networks on Chips: Technology and Tools. Morgan Kaufmann, 2006, ISBN 978-0123705211.
2. L. S. Jerger and T. G. Rogers, On-Chip Networks, Second Edition: Architectures, Methods, and Protocols. Morgan Kaufmann, 2017, ISBN 978-0124081321.
3. M. Keating et al., Low Power Methodology Manual for System-on-Chip Design. Springer, 2007, ISBN 978-0387717135.

**E-References:**

- **https://elearn.maven-silicon.com/course/vlsi-system-on-chip-design-8**

# MODEL BASED DEVELOPMENT USING SIMULINK

| | | | |
|---|---|---|---|
| Course Code | **23ECE661** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **0:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **25** | Total Marks | **100** |
| Credits | **01** | Exam Hours | **2** |
| Examination Type (SEE) | **Practical** | | |

**Prerequisites:** Basics of MATLAB

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand the fundamentals of Model-Based Design.*
*COB-2: Learn the basics of signal generation and visualization using Simulink. COB-3: Develop skills in building models for digital systems.*
*COB-4: Create interactive and functional models, including a GUI. COB-5: Explore embedded system modeling using Simulink.*

| Sl. No. | EXPERIMENTS |
|---|---|
| **1** | Introduction to Model Based Design and Introduction to MATLAB Environment |
| **2** | Introduction to Simulink and Generate the following signals using Simulink and display these signals on a single scope with separate inputs.<br>i) Sinusoidal signal, ii) Square signal, iii) Sawtooth signal, and iv) Random signal |
| **3** | Building model for Mod N up/down counter and Building model to find Factorial of a given number. |
| **4** | Building model for use of If-Else block. |
| **5** | Building model for use of Nested if blocks. |
| **6** | Building model for use of Switch block. |
| **7** | Building model GUI for conversion of colour image to RGB. |
| **8** | Building model to find Speed of the vehicle. |
| **9** | Building model for Mod N counter using Enable subsystem. |
| **10** | Building model for Mod-N counter using Triggered subsystem. |
| **11** | Building model for embedded C code for Mod-5 Counter and Introduction to State flow in Simulink. |
| **12** | Introduction to MIL, SIL, PIL and HIL. |

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Demonstrate proficiency in using MATLAB and Simulink to design and simulate basic models.*
*CO-2: Design and implement Mod N counters, factorial models.*
*CO-3: Apply GUI design principles in Simulink to create interactive models for real-world applications.*
*CO-4: Develop and integrate embedded C code for system modeling and understand the role of MIL, SIL, PIL, and HIL testing.*
*CO-5: Assess and validate system models by leveraging advanced Simulink features.*

**Text Books:**

1. Steven T. Karris, "Introduction to Simulink® with Engineering Applications", Orchard Publications, 2011, ISBN : 978-1934404218.

**Reference Books:**

1. Devendra K. Chaturvedi, "Modeling and Simulation of Systems Using MATLAB and Simulink", CRC Press Taylor & Francis Group, 2010, ISBN 9780815351382

# FPGA SYSTEM DESIGN USING VERILOG

| | | | |
|---|---|---|---|
| Course Code | **23ECE662** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **0:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **25** | Total Marks | **100** |
| Credits | **01** | Exam Hours | **2** |
| Examination Type (SEE) | **Practical** | | |
| **Prerequisites:** Digital Circuits Design, Verilog HDL | | | |

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand FPGA Design flow for VLSI Chip Design*
*COB-2: Understand the concept of Design and implementation of Advanced Digital System Design*
*COB-3: Learning the Implementation of advanced digital circuits on FPGA boards*
*COB-4: Gain hands-on experience in writing and simulating Verilog code*
*COB-5: Develop skills in synthesizing and optimizing digital logic circuits*

| Sl. No. | Compile using any compiler, verify the functionality using suitable Simulator and download the programs on FPGA boards and Verify the Functionality |
|---|---|
| **1** | Write a Verilog description for the following combinational logic, Verify the design using Verilog test bench and perform the synthesis by downloading the design on to FPGA device.<br>a) Structural modelling of Full adder using two half adders and OR Gate<br>b) BCD to Excess-3 code converter |
| **2** | Write a Verilog description for the following Sequential Circuits, Verify the design using Verilog test bench and perform the synthesis by downloading the design on to FPGA device.<br>a) Mod-N counter<br>b) Random sequence detector. |
| **3** | Write a Verilog description for the following Sequential Circuits, Verify the design using Verilog test bench and perform the synthesis by downloading the design on to FPGA device.<br>a) SISO and PISO shift register<br>b) Ring counter and Johnson counter. |
| **4** | Write a Verilog description for the following Digital Circuits, Verify the functionality using Verilog test bench and perform the synthesis by downloading the design on to FPGA device.<br>a) 4-Bit Ripple Carry Adder<br>b) 4-Bit Linear Feedback shift register |
| **5** | Write a Verilog description for the following Digital Circuits, Verify the functionality using Verilog test bench and perform the synthesis by downloading the design on to FPGA device.<br>a) 4-bit Array Multiplication<br>b) 4-bit Booth Multiplication |
| **6** | Write a Verilog description to design a clock divider circuit that generates $1/2^{nd}$, $1/3^{rd}$ and $1/4^{th}$ clock from a given input clock. Port the design to FPGA and validate the functionality using output device. |
| **7** | Interface a Stepper motor to FPGA and Write a Verilog description to Control Stepper motor rotation. |

| | |
|---|---|
| **8** | Interface a DAC to FPGA and Write a Verilog description to generate square wave of frequency F KHz. Modify the code to down sample the frequency to F/2 KHz. Display the original and Down sampled signals by connecting them to an output device. |
| **9** | Write a Verilog description to convert an analog input of a sensor to digital form and to display the same on a suitable display like set of simple LEDs like 7-Segment display digits. |
| **10** | Interface a PS/2 keyboard with an FPGA board, capture keyboard scan codes, and display them using Verilog hardware description language. |

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Familiarize with the EDA tool to write HDL programs to understand simulation and synthesis of digital design.*
*CO-2: Understand the concept of Design and implementation of Advanced Digital System Design.*
*CO-3: Design, Learning the Implementation of advanced digital circuits on FPGA boards.*
*CO-4: Write and simulate a Verilog code for various designs and applications.*
*CO-5: Develop skills in synthesizing and optimizing digital logic circuits.*

**Text Books:**

1. SamirPalnitkar, "Verilog HDL : A guide to digital design and synthesis", Pearson Education, II Edition.
2. Donald E Thomas, Philip R Moorby, "The Verilog hardware description Language", Springer Science Business Media , LLC, 5th Edition.

**Reference Books:**

1. Michael D. Ciletti, "Advanced digital design with the Verilog HDL", Pearson (PHI),II Edition
2. Padmanabhan, Tripura Sunadri, "Design through Verilog HDL", Wiley.

# NETWORK SECURITY

| | | | |
|---|---|---|---|
| Course Code | **23ECE663** | CIE Marks | **50** |
| Teaching Hours/Week (L:T:P) | **1:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **20** | Total Marks | **100** |
| Credits | **01** | Exam Hours | **01** |
| Examination Type (SEE) | **Theory** | | |

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Describe the need for network security, approaches, and types of attacks.*
*COB-2: Understand Transport Level Security and Secure Socket Layer.*
*COB-3: Know about Security concerns in Internet Protocol security.*
*COB-4: Discuss about Intruders, Intrusion detection and Malicious Software.*
*COB-5: Discuss about Firewalls, Firewall characteristics, Biasing and Configuration.*

**Module-I**

**Attacks on Computers and Computer Security:** Need for Security, Security Approaches, Principles of Security, Types of Attacks.

**Module-II**

**Transport Level Security:** Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)

**Module-III**

**IP Security:** Overview of IP Security (IPSec), IP Security Architecture, Modes of Operation, Security Associations (SA), Authentication Header (AH), Encapsulating Security Payload (ESP), Internet Key Exchange.

**Module-IV**

**Intruders:** Intrusion, Detection.
**Malicious Software:** Viruses and Related Threats, Virus Counter measures,

**Module-V**

**Firewalls:** The Need for firewalls, Firewall Characteristics, Types of Firewalls, Firewall Biasing, Firewall location and configuration

***COURSE OUTCOMES:***

**After studying this course, students will be able to:**

*CO-1: Explain different types of computer attacks and core security principles.*
*CO-2: Understand the concept of Transport Level Security and Secure Socket Layer.*
*CO-3: Apply IP security protocols for secure network communication.*
*CO-4: Detect intrusions and mitigate malware threats effectively.*
*CO-5: Design and configure firewall systems for network protection.*

**Text Books:**

1. W. Stallings, Cryptography and Network Security: Principles and Practice, 5th ed. Pearson Education Inc., 2014, ISBN 978-81-317-6166-3.
2. A. Kahate, Cryptography and Network Security. TMH, 2003, ISBN 978-0070494830.

**Reference Books:**

1. B. A. Forouzan, Cryptography and Network Security. TMH, 2007, ISBN 978-0070660464.

# INDIAN KNOWLEDGE SYSTEM

**(Common to All UG Programs)**

| | | | |
|---|---|---|---|
| **Course Code** | **23IKS680** | **CIE** | **100 Marks** |
| **Credits: L:T:P** | **1: 0: 0** | **SEE** | **---** |
| **Total Hours** | **15** | **SEE Duration** | **--** |

**Course Learning Objectives:** The students will be able to:

| | |
|---|---|
| **COB-1** | Facilitate with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system. |
| **COB-2** | Understand the traditional knowledge and analyze it and apply it to their day-to-day life. |

| **Unit-I** | **05 Hrs** |
|---|---|
| **Introduction to Indian Knowledge Systems (IKS):** Overview, Vedic Corpus, Philosophy, Character scope and importance, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge vs. western knowledge. | |
| **Unit – II** | **05 Hrs** |
| **Traditional Knowledge in Humanities and Science**s: Linguistics, Number and measurements- Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology. | |
| **Unit -III** | **05 Hrs** |
| **Traditional Knowledge in Professional domain:** Town planning and architecture-Construction, Health, wellness and Psychology-Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals. | |

| **Course Outcomes: After studying this course, the students will be able to** | |
|---|---|
| **CO1:** | Provide an overview of the concept of the Indian Knowledge System and its importance. |
| **CO2:** | Appreciate the need and importance of protecting traditional knowledge. |
| **CO3:** | Recognize the relevance of Traditional knowledge in different domains. |
| **CO4:** | Establish the significance of Indian Knowledge systems in the contemporary world. |

**Text Books:**

1. **Introduction to Indian Knowledge System- concepts and applications**, B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, 2022, PHI Learning Private Ltd, ISBN-978-93- 91818-21-0

**Reference Books:**

1. **Traditional Knowledge System in India**, Amit Jha, 2009, Atlantic Publishers and Distributors
2. (P) Ltd., ISBN-13: 978-8126912230,
3. **Knowledge Traditions and Practices of India**, Kapil Kapoor, Avadesh Kumar Singh, Vol. 1,
4. 2005, DK Print World (P) Ltd., ISBN 81-246-0334,

**E-References:**

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

Tungabhadra Education Health & Rural Development (TEHRD) Trust®, Ballari
ಕಿಷ್ಕಿಂದ ವಿಶ್ವವಿದ್ಯಾಲಯ KISHKINDA UNIVERSITY
Established under Karnataka Act, No.20 of 2023 | Recognized by Govt. of Karnataka & UGC, New Delhi

# Electronics and Communication Engineering

## FACULTY OF ENGINEERING & TECHNOLOGY

## 2023 Scheme & Syllabus

Scheme of
Teaching & Evaluation for

## VII Semester

# LOW POWER VLSI DESIGN

| | | | |
|---|---|---|---|
| Course Code | **23ECE710** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Basics of CMOS IC Design & Digital circuit Design.

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to*:**

*COB-1: Know the Fundamentals of Low power and Understand sources and impact of power dissipation in VLSI circuits.*
*COB-2: Explore techniques to reduce switching activity and optimize circuit design to achieve low power in VLSI Circuits.*
*COB-3: Learn special low power design methods including clock network and architecture-level strategies.*
*COB-4: Study the approaches to minimize the leakage power using different digital circuitry techniques.*
*COB-5: Gain knowledge of advanced low power optimization techniques and CAD tools.*

## Module-I

**Fundamentals of Low Power VLSI Design:** Need for Low Power Circuit Design**;** Sources of Power Dissipation: Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching.
**Power Dissipation Short Channel Effects:** Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

## Module-II

**Achieving Low Power Techniques:** Switching activity reduction, algorithmic optimization, architecture optimization, logic optimization, circuit optimization; Architectural Level Approach: Pipelining and Parallel Processing Approaches; Different logic styles: Static and dynamic logic, Clock gating, reducing glitching through path balancing, input reordering.

## Module-III

**Special Low Power VLSI Design Techniques:** Introduction, Power reduction in clock networks, CMOS floating node, Delay balancing, Switching activity reduction, parallel architecture voltage reduction, operator reduction, loop unrolling.

## Module-IV

**Minimizing Switched Capacitance:** Introduction, system-level approaches, transmeta's Crusoe processor, bus encoding, gated-clock FSMs, FSM state encoding, FSM Partitioning, operand isolation, precomputation, logic styles for low power. Minimizing Leakage Power.

## Module-V

**Low Power VLSI Design and Optimization Techniques:** Multiple threshold voltages, approaches for minimizing leakage power, Adiabatic Logic Circuits, Dynamic Voltage and Frequency Scaling (DVFS), Clock Gating and Power Gating, Dynamic Power Management (DPM), Clock Distribution Network Optimization, Battery-Driven System, CAD Tools for Low Power VLSI Circuits.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Know the basics of Low power VLSI and Identify different sources of power dissipation in VLSI circuits.*
*CO-2: Apply architectural and logic-level methods to reduce power consumption.*
*CO-3: Implement specialized low power design techniques to achieve low power in VLSI circuits.*
*CO-4: Analyze and minimize switched capacitance and leakage power in VLSI designs.*
*CO-5: Utilize advanced optimization techniques and tools for low power VLSI design.*

**PRACTICAL COMPONENTS**

**LIST OF EXPERIMENTS**

1. Implement Power Characterization of CMOS Inverter and NAND Gate
2. Analyze the Power Estimation at Circuit and Gate Level.
3. Analyze the Power Optimization in Combinational Logic Using Logic Restructuring.
4. Analyze the Power Optimization in Sequential Circuits using Clock Gating.
5. Analyze the RTL Power Optimization using Operator Scheduling and Resource Sharing.
6. Design and Analysis of Low Power, High-Speed Adders and Multipliers.
7. Analyze the Power Gating and Multi-Vt Cell Based Power Reduction.
8. Design of Energy Recovery Logic (Adiabatic Circuits).
9. Implement Low Power Clocking and Gated Clock Design for a Sequential System.
10. Design of Low Power Memory Blocks.

**Text Books:**

1. Kiat-Seng Yeo, Kaushik Roy, “Low-Voltage, Low-Power VLSI Subsystems”, TMH Professional Engineering, 2005.
2. Anantha P. Chandrakasan, and Robert W. Brodersen, Low Power Digital CMOS Design, Kluwer Academic Publications, 2012.
3. Gary Yeap, “Practical Low Power Digital VLSI Design”, Springer US, Kluwer Academic Publishers, 2002.
4. Ajit. Pal, Low power VLSI Circuits and systems, springer

**Reference Books:**

1. Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, TMH.
2. Neil H. E. Weste and K. Eshraghian, Principles of CMOS VLSI Design, 2nd Edition, Addison Wesley (Indian reprint).
3. Kaushik Roy, Sharat C. Prasad, “Low Power CMOS VLSI Circuit Design”, John Wiley & Sons, 2000.
4. Philip Allen, and Douglas Holberg, CMOS Analog Circuit Design, Oxford University Press.

**E-References:**

1. NPTEL Course: https://archive.nptel.ac.in/courses/106/105/106105034/

# MICROWAVE AND OPTICAL COMMUNICATION

| | | | |
|---|---|---|---|
| Course Code | **23ECE720** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Antennas and Wave Propagation

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the principles and operation of microwave tubes and solid-state microwave devices.*
*COB-2: Explore waveguide components, their characteristics, and applications in microwave systems.*
*COB-3: Learn microwave device behavior and measurement techniques using scattering parameters.*
*COB-4: Study fundamentals of optical fibers, propagation, and transmission characteristics.*
*COB-5: Gain knowledge of optical communication system components, including transmitters, amplifiers, and receivers.*

## Module-I

**Microwave Tubes and Solid-State Devices:**
**Microwave Tubes, Amplifiers and Oscillators:** Limitations and Losses of conventional Tubes at Microwave Frequencies, Microwave Tubes – O Type and M Type Classifications; 2 Cavity Klystrons – Structure, Reentrant Cavities, Velocity Modulation Process and Applegate Diagram, Bunching Process, power output; Reflex Klystrons – Structure, Velocity Modulation and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes and O/P Characteristics,
**Solid State Devices:** Gunn Diodes – Principle, Characteristics, Modes of Operation - Gunn Oscillation Modes, Principle of operation of IMPATT and TRAPATT Devices, PIN Diode, Tunnel Diode

## Module-II

**Waveguide components**: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Waveguide Attenuators – Different Types, Resistive Card and Rotary Vane Attenuators; Waveguide Multiport Junctions - E plane and H plane Tees. Ferrites– Composition and Characteristics, Faraday Rotation, Ferrite Components – Gyrator, Isolator.

## Module-III

**Microwave Devices and Measurement Techniques:**
**Scattering matrix:** Scattering Matrix Properties, Directional Couplers – 2 Hole, Bethe Hole, [s] matrix of Magic Tee and Circulator.
**Microwave Measurements:** Description of Microwave Bench – Different Blocks and their Features, Errors and Precautions, Measurement of Attenuation, Frequency. Standing Wave Measurements, measurement of Low and High VSWR, Cavity Q, Impedance Measurements.

## Module-IV

**Introduction to optical fibers and transmission characteristics-** The propagation of light in optical waveguides – Classification of optical fibers – Numerical aperture, Step index and Graded index fiber – Modes in cylindrical fiber – Linearly polarized modes, Attenuation: Absorption, Scattering, Bending losses. Modal dispersion and chromatic dispersion – Single mode fiber - waveguide dispersion– MFD – PMD.

## Module-V

**Optical communication systems and design-** Transmitter module: Signal formats – Electronic driving circuit – Modulation circuit – external modulators. Amplifier: EDFA, Semiconductor Optical Amplifier. Receiver Module: Optical front end – Quantizer – Decision circuit, Light Sources, Optical Sources, LED, Light Detectors, LASERS, WDM Concepts.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Explain the working and applications of microwave tubes and solid-state devices.*
*CO-2: Identify and analyze waveguide components and their roles in microwave circuits.*
*CO-3: Measure and interpret microwave device parameters using scattering matrix and bench setups.*
*CO-4: Describe optical fiber types, light propagation, and dispersion effects.*
*CO-5: Design basic optical communication systems with appropriate sources, detectors, and amplifiers.*

**PRACTICAL COMPONENTS**

**LIST OF EXPERIMENTS**

1. To understand and analyze the concepts of klystron working, bench setup and its applications.
2. To understand and acquire the knowledge about the concepts of gunn diode characteristics and its applications
3. To understand and analyze the Measurement of attenuation in a waveguide.
4. To provide an in-depth analysis of directional coupler using other wave guides and its many Applications.
5. To understand and identify the scattering parameters of a E-Plane Tee.
6. To understand and analyze the Measurement of Microwave Frequency.
7. To understand and identify the impedance of a given load.
8. To understand and analyze the concepts of VSWR Measurement and its applications.
9. To study the relationship between the optical power output and dc forward current of LED
10. To find the characteristics of Optical Power (Po) of laser diode vs. Laser diode forward current (IF).
11. To study the following characteristics of intensity modulation of LASER output through optical fiber.
12. To measure the numerical aperture of the plastic fiber.

**Text Books:**

1. Samuel Y. Liao -Microwave Devices and Circuits, 3rd Edition, Pearson, 2003.
2. Gerd Keiser - Optical Fiber Communication, 4th Edition, TMH, 2008.

**Reference Books:**

1. Wayne Tomasi- Electronic Communications Systems, 5th Edition, Pearson.
2. David M. Pozar - Microwave Engineering – 3rd edition, John Wiley & Sons (Asia) Pvt Ltd., 2011 Reprint.
3. G.S. Raghuvanshi - Microwave Engineering, Cengage Learning India Pvt. Ltd., 2012.
4. George Kennedy - Electronic Communication System, 6th Edition, McGraw Hill.

**E-References:**

**1.** **https://archive.nptel.ac.in/courses/108/101/108101112/**

# DATA STRUCTURES USING PYTHON

| | | | |
|---|---|---|---|
| Course Code | **23ECE730** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:2** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)+20(P)** | Total Marks | **100** |
| Credits | **04** | Exam Hours | **3** |
| Examination type (SEE) | **IPCC** | | |

**Prerequisites:** Basic understanding of Python Programming.

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*CO1: Introduce fundamental data structures and Python programming concepts.*
*CO2: Develop proficiency in implementing and analyzing linear data structures such as arrays, stacks, and queues.*
*CO3: Enhance understanding of linked lists, trees, and graphs, focusing on their operations and applications.*
*CO4: Equip students with the skills to implement and evaluate sorting and searching algorithms.*
*CO5: Apply data structures and algorithms to solve real-world computational problems effectively.*

### Module-I

**Introduction to Data Structures & Python Basics:** Introduction to Data Structures: Importance & Applications Overview of Python: Syntax, Data Types, Control Structures, Functions and Recursion, Lists and Tuples in Python, Time and Space Complexity Basics.

### Module-II

**Arrays, Stacks, and Queues:** Arrays: Representation, Operations & Applications. Stack: LIFO Principle, Implementation using Lists, Applications (Parenthesis Matching, Infix to Postfix), Queue: FIFO Principle, Types (Simple, Circular, Deque, Priority Queue). Implementation of Stack and Queue using Python.

### Module-III

**Linked Lists:** Introduction to Linked Lists: Singly, Doubly & Circular Linked Lists. Operations on Linked Lists: Insertion, Deletion, Traversal. Applications of Linked Lists. Python Implementation of Linked Lists.

### Module-IV

**Trees and Graphs:** Trees: Introduction, Binary Trees, Binary Search Trees (BST), Tree Traversals (Preorder, In order, Post order), Heap and Priority Queue. Graphs: Representation (Adjacency List, Adjacency Matrix). Graph Traversal Algorithms: BFS and DFS. Applications of Trees and Graphs.

### Module-V

**Sorting, Searching, and Hashing:** Searching Algorithms: Linear Search, Binary Search. Sorting Algorithms: Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort. Hashing Techniques: Hash Functions, Collision Resolution (Chaining, Open Addressing). Applications of Sorting and Searching in Engineering Problems Python Implementations of Searching and Sorting.

## *COURSE OUTCOMES:*

***After studying this course, students will be able to:***

*CO1: Demonstrate a clear understanding of various data structures and their applications.*
*CO2: Implement and manipulate data structures using Python programming language.*
*CO3: Analyze the time and space complexity of algorithms and data structures.*
*CO4: Design and implement efficient algorithms for sorting, searching, and data manipulation.*
*CO5: Apply appropriate data structures and algorithms to solve complex computational problems.*

**PRACTICAL COMPONENT**

**LIST OF THE EXPERIMENTS:**

1. Implement Array Operations (Insertion, Deletion, Searching).
2. Implement Stack ADT using List.
3. Implement Queue ADT using List.
4. Implement Circular Queue using List.
5. Implement Singly Linked List with Insertion, Deletion, and Traversal.
6. Implement Doubly Linked List with Insertion, Deletion, and Traversal.
7. Implement Stack ADT using Linked List.
8. Implement Queue ADT using Linked List.
9. Implement Binary Search Tree (BST) – Insert, Delete, and Traversals ( In order, Preorder, Post order).
10. Implement Graph Traversal Algorithms– Breadth-First Search (BFS) & Depth-First Search (DFS).
11. Implement Sorting Algorithms – Bubble Sort, Insertion Sort, and Quick Sort.
12. Implement Hash Table using Open Addressing and Chaining.

**Text Books:**

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy in Python", CareerMonk Publications.
2. Mark Lutz, "Learning Python", O'Reilly Media.

**Reference Books:**

1. Thomas H. Cormen et al., "Introduction to Algorithms", MIT Press.
2. Reema Thareja, "Data Structures Using Python", Oxford University Press.

**E-References:**

1. NPTEL Course: Data Structures and Algorithms using Python (https://nptel.ac.in)
2. GeeksforGeeks Python Data Structures Tutorial (https://www.geeksforgeeks.org/python-data-structures)

# RADAR ENGINEERING

| | | | |
|---|---|---|---|
| Course Code | **23ECE741** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Digital Communication (DC), Digital Signal Processing (DSP)

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the basic principles and types of radar systems.*
*COB-2: Analyze radar range equations and system performance factors.*
*COB-3: Explore MTI and Doppler radar techniques for target detection.*
*COB-4: Examine tracking radar systems and tracking methods.*
*COB-5: Study radar antennas, receivers, and display technologies.*

## Module-I

**Basics of Radar:** Introduction, Maximum Unambiguous Range, Radar Waveforms, Definitions with respect to pulse wave form-PRF, PRI, Duty Cycle, Peak Transmitter Power, Average transmitter Power. Simple form of the Radar Equation, Radar Block Diagram and Operation, Radar Frequencies, Applications of Radar, The Origins of Radar, Illustrative Problems.

## Module-II

**The Radar Equation:** Prediction of Range 'Performance, Detection of signal in Noise, Minimum Detectable Signal, Receiver Noise, SNR, Modified Radar Range Equation, Envelope Detector - False Alarm Time and Probability, Probability of Detection, Radar Cross Section of Targets: simple targets - sphere, cone-sphere, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

## Module-III

**MTI and Pulse Doppler Radar:** Introduction, Principle, Doppler Frequency Shift, Simple CW Radar, Sweep to Sweep subtraction and Delay Line Canceler, MI1 Radar with- Power Amplifier Transmitter, Delay Line Cancelers- Frequency Response of Single Delay- Line Canceler, Blind Speeds, Clutter Attenuation, MI1 Improvement Factor, N- Pulse Delay-Line Canceler, Digital MTI Processing-Blind phases, I and Q Channels, Digital MTI Doppler signal processor, Moving Target Detector- Original MTD.

## Module-IV

**Tracking Radar:** Tracking with Radar- Types of Tracking Radar Systems, Mono-pulse Tracking- Amplitude Comparison Mono-pulse (one-and two- coordinates), Phase Comparison Mono-pulse. Sequential Lobing, Conical Scan Tracking, Block Diagram of Conical Scan Tracking Radar, Tracking in Range, Comparison of Trackers.

## Module-V

**The Radar Antenna:** Functions of The Radar Antenna, Antenna Parameters, Reflector Antennas and Electronically Steered Phase Array Antennas.
**Radar Receiver:** The Radar Receiver, Receiver Noise Figure, Super Heterodyne Receiver, Duplexers and Receivers Protectors, Radar Displays.

## *COURSE OUTCOMES:*

***After studying this course, a student will be able to:***

*CO-1: Understand the fundamental principles, parameters, and applications of radar systems.*
*CO-2: Apply the radar range equation to evaluate performance and analyze detection capabilities under noisy conditions.*
*CO-3: Explain the operation and processing techniques of MTI and pulse Doppler radar systems.*
*CO-4: Analyze different radar tracking methods and assess their effectiveness in various scenarios.*

*CO-5: Describe the functions and characteristics of radar antennas, receivers, and display systems.*

**Text Books:**

1. Introduction to Radar Systems- Merrill Skolink, 3e,TMH, 2001

**Reference Books:**

1. Radar Principles, Technology, Applications-ByronEdde, Pearson Education, 2004.
2. Radar Principles-Peebles .Jr, P.Z. Wiley.New York, 1998.
3. Principles of Modem Radar: Basic Principles-Mark A. Rkhards, James A. Scheer,William.A. Holm.Yesdee, 2013

# ADHOC AND SENSOR NETWORKS

| | | | |
|---|---|---|---|
| Course Code | **23ECE742** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites**: Data Communication and Computer Networks

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the fundamental concepts of ADHOC networks and Wireless Sensor Networks.*
*COB-2: Study the MAC protocols for ADHOC networks.*
*COB-3: Understand the challenges, applications and architectures for Wireless Sensor Networks.*
*COB-4: Study the networking concepts and protocols for efficient data transmission in ADHOC networks.*
*COB-5: Understand the network security requirements using different technologies to enhance the efficiency of ADHOC and Wireless Sensor Networks.*

## Module-I

**AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS**

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).

## Module-II

**MAC Protocols for Ad hoc wireless Networks**: Introduction, Issues in designing a MAC protocol for Ad hoc wireless Networks, Design goals of a MAC protocol for Ad hoc wireless Networks, Classification of MAC protocols, Contention based protocols with reservation mechanisms. Contention-based MAC protocols with scheduling mechanism, MAC protocols that use directional antennas, Other MAC protocols.

## Module-III

**SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

## Module-IV

**WSN NETWORKING CONCEPTS AND PROTOCOLS**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

## Module-V

**SENSOR NETWORK SECURITY**

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Understand the fundamental concepts and challenges of ADHOC and Wireless Sensor Networks.*
*CO-2: Analyze various MAC protocols and network architectures used in ADHOC and WSN environments.*
*CO-3: Implement the architecture, applications and challenges for Wireless Sensor Networks.*
*CO-4: Implement the networking concepts and various protocols for efficient data transmission in ADH sensor networks.*
*CO-5: Evaluate the security challenges and implement security mechanisms for Wireless Sensor Networks.*

**Text Books:**

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols," Pearson Education, 2004.

**Reference Books:**

1. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks," John Wiley & Sons, 2005.
2. Kazem Sohraby, Daniel Minoli, and Taieb Znati, "Wireless Sensor Networks: Technology, Protocols, and Applications," Wiley, 2007.
3. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: An Information Processing Approach," Morgan Kaufmann, 2004.

**E-References:**

**1. https://archive.nptel.ac.in/courses/106/105/106105160/**

# SATELLITE COMMUNICATION

| | | | |
|---|---|---|---|
| Course Code | **23ECE743** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Knowledge of Basic Geometry, Fundamentals of Communication Systems

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the overview of the satellite systems, Launching methods of the Orbits and Geostationary Orbits.*
*COB-2: Understand Earth and space segments in the satellite communications.*
*COB-3: Know satellite subsystems, power systems and Satellite wide band receivers for effective communication.*
*COB-4: Knowledge of every aspect of satellite communication like satellite link design, earth station technology and different access system towards a satellite.*
*COB-5: Examine various satellite applications such as navigation and video and Imaging communications.*

## Module-I

**Satellite Systems and Orbits:** Overview of satellite systems: Introduction, Frequency allocations for satellite systems.
**Orbits and launching methods**: Kepler's three laws of planetary motion, terms used for earth orbiting satellites, orbital elements, apogee and perigee heights, orbit perturbations, inclined orbits, standard time.
**The Geostationary orbit:** Introduction, antenna look angles, polar mount antenna, limits of visibility, near geostationary orbits, earth eclipse of satellite.

## Module-II

**Space Segment & Earth Segment: The Space segment**: Introduction, power supply, attitude control, station keeping, thermal control, TT&C subsystem, transponders.
**The Earth segment:** Introduction, receive-only home TV systems, master antenna TV system, Community antenna TV system, transmit-receive earth station.

## Module-III

**Satellite Subsystems:** Satellite subsystem; Attitude control, station keeping, Thermal control, Telemetry, Tracking, Command and Monitoring (TTC&M); power systems, transponders, satellite wide band receiver.

## Module-IV

**Satellite link design and Satellite access:** Atmospheric losses, Basic transmission theory, system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; communication link design procedure.

## Module-V

**Applications of Satellites:** Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture, Multifunctional Advanced Video and Imaging Communications (MAVIC).

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Explain the historical background, fundamental concepts, and Launching methods of the Orbits and Geostationary Orbits in satellite communication.*
*CO-2: Describe the Earth and space segments involved in satellite communication systems.*
*CO-3: Implement the satellite subsystems, power systems and Satellite wide band receivers for effective communications in different scenarios.*
*CO-4: Analyze various aspects of satellite communication, including satellite link design and multiple access techniques.*
*CO-5: Apply the principles of satellite communication to real-world applications in telecommunications, navigation, and video and imaging communications.*

**Text Books:**

**1.** Dennis Roddy, "Satellite Communications", McGraw-Hill international, 4th Edition, 2006.

**Reference Books:**

1. Timothy Pratt, Charles Bostian, Jeremy Allnutt. "Satellite Communications", John Wiley Pvt Ltd & Sons, 2nd Edition, 2008.

**E-References:**

**1.** **https://archive.nptel.ac.in/courses/117/105/117105131/**

# Electronics and Communication Engineering

## FACULTY OF ENGINEERING & TECHNOLOGY
## 2023 Scheme & Syllabus

Scheme of
Teaching & Evaluation for

# VIII Semester

# WIRELESS COMMUNICATION

| | | | |
|---|---|---|---|
| Course Code | **23ECE810** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Digital Communications, Data Communication and computer networks

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the evolution and various generations of wireless systems and networks.*
*COB-2: Understand the needful concepts behind the wireless network architecture and operation.*
*COB-3: Understand the system operation for GSM networks.*
*COB-4: Understand the concept of Code Division Multiple Access technology in wireless network communications.*
*COB-5: Know and understand the various wireless modulation and coding techniques.*

## Module-I

**Wireless Telecommunication Systems and Networks:** Introduction, History and Evolution, Different generations of wireless cellular networks 1G, 2G, 3G and 4G networks, Common Cellular System and network components, views of cellular networks, 3G cellular systems components, Cellular component identification Call establishment.

## Module-II

**Wireless Network Architecture and Operation:** Introduction, Cellular concept and fundamentals, Capacity expansion techniques, Cellular backbone networks, Mobility management, Radio resources and power management, GSM system overview, GSM and TDMA techniques, GSM Network and system Architecture, GSM channel concepts, GSM Identifiers.

## Module-III

**Global System for Mobile Communication (GSM):** Introduction, System operation, Traffic cases, Call handoff, Roaming, GSM protocol architecture. TDMA systems. CDMA technology.

## Module-IV

**Code Division Multiple Access (CDMA):** Introduction, CDMA technology, CDMA overview, CDMA channel concept CDMA operations.

## Module-V

**Wireless Modulation-Coding Techniques:** Introduction, Air interface, Path loss models, Wireless coding techniques, Digital modulation techniques, OFDM, UWB radio techniques, Diversity techniques, Typical GSM Hardware.

## *COURSE OUTCOMES:*

***After studying this course, the students will be able to:***

*CO-1: Explain the evolution of wireless networks and differentiate between various wireless generations.*
*CO-2: Analyze the wireless network architecture and operational principles of wireless communication systems.*
*CO-3: Describe the system operation and key functionalities of GSM networks for mobile communications.*
*CO-4: Learn and apply the concept of Code Division Multiple Access technology in wireless network communications.*
*CO-5: Evaluate different modulation and coding techniques used in wireless communication.*

**Text Books:**

1. Gary J Mullett, “Introduction to wireless Telecommunications Systems and Networks”, Thomson/Cengage Learning, 2006.

**Reference Books:**

1. "Introduction to Wireless Telecommunications Systems and Networks", Gary Mullet, First Edition, Cengage Learning India Pvt Ltd., 2006, ISBN -13: 978-81-315-0559-5.
2. "Wireless Communications: Principles and Practice" Theodore Rappaport,2• Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.

**E-References:**

1. https://archive.nptel.ac.in/courses/117/102/117102062/

# RESEARCH METHODOLOGY AND IPR

| | | | |
|---|---|---|---|
| Course Code | **23RMI821** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination Type (SEE) | **Theory** | | |

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand research fundamentals, formulation of the research problems and learn the literature review process.*
*COB-2: Know the data collection methods and data analyzing techniques to carry the further research process.*
*COB-3: Design research strategies and hypothesis formulation using statistical tests.*
*COB-4: Learn the test procedures and should be able to present the research work.*
*COB-5: Learn about Law of Patents, Patent Searches, Ownership, Transfer Patentability, intellectual property rights and the patent filing process.*

## Module-I

**Introduction** - Objective of Research; Definition and Motivation; Types of Research; Research Approaches, Steps in Research Process; Criteria of Good Research; Ethics in Research.
**Research Formulation and Literature Review:** Problem Definition and Formulation; Literature Review; Characteristics of Good Research Question; Literature Review Process.

## Module-II

**Data Collection** - Primary and Secondary Data; Primary and Secondary Data Sources; Data Collection Methods; Data Processing; Classification of Data.
**Data Analysis** - Statistical Analysis; Multivariate Analysis; Correlation Analysis; Regression Analysis; Principle Component Analysis; Samplings

## Module-III

**Research Design** - Need for Research Design; Features of a Good Design; Types of Research Designs; Induction and Deduction.
**Hypothesis Formulation and Testing** - Hypothesis; Important Terms; Types of Research Hypothesis; Hypothesis Testing; Z-Test; t-Test; f-Test; Making a Decision; Types of Errors; ROC Graphics.

## Module-IV:

**Test Procedures** - Parametric and Non-Parametric Tests; ANOVA; Mann-Whitney Test; Kruskal-Wallis Test; Chi-Square Test; Multi-Variate Analysis.
**Presentation of the Research Work** - Business Report; Technical Report; Research Report; General Tips for Writing Report; Presentation of Data; Oral Presentation; Bibliography and References; Intellectual Property Rights; Open-Access Initiatives; Plagiarism

## Module-V

**Law of Patents, Patent Searches, Ownership, Transfer Patentability Design Patents** - Double Patenting, Patent Searching, Patent Application Process – Prosecuting the Application, Post-issuance Actions, Term and Maintenance of Patents. Ownership Rights, Sole and Joint Inventors, Inventions Made by Employees and Independent Contractors – Assignment of Patent Rights, Licensing of Patent Rights – Invention Developers and Promoters. **Patent Infringement, New Developments and International Patent Law** - Direct Infringement - Inducement to Infringe – Contributory Infringement – First Sale Doctrine – Claims Interpretation – Defenses to Infringement – Remedies for Infringement – Resolving an Infringement Dispute – Patent Infringement Litigation. New Developments in Patent Law.

***COURSE OUTCOMES***:

***After studying this course, students will be able to:***

*CO-1: Formulate the research problems and do the literature review process.*
*CO-2: Collect the data and analyze to carry the further research process.*
*CO-3: Understand the research design and Formulation of Hypothesis and Testing.*
*CO-4: Understand the test procedures, Presentation of the Research Work and will be able to write and publish a technical research paper in a peer-reviewed journal.*
*CO-5: Understand the Law of Patents, Patent Searches, Ownership, Transfer Patentability, Design Patents Patent Infringement, New Developments and International Patent Law.*

**Text Books:**

1. Research Methodology. Methods & Technique: Kothari. C.R.

**Reference Books:**

1. Research Methodology, S.S Vinod Chandra, S Anand Hareendran, Pearson
2. Intellectual Property – Copyrights, Trademarks, and Patents by Richard Stim, Cengage Learning

# ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING (AI & ML)

| | | | |
|---|---|---|---|
| Course Code | **23ECE822** | CIE Marks | **50** |
| Teaching Hours / Week (L:T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination type (SEE) | **Theory** | | |

**Prerequisites:** Algebra, Fundamentals of Python.

## *COURSE OBJECTIVES:*

***The objectives of the course are to enable students to:***

*COB-1: Understand the fundamentals of Artificial Intelligence with a focus on problem-solving methods, including state space search and heuristic strategies.*

*COB-2: Equip with AI techniques for problem reduction, game playing, and logic-based reasoning using propositional and predicate logic.*

*COB-3: Explore advanced AI problem-solving paradigms like planning and knowledge representation techniques for intelligent system design.*

*COB-4: Understand the fundamentals of Machine Learning and data understanding, emphasizing types, processes, and applications in real-world scenarios.*

*COB-5: Provide foundational knowledge in multivariate statistics and learning theory essential for building effective machine learning models.*

## Module-I

**Introduction to AI**: Introduction, Problem Solving: state space search and control strategies: Introduction, General problem solving, Characteristics of problem, Exhaustive Searches, Heuristic Search Techniques, Interative Deepening, Constant satisfaction.

## Module-II

**Problem reduction Techniques:** Problem reduction and Game playing, Logic concepts and logic programming: Introduction, Problem reduction, Game playing, Bounded look ahead strategy and Use of, Alpha-Beta Pruning, Two –player perfect information games. Propositional calculus, Propositional logic, Natural Deduction system, Axiomatic system, Semantic tableau system in propositional logic, resolution refutation in propositional logic, Predicate logic, Logic programming.

## Module-III

**Advanced problem-solving paradigm:** planning- types of planning systems, Block world problem, logic based planning, Linear planning using a goal stack, Means-ends analysis, Non –linear planning strategies. Knowledge representation: Approaches to knowledge representation, knowledge representation using semantic network, Extended semantic networks for KR, Knowledge representation using frames.

## Module-IV

**Introduction to Machine Learning:** Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to Other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Application. Understanding Data: Introduction, Big Data Analytics and Types of Analytics, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization, Bivariate Data and Multivariate Data.

## Module-V

**Understanding Data:** Multivariate Statistics, Essential Mathematics for Multivariate Data, Overview of Hypothesis, Feature Engineering and Dimensionality Reduction Techniques. Basics of Learning Theory: Introduction to Learning and its Types, Introduction to Computation Learning Theory, Design of a Learning System, Introduction to Concept Learning, Induction Biases, Modelling in Machine Learning.

***COURSE OUTCOMES:***

***After studying this course, students will be able to:***

*CO-1: Apply AI techniques such as heuristic search and constraint satisfaction to solve general and structured problems efficiently.*
*CO-2: Implement problem-solving strategies using logic programming and optimize game-tree searches with techniques like alpha-beta pruning.*
*CO-3: Design planning systems and represent knowledge effectively using semantic networks and frames.*
*CO-4: Explain machine learning concepts and perform basic data analysis using descriptive and multivariate techniques.*
*CO-5: Understand the foundational knowledge in multivariate statistics and learning theory essential for building effective machine learning models.*

**Text Books:**

1. Artificial Intelligence, Saroj Kaushik Cengage Learning 2014 Edition.
2. S Sridhar and M Vijayalakshmi, "Machine Learning", Oxford University Press, 2021.

**Reference Books:**

1. Artificial Intelligence: Structures and Strategies for Complex Problem Solving, George F Luger Pearson Addison Wesley 6th Ed, 2008.
2. Artificial Intelligence, E Rich, K Knight, and S B Nair Tata Mc-Graw Hill 3rd Ed, 2009.
3. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig Prentice Hall 3rd, 2009.

**E-References:**

1. **https://onlinecourses.nptel.ac.in/noc22_cs56/preview**

# MICRO-ELECTRO MECHANICAL SYSTEMS (MEMS)

| | | | |
|---|---|---|---|
| Course Code | **23ECE823** | CIE Marks | **50** |
| Teaching Hours / Week (L: T:P) | **3:0:0** | SEE Marks | **50** |
| Total Hours of Pedagogy | **40(T)** | Total Marks | **100** |
| Credits | **03** | Exam Hours | **3** |
| Examination Type (SEE) | **Theory** | | |

**Prerequisites:** Analog Electronic Circuits, Sensors and Actuators.

***COURSE OBJECTIVES:***

***The objectives of the course are to enable students to:***

*COB-1: Understand the fundamental characteristics and fabrication processes of MEMS devices.*
*COB-2: Explore electrostatic and thermal sensing and actuation principles in MEMS.*
*COB-3: Study piezoresistive and piezoelectric sensing and actuation mechanisms.*
*COB-4: Learn bulk and surface micromachining techniques for MEMS fabrication.*
*COB-5: Investigate polymer-based MEMS materials and their applications.*

## Module-I

**Introduction:** Intrinsic Characteristics of MEMS- Miniaturization, Microelectronics Integration, Mass Fabrication with Precision, Sensors and Actuators- Energy Domains and Transducers, Sensors, Actuators.
**Introduction to Micro fabrication:** The Microelectronics Fabrication Process, Silicon based MEMS processes, New Materials and Fabrication Processes, Points of Consideration for Processing.

## Module-II

**Electrostatic Sensing and Actuation:** Introduction to Electrostatic Sensors and Actuators, Parallel-Plate Capacitors, Applications of Parallel Plate Capacitors, Interdigitated Finger Capacitors, Applications of Comb Drive Devices.
**Thermal Sensing and Actuation:** Introduction, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications.

## Module-III

**Piezoresistive Sensors:** Piezoresistive Sensor Materials, Stress Analysis of Mechanical Elements, Applications of Piezoresistive Sensors.
**Piezoelectric Sensing and Actuation**: Introduction, Properties of Piezoelectric Materials, Applications.

## Module-IV

**Bulk Micromachining and Silicon Anisotropic Etching:** Introduction, Anisotropic Wet Etching, Dry Etching of Silicon-Plasma Etching, Deep Reactive Ion Etching (DRIE), Isotropic Wet Etching, Gas-Phase Etchants, Native Oxide, Wafer Bonding, Case Studies.
**Surface Micromachining:** Basic Surface Micromachining Processes, Structural and Sacrificial Materials, Acceleration of Sacrificial Etch, Stiction and Anti Stiction Methods, Assembly of 3D MEMS, Foundry Process.

## Module-V

**Polymer MEMS:** Introduction, Polymers in MEMS-Polyimide, SU-8, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluoro carbo, Representative Applications-Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors.

***COURSE OUTCOMES:***
***After studying this course, students will be able to:***

*CO-1: Explain MEMS device characteristics and micro fabrication processes.*
*CO-2: Apply electrostatic and thermal principles to design MEMS sensors and actuators.*
*CO-3: Analyze piezoresistive and piezoelectric effects in MEMS applications.*
*CO-4: Utilize bulk and surface micromachining techniques for MEMS device fabrication.*
*CO-5: Identify polymer MEMS materials and their uses in various sensor applications.*

**Text Books:**

1. C. Liu, Foundations of MEMS, 2nd ed. Pearson Education, 2012, ISBN 978-0132497366.
2. S. D. Senturia, Microsystem Design, 2nd ed. Springer Publication, 2000, ISBN 978-0792372462.

**Reference Books:**

1. T.-R. Hsu, MEMS & Micro Systems: Design and Manufacture, 2nd ed. TMH, New Delhi, 2002, ISBN 978-0070481885.

**E-References:**

- https://nptel.ac.in/courses/108106165
- https://www.me.iitb.ac.in/~gandhi/me645/05L1_coursecontents_mtvn.pdf

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