GOVERNMENT OF INDIA
MINISTRY OF
PARLIAMENTARY AFFAIRS

Azadi Ka Amrit Mahotsav

mygov मेरी सरकार

PREAMBLE TO THE CONSTITUTION

# PREAMBLE

**WE, THE PEOPLE OF INDIA,**

having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC **REPUBLIC** and to secure to all its citizens:

**JUSTICE**, social, economic and political;

**LIBERTY** of thought, expression, belief, faith and worship;

**EQUALITY** of status and of opportunity;

and to promote among them all

**FRATERNITY** assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this 26th day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

I have read the Preamble

[redacted]

Signature

23-01-2022

# SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

*("Deemed to be University u/s 3 of the UGC Act, 1956")*
Accredited 'A+' Grade by NAAC
**Agalakote, B.H.Road, Tumkur – 572 107.KARNATAKA, INDIA.**

No. SSAHE/ACA-S&C/24/UG(BE)/2024 Date: 15/07/2024

## N O T I F I C A T I O N

**Sub: - Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (3rd Year Electronics and Communication Engineering)**

Ref: Proceedings of the Academic Council meeting held on 10/07/2024 vide agenda No. SSAHE/AC/XXVIII-12/2024

In exercise of the powers vested under section 6 of 6.05 of MoA / Rules of SSAHE, the Revised Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (3rd Year Electronics and Communication Engineering) is notified herewith as per Annexure.

**By Order,**

**REGISTRAR**

REGISTRAR
Sri Siddhartha Academy of Higher Education
TUMKUR - 572 107, Karnataka.

To,
Dean / Principal, Sri Siddhartha Institute of Technology,

Copy to
1) Office of the Chancellor, SSAHE, for kind information,
2) PA to Vice-Chancellor / PA to Registrar / Controller of Examinations / Finance Officer, SSAHE
3) All Officers of the Academy Examination Branch / Academic Section
4) Guard File / Office copy.

S.S.A.H.E TUMKUR

## DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

### Vision

Mould quality technocrats in the field of Electronics and Communication with human values to cater the societal needs.

### Mission

- To impart high-quality academic environment.
- To provide training in new tools and technologies.
- To facilitate continuous learning and research environment.
- To inculcate professionalism with ethical values, with little impact on environment.

### Program Educational Objectives

- PEO-1: Proficient to apply the knowledge gained in mathematics, science and engineering to the field of electronics and communication engineering for the synthesis and analysis of systems.
- PEO-2: Competent to pursue higher studies and research, with effective communication.
- PEO-3: Aware of new technologies in the domain field, apply the same for the societal requirement minimizing the impact on environment and ethical practices in their domain.

### Program Outcomes

### Engineering Graduates will be able to:

- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes (PSOs)

- The ability to identify, analyse and design systems related to modern engineering hardware and software tools, in Electronics and Communication Engineering in the areas of electronics, communication, image processing, VLSI, signal processing and embedded systems for solving day to day problems.
- Impart the awareness about the impact of professional engineering solutions in societal and environmental context, professional ethics and be able to communicate effectively.

**SRI SIDDHARTHA INSTITUTE OF TECHNOLOGY- TUMAKURU-572105**

(A constituent College of Siddhartha Academy of Higher Education, Deemed-to-be-University)

**Scheme of Teaching and Examination (160 Credits Scheme, NEP Batch)**

**THIRD YEAR B.E., Electronics and Communication Engineering**

**5th Semester B.E.** **Effective from the Academic year 2024-25**

| Sl. No. | Course Code | | Course Title | Teaching Dept. | L | T | P | Credits | CIE Marks | SEE Marks | Total Marks | Exam Hrs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PC | 22EC501 | Embedded System Design | EC | 3 | - | - | 3 | 50 | 50 | 100 | 3 |
| 2 | PC | 22EC502 | Digital Signal Processing | EC | 3 | - | 2 | 4 | 50 | 50 | 100 | 3 |
| 3 | PC | 22EC503 | Principles of CMOS VLSI design | EC | 3 | - | 2 | 4 | 50 | 50 | 100 | 3 |
| 4 | PE | 22EC5PE4x | Professional Elective-I | EC | 3 | - | - | 3 | 50 | 50 | 100 | 3 |
| 5 | OE | 22EC5OE5x | Open Elective-I | EC | 3 | - | - | 3 | 50 | 50 | 100 | 3 |
| 6 | HS | 22IE56X | Institutional Elective (561: Research Methodology, 562: Management and Entrepreneurship, 563: Project Management) | EC | 2 | - | - | 2 | 50 | 50 | 100 | 3 |
| 7 | PC | 22EC507 | Dept. Skill Lab - 3 | EC | 1 | - | 2 | 2 | 50 | 50 | 100 | 3 |
| 8 | HS | 22SK508 | Skill Development-II | T&P | - | - | 2 | 1 | 50 | - | 50 | - |
| L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination | | | | **Total** | **18** | **-** | **8** | **22** | **400** | **350** | **750** | -- |

| Professional Elective - I | | Open Elective - I | |
|---|---|---|---|
| 22EC5PE41 | Digital Image Processing and Computer Vision | 22EC5OE51 | Sensors and Instrumentation |
| 22EC5PE42 | Robotics and Automation | 22EC5OE52 | Information Theory and Coding |
| 22EC5PE43 | Python Programming | 22EC5OE53 | Digital System Design using Verilog |
| 22EC5PE44 | Real Time Operating Systems | | |

**6th Semester B.E.** **Effective from the Academic year 2024-25**

| Sl. No. | Course Code | | Course Title | Teaching Dept. | L | T | P | Credits | CIE Marks | SEE Marks | Total Marks | Exam Hrs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PC | 22EC601 | Microwave Theory and Antennas | EC | 3 | - | - | 3 | 50 | 50 | 100 | 3 |
| 2 | PC | 22EC602 | Digital Communication | EC | 3 | - | 2 | 4 | 50 | 50 | 100 | 3 |
| 3 | PC | 22EC603 | Computer Communication Networks | EC | 3 | - | 2 | 4 | 50 | 50 | 100 | 3 |
| 4 | PE | 22EC6PE4x | Professional Elective-II | EC | 3 | - | - | 3 | 50 | 50 | 100 | 3 |
| 5 | OE | 22EC6OE5x | Open Elective-II | xx | 3 | - | - | 3 | 50 | 50 | 100 | 3 |
| 6 | PC | 22xx66x | Online Course: NPTEL/MOOC/SWAYAM 22NP661-NPTEL, 22MC662-MOOC, 22SW663-SWAYAM | EC | 2 | - | - | 2 | 50 | - | 50 | - |
| 7 | PW | 22ECMP607 | Mini Project | EC | - | - | 4 | 2 | 50 | 50 | 100 | 3 |
| 8 | HS | 22SK608 | Placement Training | T&P | - | - | 2 | 1 | 50 | - | 50 | - |
| L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination | | | | **Total** | **17** | - | **10** | **22** | **400** | **300** | **700** | - |

| **Professional Elective - II** | | **Open Elective - II** | |
|---|---|---|---|
| 22EC6PE41 | Machine Learning | 22EC6OE51 | Introduction to Embedded System |
| 22EC6PE42 | Analog and mixed signal VLSI Design | 22EC6OE52 | Pattern Recognition |
| 22EC6PE43 | Information security and Cyber space | 22EC6OE53 | Robotics |
| 22EC6PE44 | Sensors and Signal Conditioning | | |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Embedded System Design** | | | |
| **Subject Code:** | **22EC501** | **L – T – P - C:** | **3 – 0 – 0– 3** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | Overview the design principles of Embedded System. |
| 2 | Understanding the role of firmware, operating systems in correlation with hardware systems. |
| 3 | Study single purpose processors for specific applications. |
| 4 | Learn the concept of interrupts, their service mechanism and scheduling. |

| Unit | Description | Hrs |
|---|---|---|
| I | **INTRODUCTION:** Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them, Processor Technology, Design Technology, IC Technology. (Text 1: 1.1 to 1.5) | **8** |
| II | **GENERAL-PURPOSE PROCESSORS:** Basic Architecture, Operation, Programmer's View, Development Environment, ASIPS. **SINGLEPURPOSE PROCESSORS:** Standard Single-Purpose Peripherals, Timers, Counters, UART, PWM, LCD Controllers, Keypad controllers, Stepper Motor Controller, A to D Converters. (Text 1: 3.1 to 3.6, 4.1 to 4.8) | **8** |
| III | **Memory:** Introduction, Common Memory Types, Composing Memory, Memory Hierarchy and Cache, Cache replacement Policies. **Interfacing:** Communication Basics, Multilevel Bus Architectures, Advanced Communication Principles. Serial Protocols: I2C,CAN, FireWire , USB **Parallel Protocols:** PCI Bus, ARM Bus Wireless Protocols: IrDA, Bluetooth, IEEE 802.11. (Text 1: 5.1 to 5.5, Text 1: 6.1 to 6.2, 6.7 to 6.11) | **8** |
| IV | **Interrupts:** Basics: Shared Data Problem, Interrupt latency, Survey of Software **Architectures:** Round Robin, Round Robin with Interrupts, Function Queues scheduling RTOS architecture. (Text 2: 4.1 to 4.4, 5.1 to 5.4) | **8** |
| V | **Introduction to RTOS:** Task- states, Semaphores and shared data. More operating systems services - Massage Queues, Mail Boxes, Pipes, Timers, Events. (Text 2: 6.1 to 6.3, 7.1 to 7.3) | **8** |

**Course Outcomes:**

| Course Outcome | Descriptions |
|---|---|
| **CO1** | Illustrate the embedded system components suitable for addressing the design challenges and optimization needs. (L1) |
| **CO2** | Interpret the internal architecture of general microcontrollers and |

| | |
|---|---|
| | interfacing mechanism of different peripheral devices with RTOS. (L2) |
| **CO3** | Apply interrupt priority, interrupt enabling and disabling and different software architectures to solve interrupt handling problem. (L2) |
| **CO4** | Analyze shared data problem in an embedded system and their solution through real-time operating system services. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | 3 | 2 | | | | | | | | | | 1 | |
| **CO2** | | 2 | 1 | | | | | | | | | | | |
| **CO3** | 1 | 3 | 2 | | | | | | | | | | 2 | |
| **CO4** | 1 | 3 | 1 | 2 | | | | | | | | | 2 | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Frank Vahid | Embedded System Design: A Unified Hardware/Software Introduction | Pearson Education, Second Edition, 2014<br>ISBN:9971- 51-405-2<br>2002 |
| 2 | David E. Simon | An Embedded software Primer | CISCO Press, 2017.<br>ISBN:81-7758-154-6<br>2006 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Raj Kamal | Embedded Systems: Architecture and Programming | TMH. 2008 Education Asia / PHI<br>Indian Reprint 2002 |
| 2 | Shibu K.V | Introduction to Embedded Systems | McGraw-Hill Education(INDI A) Private limited<br>2012 |
| 3 | James K | Embedded Systems: A Contemporary Design Tool | John Weily India Pvt. Ltd<br>2014 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: DIGITAL SIGNAL PROCESSING** | | | |
| **Subject Code:** | **22EC502** | **L – T – P - C:** | **3 – 0 – 2 – 4** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | Review the basics of digital signal processing. |
| 2 | Study the FFT Algorithms. |
| 3 | Understand the concepts of analog and digital filter design and its structures. |
| 4 | Learn the architecture and instruction set of TMS32067xx processor. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Frequency Domain Sampling:** Introduction, Frequency domain sampling and reconstruction of discrete time signals, Discrete Fourier Transform (DFT): Discrete Fourier Transform, DFT as a linear transformation, Relationship of DFT to other transforms, Properties of DFT (without derivation. (Text 1: 7.1, 7.2) | 8 |
| II | **Linear Filtering:** Introduction, Use of DFT in linear filtering, Filtering long data sequences: overlap-save, overlap-add method Fast Fourier Transform (FFT) algorithms: Direct computation of DFT, Radix-2 FFT algorithm: Decimation-in-time algorithm, Decimation-in-frequency algorithm (without derivation). (Text 1: 7.3.1, 7.3.2, 8.1.1 to 8.1.3) | 8 |
| III | **FIR Filters and its applications:** Introduction, Design of FIR filters: Symmetric and antisymmetric FIR filters, Design of linear phase FIR filters using windows and frequency sampling methods, FIR differentiators, Structures for FIR Systems: Direct form structures, cascade form structures and linear phase structures. (Text 1:10.2.1, 10.2.2 to 10.2.3, 10.2.5,10.2.6, 9.2.1 and 9.2.2) | 8 |
| IV | **IIR Filters:** Introduction, Analog filter specifications, Classification of analog filters: Butterworth and Chebyshev approximations, Frequency transformations, Design of analog filters. Digital IIR filter design using impulse invariant technique, Bilinear transformations. IIR filter structures: Direct form (I and II), Cascade, Parallel structures. (Text 1: 10.3.2, 10.3.3, 10.3.5, 9.3.1, 9.3.3, 9.3.4) | 8 |
| V | **Architecture and Instruction set of TMS320C67x processor:** Introduction, Architecture, Pipelining, Linear and circular addressing modes, Instruction sets, Assembler directives, Interrupts, Memory considerations, Fixed and floating point formats, Implementation of FIR and IIR filters. (Text 2: 3.1 to 3.9.3, 3.14, 3.18, 4.7, 5.4) | 8 |

**LAB CONTENT**

| Sl. No. | Experiment Description |
|---|---|
| 1. | Compute N point DFT of a given sequence and to plot magnitude and phase spectrum and verification of its properties. |
| 2. | Compute the linear convolution and Circular convolution of two sequences using DFT and IDFT and plot the graphs. |
| 3. | Compute autocorrelation and cross correlation of a given sequence and verification of its properties and plot the graphs. |
| 4. | For a given difference equation, determine i) Impulse response ii) Step response iii) Steady state response iv) Steady state response with initial conditions and plot the graphs. |
| 5. | Design of FIR filter for given specifications and plot the magnitude and phase response. |
| 6. | Design of IIR filter for given specifications and plot the magnitude and phase response. |
| 7. | Application of FIR filters: Design of Differentiator. |
| | **LIST OF EXPERIMENTS USING DSP PROCESSOR (C program)** |
| 8. | Compute the Linear convolution and Circular convolution of two given sequences. |
| 9. | Computation of N- Point DFT of a given sequence. |
| 10. | Compute the Impulse response of first order and second order system. |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Apply and realize DFT on digital signals for linear filtering applications. (L3) |
| **CO2** | Interpret and realize the computational complexity of DFT using FFT algorithms. (L2) |
| **CO3** | Design and realize FIR and IIR digital filters. (L3) |
| **CO4** | Outline the architecture and instruction set of TMS32067xx processor. (L2) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | | | | 2 | | | | | | | | | |
| CO2 | | 1 | | | 2 | | | | | | | | | |
| CO3 | | 3 | 2 | | 3 | | | | | | | 2 | | |
| CO4 | 2 | | | | | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Digital Signal Processing: Principles, Algorithms and Applications | J. G. Proakis, D. G. Manolakis | Pearson Education Asia/Prentice Hall of India , 4th Edition,2014 |
| 2 | Digital Signal Processing and Applications with TMS320C6713 and TMS320C6416 DSK | Rulph Chassaing, Donald Reay | Wiley India , 2nd Edition,2014 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Digital Signal Processing: A Computer based Approach | S. K. Mitra | McGraw Hill, 4th Edition,2013 |
| 2 | Digital Signal Processors – Architectures, Implementations and Applications | Sen M. Kuok, Woon-Seng S. Gan | Pearson/ Prentice Hall,2005 |
| 3 | Digital Signal Processing: A Practical Approach | Emmanuel Ifeachor, Barrie W. Jervis | 2nd Edition, Pearson Education ,2002 |

| Department: Electronics and Communication Engineering | | | Semester: | 5 |
|---|---|---|---|---|
| **Subject: Principles of CMOS VLSI Design** | | | | |
| **Subject Code:** | **22EC503** | | **L – T – P - C:** | **3 – 0 – 2 – 4** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | Learn the principles, operations and applications of MOSFETs. |
| 2 | Realize the stick diagrams and layouts using Lambda based design rules for a given schematic and to categorize the different MOS technologies. |
| 3 | Understand the modeling of digital circuits using different CMOS design styles. |
| 4 | Acquire the knowledge about scaling parameters, subsystem design and memory design. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Overview of VLSI:** Introduction, VLSI Design Flow, Ideal Switches and Boolean operations, MOSFET as switches, FET Threshold voltage concepts, Pass Transistors and characteristics, CMOS Logic - Basic gates and Compound gates, MOS layers, Layout and Stick diagrams of simple logic gates, Transmission Gate Circuits.<br>(Text 1: 1.1, 2.1, 2.2, 2.3, 2.4, 2.5. Text 2: 3.1, 3.2, 3.7) | 8 |
| II | **MOS Transistor theory:** Introduction, I-V Characteristics, DC analysis of CMOS Inverter.<br>**Fabrication:** nMOS fabrication, CMOS fabrication. Lambda-based design rules. (Text 1: 7.1, Text 2: 1.7, 1.8, 2.1.1, 2.1.2, 3.3.1) | 8 |
| III | **Basic Circuit Concepts:** Sheet resistance, Area capacitances, Capacitance calculations. Delay unit, Inverter delays, Switching Characteristics, Rise Time and Fall Time Calculations, Propagation delay.<br>(Text 2: 4.1, 4.3, 4.4, 4.5, 4.6, Text 1: 7.2.1, 7.2.2, 7.2.3) | 8 |
| IV | **CMOS Subsystem Design and Process:** Architectural issues, Switch logic, Gate logic-NMOS and BiCMOS of Inverter, NAND and NOR, ALU subsystem Design-Datapath of a processor, Standard Adder Element Design, Implementation of 4-bit Adder and ALU. (Text 2: 6.1, 6.2, 6.3.1, 6.3.2, 6.3.3, 8.2, 8.3) | 8 |
| V | **Memory elements**: Static RAM-General SRAM cell, 6T and 4T SRAM Models, Multiport SRAM, SRAM Arrays, DRAM- 1T DRAM cell, Write and Read Operations.<br>**Scaling of MOS Circuits:** Constant Voltage, Constant field, Combined Voltage and Dimension Scaling Models, Scaling factors for Device Parameters. (Text 1: 13.1, 13.2, 13.3, Text 2: 5.1, 5.2) | 7 |

**LAB CONTENT**

| Sl. No. | | Experiment Description |
|---|---|---|
| 1 | a | 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. |
| | b | Realize a two input NAND gate using CMOS logic and verify its truth table in both schematic and layout for specified technology. |
| 2 | a | Realize a two input NOR gate using CMOS logic and verify its truth table in both schematic and the layout for specified technology. |
| | b | Implement a two input XOR gate with minimum number of transistors and verify its timing diagram in both schematic and layout. |
| 3 | a | 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 |
| | b | 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. |
| 4 | a | 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 | Implement a SR 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. Show the 3Dand 2D view for the layout. |
| 5 | a | 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. |
| | b | 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. |
| 6 | a | 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. |
| | b | 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. |
| 7 | a | 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. |
| | b | 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. |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| CO1 | Analyze transistor level schematics, scaling parameters and outline the various fabrication processes. (L2) |
| CO2 | Estimate the design parameters for speed, area and power optimization. (L3) |
| CO3 | Apply the different design techniques used in modeling the digital circuits. (L3) |
| CO4 | Design the sub systems using different CMOS design styles. (L4) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | | |
| CO2 | | 1 | | | | | | | | | | | | |
| CO3 | | 2 | 2 | 1 | | | | | 2 | | | 2 | | |
| CO4 | 2 | | 2 | | | | | | | | | 2 | | |

**Text Books:**

| Sl No | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Introduction to VLSI circuits and systems | John P Uyemura | John Wiley & sons, 4th Edition, 2006. |
| 2 | Basic VLSI Design | Douglas A. Pucknell & Kamran Eshraghian | PHI,3rd Edition,2005 |

**Reference Books:**

| Sl No | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | CMOS VLSI Design: A Systems Perspective | Neil H. E. Weste, David Harris and Ayan Banerjee | Pearson Education Pvt. Ltd.,3rd Edition,2006 |
| 2 | Fundamentals of Semiconductor Devices | M. K. Achuthan and K.N. Bhat | Tata McGraw-Hill, 2nd Edition,2006 |
| 3 | CMOS Digital Integrated Circuits: Analysis and Design | Sung-Mo Kang & Yusuf Leblebici | Tata McGraw-Hill 3rd Edition,2003 |
| 4 | Modern VLSI Design- IP Based Design | Wayne Wolf | PHI Publishers, 4th Edition,2009 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Digital Image Processing and Computer Vision** | | | |
| **Subject Code:** | **22EC5PE41** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | To introduce the concepts of image processing and basic analytical methods in image processing. |
| 2 | To explore image enhancement techniques in spatial and frequency domains. |
| 3 | To teach the students on image transformation techniques for the image analysis. |
| 4 | To make use of feature extraction techniques for object detection applications. |

| Unit | Description | Hrs |
|---|---|---|
| I | **DIGITAL IMAGE FUNDAMENTALS:** Introduction, Digital Image Processing definition, fundamental steps in digital image processing, classification of digital images, image file formats, Applications of Digital Image Processing, Convolution and Correlation: 2D convolution through graphical method, convolution through Z transform, circular convolution, correlation through matrix analysis. (Text1: 1.1 to 1.4, Text2: chapter 1: 1.9 to 1.10 chapter 3: 3.1 to 3.7) | 8 |
| II | **ELEMENTS OF VISUAL PERCEPTION:** Introduction, Structure of human eye, Image formation in an eye, Brightness adaptation and discrimination, Light and Electromagnetic spectrum, Image sensing and acquisition, Image sampling and quantization, Some basic Relationship between pixels: Neighbors of a pixel, Adjacency, connectivity, regions, and Boundaries, Distance Measures. (Text1: 2.1 to 2.5) | 8 |
| III | **IMAGE TRANSFORMS:** Introduction, Two dimensional orthogonal and Unitary transforms, Properties of Unitary transforms, two-dimensional discrete Fourier Transform, Discrete Cosine Transforms, Sine Transforms, Hadamard Transform, Haar Transform. (Text2: 4.1 to 4.12) | 8 |
| IV | **INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING:** Introduction, Image Negative, Log transformation, Power Law(gamma transformation) ,Piecewise-linear transformation functions, Histogram Processing: Histogram Equalization, Histogram Matching, Linear gray level transformation, local or neighborhood operation, Median filter, Spatial domain high pass filtering or Image Sharpening, Bit plane slicing, Image enhancement in the frequency domain, Homomorphic filter, zooming operation, Image Arithmetic. (Text1:3.1 to 3.4, Text2: 5.1 to 5.15) | 8 |
| V | **IMAGE SEGMENTATION AND FEATURE EXTRACTION:** Introduction, Point, Line, and Edge Detection, Thresholding, Segmentation by Region Growing and by Region Splitting and Merging, Boundary Preprocessing, Boundary Feature | 8 |

| | | |
|---|---|---|
| | Descriptors, Region Feature Descriptors, Principal Components as Feature Descriptors. (Text 1: 10.1 to 10.4, 11.1 to 11.5) | |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Mathematically represent the various types of images and image processing systems.(L1) |
| **CO2** | Interpret the various image enhancement techniques in spatial domain and frequency domain. (L3) |
| **CO3** | Analyze the Images using various Image transformation Techniques. (L4) |
| **CO4** | Apply segmentation and feature extraction techniques on images to extract the region of interest. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | | | | | | | | | | | |
| **CO2** | 1 | | 3 | | 2 | | | | | | | | | |
| **CO3** | | 3 | | | | | | | | | | | | |
| **CO4** | | 1 | | 2 | | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Authors | Volume and Year of Edition |
|---|---|---|---|
| 1 | Digital Image Processing | RafaelC. Gonzalez, Richard E. Woods | Pearson Education Pvt. Ltd, 4 th edition 2018. |
| 2 | Digital Image Processing | Jayaraman | Tata McGraw-Hill Education, 3rd Edition 2012. |

**Reference Books:**

| Sl. No. | Title | Authors | Volume and Year of Edition |
|---|---|---|---|
| 1 | Fundamentals of Digital Image Processing | Anil Jain K | PHI Learning Pvt. Ltd., 2011 |
| 2 | Digital Image Processing | William K. Pratt | John Wiley, 4th Edition, 2007 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: ROBOTICS AND AUTOMATION** | | | |
| **Subject Code:** | **22EC5PE42** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Introduce the fundamental concepts in robotics. |
| 2 | Acquire the knowledge in kinematics and programming. |
| 3 | Understand the topics in robotics with emphasis on basics of manipulators, coordinate transformation and kinematics, trajectory planning, control techniques. |
| 4 | Study the sensors and devices in robot applications and vision analysis. |

| Unit | Description | Hrs |
|---|---|---|
| I | **BASIC CONCEPTS OF ROBOTICS:** Introduction, Evolution of robots and robotics, Laws of Robot, Robot definition, Generations of Robots, Robot anatomy, Coordinate frames, mapping and transforms. (Text 1: 1.1 to 1.6, 2.1to 2.5) | 8 |
| II | **END EFFECTORS:** Introduction, Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Consideration. (Text 2: 5.1 to 5.4) | 8 |
| III | **KINEMATICS:** Introduction, Direct kinematic model: Mechanical structure and notations, Description of joints and links. Kinematic modeling of the manipulator.Denavit –Hartenberg Notation. ROBO Software implementation of kinematic models.<br>(Text1: 3.1 to 3.4) | 8 |
| IV | **PATH PLANNING:** Introduction, **Definitions** of Trajectory planning, Trajectory planning problem, terminology, steps in trajectory planning, classification of trajectory planning, types of trajectory function tasks, joint space techniques, Cartesian space technique.<br>(Text 1: 7.1 to 7.8) | 8 |
| V | **ROBOTIC SENSORS AND VISION:** Introduction, Sensors and Robotics, Kinds of sensors used in Robotics. Robotic Vision, Industrial applications of vision –controlled robotic vision systems. (Text 1: 9.1 to 9.5) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Outline the Robotic basics and their classification.(L2) |
| **CO2** | Analyze the end effectors of Robotics. (L3) |
| **CO3** | Interpret the Kinematics and path planning for Robotic system. (L3) |
| **CO4** | Design sensors and robotics for industrial applications.(L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | | | | | | | | | | | | |
| **CO2** | | 2 | | | 2 | | | | | | | | | |
| **CO3** | | | 3 | 2 | 2 | | | | | | | | 2 | |
| **CO4** | | 2 | 2 | | | | | | | | | 2 | | |

**Text Books:**

| Sl.No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Robotics And Control | R K Mittal And I J Nagarth | Mc Graw – Hill, 2003 |
| 2 | Industrial Robotics – Technology, Programming and Applications | M.P.Groover | McGraw-Hill, 2001 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Robotics Control, Sensing,Vision and Intelligence | Fu.K.S. Gonzalz.R.C., and Lee C.S.G. | Mc Graw – Hill, 1987 |
| 2 | Robotic engineering-AnIntegrated Approach | Richard D. Klafter, Thomas A. Chmielewski and MichaelNegin, | Prentice Hall Inc, 1989 |
| 3 | Robotics and Image Processing | Janakiraman. P. A | Tata McGraw-Hill, 1995 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Python Programming and Applications** | | | |
| **Subject Code:** | **22EC5PE43** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | Acquire the knowledge on fundamentals of Python scripts. |
| 2 | Learn core Python scripting elements such as variables and flow control structures. |
| 3 | Write Python functions to facilitate code reuse. |
| 4 | Develop the ability to write database applications in Python. |

| Unit | Descritption | Hrs |
|---|---|---|
| **1** | **Parts of Python Programming Language:**Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type() Function and Is Operator, Dynamic and Strongly Typed Language, **Control Flow Statements,** The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, **Functions,** Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables. (Text 1: (2.7- 4.8) | **8** |
| **2** | **Strings:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, **Lists,** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, The del Statement. (Text 1: Chapter 5 and 6) | **8** |
| **3** | **Dictionaries:** Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, The del Statement, **Tuples and Sets,** Creating Tuples, Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Tuple Methods, Using zip() Function, Sets, Set Methods, Traversing of Sets. (Text 1: Chapter 7 and 8) | **8** |

| | | |
|---|---|---|
| **4** | NumPy Basics: Arrays and Vectorized Computation: The NumPy ndarray: A Multidimensional Array Object: Creating ndarrays, Data Types for ndarrays, Arithmetic with NumPy Arrays, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Transposing Arrays and Swapping Axes, Universal Functions: Fast Element-Wise Array Functions, Array-Oriented Programming with Arrays: Expressing Conditional Logic as Array Operations, Mathematical and Statistical Methods, Methods for Boolean Arrays, Pseudorandom Number Generation. (Text 2: Chapter 4) | **8** |
| **5** | Applications of Python in Machine learning: Basics of machine learning, problems that machine learning can solve, task and data, Essential Libraries and tools- Jupyter notebook, numpy, scipy, matplotlib, pandas. (Text 3: 1.1 -1.5) | **7** |

**Course Outcomes:**

| Course Outcomes | Description |
|---|---|
| **CO1** | Interpret the basic principles of Python programming language. (L1) |
| **CO2** | Identify the methods to create and manipulate lists, tuples and dictionaries.(L2) |
| **CO3** | Write python programs for solving problems. (L2) |
| **CO4** | Analyze the packages to effectively apply for applications.(L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | | | | | | | | | | | |
| **CO2** | 2 | 1 | | | | | | | | | | | | |
| **CO3** | | 2 | 2 | | | | | | | | | | | |
| **CO4** | | 2 | 1 | | | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Introduction to Python Programming | Gowri shankar S, Veena A | 1st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372 |
| 2 | Python for Data Analysis | Wes McKinney | 2nd Edition, O'Reilly Media, ISBN: 978-1-491-95766-0, 2018 |
| 3 | Introduction to machine learning with python | Andreas C. Müller and Sarah Guido | 1st edition, O'Reilly Media, Inc, 2016, 978-1-449-36941-5 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Data Analytics using Python | Bharti Motwani | 2nd edition, Wiley Publications, June 2020, ISBN-13: 978- 8126502950, |
| 2 | Python Programming | John M Zelle | Ingram short title , 3rd edition, 2018, ISBN No.: 1590282752 |
| 3 | Python Crash Course | Eric Matthes | *No* Starch Press, 2020, 2nd Edition, ISBN No. : 1593279280 |
| 4 | Python For Beginners: The Easiest and Quickest Way to Learn Python Coding | Ike Beck | Siemen Mayer, Edition 2022, ISBN No.: 9783986532222 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Real Time Operating Systems** | | | |
| **Subject Code:** | **22EC5PE44** | **L – T – P - C:** | **3 – 0 – 0 – 3** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | Review the basics of real time system. |
| 2 | Study the RTOS Architecture. |
| 3 | Understand the concepts of Task Scheduling and context switching. |
| 4 | Learn the Real-Time System Development Tools |

| Unit | Description | Hrs |
|---|---|---|
| I | **Introduction to Real-Time Systems** : Definitions and Characteristics of Real-Time Systems, Applications of Real-Time Systems, Basic Concepts of Real-Time Systems, Real-Time System Design Issues, Timing Constraints and Predictability. (Text 1: 1.1, 1.2) | 8 |
| II | **Overview of RTOS Architectures**: RTOS Architecture, RTOS Services, Static and Dynamic Scheduling, Clock-Driven and Event-Driven Scheduling, Rate Monotonic Scheduling (RMS),Earliest Deadline First (EDF) Scheduling. (Text 2: 2.1, 2.2, 3.1 to 3.3) | 8 |
| III | **Introduction to Task Scheduling**: Task Scheduling and Context Switching, Pre-emptive and Non-Pre-emptive Scheduling, Priority Inversion Problem and Solutions, Multiprocessor Scheduling, Partitioned Scheduling, Global Scheduling, Hybrid Scheduling, Case Studies of Real-Time Scheduling Algorithms. (Text 1: 5.1,5.2, 5.3, 6.1 to 6.3,7.1 to 7.3) | 8 |
| IV | **Introduction to Inter-Task Communication and Synchronization:** Shared Data and Mutual Exclusion, Message Passing Mechanisms, Event Synchronization Deadlock: Detection, Prevention, and Avoidance. (Text 2: 5.1 to 5.6) | 8 |
| V | **Introduction to Real-Time System Development Tools:** Integrated Development Environments (IDEs), Debuggers, Simulators, and Profilers, Case Studies of RTOS: FreeRTOS, VxWorks, and RT-Linux, Real-Time Control Systems, Safety-Critical Systems, Performance Analysis and Optimization, Timing Analysis, Resource Optimization. (Text 1: 8.1 to 8.3,9.1 to 9.3, 10.1 to 10.4) | 7 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Apply Real time systems and real-time design issues. (L3) |
| **CO2** | Interpret the RTOS Architecture, RTOS Services. (L2) |
| **CO3** | Outline Inter task communication and synchronization. (L3) |
| **CO4** | Interpret the case studies in real time system development tools. (L2) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | 2 | | | | | | | | | | | | |
| **CO3** | 2 | 3 | 2 | 3 | | | | | | | | 2 | | |
| **CO4** | 3 | | 2 | | | | | | | | | 2 | | |

**Text Books:**

| Sl No | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Real-Time Systems | Jane W. S. Liu | Integre - Technical Publications Co. Inc.,, 2000 |
| 2 | Real-Time Systems: Design Principles for Distributed Embedded Applications | Hermann Kopetz | Springer, 3rd Edition,2019 |

**Reference Books:**

| Sl No | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Real Time Operating system Book1 The Foundations | Jim Cooling | Amazon Digital Services LLC - Kdp, 2018 |
| 2 | Real Time Operating system Book 2 The Practice- Using STM Cube, FreeRTOS and the STM32 Discovery Board: 1 (Engineering of Real-Time Embedded Systems) | Jim Cooling | Amazon Digital Services LLC - Kdp, 2019 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Sensors and Instrumentation** | | | |
| **Subject Code:** | **22EC5OE51** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Study commonly used sensors in industry for measurement of temperature, position, accelerometer, vibration sensor, flow and level. |
| 2 | Learn the use of sensors for measurement of displacement, force and pressure. |
| 3 | Understand the fundamentals of intelligent sensors. |
| 4 | Acquire the knowledge about the data acquisition system using ADC. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Sensors & Transducer:** Introduction to sensors/transducers, Principles, Classification, Parameter, Environmental parameters, Characterization. (Text 1: 1.1 - 1.6) | 8 |
| II | **Mechanical and Electromechanical Sensors:** Introduction, Resistive potentiometer, Strain gauge, Inductive sensors, Capacitive sensors, Force sensors, Ultrasonic sensors. (Text 1: 2.1 - 2.7) | 8 |
| III | **Thermal, Magnetic and Radiation sensors:** Introduction, Gas thermometric sensors, Thermal expansion type thermometric sensors, Acoustic temperature sensors, Magneto resistive sensors, Hall effect sensors, Inductive and eddy current sensors, Basic characteristics of radiation sensors, Types of photo detectors. ( Text 1: 3.1 - 3.4, 4.1 - 4.5, 5.1 - 5.3) | 8 |
| IV | **Data Acquisition and Conversion:** Introduction, Objectives of data acquisition system, Signal conditioning of inputs, Single channel DAS, Multichannel DAS, Computer based DAS, Digital to analog converters and analog to digital converters. ( Text 2: 6.1 - 6.7) | 8 |
| V | **Smart Sensors:** Introduction, Primary sensors, Excitation, Amplification, Filters, Converters, Compensation, Information or processing, Data communication, The automation. (Text 2: 7.1 - 7.10) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Recall instrumentation, sensor theory and technology.(L1) |
| **CO2** | Demonstrate the use of mechanical, thermal, magnetic and radiation sensors. (L2) |
| **CO3** | Identify and use data acquisition methods.(L3) |
| **CO4** | Analyze intelligent instrumentation in industrial automation.(L4) |

**Course Articulation Matrix**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | 1 | 1 | | | | | | | | | | |
| **CO2** | | 2 | 2 | | 3 | | | | | | | | | |
| **CO3** | 3 | | | 1 | | 3 | | | | | | | | |
| **CO4** | | 2 | | 2 | | 2 | | | | | | 2 | | |

**Text Books:**

| Sl. No. | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Sensors and Transducers | D Patranabis | PHI , 2nd edition, 2013 |
| 2 | Electronic Instrumentation | H.S.Kalsi | TMH , 2nd edition, 2008 |

**Reference Books:**

| Sl. No. | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | PC interfacing for Data Acquisition & Process Control | S. Gupta, J.P. Gupta | Instrument Society of America, 2nd edition, 1994 |
| 2 | Lab VIEW Graphical Programing II | Gary Johnson | McGraw Hill , 2nd edition, 1997 |
| 3 | Instrument Transducers | Hermann K.P. Neubert, | Oxford University Press , 2nd edition, 2012 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: : Information Theory and Coding** | | | |
| **Subject Code:** | **22EC5OE52** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand the concept of Source Entropy and Information Rate with reference to dependent and independent sources. |
| 2 | Study various Source encoding Algorithms. |
| 3 | Learn the basics of discrete communication channels. |
| 4 | Acquire the knowledge of various Error control coding Algorithms. |

| Unit | Description | Hrs |
|---|---|---|
| I | Information Theory: Introduction, Measure of Information, Average Information Content of Symbols in Long Independent Sequences, Average Information Content of Symbols in Long Dependent Sequences, Some properties of Entropy, Extension of a DMS, Markoff Statistical Model for Information Sources, Entropy and Information Rate of Markoff Sources. (Text 1: 4.1, 4.2, 4.3, 4.3.1) (Text 2: 2.1) | 8 |
| II | Source Coding: Introduction, Properties of Codes, Prefix Codes, Kraft McMillan Inequality property, Code Efficiency and Redundancy, Source Coding theorem, Huffman codes. (Text 2: 2.2, 2.3) | 8 |
| III | Communication Channels: Introduction, Discrete Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, System Entropies, Mutual Information and properties of Mutual information, Rate of Information transmission over discrete channel, Channel capacity. (Text 2: 2.4 to 2.9) (Text 1: 4.5, 4.6) | 8 |
| IV | Error control coding -Introduction, methods of Controlling Errors, Types of Errors, types of Codes, Linear Block Codes: matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes. (Text 1: 9.1, 9.2) | 8 |
| V | Binary Cyclic Codes: Introduction, Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction. Convolution Codes: Convolution Encoder, Time domain approach, Transform domain approach. (Text 1: 9.3, 9.3.1, 9.3.2, 9.3.3) (Text2: 8.6) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Identify the basic knowledge for measuring of Information and entropy of independent & dependent sources. (L2) |
| **CO2** | Apply various source coding techniques to reduce redundancy. (L3) |
| **CO3** | Analyze the capacity of Symmetric, Erasure, and Cascaded Channels. (L4) |
| **CO4** | Design of Linear block codes, Binary Cyclic codes and Convolution codes. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | | | | | | | | | | | |
| **CO2** | 2 | | 2 | | | | | | | | | | | |
| **CO3** | 3 | 2 | 1 | | | | | | | | | 2 | | |
| **CO4** | 3 | 2 | 3 | 1 | | | | | | | | 1 | | |

**Text Books:**

| Sl. No. | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Digital and Analog communication systems. | K. Sam Shanmugam | John Wiley India Pvt. Ltd,2012 |
| 2 | Digital communication. | Simon Haykin | John Wiley India Pvt. Ltd,2013 |

**Reference Books:**

| Sl. No. | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Error Control Coding. | Shu Lin and Daniel J Costello | Pearson Education Limited, 2nd Edition, 2011 |
| 2 | ITC and Cryptography. | Ranjan Bose | TMH, 2nd Edition, 2007 |
| 3 | Elements of Information Theory. | Thomas Cover, Joy Thomas | John Wiley, 1991 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Digital System Design using Verilog** | | | |
| **Subject Code:** | **22EC5OE53** | **L – T – P - C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Learn the notions of digital system design using an integrated development environment for design entry through Verilog. |
| 2 | Understand the difference between concurrent and sequential programming. |
| 3 | Study verilog models representing structure, behavior or data flow concepts describing the internal structure or external behavior of the circuit. |
| 4 | Acquire knowledge of binary arithmetic circuits. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Introduction to Verilog:** Introduction to HDL, history of HDLs, capabilities. Modules and ports, Expressions. Basic concepts: Lexical conventions, data types, system tasks and compiler directives. (Reference Text 2: 1.1 to 1.3, 2.1,4.1 to 4.2 ) (Text1:3.1 to 3.4,) | 8 |
| II | **Gate level Modeling:** Gate types, gate delays, examples. Timing and delays: Types of delay models, path delay models. (Text1: 5.1 to 5.3,10.1 to 10.2) | 7 |
| III | **Behavioral Modeling:** Structured procedures, procedural assignments, timing controls, conditional statements, multiway branching, generate blocks, examples. (Text1: 7.1 to 7.6, 7.8 to 7.10) | 8 |
| IV | **Data flow Modeling:** Continuous assignments, delays, expression, operators and operands, operator types, Examples.<br>**Tasks and Functions:** Difference between tasks and functions, tasks, functions. (Text1: 6.1- 6.6, 8.1 to 8.4) | 8 |
| V | **Design of networks for arithmetic operations:** Design of a serial adder with accumulator, State graphs for control networks, Design of a binary multiplier, Multiplication of signed binary numbers, Design of a binary divider (Text2: 4.1 to 4.5) | 9 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Define the constructs and conventions of the Verilog programming. (L1) |
| **CO2** | Analyze control networks for arithmetic operations. (L2) |
| **CO3** | Design combinational and sequential digital circuits. (L3) |
| **CO4** | Develop Verilog code for digital circuits using dataflow, behavioural and structural modelling. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | | 2 | | | | | | | | | | | |
| **CO3** | | 1 | | | | | | | | | | | | |
| **CO4** | 1 | 1 | | | | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Verilog HDL A Guide to Digital Design and Synthesis | Samir Palnitkar | Pearson Education, Second edition, ISBN 81-7758-918-0 2008 |
| 2 | Digital Systems Design using VHDL | Charles H. Roth. Jr | Thomson Learning ISBN 981-240-052-4, 2006 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | HDL programming(VHDL and Verilog | Nazein M. Botros | Dreamtech press, 2009 ISBN-10: 8177226975, |
| 2 | A Verilog HDL Primer | J Bhasker | BS publications, Second edition, 2007 ISBN 81-7800-012-1 |
| 3 | Verilog HDL | Joseph Cavanagh | CRC Press ,2007 |

| Department: Humanities and Sciences | | Semester: | 5 |
|---|---|---|---|
| **Subject: Research Methodology** | | | |
| **Subject Code:** | **22IE561** | **L – T – P - C:** | **2 – 0 – 0 – 2** |

| Sl. No | Course Objectives |
|---|---|
| 1 | To give an overview of the research methodology and explain the technique of defining a research problem. |
| 2 | To explain carrying out a literature search, its review and to explain various research designs and their characteristics. |
| 3 | To explain the details of sampling designs, and also different methods of data collections. |
| 4 | To develop theoretical, conceptual frameworks, writing a review, to explain the art of interpretation and the art of writing research reports. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Research Methodology:** Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.<br>**Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. (Text 1: Chapter 1, 2)<br>Bloom's Taxonomy Level: $L_1$ – Remembering, $L_2$ – Understanding. | 6 |
| II | **Reviewing the literature:** Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. (Text 2: Chapter 3) Bloom's Taxonomy Level: $L_1$ – Remembering, $L_2$ – Understanding. | 5 |
| III | **Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs. Design of Sample Surveys: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. (Text 1: Chapter 3, 4.1 – 4.6)<br>Bloom's Taxonomy Level: $L_1$ – Remembering, $L_2$ – Understanding. | 7 |

| | | |
|---|---|---|
| IV | **Data Collection:** Experimental and Surveys, Collection of Primary and Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.<br>**Hypothesis-** Basic concepts, types of hypothesis, Formulation of hypothesis, testing of hypothesis, Analysis of data, Interpretation of data- Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Editing, classification and tabulation. (Text 1: Chapter 6, 9.1-9.4, 14.1 – 14.4)<br>Bloom's Taxonomy Level: $L_1$ – Remembering, $L_2$ – Understanding. | 6 |
| V | **Report Writing:** Significance of Report Writing, Different Steps in Writing Report, Layout. Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Research ethics, Citations, Similarity check. (Text 1: Chapter 14.5 – 14.20, Text 2: Chapter 6) | 4 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Discuss research methodology and the technique of defining a research problem. |
| **CO2** | Explain the functions of the literature review in research, carrying out a literature search. |
| **CO3** | Developing theoretical and conceptual frameworks and writing a review. |
| **CO4** | Explain various research designs, their characteristics, the art of interpretation and the art of writing research reports. |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 2 | 1 | 2 | 2 | 1 | 1 | 3 | 3 | 2 | 3 | | |
| **CO2** | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | | |
| **CO3** | 3 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 2 | 3 | | |
| **CO4** | 1 | 3 | 2 | 1 | 1 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Research Methodology: Methods and Techniques | C.R. Kothari, Gaurav Garg | New Age International 4th Edition, 2018 |

| | | | |
|---|---|---|---|
| 2 | Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2) | Ranjit Kumar | SAGE Publications Ltd. 3rd Edition, 2011 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Research Methods: the concise knowledge base | Trochim | Atomic Dog Publishing2005 |
| 2 | Conducting Research Literature Reviews: From the Internet to Paper | Fink A | Sage Publications 2009 |

| Department: Electronics and Communication Engineering | | Semester: | 5 |
|---|---|---|---|
| **Subject: Dept. Skill Lab-3** | | | |
| **Subject Code:** | **22EC507** | **L – T – P - C:** | **1 – 0 – 2 – 2** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand the fundamentals of embedded systems and microcontroller programming. |
| 2 | Learn to interface peripherals with the LPC2128 microcontroller and develop embedded applications. |
| 3 | Gain hands-on experience in designing, simulating, and debugging embedded systems using Simulation software. |
| 4 | Develop problem-solving skills and proficiency in programming real-time embedded systems. |

**Lab Content:**

| Experiment no. | Description |
|---|---|
| 1. | Interface a 4x4 matrix keypad with the LPC2128 microcontroller and display the pressed key on the LCD. |
| 2. | Convert analog signals from a potentiometer to digital using the Analog-to-Digital Converter (ADC) of the LPC2128 microcontroller. |
| 3. | Generate PWM signals using the PWM module of the LPC2128 microcontroller and control the brightness of an LED. |
| 4. | Implement interrupt-driven programming to toggle an LED in response to a button press. |
| 5. | Establish UART communication between the LPC2128 microcontroller and a computer, and transmit and receive data. |
| 6. | Implement timer-based applications such as generating delays and periodic interrupts. |
| 7. | Interface an external EEPROM memory with the LPC2128 microcontroller and store and retrieve data. |
| 8. | Develop a simple real-time operating system (RTOS) application using FreeRTOS on the LPC2128 microcontroller. |
| 9. | Design a digital clock using Simulink |
| 10. | Implement a basic traffic light control system using Simulink |

**Course outcome:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Demonstrate proficiency in programming and interfacing peripherals with the LPC2128 microcontroller. (L2) |
| **CO2** | Design and simulate embedded systems using Proteus and Simulink software. (L3) |
| **CO3** | Develop problem-solving skills in embedded system design and debugging. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 3 | | | | | | | | | | | |
| **CO2** | 2 | 3 | 3 | | 2 | | | | | | | | | |
| **CO3** | 2 | 3 | 3 | | | 2 | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Authors | Volume and Year of Edition |
|---|---|---|---|
| 1 | ARM LPC2148 Based Embedded Systems: Concepts, Designs, and Programming | Sumit Ahuja | Khanna Publishers, 1st Edition, 2018 |
| 2 | Embedded Systems: Using Assembly and C | Muhammad Ali Mazidi, Shujen Chen, Sepehr Naimi | Pearson Education, 1st Edition, 2009 |

| Department: Electronics and Communication Engineering | | | Semester: | 6 |
|---|---|---|---|---|
| **Subject: Microwave Theory and Antennas** | | | | |
| **Subject Code:** | **22EC601** | **L – T – P -C:** | | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand the basic concept of microwave generation. |
| 2 | Learn the representation of microwave networks and analyse the port details of microwave devices. |
| 3 | Acquire the knowledge of antenna basics and types of antennas. |
| 4 | Know the applications of microwaves and able to do project work. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Microwave Vacuum Tubes:** Introduction, Reflex Klystron Oscillator, Mechanisms of Oscillations, Modes of oscillations, Travelling wave Tube Amplifier, Magnetron Oscillator (Qualitative discussion, construction, operation). Microwave solid state devices: PIN diode and its applications, Gunn diode (Theory of operation) (Text 2: 9.1 to 9.4, 10.2.6, 10.3) | **8** |
| II | **Microwaves:** Introduction, Transmission lines (end equations only for Reflection Coefficient and Transmission Coefficient, Standing Wave and Standing Wave Ratio).<br>**Microwave Network Theory and Passive Devices:** Introduction, Scattering or SMatrix Representation of Multiport Network, Properties of S-parameters.<br>**Microwave Passive Components:** Coaxial Cables, Coaxial Line to Waveguide Adapters, Attenuators, Phase Shifters (Dielectric and Precision Dielectric Phase Shifters) Waveguide Tees, Magic Tee, Ferromagnetic Insert and Component: Circulators, Isolators and Directional Couplers. (Text 1: 1.1, Text 2: 6.1, 6.3, 6.3.1, 6.4.1, 6.4.11, 6.4.14, 6.4.15, 6.4.16, 6.4.17 & 6.4.18) | **8** |
| III | **Antenna basics:** Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Radio Communication Link, Antenna Field Zones. (Text 3: 2.1 to 2.7, 2.9 to 2.11 & 2.13) | **8** |
| IV | **Point Sources and Arrays:** Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Arrays of two isotropic point sources, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing.<br>**Electric Dipoles:** Introduction, Short Electric Dipole, Radiation Resistance of a Short Electric Dipole. (Text 3: 5.1 – 5.5, 5.9, 5.13,6.1, 6.2 & 6.4) | **8** |
| V | **Antenna Types:** Introduction, The Helix geometry, Helix modes, Patch or Micro Strip antenna, Horn Antenna, Parabolic reflector. (Text 3: 7.19, 8.3, 8.4, 8.5, 8.8, 9.7,14.2, 14.3, 14.4)<br>**Applications of Microwaves:** Introduction, Microwave Radar Systems, The Radar Range equation, Duplexer, Pulsed Radar, CW Radar, Satellite Communication systems and microwave ovens. (Text 2: 11.2, 11.2.1, 11.2.2, 11.2.4, 11.3.2) | **8** |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Identify the parameters associated with active and passive devices in microwave applications. (L2) |
| **CO2** | Apply the knowledge of S-parameter properties for measuring the performance of microwave networks. (L3) |
| **CO3** | Interpret the design parameters of an antenna and arrays of antennas. (L3) |
| **CO4** | Demonstrate the applications of microwaves in communication and domestic applications.(L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | | 3 | | | | | | | | | | | | |
| **CO3** | 1 | 1 | | | | | | | | | | 2 | 1 | |
| **CO4** | | 2 | | | | 1 | | | | | | 2 | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Microwave devices and circuits | Samuel Y Liao | Pearson , 3rd Edition, 2008 |
| 2 | Microwave Engineering | Annapurna das and Sisir K das | McGraw Hill Education, 3rd Edition, 2015 |
| 3 | Antennas and Wave Propagation | John D Kraus | McGraw Hill Education, 4th Edition, 2010 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Microwave Engineering | David M Pozar | John wiley & Sons, 4$^{th}$ edition, 2012. |
| 2 | Microwave and Radar Engineering | M Kulkarni | Umesh Publications, 4$^{th}$ edition, 2009. |
| 3 | Antennas and Wave Propagation | K.D. Prasad | Satya Prakashan, 2021st edition, 2021. |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Digital Communication** | | | |
| **Subject Code:** | **22EC602** | **L – T – P - C:** | **3 – 0 – 2 – 4** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand the basics of information theory. |
| 2 | Study the various waveform coding schemes. |
| 3 | Learn the various baseband transmission schemes and understand the various band pass signalling schemes. |
| 4 | Know the fundamentals of channel coding. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Information Theory:** Discrete Memory less source, Information, Entropy, Mutual Information - Discrete Memory less channels – Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law - Source coding theorem - Huffman codes. (Text 1: 2.1 to 2.9 ) | 8 |
| II | **Introduction and waveform coding techniques:** Introduction, Basic signal processing operations in digital communication, PCM, Quantization noise and SNR, Robust quantization, DPCM, DM, ADM, Coding speech at low bit rates, ADPCM, Adaptive sub-band coding. (Text 1: 1.2, 5.1 to 5.8 ) | 8 |
| III | **Base-band shaping for data transmission:** Base-Band Shaping for Data Transmission, Discrete PAM signals, Power spectra of discrete PAM signals, ISI, Nyquist's criterion for distortion less base-band binary transmission, Correlative coding, Eye pattern, Base-band M-ary PAM systems, Adaptive equalization for data transmission. (Text 1: 6.1 to 6.8 ) | 8 |
| IV | **Digital modulation techniques:** Digital Modulation formats, Coherent binary modulation techniques, Coherent Quadrature modulation techniques, Non-coherent binary modulation techniques. (Text1: 7.1 to 7.4 ) | 8 |
| V | **Spread spectrum modulation:**<br>Pseudo noise sequences, Notion of spread Spectrum, Direct sequence spread spectrum with coherent binary PSK, Frequency hop spread spectrum, Applications.<br>**Error Control Coding:** Channel coding theorem - Linear Block codes - Hamming codes. (Text 1:9.1 to 9.3, 9.6, 9.7, 8.3 to 8.4 ) | 8 |

| Sl. No | Experiment Description using hardware |
|---|---|
| 1 | Study the digital modulation and demodulation using Amplitude Shift Keying technique. |
| 2 | Study the digital modulation and demodulation using Frequency Shift Keying technique. |
| 3 | Study the digital modulation and demodulation using Phase Shift Keying technique. |
| 4 | Study the digital modulation and demodulation using Differential Phase Shift Keying technique. |
| 5 | Measurement of Frequency of Operation, Operating wavelength, Guide wavelength, VSWR and Cutoff wavelength of a given component using microwave test bench. |
| 6 | Measurement of losses in a given optical fiber and numerical aperture. |
| **Experiment Description using Matlab** | |
| 7 | Generation and demodulation of Amplitude Shift Keying using Matlab. |
| 8 | Generation and demodulation of Phase Shift Keying using Matlab. |
| 9 | Generation and demodulation of Frequency Shift Keying using Matlab. |
| 10 | Matlab code for line codes. |
| 11 | Matlab code to determine i) entropy ii) joint entropy iii) conditional entropy. |
| 12 | Matlab code to generate hamming code. |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Interpret the various waveform coding techniques and its variants in applications like digital telephony and speech coding at low bit rates.(L1) |
| **CO2** | Analyze the characteristics of baseband signalling schemes and their performance. (L3) |
| **CO3** | Evaluate the band pass signalling schemes. (L2) |
| **CO4** | Make use of the experimental data, applying the results and prepare a formal laboratory report. (L4) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | | | | |
| **CO2** | 2 | 3 | 1 | | | | | | | | | | | |
| **CO3** | 2 | 1 | 2 | 1 | | | | | | | | | | |
| **CO4** | 1 | 1 | 3 | | 2 | | | | | 3 | | 1 | | |

**Text Books:**

| Sl No | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Digital communication systems | Simon Haykin | 2013. John wiley, ISBN: 81-265-0824-8 |
| 2 | Digital communications | John G Proakis and Masoud Salehi | Mcgraw hill, fifthedition, 2014. ISBN: 978-0-07-295716-7 |

**Reference Books:**

| Sl No | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Digital and analog communication systems | K.Sam Shanmugam | John Wiley, 2012. ISBN: 978-0-47-103090-4 |
| 2 | Analog and Digital Communications. | H P Hsu | TMH 2017 ISBN: 978-0070306363 |
| 3 | Principles of digital communication. | Taub and Schilling | Tata Mcgraw-hill,28th reprint,2017. ISBN: 978-0-07-064811-1 |
| 4 | Digital communications. | Bernard Sklar | Pearson education, 2009.ISBN: 81-7808-373-6 |

| Department: Electronics and Communication engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Computer Communication Networks** | | | |
| **Subject Code:** | **22EC603** | **L – T – P – C:** | **3 – 0 – 2 – 4** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Familiarize the students with functions of various layers in the network model (OSI,TCP/IP) for data communications. |
| 2 | Analyse Guided/Un-guided media, Framing techniques, flow control, error control mechanisms and Data link, MAC protocols. |
| 3 | Understand Network layer Services, IP addressing, Packet formats & Routing protocols. |
| 4 | Comprehend the Transport layer Services, TCP/UDP Packet formats & Protocols. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Data Communications:** Introduction, Components, Representations, Data Flow, Networks: Network criteria, Physical Structures, Network Types: LAN, WAN, Switching, The Internet, Accesing the internet.<br>**Network Models:** TCP/IP Protocol Suite: Layered Architecture, The OSI model: OSI versus TCP/IP.<br>**Data-Link Layer:** Introduction, Nodes and Links, Services, Categories of link, Two sub layers, Link Layer addressing: ARP, Data Link Control (DLC) services: Framing, Flow and Error Control, Simple protocol, Stop and wait protocol. (Text 1: 1.1 - 1.1.3, 1.2, 1.2 - 1.2.2, 1.3 - 1.3.5, 2.2 - 2.2.3, 2.3, 2.3.1, 9.1 - 9.1.4, 9.2 - 9.2.2, 11.1 - 11.1.2, 11.2.1, 11.2.2) | 9 |
| II | **Media Access Control:** Introduction. Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Controlled Access: Reservation, Polling, Token Passing. Channelization: FDMA, TDMA, CDMA.<br>**Wired and Wireless LANs:** IEEE project 802, Ethernet Evolution, Standard Ethernet: Characteristics, Efficiency, Implementation.<br>**Wireless LANs:** Characteristics, Access control, IEEE 802.11 project: Architecture, , MAC Sub layer, Bluetooth: Architecture.<br>(Text 1: 12.1 - 12.1.4, 12.2.1 - 12.2.3, 12.3 - 12.3.3, 13.1.1, 13.1.2, 13.2, 13.2.1, 13.2.4, 13.2.5, 15.1.2, 15.1.3, 15.2, 15.2.1, 15.2.2, 15.3, 15.3.1) | 8 |
| III | **Connecting Devices:** Introduction, Hubs, link layer Switches, Routers, Virtual LANs: Membership, Configuration.<br>**Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Packet switching, Datagram Approach, Virtual circuit approach.<br>**IPV4 Addresses:** Address Space, Classful Addressing, Classless Addressing, Network Address Translation.<br>(Text 1: 17.1.1 - 17.1.3, 17.2, 18.1 - 18.1.2, 18.2.1, 18.2.2, 18.4 - 18.4.3, | 8 |

| | | |
|---|---|---|
| | 18.4.5) | |
| IV | **Network Layer Protocols:** Introduction, Internet Protocol (IP): Datagram Format, Security of IPv4 Datagram, Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP.<br>**Next Generation IP:** IPV6 Addressing, Representation, Address Space, IPV6 Protocol- packet format, Transition from IPv4 To IPv6, Strategies.<br>**Uni-cast Routing:**Routing Algorithms: Distance Vector Routing, Link State Routing. (Text 1:19.1, 19.1.1, 19.1.4, 19.3 - 19.3.4, 22.1 - 22.1.2, 22.2, 22.2.1, 22.4, 22.4.1 ,20.2, 20.2.1, 20.2.2) | 8 |
| V | **Transport Layer:**Transport Layer Services, Protocols, Transport Layer Protocols: Go-Back-N Protocol, Selective Repeat protocol.<br>**Transport Layer Protocols in the Internet:** User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, TCP Segment, TCP Connection.<br>(**Text 1:** 23.1.1, 23.2, 23.2.3, 23.2.4 ,24.2, 24.2.1, to 24.2.3, 24.3, 24.3.1 - 24.3.4 ) | 7 |

**Lab Contents:**

| Sl. No. | PART-A: Experiments using C/Python programming |
|---|---|
| 1 | Implement Bit stuffing & De-stuffing Algorithm. |
| 2 | Implement Character stuffing & De-stuffing Algorithm. |
| 3 | Implement Encryption and Decryption algorithms. |
| 4 | Implement STOP and WAIT protocol, Sliding window protocol. |
| **PART-B : Simulation Experiments using Cisco Packet tracer/NS2/NS3** | |
| 5 | 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. |
| 6 | Simulate different types of internet traffic such as FTP and TELNET over a network to analyze the throughput. |
| 7 | Simulate Ethernet LAN using n nodes and set multiple traffic nodes to determine collision across different node. |
| 8 | Test and verify Network configurations using Packet Tracer. |
| 9 | Performing an Initial Router configuration Cisco Packet Tracer. |
| 10 | Performing OSPF configuration using Cisco Packet Tracer. |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Identify the functions of various layers in the network model (OSI,TCP/IP) for data communications. (L1) |
| **CO2** | Demonstrate Guided/Un-guided media, Framing techniques, flow control, error control mechanisms and Data link, MAC protocols. (L3) |
| **CO3** | Summarize & Simulate Network layer devices, Services, IP Packet formats, Protocols. (L2) |
| **CO4** | Interpret Transport layer Services, Packet formats, Protocols. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | | | |
| **CO2** | 2 | 2 | 2 | 1 | 2 | | | | | 1 | | | 2 | |
| **CO3** | 2 | 2 | 1 | | 2 | | | | | 1 | | | 2 | |
| **CO4** | 2 | 2 | 1 | | 2 | | | | | 1 | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Data Communication and Networking | B Forouzan | McGraw Hill,2013, 5th Edition |
| 2 | Computer networks | Andrew S.Tenenbaum | Pearson Prentice hall, 2010, 4th Edition |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Computer Networks | James F.Kurose, Keith W.Ross | Pearson Edu., 2nd Edition, 2003 |
| 2 | Introduction to Data Communication and Networking | Wayne Tomasi | Pearson Edu., 2007 |
| 3 | Computer Networks | V.S. BagadandI. A .Dotre | Technical publications, 2nd edition, 2009. |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Machine Learning** | | | |
| **Subject Code:** | **22EC6PE41** | **L – T – P - C:** | **3 – 0 – 0 – 3** |

| Sl. No. | Course Objectives |
|---|---|
| 1 | Learn a spectrum of machine learning algorithms with a sound mathematical background. |
| 2 | Understand supervised learning methods and its evaluation metrics. |
| 3 | Study Unsupervised learning methods and its evaluation metrics. |
| 4 | Learn Bayesian techniques for solving problems in machine learning. |

| Unit | Description | Hrs |
|---|---|---|
| I | Introduction To Machine Learning: Machine learning Landscape: Purpose of Machine Learning, examples of applications, Types of ML, main challenges of ML, Testing & Validating End to end Machine learning Project: Working with real data, look at the big picture, Get the data, Discover, and visualize the data, Prepare the data, select, and train the model, Fine tune your model. (Text 1: Chapter 1 & 2) | 8 |
| II | **SUPERVISED LEARNING**: Linear Regression, Multiple Linear Regression, Logistic Regression, K Nearest Neighbours, Decision Trees: ID3, Classification and Regression Trees, Support Vector Machines: Linear and Non-Linear, Kernel Functions. (Text 1: Chapter 4) | 8 |
| III | **DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS** Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm, and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test. (Text 2: Chapter 19) | 7 |
| IV | **ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING** Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: Introduction to Clustering, K-means clustering, Dimensionality reduction-Principal Component Analysis. (Text 1: Chapter 7) | 8 |
| V | **Classifying with probabilistic models**: Bayes Theorem, Concept Learning – Maximum Likelihood, Minimum Description Length Principle, Bayes Optimal Classifier, Naïve Bayes Classifier, example Bayesian Belief Network, EM Algorithm. (Text 3: Chapter 6) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Choose machine learning techniques in computing systems.(L2) |
| **CO2** | Apply Supervised learning algorithms to do prediction and classification.(L3) |
| **CO3** | Apply unsupervised learning algorithms to learn patterns from given training set of unlabeled data points.(L3) |
| **CO4** | Interpret the Bayesian techniques and derive the learning rules.(L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | | | | | | | | | | | | | |
| **CO2** | | 2 | 3 | 2 | | | | | | | | 1 | | |
| **CO3** | | 2 | 3 | 2 | | | | | | | | 1 | | |
| **CO4** | | | 2 | | | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Hands-on Machine Learning with Scikit- Learn &TensorFlow | Aurelien Geron | 2nd Edition, O'Reilly, 2019 |
| 2 | Introduction to Machine Learning | Ethem Alpaydin | 4 th Edition, MIT Press 2020 |
| 3 | Machine Learning | Tom Mitchell | 3 rd Edition, McGraw Hill 1997 |

**Reference Books:**

| Sl No | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Pattern Recognition and Machine Learning Christopher M. Bishop 1 st Springer 2006 | Pattern Recognition and Machine Learning Christopher M. Bishop 1 st Springer 2006 | Pattern Recognition and Machine Learning Christopher M. Bishop 1 st Springer 2006 |

Mooc Course:
Introduction to Machine Learning : NPTEL 2023: https://nptel.ac.in/courses/106106139

| Department: Electronics and Communication Engineering | | | Semester: | 6 |
|---|---|---|---|---|
| Subject: Analog and Mixed Signal VLSI Design | | | | |
| Subject Code: | 22EC6PE42 | | L – T – P - C: | 3 – 0 – 0 – 3 |

| Sl. No | Course Objectives |
|---|---|
| 1 | Learn the issues of analog and digital system design. |
| 2 | Study and compare different architectures of data converters and their SNRs with pros and cons. |
| 3 | Understand the fabrication steps at submicron technology. |
| 4 | Acquire the knowledge of single stage amplifiers using MOSFET. |

| Unit | Description | Hrs |
|---|---|---|
| I | **DAC Fundamentals & Architectures**: Introduction, DAC Specifications, Mixed Signal Layout Issues. DAC Architectures: Resistors String, R-2R Ladder Networks, Charge Scaling DAC (Excluding Split Array), Cyclic DAC, Pipeline DAC, Problems on all types of DAC. (Text Book 1: 28.4, 28.6, 29.1.2, 29.1.3, 29.1.5, 29.1.6, 29.1.7 ) | 9 |
| II | **ADC Fundamentals & Architectures**: Introduction, Analog versus Digital Discrete Time Signals, Sample and Hold characteristics, ADC Specifications, ADC Architectures: Flash ADC, 2-step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC (excluding charge redistribution SAR), Problems on all types of ADC. (Text Book 1: 28.1, 28.3, 28.5, 29.2.1, 29.2.2, 29.2.3, 29.2.4, 29.2.5 ) | 9 |
| III | **Sampling and Aliasing**: Impulse Sampling, Quantization noise, Spectral density of quantization noise. Data Converter SNR: Improving SNR using averaging (Excluding jitter & averaging onwards), Decimating filters for ADCs (Excluding decimating without averaging onwards), and Interpolating filters for DAC. (Text Book 2: 30.1.1, 30.3.2, 31.1.1, 31.1.2, 31.2.1, 31.2.2, 31.2.3) | 8 |
| IV | **Sub-Micron CMOS Circuit Design**: CMOS Process flow, Submicron Capacitors and Resistors. Digital Circuit Design: MOSFET switch (up to bidirectional switches), Delay, Adder elements.<br>(Text Book 2: 33.1.1, 33.1.2, 33.2.1, 33.2.2, 33.2.3) | 7 |
| V | **Single Stage Amplifiers**: Basic concepts, Common Source Amplifier with resistive load, diode connected load, Source Follower, Common Gate Amplifier. (Only voltage gain expressions using large signal and small signal models) (Text Book 3: 3.1, 3.2.1, 3.2.2, 3.3, 3.4) | 7 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Interpret the different data converters and layout issue of mixed signal systems. (L2) |
| **CO2** | Analyze the fabrication process flow of MOSFET and passive components at submicron level. (L2) |
| **CO3** | Apply the different techniques to improve the SNR. (L3) |
| **CO4** | Design of single stage amplifiers using signal models. (L4) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | | | | | | | | | | | 2 | |
| **CO2** | 1 | | | | | | | | | | | | | |
| **CO3** | | 2 | | | | | | | | | | | | |
| **CO4** | | | 3 | | | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | CMOS Circuit Design, Layout, Simulation | R. Jacob Baker | John Wiley & Sons, INC. 4th Edition, 2019. |
| 2 | CMOS Mixed Signal Circuit Design | R. Jacob Baker | Volume –II, John Wiley & Sons, INC. 2009. |
| 3 | Design of Analog CMOS Integrated Circuits | B Razavi | Tata McGraw Hill, 2009. |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | CMOS Analog and Mixed-Signal Circuit Design | Arjuna Marzuki | CRC Press 1st Edition, 2020. |
| 2 | CMOS Circuit Design, Layout and Simulation | R. Jacob Baker, Harry W. Li, David E Boyce | IEEE Press, 2002.. |
| 3 | VLSI Design Techniques for Analog and Digital Circuits | Randall Geiger, Phillip E. Allen, Noel Stradder | Tata McGraw Hill, 2010. |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Information Security and Cyber space** | | | |
| **Subject Code:** | **22EC6PE43** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand the Information Security goals, and classical encryption techniques. |
| 2 | Learn the Symmetric and Asymmetric cryptography techniques in different domains and applications. |
| 3 | Study the need for cyberspace and cyber security. |
| 4 | Explain different message authentication codes, hash functions and cyberspace terminologies. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Classical Encryption Techniques:** Introduction **-** Cyber Attacks, Defence Strategies and Techniques, Mathematical Background for Cryptography - Modulo Arithmetic's A Model of Network Security. Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques. (Text 1: 1.3, 1.4, 1.5, 1.6, 2.1 to 2.5, Text 2: 1.1-1.5) | **8** |
| II | **Block ciphers:** Introduction, Public key cryptography and other public key cryptosystem. Block cipher principles, The Data Encryption Standard, A DES Example, Strength of DES. Block Cipher modes of operation. Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie- Hellman Key Exchange. (Text 1: 3.1 to 3.5, 9.1, 9.2, 10.1) | **8** |
| III | **Message authentication and Hash functions**: Introduction, Cryptographic Hash Functions: Applications of Cryptographic hash functions, Two simple hash Functions. Message Authentication codes: Authentication Requirements, security of MAC's. Digital Signatures: Digital Signatures, Digital Signature Standard. (Text 1: 11.1, 11.2, 12.1 to 12.4, 13.1 & 13.4) | **8** |
| IV | **Introduction to Cyber space**: Fundamental notions of copyright law, Need to protect data in cyberspace, Types of data, Legal framework of data protection, IT act aim and objectives, Scope of the act, Secure electronic records and secure digital signatures, Regulation of certifying authorities: Digital Signature certificates. (Text 2:1.1 – 1.5, 7.1 – 7.3) | **8** |
| V | **IP PROTECTION ISSUES IN CYBERSPACE**: Copyright issues in cyberspace, Copyright infringement in digital environment-Software piracy, Linking, Framing, Caching, Meta Tagging, Legal protection of copyright in International Framework-WCT, WPPT, TRIPS. Indian legal protection of copyright in cyberspace & concept of DRM.<br>**EMERGING ISSUES OF CYBERSPACE:** Cloud Computing and Internet of Things. (Text 2: 12.1 – 12.3 and 15.1 – 15.3) | **8** |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Recognize the need of enforcing security policies, standards and practices from intruders and viruses in an open information system, with case studies. (L2) |
| **CO2** | Extend the importance of cryptographic algorithms. (L2) |
| **CO3** | Interpret different cryptographic techniques for cyber security. (L3) |
| **CO4** | Analyze Data Protection regime and privacy aspects of cyberspace. (L2) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | | | | 1 | |
| **CO2** | | 2 | 3 | 1 | | | | | | | | | | |
| **CO3** | | 1 | 2 | 1 | 2 | | | 1 | | | | | | |
| **CO4** | | 1 | | 1 | 2 | | | 1 | | | | | | 2 |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Cryptography and Network Security Principles and Practice | William Stallings | Pearson Education Inc., 6thEdition, 2014 |
| 2 | Internet Law- Regulating Cyberspace and emergingTechnologies | Rodney D Ryder & Nikhil Naren | Bloomsbury ,2020 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Cyber Law simplified | Vivek Sood | Mc-Graw Hill, 11th reprint , 2013 |
| 3 | Cryptography and Network Security | Behrouz A. Forouzan and DebdeepMukhopadhyay | McGrawHill Education, 2nd Edition, 2014 |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Sensors and Signal Conditioning** | | | |
| **Subject Code:** | **22EC6PE44** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand various technologies associated in manufacturing of sensors. |
| 2 | Acquire knowledge about types of sensors used in modern digital systems. |
| 3 | Learn about material properties required to make sensors. |
| 4 | Study intelligent sensors used in signal processing. |

| Unit | Description | Hrs |
|---|---|---|
| I | **INTRODUCTION TO SENSOR BASES MEASUREMENT SYSTEMS**: Introduction, General concepts and terminology, sensor classification, primary sensors, material for sensors, micro sensor technology, magneto resistors, light dependent resistors, resistive hygrometers, resistive gas sensors, liquid conductivity sensors (Text1: 1.2 to 1.8) | 8 |
| II | **REACTANCE VARIATION AND ELECTROMAGNETIC SENSORS:** Introduction, Capacitive Sensors, Inductive Sensors, Electromagnetic Sensors. Signal Conditioning for Reactance Variation Sensors-Problems and Alternatives, ac Bridges Carrier Amplifiers, Coherent Detection, Specific Signal Conditioners for Capacitive Sensors, Resolver-to-Digital and Digital-to-Resolver Converters. (Text1: 2.4 to2.10) | 8 |
| III | **SELF-GENERATING SENSORS**: Introduction, Thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors. (Text1: 3.6 to 3.12) | 8 |
| IV | **DIGITAL AND INTELLIGENT SENSORS**: Introduction, position encoders, resonant sensors, sensors based on quartz resonators, SAW sensors, Vibrating wire strain gages, vibrating cylinder sensors, Digital flow meters. (Text 1: 4.1 to 4.12) | 8 |
| V | **SENSORS BASED ON SEMICONDUCTOR JUNCTIONS:** Introduction, Thermometers based on semiconductor junctions, magneto diodes and magneto transistors, photodiodes and phototransistors, sensors based on MOSFET transistors, charge coupled sensors – types of CCD imaging sensors, ultrasonic-based sensors. (Text 1: 6.2 to 6.13) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Label various types of sensors and their construction. (L1) |
| **CO2** | Identify the sensors for specific end user application. (L2) |
| **CO3** | Apply the knowledge of Sensors for developing prototype models. (L3) |
| **CO4** | Analyze the sensors performance in integrated system design. (L4) |

**Course Articulation Matrix**

| PO/PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | | | | | | | | | | | | |
| **CO2** | 2 | | 2 | | 3 | | | | 2 | | | | | |
| **CO3** | 2 | | | | | 3 | | | | 2 | | | | |
| **CO4** | 2 | | | 3 | | | | | | | 3 | | | |

**Text Books:**

| Sl No | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Ramon PallásAreny, John G. Webster | "Sensors and Signal conditioning", | John Wiley and Sons , 2nd Edition, 2000 |

**Reference Books:**

| Sl No | Text Book title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Wai Lok, Bin Gai | Sensor Signal and Information Processing | John Willey , 2nd Edition, Feb 2020 |
| 2 | Curtis D Johnson, | Process Control Instrumentation Technology | Pearson New International Technology , 4th Edition, June 2020 |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Introduction to Embedded Systems** | | | |
| **Subject Code:** | **22EC6OE51** | **L – T – P – C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Introduce students to basic concepts of Microprocessors and Microcontrollers. |
| 2 | Introduction to basic concepts of embedded system design from both the hardware and software point of view. |
| 3 | Define hardware and software communication and control requirements. |
| 4 | Effectively bridge the gap between hardware and software design in different industrial production contexts. |

| Unit | Description | Hrs |
|---|---|---|
| I | **MICROPROCESSORS AND MICROCONTROLLERS**<br>Introduction to Microprocessor and Microcontrollers, RISC and CISC CPU architecture Harvard and Von Neumann Architectures, General Features and Architecture of Microcontrollers. (Text 1: 2.1 – 2.7) | **07** |
| II | **INTRODUCTION TO EMBEDDED SYSTEM DESIGN**:<br>Overview of embedded systems, embedded system design challenges, common design metrics and optimizing them, Processor Technology, Design Technology. (Text 2: 1.1 – 1.5) | **08** |
| III | **SINGLE PURPOSE PROCESSORS:**<br>Timers, Countersuit, PWM, LCD Controllers, Stepper Motor Controllers,A to D Converters Examples Problems. (Text 2: 4.1 – 4.8, 6.1 – 6.8) | **08** |
| IV | **INTERRUPTS:** Basics, Shared Data Problem, Interrupt latency, Survey of software Architecture, Round Robin, Round Robin with interrupts, Function queues scheduling. (Text 3: 4.1 – 4.4, 5.1 – 5.4) | **08** |
| V | **INTRODUCTION TO RTOS:**<br>Tasks, States, Data, Semaphores, shared data, More Operating system services, Message Queues, Mail Boxes, Timers, Events. (Text 2: 6.1 – 6.3, 7.1 – 7.3) | **08** |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, Manufacturability and sustainability. (L3) |
| **CO2** | To apply formal design methodology to optimize various aspects in the design of embedded systems for industrial applications. (L3) |

| | |
|---|---|
| **CO3** | Apply Knowledge of various embedded processor architectures in Industrial automation and various other applications. (L3) |
| **CO4** | Design systems for Real time processing. (L3) |

**Course Articulation Matrix:**

| PO/PSO CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | | | | | | | | | | | | | |
| **CO2** | | | 2 | | | | | | | | | | | |
| **CO3** | | | 3 | | | | | | | | | | | |
| **CO4** | | 2 | 3 | 2 | | 2 | | | | | | 2 | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | "The 8051 Microcontroller and Embedded Systems" | Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay. | Pearson Education, Second Edition, 2014. |
| 2 | Frank Vahid, Tony Givargis | Embedded System Design: A Unified Hardware/Software Introduction. | Pearson Education, Second Edition, 2014 ISBN:9971- 51-405-2 |
| 3 | David E. Simon | An Embedded software Primer | CISCO Press, 2017. ISBN:81-7758-154-6 2006 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Raj Kamal, | Embedded Systems: Architecture and Programming | TMH. 2008 Education Asia / PHI Indian Reprint 2002 |
| 2 | Shibu K. V | Introduction to Embedded Systems | McGraw-Hill Education(INDI A) Private limited 2012 |
| 3 | James K | Embedded Systems: A Contemporary Design Tool | John Weily India Pvt. Ltd 2014 |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Pattern Recognition** | | | |
| **Subject Code:** | **22EC6OE52** | **L – T – P - C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Understand the fundamental concepts of pattern recognition systems. |
| 2 | Learn the concepts of Probability theory, random variables, joint distribution and density function. |
| 3 | Study the principles of statistical decision and non-parametric decision making. |
| 4 | Acquire the knowledge of various clustering methods. |

| Unit | Description | Hrs |
|---|---|---|
| I | **Introduction to Pattern Recognition:** Introduction, Machine perception-an example, pattern recognition systems, the design cycle, learning and adaptation, applications of pattern recognition, statistical decision theory, image processing and analysis. (Text 2: 1.1-1.5, Text 1: 1.1 – 1.3) | 6 |
| II | **Probability:** Introduction, Probabilities of events, random variables, joint distributions and densities, moments of random variables, estimation of parameters from samples, problems. (Text 1: 2.1 – 2.6) | 8 |
| III | **Statistical decision making:** Introduction, Bayes' theorem, multiple features, conditionally independent features, decision boundaries, unequal costs of error, Leaving-One-Out Technique, problems. (Text 1: 3.1 -3.5, 3.8) | 9 |
| IV | **Nonparametric decision making:** Introduction, histograms, kernel and window estimators, adaptive decision boundaries, adaptive discriminant functions, problems. (Text 1: 4.1 – 4.4, 4.6) | 9 |
| V | **Clustering:** Introduction, Hierarchical clustering: Agglomerative clustering algorithm, Single-Linkage algorithm, Complete-Linkage algorithm, Average-Linkage algorithm, Wards method, Partitioned clustering: Forgy's algorithm, Kmeans algorithm, Iso data Algorithm, problems. (Text 1: 5.1 – 5.3) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Outline various techniques involved in pattern recognition. (L1) |
| **CO2** | Apply the knowledge of probability to statistical and non-parametric decision making. (L3) |
| **CO3** | Analyze classification problems and estimate classifier performance. (L3) |
| **CO4** | Interpret the principles of clustering approaches to pattern recognition. (L2) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | | | | | 2 | | | | | | | | | |
| CO2 | 2 | 1 | | 2 | | | | | | | | | | |
| CO3 | 2 | 1 | | 1 | 1 | | | | | | | | | |
| CO4 | | 2 | | | 2 | | | | | | | | | |

**Text Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Pattern Recognition and Image Analysis. | Earl Gose, Richard Johnsonbaugh, Steve Jost | Pearson, 978-93-325-4979-1, 2015 |
| 2 | Pattern Classification. | Richard O. Duda, Peter E. Hart, David G. Stork | Wiley, 978-81265-1116-7, 2009 |

**Reference Books:**

| Sl. No. | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Pattern Recognition. | Konstantinos Koutroumbas Sergios Theodoridis | Academic Press, 2008 ISBN: 978-1-597-49272-0 |
| 2 | Pattern Recognition and Machine learning. | Christopher M Bishop | Springer, 2009 ISBN-13:978-0-387-31073-2 |
| 3 | Pattern Recognition. | Narasimha Murthy | Universities Press, 2011 ISBN-13: 978-8173-717-253 |

| Department: Electronics and Communication Engineering | | Semester: | 6 |
|---|---|---|---|
| **Subject: Robotics** | | | |
| **Subject Code:** | **EC6OE53** | **L – T – P - C:** | **3 – 0 – 0 – 3** |

| Sl. No | Course Objectives |
|---|---|
| 1 | Acquire the knowledge of basic components of a robot anatomy. |
| 2 | Learn the various types of end effectors and sensors. |
| 3 | Understand programming concepts of robot kinematics. |
| 4 | Study the sensors and devices in robot application and vision system. |

| Unit | Description | Hrs |
|---|---|---|
| I | **FUNDAMENTALS OF ROBOT**: Introduction, Robot Anatomy , Co-ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications. (Text 1: 1.1 to 1.6, 2.1 to 2.5) | 8 |
| II | **ROBOT DRIVE SYSTEMS AND END EFFECTORS:** Introduction, Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives, D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations. (Text 2: 5.1 to 5.4) | 8 |
| III | **KINEMATICS:** Introduction, Direct kinematic model: Mechanical structure and notations, Description of joints and links. Kinematic modeling of the manipulator. Denavit – Hartenberg Notation. (Text1: 3.1 to 3.4) | 8 |
| IV | **PATH PLANNING:** Introduction, Definitions of Trajectory planning, Trajectory planning problem, terminology, steps in trajectory planning, classification of trajectory planning, types of trajectory function tasks, joint space techniques, Cartesian space technique. (Text 1: 7.1 to 7.3) | 8 |
| V | **ROBOTIC SENSORS AND VISION:** Introduction, Definitions, Sensors and Robotics, Kinds of sensors used in Robotics. Robotic Vision, Industrial applications of vision –controlled robotic vision systems. (Text 1: 9.1 to 9.5) | 8 |

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Outline the Robotic basics and their classification.(L1) |
| **CO2** | Analyze the drive system and End effector of Robotics. (L4) |
| **CO3** | Interpret the Kinematics and path planning for Robotic system. (L3) |
| **CO4** | Design Robotic sensors for vision. (L3) |

**Course Articulation Matrix:**

| PO/PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | | | | | 2 | | | 3 | 1 | | 1 | | | |
| **CO2** | 3 | | | | | | | | 1 | 1 | 2 | | | |
| **CO3** | 3 | | | | | | | | 2 | 2 | 3 | | | |
| **CO4** | 1 | | | | 3 | | | 2 | | | | | | |

**Text Books:**

| Sl No | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Robotics And Control | R K Mittal And I J Nagarth | McGraw – Hill, 2002 |
| 2 | Industrial Robotics – Technology, Programming and Applications | M.P.Groover | McGraw – Hill, 2nd edition, 2000 |

**Reference Books:**

| Sl No | Title | Author | Volume and Year of Edition |
|---|---|---|---|
| 1 | Robotics Control, Sensing, Vision and Intelligence | Fu.K.S, Gonzalz.R.C., and Lee C.S.G., | McGraw-Hill Book Co., 2000 Reprint |
| 2 | Robotic engineering- An Integrated Approach | Richard D. Klafter, Thomas A. Chmielewski and Michael Negin | Prentice Hall India Learning Private Limited, 1997 |
| 3 | Robotics and Image Processing | Janakiraman. P. A | McGraw Hill Education India Pvt Ltd, 2002 |

| Department: Electronics and Communication Engineering | | | Semester: | 5 |
|---|---|---|---|---|
| **Subject: Mini Project** | | | | |
| **Subject Code:** | **22ECMP607** | **L – T – P - C:** | | **0 – 0 – 4 – 2** |

## Description

**Guidelines for Student Project Work**:

- ✓ Students (Maximum-4, becomes one Group) shall carry out a detailed survey on the area and the topic on which they are interested to do the Mini project work.
- ✓ Each group instructed to prepare synopsis of three different topics with tittle of the Mini project work and submit to class teachers.
- ✓ Project Evaluation Committee (PEC) will review the synopsis and suggest suitable title in relevance to recent trends in Electronics and Communication Engineering domain and allot the guide.
- ✓ Each group instructed to give a detailed presentation and justify the tittle of the project with problem definition.
- ✓ Each group meet the guide frequently (every two weeks) with Project Dairy (100 Pages ruled note book) and discuss the work progress.
- ✓ Each guide has to write the observations and recommendations in the Project Diary, during every meeting. Get the signature of the Guide and HoD.
- ✓ After successful implementation of the Project work each group has to make an arrangement for final demonstration of the work in the department.
- ✓ Concerned Guide and PEC members evaluate the work as per Rubrics during the Project work Seminar, as per calendar of events.
- ✓ Final presentation involves: Introduction, Literature Survey (Minimum 06 papers), Problem Statement, Motivation, Objectives, Proposed methodology for solving societal problems.

**CIE-Continuous Internal Evaluation**: Continuous evaluation will be done by respective Project Guides and PEC members based on the Regularity, Technical Knowledge and Competence, Programming Skills, Communication Skills, Demonstration skills, Collaborative Learning and Documentation Skills of the students.

**Course Outcomes:**

| Course outcome | Descriptions |
|---|---|
| **CO1** | Identify the electronic solutions for day to day societal problems with available tools (L2) |
| **CO2** | Develop the system according to the problem stated in project work (L3) |
| **CO3** | Implement and Test the performance of the system (L4) |