# Academic Program: UG

## Academic Year 2020-21

## Syllabus

# V & VI Semester B.E.

# Electronics & Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

**(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)**

**Ph**: **0836-2447465 Fax: 0836-2464638 Web:** www.sdmcet.ac.in

## SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for V & VI semester of UG program in Electronics and Communication Engineering is recommended by Board of Studies of Electronics and Communication Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2020-21 till further revision.

Chairman BOS & HOD Principal

**SDM College of Engineering & Technology, Dharwad-02**

**Department of Electronics & Communication Engineering**

**College – Vision and Mission**

## VISION:

To develop competent professionals with human values

## MISSION:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

## SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

## SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

## Department- Vision and Mission

### Vision

Fostering excellence in the field of Electronics & Communication Engineering, showcasing innovation, research and performance with continuous Industry – Institute Interaction with the blend of Human values.

### Mission

**M1:** To provide quality education in the domain of Electronics & Communication Engineering through state of the art curriculum, effective teaching learning process and the best of laboratory facilities.

**M2:** To encourage innovation, research culture and team work among students.

**M3:** Interact and work closely with industries and research organizations to accomplish knowledge at par.

**M4:** To train the students for attaining leadership with ethical values in developing and applying technology for the betterment of society and sustaining the global environment.

### Program Educational Objectives (PEOs)

The Graduates, after a few years of Graduation will be able to:

I. **Apply** the latest in-depth knowledge in the field of Electronics and Communication Engineering with Mathematical applications to address real life challenges.
II. **Exhibit** the confidence for independent working and / or spirit to work cohesively with group.
III. **Readily** be accepted by the Industry globally.
IV. **Develop** design skills, fault diagnosis skills, communication skills and create research orientation.
V. **Inculcate** professional, social ethics and to possess awareness regarding societal responsibility, moral and safety related issues

**Programme Outcomes (POs):**

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations 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.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

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

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

## PROGRAM SPECIFIC OUTCOMES (PSOs)

**13.** Design economically and technically sound analog and / or digital systems based on the principles of signal processing, VLSI and communication Engineering (PO-13)

**14.** Integrate hardware – software, and apply programming practices to realize the solutions in electronics domain. (PO-14)

### Scheme and Syllabus
### V Semester

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration in Hrs. |
| 18UHUC500 | HU | Management, Entrepreneurship and IPR | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UECC500 | PC | CMOS VLSI Design | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UECC501 | PC | Communication Systems -II | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UECC502 | PC | Digital Signal Processing | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECC503 | PC | Information Theory & Coding | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| **18UECE5XX** | **PE** | **Program Elective-I** | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECL504 | PC | Communication Systems Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UECL505 | PC | DSP Laboratory | 0 – 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UECL506 | PC | Minor Project-1 | 0 – 0 - 2 | 1 | 50 | -- | -- | -- | -- |
| 18UHUL507 | HU | Soft skills/Aptitude | 0 - 0 - 2 | 1 | 50 | -- | -- | -- | -- |
| **Total** | | | **21- 0 -10** | **26** | **500** | **600** | | **100** | |

**Program Elective-I**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 18UECE510 | PE | Object Oriented Programming using C++ | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECE511 | PE | Telecommunication Networks | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECE512 | PE | Scientific Computing using Python | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECE513 | PE | Sensors and Transducers | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |

HU- Humanities, PC- Program Core

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination
**L**: Lecture **T**: Tutorials **P**: Practical
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

## VI Semester

| Course Code | Course Category | Course Title | Teaching | | Examination | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | L-T-P (Hrs/Week) | Credits | CIE | Theory (SEE) | | Practical (SEE) | |
| | | | | | Max. Marks | *Max. Marks | Duration in Hrs. | Max. Marks | Duration In Hrs. |
| 18UECC600 | PC | Analog & Mixed Mode VLSI Design | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UECC601 | PC | IOT & Embedded System Design | 4 - 0 - 0 | 4 | 50 | 100 | 3 | - | - |
| 18UECE6XX | PE | **Program Elective-II** | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE6XX | PE | **Program Elective-III** | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE6XX | OE | **Open Elective** | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECL602 | PC | Embedded Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UECL603 | PC | VLSI Laboratory | 0 - 0 - 3 | 1.5 | 50 | -- | -- | 50 | 3 |
| 18UECL604 | PC | Minor Project-2 | 0 - 0 - 4 | 2 | 50 | -- | -- | 50 | 3 |
| 18UHUL605 | HU | Soft skills/Aptitude | 0 - 0 - 2 | 1 | 50 | -- | -- | -- | -- |
| | | **Total** | **17 - 0 -12** | **23** | **450** | **500** | | **150** | |

**Program Elective-II**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 18UECE610 | PE | System Verilog | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE611 | PE | Advanced Digital System Design | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE612 | PE | Image Processing & Computer Vision | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE613 | PE | Operating System | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |

**Program Elective-III**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 18UECE620 | PE | Speech Processing | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE621 | PE | Robotics | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE622 | PE | Data structure using C++ | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |
| 18UECE623 | PE | Artificial Intelligence | 3 - 0 - 0 | 3 | 50 | 100 | 3 | - | - |

**Open Elective**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 18UECE630 | OE | Cryptography | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECE631 | OE | Soft Computing | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECE632 | OE | Automotive Electronics | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |
| 18UECE633 | OE | Multimedia Communication | 3 - 0 - 0 | 3 | 50 | 100 | 3 | -- | -- |

PC- Program Core, PE-Program Elective, OE- Open Elective and HU- Humanities

**CIE**: Continuous Internal Evaluation **SEE**: Semester End Examination
**L**: Lecture **T**: Tutorials **P**: Practical
*SEE for theory courses is conducted for 100 marks and reduced to 50 marks

## V Semester

| 18UHUC500 | Management, Entrepreneurship & IPRs | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**

This course focuses on concepts of Entrepreneurship, concepts of Management and about the Intellectual Property Rights. Entrepreneurship part discusses about meaning of Entrepreneurship, Business ideas, family business and doing business in India. Management part discusses about Planning, Forecasting, Organizing & Staffing, Motivating and Controlling. Intellectual Property Rights part discusses various legal aspects of Patents, Trademarks and Copyright.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Understand** the concept of Entrepreneurship and Business ideas. | 12 | 6 | - |
| **CO-2** | **Describe** about family business in India and doing business in India | 12 | 6 | - |
| **CO-3** | **Discuss** Management principles/process and illustrate Planning and Organizing. | - | 11 | - |
| **CO-4** | **Analyze** aspects of Motivating and Controlling functions of Management. | - | 6 | - |
| **CO-5** | **Discuss** about the legal aspects of Intellectual Property Rights: Patents, Trade Marks and Copyright. | 8 | 12 | 7 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | - | - | - | - | - | 2.0 | 1.0 | 3.0 | - | - | 2.0 | 2.7 | **-** | **-** |

**Contents:**

**Unit-I**

**Entrepreneurship**

**Understanding Entrepreneurship:** Introduction, Definition, Role of an Entrepreneur, Reasons for growth of Entrepreneurship, Age of an Entrepreneurial firm, Why start a business, Entrepreneurial Characteristics & Skills, Types of Entrepreneurs, Entrepreneurial failure.

**Growth of a Business Idea:** Introduction, New Business Idea, Pre-selection process, Sources of Business Ideas, Preliminary Research, Business Idea Evaluation, Other analysis.

**Family Business:** Introduction, Family Business in India, The Founder, The Next Generation, Entry of Family Members, Non-family Managers, Succession, Best Practices. **11 Hrs**

## Unit-II

**Doing Business in India:** Introduction, Major Issues, Types of Organizations, Legal Compliances.

**Entrepreneurial Support:** Introduction, Policies, Business Incubation, Business Clusters.

**Management**

**Planning, Forecasting and Decision Making:** Nature of Planning, the foundation of planning, some planning concepts, forecasting, nature of decision making, management science, tools for decision-making. **11 Hrs**

## Unit-III

**Organizing and staffing:** nature of organizing, traditional organizational theory, technology and modern organization structures, staffing technical organization, authority and power; delegation, meeting & committees.

**Motivating:** Motivation, leadership, motivating and leading technical professionals. **10 Hrs**

## Unit-IV

**Controlling:** process of control, financial controls, and non-financial controls.

**Intellectual Property Rights**

**Patents:** Introduction, Protectable Subject Matter-Patentable Invention, Procedure for Obtaining Patent, Provisional and Complete Specification, Rights conferred on a Patentee, Transfer of Patent, Revocation and Surrender of Patents, Infringement of Patents. **10 Hrs**

## Unit-V

**Trade Marks:** Introduction, Statutory Authorities, Principles of Registration of Trade Marks, Rights conferred by Registration of Trade Marks, Infringement of Trade Marks and Action against Infringement, Procedure of Registration and Duration.

**Copyright:** Introduction, Author and Ownership of Copyright, Rights conferred by Copyright, Term of Copyright, Assignment/License of Copyright, Infringement of Copyright, Infringement in Literary, Dramatic and Musical Works. **10 Hrs**

**Reference Books:**


1) Rajeev Roy, “Entrepreneurship”, 2nd Edition, 2011, Oxford University Press, New Delhi.
2) Daniel L Babcock, Lucy C Morse, "Managing Engineering and Technology" Third Edition, 2005, Prentice Hall of India Pvt. Ltd., New Delhi.
3) Wadehra B. L.,"Law relating to Intellectual Property”,4th Edition, 2012, Universal

Law Publishing Co. Pvt. Ltd., Delhi.
4) N. K. Acharya, "Text book on Intellectual Property Rights" Asia Law House, Hyderabad, 4th Edition.

| 18UECC500 | CMOS VLSI Design | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**

The course focuses on the theory, fabrication and design principles of CMOS devices and circuits. The course concentrates on the study and analysis of various combinational and sequential MOS logic circuits for digital VLSI applications.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Explain** the theory, construction and the characteristics of MOS structures and logic circuits. | - | - | 1,2,13 |
| **CO-2** | **Elaborate** the steps and processes involved in the VLSI fabrication technology. | - | - | 1,2,4 |
| **CO-3** | **Apply** design rules to design layout of various digital VLSI circuits. | 5 | 1,2 | 3,9 |
| **CO-4** | **Estimate** the parasitics for various MOS layouts. | - | 1 | 2 |
| **CO-5** | Perform a **comparative** study of different MOS circuit technologies. | 2 | 4,13 | 1,5,9 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 1.4 | 1.6 | 1 | 1.5 | 2 | - | - | - | 1 | - | - | - | 1.5 | - |

**Pre-requisites:** Semiconductor Devices, Analog Electronic circuits, Digital Electronic circuits

**Contents:**

**Unit-I**

**MOS Transistor:** Metal Oxide Semiconductor (MOS) Structure, MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects. Introduction to FinFET.

**MOS Inverters:** Static Characteristics: Introduction, Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter. **10 Hrs**

**Unit-II**

**Fabrication Technology:** Introduction, Czochralski growth process, Fabrication processes: Thermal oxidation, Diffusion, Ion implantation, Photo lithography, Epitaxy, Metallization and interconnections, Ohmic and Schottky contacts, fabrication of resistors and capacitors.

**Basic CMOS Technology**: Basic CMOS technology: P-Well / N-Well / Twin Well process, MOS mask layer, stick diagrams, Lambda based design rules, Schematic and Layouts **10 Hrs**

**Unit-III**

**Basic Circuit Concepts**: Sheet resistance, standard unit capacitance, concepts delay unit time, Inverter delays, driving capacitive loads, Propagation delays, PVT analysis and Process corners, RC delay, Elmore Delay, Logical Effort, Electrical Effort, Parasitic delay, Non-ideal delay, Examples **12 Hrs**

**Unit-IV**

**Combinational MOS Logic Circuits & Sequential MOS Logic Circuits:** Introduction, MOS logic circuits with depletion nMOS loads, CMOS logic circuits, complex logic circuits, CMOS Transmission gate, Introduction to sequential MOS logic circuits, Behavior of bi-stable elements, SR latch circuit, clocked latch and flip flop circuits **10 Hrs**

**Unit-V**

**Dynamic Logic Circuits:** Introduction, Basic principles of Pass transistor circuits, voltage bootstrapping, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, high performance dynamic CMOS circuits, Semiconductor Memories. **10 Hrs**

**Reference Books:**


1) Sung Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3/e, McGraw-Hill, 2008.
2) Kanaan Kano, “Semiconductor Devices”, 3/e,Pearson education, 2004.
3) Douglas A Pucknell & Kamran Eshragian, “Basic VLSI Design”, 3/e, PHI, 2005.
4) Michael John Sebastian Smith “Application Specific Integrated Circuits”, Pearson Publication, 2013.


| 18UECC501 | Communication Systems - II | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**

The course focuses on shaping of baseband signal for data transmission, various digital modulation techniques along with probability of error computation, spread spectrum techniques for secure communication. The microwave sources, devices and propagation of microwaves in waveguides is dealt along with application in RADAR engineering.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13,14) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| **CO-1** | **Explain** various signaling formats used for baseband signal transmission and **analyze** the effect of channel on transmission | 1,2 | 3 | - |
| **CO-2** | **Describe** various digital modulation and spread spectrum techniques and **analyze** their performance measures | 1,2,3 | 13 | 12 |
| **CO-3** | **Analyze** the modes of wave propagation in a rectangular waveguide and **derive** scattering matrix for various waveguide components | 1,2 | - | - |
| **CO-4** | **Describe** the working principle of various microwave semiconductor devices and microwave tubes, **outline** their properties and applications | - | 1,2 | - |
| **CO-5** | **Understand** Radar concepts, different forms of Radar and their applications | - | 1,2,3,13 | 12 |

| POs/PSOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2.6 | 2.6 | 2.3 | - | - | - | - | - | - | - | - | 1.0 | 2.0 | - |

**Pre-requisites:** Communication Systems - I

**Contents:**

**Unit – I**

**Base-band shaping for data transmission**: Discrete PAM signals, power spectra of discrete PAM signals. Inter-symbol Interference, Nyquist criterion for distortionless base-band binary transmission, correlative coding, eye pattern, base-band M-ary PAM systems, adaptive equalization for data transmission. **10 Hrs**

**Unit – II**

**Digital modulation techniques:** Gram-Schmidt orthogonalization procedure, geometric interpretation of signals, digital modulation formats, coherent binary modulation techniques, coherent quadrature modulation techniques, non- coherent binary modulation techniques, comparison of binary and quaternary modulation techniques, M-ary modulation techniques, bandwidth efficiency.

**Spread Spectrum Modulation:** Pseudo noise sequences, a notion of spread spectrum, direct sequence spread coherent binary PSK, signal space dimensionality and processing gain, probability of error, frequency hop spread spectrum, applications**.** **12 Hrs**

**Unit – III**

**Introduction to Microwaves:** Microwave frequency bands, applications of microwaves.

**Rectangular waveguides:** Propagation of waves in a waveguide, modes, TE and TM modes, propagation of TE and TM modes in rectangular waveguides.

**Waveguide Components:** Waveguide Tees(T-Junctions), directional coupler, circulator and isolator**.** **10 Hrs**

**Unit – IV**

**Transferred electron and avalanche transit time devices:** Gunn-effect diode, modes of operation, Read diode, IMPATT Diode, TRAPATT Diode.

**Microwave Tubes:** Two cavity Klystron amplifier, Reflex Klystron oscillator, applegate diagram, construction and working principle of magnetron and travelling wave tube. **11 Hrs**

**Unit – V**

**Introduction to Radar:** Basic Radar, Radar block diagram, Radar range equation, Radar frequencies and applications, MTI and Pulse Doppler Radar, Digital MTI processing. **09 Hrs**

**Reference Books:**


1) Simon Haykin, “Digital Communications”, John Wiley India Pvt. Ltd., 2009.
2) Samuel Y. Liao, “Microwave Devices and Circuits”, 4th Edition, Pearson, 2008.
3) Merrill I. Skolnik, "Introduction to Radar systems", 3rd Edition, TMH, 2001.
4) B. P. Lathi, Zhi Ding, “Modern Digital and Analog Communication Systems, 4th Edition, Oxford University Press.


| 18UECC502 | Digital Signal Processing | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on Discrete Fourier Transforms, properties and their applications. It also deals with the design of analog and digital filters using various methods and their realization.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Compute** Discrete Fourier Transform (DFT), Inverse DFT (IDFT) and **apply** the properties of DFT to **solve** signal processing problems | 1,2 | - | 13 |
| CO-2 | **Optimize** the computation of DFT and **Compare** with direct computations. | 2, 3, | 13, 12 | - |
| CO-3 | **Design** various types of filters using pole-zero techniques, Butterworth and Chebyshev approximations. | 2, 3 | 12 | - |
| CO-4 | **Design** digital IIR filters to satisfy the given specifications and their hardware implementation. | 2, 3 | 12 | - |
| CO-5 | **Design** digital FIR filters to satisfy the given specifications and their hardware implementation. | 2, 3 | 12 | - |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 1 | 3 | 3 | - | - | - | - | - | - | - | - | 2 | 1.5 | - |

**Pre-requisites:** Signals and Systems

**Contents:**

**Unit-I**

**Discrete Fourier Transform (DFT):** Introduction to Digital Signal Processing, frequency domain sampling and reconstruction of discrete time signals, Discrete Fourier Transform, Properties of DFT, Linear Filtering Methods based on DFT, frequency analysis of signals using DFT. **07 Hrs**

**Unit-II**

**Efficient Computation of the DFT:** Radix-2 Fast Fourier Transform (FFT) algorithms for the computation of DFT and IDFT: Decimation-In-Time (DIT) and Decimation-In-Frequency (DIF) algorithms, comparison of direct computation and FFT computation of DFT, applications of FFT algorithms. **08 Hrs**

## Unit-III

**Pole-Zero Placement Method for Design of Simple Filters:** Ideal filter characteristics, Simple IIR & FIR digital filters, Notch filters, Comb filters, All-pass filters, Digital Resonators.

**Design of Analog IIR Filters:** Introduction to Butterworth and Chebyshev type – I approximations, Design of analog filters. **08 Hrs**

## Unit-IV

**Design of Digital IIR Filters:** IIR filter design by Approximation of Derivatives, Impulse Invariance and Bilinear Transformation, frequency transformations in digital domain (LPF, HPF only), Implementation of Discrete-Time Systems for IIR filters. **08 Hrs**

## Unit-V

**Design of Digital FIR Filters:** Symmetric and Antisymmetric FIR filters, Design of Linear phase FIR filters using windows method and frequency sampling method, Design of FIR Differentiators, Design of Hilbert Transformers, Implementation of Discrete-Time Systems for FIR filters. **08 Hrs**

**Reference Books:**


1) Proakis & Monalakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4/e, Pearson Education, New Delhi, 2007.
2) Sanjit K. Mitra, “Digital Signal Processing”, 2/e Tata Mc-Graw Hill, 2004.
3) Li Tan, “Digital Signal Processing Fundamentals and Applications”, Elsevier,2003.
4) Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, Pearson Education, 2/e, 1999.
5) Alan V. Oppenheim and A. S. Willsky, “Signals and Systems”, Second Edition, Pearson Education.

| 18UECC503 | Information Theory and Coding | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on the basic concepts of information theory and coding, including information theory, source coding, different communication channel models, channel capacity and channel coding.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Analyze** and **evaluate** dependent model and Markoff model of information sources. | - | 1,2 | 3 |
| **CO-2** | **Construct** the codes using different source coding algorithms. | 3 | 1,2 | 5 |
| **CO-3** | **Design** and **evaluate** Communication Channel to improve the efficiency. | - | 1,2 | 3 |
| **CO-4** | **Design** and **Analyze** linear Block codes and binary cyclic codes for error detection and correction capabilities. | - | 3,13 | 1,2,5 |
| **CO-5** | **Analyze** the convolution codes using different techniques. | - | 1,2 | - |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 1.8 | 1.8 | 1.75 | - | 1 | - | - | - | - | - | - | - | 2 | - |

**Pre-requisites:** Probability theory, Communication Systems

**Contents:**

**Unit-I**

**Information Theory** : Introduction, Measure of information, Information content of message, Average Information content of symbols in Long Independent sequences, Average Information content of symbols in Long dependent sequences, Markov Statistical Model for Information Sources, Entropy and Information rate of Markoff Sources. **08 Hrs**

**Unit-II**

**Source Coding**: Basic definitions, Encoding of the source output, Properties of codes, Prefix codes, Kraft McMillan's Inequality, Code efficiency and redundancy, Shannon's first theorem (Noiseless coding theorem), Shannon-Fano algorithm, Huffman coding. **08 Hrs**

**Unit-III**

**Information Channels**: Communication Channels, Discrete Communication channels, Channel Matrix, Joint Probability Matrix, Binary Symmetric Channel, Entropy functions of a channel, Relation between entropies, Mutual information and its properties, Rate of transmission over a discrete channel, Shannon's theorem on channel capacity. **07 Hrs**

**Unit-IV**

**Error Control Coding:** Types of errors, types of codes, Linear Block Codes: Matrix description of linear block codes. Error detecting and correcting capabilities of linear block codes, Lookup table decoding using standard array, Single error correcting Hamming codes.

**Binary Cyclic Codes:** Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation, Error detection and error correction.

**09 Hrs**

**Unit-V**

**Convolution Codes**: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, Viterbi Algorithm. **07 Hrs**

**Reference Books:**


1) K. Sam Shanmugam, "Digital and analog communication systems", John Wiley, 2005**.**
2) P.S. Satyanarayana. "Concepts of Information Theory & coding", Dynaram Publications, 2005.
3) Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw-Hill Publication, 2002.
4) Daniel J. Costello and Shu Lin, "Error Control Coding: Fundamentals and Applications", Pearson, Second Edition, 2011.


## 18UECE510 Object Oriented Programming using C++ (3-0-0) 3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course is aimed at the basics of object oriented programming. The language selected for illustrating the concepts is C++. The course deals with functions and discusses the classes and objects. Then inheritance and polymorphism are introduced. This is followed by templates and exception handling. Real life examples help in understanding the significance of the course.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Understand** and **Apply** the concepts of classes and objects to a given real-life problem. | - | 1,2,13 | 3, 5 |
| CO-2 | **Implement** the constructor/ destructor functions and use the operator overloading concept to develop object oriented programs. | - | 1,2,3 | 12 |
| CO-3 | **Develop** the code using inheritance. | - | 1,2,3 | 12 |
| CO-4 | **Write** the object oriented code using virtual functions and illustrate the function overloading basics in developing the templates for different functionalities. | - | 1,2,3 | 12,5 |
| CO-5 | **Understand** and **Implement** the operational aspects of error checking through exception handling to develop robust codes. | - | 1,2,3 | 12 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 1.8 | - | 1 | - | - | - | - | - | - | 1 | 2 | - |

**Pre-requisites:** Basic Programming concepts

**Contents:**

**Unit-I**

**Functions:** Introduction, The main function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Default Arguments, const Arguments, Recursion, Function Overloading, Friend & Virtual Functions.

**Classes and Objects :** Introduction, Specifying a Class, Defining Member Functions, C++ program with Class, Making an outside Function Inline, Nesting of Member Functions, Private Member Functions, Arrays within a Class, Memory

Allocation for Objects, Static Data Members, Static Member Functions, Array of Objects, Objects as Function Arguments, Friendly Functions, Returning Objects, const Member Functions, Pointers to Members, Local Classes. **8 Hrs**

**Unit-II**

**Constructors and Destructors :** Introduction, Constructors, Parameterized Constructors, Multiple Constructors in a class, Constructors with Default Arguments, Dynamic Initialization of Objects, Copy Constructor, Dynamic Constructors, const Objects, Destructors.

**Operator Overloading and Type Conversions** : Introduction, Defining Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Binary Operators Using Friends, Manipulation of Strings Using Operators, Rules for Overloading Operators, Operator Overloading Examples, Type Conversions. **8 Hrs**

**Unit-III**

**Inheritance:** Extending Classes, Introduction, Defining Derived Classes, Single Inheritance, Making a Private Member Inheritable, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual Base Classes, Abstract Classes, Constructors in Derived Classes, Nesting of Classes. **7 Hrs**

**Unit-IV**

**Pointers, Virtual Functions and Polymorphism:** Introduction, Pointers, Pointers to Objects, this Pointer, Pointers to Derived Classes, Virtual Functions, Pure Virtual Functions, Virtual Constructors and Destructors.

**Templates:** Introduction, Class Templates, Class Templates with Multiple Parameters, Function Templates, Function Templates with Multiple Parameters, Overloading of Template Functions, Member Function Templates. **9 Hrs**

**Unit-V**

**Exceptions:** Introduction, Basic of Exception Handling, Exception Handling Mechanism, Throwing Mechanism, Catching Mechanism, Rethrowing an Exception. **7 Hrs**

**Reference Books:**


1) Robert Lafore, “Object Oriented Programming using C++”, Galgotia Publications, fourth edition, 2004.
2) Herbert Schildt, “C++: The Complete Reference”, fourth edition, McGraw Hill OSBORNE publications, 2003.
3) K R Venugopal, Rajkumar, T Ravishankar, “Mastering C++”, Second Edition, Tata McGraw Hill Publishing Company Limited, New-Delhi, 2006.
4) S. B. Lippman & J. Lajoie, “C++ Primer”, third edition, Addison Wesley, 2000.

| 18UECE511 | Telecommunication Networks | (3-0-0) | 3 |
|---|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on fundamental principles of telecommunication system, various switching techniques used in telecommunication, construction, operation and standards of telephone networks, data networks, Integrated Services Digital Networks and Mobile Networks.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Apply** suitable switching techniques and **select** suitable switches and hardware components for telecommunication applications | 1 | 2 | - |
| CO-2 | **Design** a plan for constructing and maintaining various parts of telephone networks | 2 | 13 | 11 |
| CO-3 | **Plan** the construction, operation and maintenance of various parts of data networks | - | 1 | 13 |
| CO-4 | **Explain** the principles, construction and operation of various parts of ISDN | - | 1 | 6 |
| CO-5 | **Describe** the principles, construction and operation of various parts and techniques of Mobile Networks | - | 12 | 2 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2.3 | 2 | - | - | - | 1 | - | - | - | - | 1 | 2 | 1.5 | - |

**Pre-requisites:** Analog and Digital Signals and Circuits, Fundamentals of Analog and Digital Communication

**Contents:**

**Unit-I**

**Introduction:** Evolution of Telecommunication, Basics of Switching System, Switching System parameters, Components of switching system.

**Strowger Switching Systems:** Signalling Tones, Strowger switching components, Step by step switching, Control in Strowger switch

**Crossbar Switching:** Principles of common control, Touchtone dial telephone, Principles of crossbar switching, Crossbar switch configurations **08 Hrs**

**Unit-II**

**Telephone Networks:** Subscriber Loop systems, Switching Hierarchy and Routing, Transmission Plan, Transmission systems, Numbering Plan, Charging Plan, Signalling Techniques, In-channel Signalling, Common channel signaling. **08 Hrs**

**Unit-III**

**Data Networks:** Data transmission in PSTNs, Switching Techniques for Data Transmission, Data Communication Architecture, Link to Link Layers, End to End Layers, Satellite based Data Networks, Local Area Networks, Metropolitan Area Networks, Fiber optic networks, Data network standards. **08 Hrs**

**Unit-IV**

**Integrated Services Digital Network:** Motivation for ISDN, ISDN services, Network and Protocol Architecture, Transmission channels, User Network Interfaces, Signalling, Numbering and addressing, Service characterization, Interworking, ISDN standards, Broadband ISDN, BISDN architecture, Voice data Integration. **08 Hrs**

**Unit-V**

**Mobile Communication:** Wireless Channel, Two-ray model, Path loss model, Fading, Multiple Access techniques, Cellular communications, Co-channel reuse ratio and Signal to interface, Trunking and grade of service, Fade margin analysis, Generations of mobile communication, Global System for Mobile (GSM). **07 Hrs**

**Reference Books:**


1) Thyagarajan Viswanathan, Manav Bhatnagar, “Telecommunication Switching Systems and Networks”, 2/e, PHI, 2015.
2) P. Gnanasivam, “Telecommunication Switching and Networks”, 2/e, New Age International Publisher, 2010.
3) J.E. Flood, “Telecommunication Switching, Traffic and Networks”, 1/e, Pearson Education, 2002.
4) Roger L Freeman, “ Fundamentals of Telecommunication”, 2/e, Wiley, 2005.

| 18UECE512 | Scientific Computing using Python | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on programming concepts in Python. It includes basic numerical algorithms covering interpolation, integration, differentiation, ordinary differential equations (ODE) and partial differential equations (PDE) solvers, and basic linear algebra.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1,12)/ PSOs (13, 14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Examine** Python syntax and semantics and use the Python flow control and functions. | - | 1,2,13 | 3 |
| CO-2 | **Write** Python scripts for plotting functions and understand the core data structures like Lists, Dictionaries. | - | 1,2,3 | 12,5 |
| CO-3 | **Understand and apply** the basic array methods to statistical problems. | - | 1,2,3 | 12 |
| CO-4 | **Implement** the codes for manipulating the polynomials, matrices and understand the basics of Matplotlib. | - | 1,2,3 | 12,5 |
| CO-5 | **Solve** the Integration and ordinary differential equations, and perform interpolation. | - | 1,2,3 | 12 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 1.8 | - | 1 | - | - | - | - | - | - | 1 | 2 | - |

**Pre-requisites:** Programming Fundamentals

**Contents:**

**Unit-I**

**The core Python language I:** Introduction, The Python shell, Numbers, variables, comparisons and logic, Python objects I: strings, Python objects II: lists, tuples and loops, Control flow, File input/output, Functions. **08 Hrs**

**Unit-II**

**Simple plotting with Pylab**: Basic plotting, Labels, legends and customization, more advanced plotting.

**The core Python language II:** Errors and exceptions, Python objects III: dictionaries and sets, Pythonic idioms: "syntactic sugar", Modules and packages, An introduction to object-oriented programming. **08 Hrs**

**Unit-III**

**Numpy I:** Basic array methods: Creating an array, NumPy's basic data types, universal functions and special values, changing the shape of an array, indexing and slicing an array, sorting an array, structured arrays, arrays as vectors, Reading and writing an array to a file, Statistical methods: ordering statistics, averages, variance and correlations, histograms. **07 Hrs**

**Unit-IV**

**Numpy II**: Polynomials: defining and evaluating a polynomial, polynomial algebra, root finding, calculus, fitting polynomials, Linear algebra: basic matrix operations, Eigen values and Eigen vectors, solving equations, Matrices: creating a matrix, matrix operations.

**Matplotlib:** Matplotlib basics, bar charts and pie charts, multiple subplots. **09 Hrs**

**Unit-V**

**SciPy:** Integration: definite integrals of a single variable, integrals of two or more variables, Ordinary differential equations: single $1^{st}$ order ODE, single $2^{nd}$ order ODE, Interpolation: univariate and multivariate interpolations. **07 Hrs**

**Reference Books:**


1) Christian Hill, "Learning Scientific Programming with Python", Cambridge University Press, 2015.
2) Sandeep Nagar, "Introduction to Python for Engineers and Scientists: Open Source Solutions for Numerical Computation", Apress Publication, 2018.
3) T.R. Padmanabhan, "Programming with Python", Springer, 2016.
4) Allen B. Downey, "Think Python", Second Edition, O'Reilly Publication, 2015.


| 18UECE513 | Sensors and Transducers | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on fundamentals in sensors & transducers like classification of various transducers, choice of proper transducers to measure various physical parameters like temperature, pressure, force, velocity and acceleration.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Explain** the working of different types of sensors, transducers and measurement systems | -- | 1 | 2 |
| CO-2 | **Describe** various methods of measurement for velocity, speed, vibration and acceleration | -- | 1 | 2 |
| CO-3 | **Explain** the working principle of various force and torque measurement transducers and their applications | -- | 1,12 | 3,13 |
| CO-4 | **Describe** construction, working principle of various pressure transducers and their applications | -- | 1,12 | 3,13 |
| CO-5 | **Discuss** the operation and applications of various temperature sensors/transducers | -- | 1,12 | 13 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 1 | 1 | -- | -- | -- | -- | -- | -- | -- | -- | 2 | 1 | -- |

**Pre-requisites:** Basic Electronics, Electrical Measurement Systems

**Contents:**

**Unit-I**

**Introduction:** Measurement and measurement system, industrial measuring parameters and their units, definitions of sensors and transducers, classification of transducers, static and dynamic characteristics, selection criteria.

**Displacement Measurement:** Resistive: Potentiometer, Strain gauges, Inductive: LVDT and Eddy current type, Capacitive: Capacitance pickups, Differential capacitive type, Piezoelectric, Ultrasonic transducers and Hall effect transducers, Optical transducers **09 Hrs**

**Unit-II**

**Velocity, Speed, Vibration and Acceleration measurement:** Velocity and Speed: Electromagnetic tachometer, Photoelectric tachometer, Toothed rotor variable

reluctance tachometer. Magnetic pickups, Encoders, Photoelectric pickups, Stroboscopes, Shaft speed measurement. Vibration and acceleration: Eddy current type, Piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type **07 Hrs**

**Unit-III**

**Force and torque measurement**: Basic methods of force measurement, elastic force traducers, strain gauge, load cells, piezoelectric force transducers, vibrating wire force transducers, Strain gauge, torque meter, Inductive torque meter, Magnetostrictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. **07 Hrs**

**Unit-IV**

**Pressure measurement**: Definition, pressure scale, standards, working principle, types, materials, design criterion: Manometers, elastic pressure sensors, secondary pressure sensors, differential pressure sensors, force balance type, motion balance, capacitive (delta cell), ring balance, vibrating cylinder type, high-pressure gauges, vacuum gauges, dead weight and vacuum gauge tester **08 Hrs**

**Unit-V**

**Temperature measurement**: Temperature Scales, Standards and Units and relations, Classification of temperature sensors Bimetallic Thermometer, Filled system thermometers, SAMA classifications, Resistance Temperature Detectors (RTD), Thermistor, Thermocouples, Study of thermocouple tables (calculation of intermediate temperature and voltage), Lead wire compensation, Cold junction compensation techniques, Protection (Thermo well), Thermopiles, Pyrometers, Temperature IC sensors (AD590 and LM35) **08 Hrs**

**Reference Books:**


1) B. C. Nakra and K. K. Choudhari, “Instrumentation Measurements and Analysis”, 3/e, Tata McGraw Hill Education, 2009
2) D. Patranabis, “Principle of Industrial Instrumentation”, 2/e, Tata McGraw Hill, 1994.
3) D.V.S. Murty, “Instrumentation and Measurement Principles”, 2/e, PHI, 2008
4) E.O. Doebelin, “Measurement Systems: application and design”, 5/e, McGraw Hill, 2003


| 18UECL504 | Communication Systems Laboratory | (0-0-3) 1.5 |
|---|---|---|

**Contact Hours: 36**

**Course Learning Objectives (CLOs):**

The course focuses on experiments highlighting the design and demonstration of filters, tuned amplifier, generation and detection of various analog, pulse and digital

modulation techniques. It also includes experiments related to microwave communication.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At **the end of the course the student** will be able to: | | **Mapping to POs (1-12) / PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Design** and plot the frequency response of active filters and class C tuned amplifier | 1,3 | 2,13 | 9,12 |
| CO-2 | **Generation** and **detection** of various amplitude modulation techniques | 1,3 | 13 | 9,12 |
| CO-3 | **Generation** and **detection** of various pulse modulation techniques | 1,3 | 13 | 9,12 |
| CO-4 | **Generation** and **detection** of various digital modulation techniques | 1,3 | 13 | 9,12 |
| CO-5 | **Demonstrate** the characteristics of microwave sources and devices | **-** | 1,13 | 9,12 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2.8 | 2 | 3 | - | - | - | - | - | 1 | - | - | 1 | 1 | - |

**List of Experiments:**

1. Design of Band pass filter and Notch filter
2. Design tuned amplifier, find centre frequency, bandwidth and quality factor
3. Amplitude modulation using transistor/FET and detection using envelop detector
4. DSBSC generation using Ring Modulator
5. Verification of sampling theorem using flat top sampling and reconstruction
6. Pulse Amplitude Modulation and demodulation
7. Pulse Width Modulation
8. ASK modulation and demodulation
9. FSK, PSK modulation
10. Measurement of guide wavelength and frequency
11. Repeller mode characteristics of Reflex Klystron
12. Measurement of coupling factor and directivity of directional coupler

**Reference Books:**

1) Simon Haykin, “An introduction to analog and digital communications”, John Wiley India Pvt. Ltd., 2008.
2) Simon Haykin, “Digital Communications”, John Wiley India Pvt. Ltd., 2009.
3) Samuel Y. Liao, “Microwave Devices and Circuits”, 4th Edition., Pearson, 2008.
4) M. Kulkarni, “Micro Wave and Radar Engineering”, Umesh Publications, 3rd edition, 1998.

| 18UECL505 | Digital Signal Processing Laboratory | (0-0-3) 1.5 |
|---|---|---|

**Contact Hours: 36**

**Course Learning Objectives (CLOs):**

The laboratory course enables students to get practical experience in processing of signals, design of filters and realization of systems.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Perform** signal manipulations and **Compute** response of LTI systems | - | 1,2,5, 12 | 13,14 |
| CO-2 | **Compute** DFT and inverse DFT and **Verify** the properties. | 1,2 | 5,12 | 13,14 |
| CO-3 | **Apply** properties of DFT to **solve** signal processing problems | 1,2 | 5,12 | - |
| CO-4 | **Design** analog filters to meet the given specifications | 2, 3 | 5,12 | - |
| CO-5 | **Design** digital filters to meet the given specifications | 2, 3 | 5,12 | - |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2.66 | 2.8 | 3 | - | 2 | - | - | - | - | - | - | 2 | 1 | 1 |

**Contents:**

1. Basic signal processing operations.
2. Response of LTI systems.
3. Computation of DFT/IDFT and verification of properties.
4. Frequency analysis of signals using DFT.
5. Linear filtering of long data sequence using DFT.
6. Efficient computation of DFT.

7. Design analog IIR filters for the given specifications and their realization.
8. Design digital IIR filters for the given specifications and their realization.
9. Design digital FIR filters for the given specifications.
10. Applications of signal processing.

**Reference Books:**


1) Proakis & Monalakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4/e, Pearson Education, New Delhi, 2007.
2) Sanjit K. Mitra, “Digital Signal Processing”, 2/e Tata Mc-Graw Hill, 2004.
3) Li Tan, “Digital Signal Processing Fundamentals and Applications”, Elsevier, 2003.
4) Emmanuel C. Ifeachor, Barrie W. Jervis, “Digital Signal Processing: A Practical Approach”, 2/e, Pearson Education, 1999.


| 18UECL506 | Minor Project-1 | (0-0-2) 1 |
|---|---|---|

**Contact Hours: 30**

**Course Learning Objectives (CLOs):**

Minor project-1 focuses on work chosen based on the courses studied to formulate the related problem definitions, building prototypes which can lead to take up the project in the higher semesters.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Identify** technical / social problem and **formulate** a problem statement | 1,2 | 6 | - |
| CO-2 | **Propose** technical approach towards solution | 2 | 6,7 | 11 |
| CO-3 | **Implement** the solution in hardware and / or software | 3,5 | 13,14 | 11 |
| CO-4 | **Organize** the topics in a systematic manner and **Prepare** the report in a specific format | 9,10 | 12 | - |
| CO-5 | **Present** the work in a systematic manner | 10 | 12 | - |

| **POs/PSO** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3 | 3 | 3 | - | 3 | 2 | 2 | - | 3 | 3 | 1 | 2 | 2 | 2 |

| 18UHUL507 | Soft skills/Aptitude | (0-0-2) | 1 |
|---|---|---|---|

**Contact Hours: 24**

**Course Learning Objectives (CLOs):**

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1 to 12)/PSO(1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Explain** the significance of communication in the profession. | | 10 | |
| CO-2 | **Use** the English language with proficiency | | 10 | 12 |
| CO-3 | **Solve** Aptitude related problems | | 9 | 12 |
| CO-4 | **Demonstrate** the competency in the placement activities. | | 9 | |

| **PO's** | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 | PSO-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | | | | | | | | | 2.0 | 2.0 | | 1.0 | | | |

**Contents:**

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

**Evaluation:**

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.

## VI Semester

| 18UECC600 | Analog and Mixed Mode VLSI Design | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**

The course focuses on the basic requirements of circuit design, difficulties in the design phase and various circuit examples. The course considers widely used analog circuits such as OPAMP, ADC, DAC, current source and sinks, mirrors and PLL as examples for the discussion.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Explain** the characteristics and short channel effects of MOS devices | - | - | 1 |
| **CO-2** | **Analyze and design** various configurations (CS, CD, CG) of single stage amplifiers. | 2,3,13 | - | 1 |
| **CO-3** | **Design** the analog circuits such as op-amps, current sources, current sinks and current mirrors. | 2,3,13 | - | - |
| **CO-4** | **Compare** data converter characteristics and **build** data converter architectures. | 13,14 | 4,5 | - |
| **CO-5** | **Explain** PLL and its applications. | 1,13 | - | - |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 1.66 | 3 | 3 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 |

**Pre-requisites:** Analog Electronics, Network Analysis, Digital circuits & Basics of CMOS VLSI Design.

**Contents:**

**Unit-I**

**Introduction to Analog Design:** Introduction to MOS, MOS V/I characteristics, second order effects, MOS device models.

**Common source single stage amplifiers**: Basic concepts, common source stage with resistive load, diode connected load, current source load, triode load and source degeneration. **12 Hrs**

**Unit-II**

**Other single stage amplifiers:** source follower, Common gate stage, Cascode stage.

**Current Sinks, Current Sources and Current Mirrors:** Current sinks and sources, techniques to improve performance of current sinks and sources, current mirrors, effects to cause current mirror to be different from ideal situation.

**10 Hrs**

**Unit-III**

**Operational Amplifiers:** General considerations, Single stage Op-Amps, two stage Op-Amps, gain boosting, comparison, common mode feedback, slew rate, power supply rejection ratio, Comparator. **10 Hrs**

**Unit-IV**

**Data Converter fundamentals and architectures:** Introduction, sample and hold characteristics, digital to analog converter (DAC) specifications, analog to digital converter (ADC) specifications, DAC architectures: Resistor string, R-2R ladder network, Charge scaling DACs, ADC architectures: Pipeline ADC, Successive approximation ADC. **10 Hrs**

**Unit-V**

**Phase Locked Loops:** Simple PLL, Basic PLL Topology, Dynamics of Simple PLL, Charge Pump PLLs, Non ideal effects in PLLs, Delay Locked Loops and Applications. **10 Hrs**

**Reference Books:**


1) Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw-Hill Edition 2008.
2) R. Jacob Baker, Harry W. LI, David E. Boyce, “CMOS Circuit Design, lay out and Synthesis”, IEEE press, 2005.
3) Phillip E. Allen, Douglas R. Holberg, “CMOS Analog Circuit Design”, 2/e, New York Oxford, Oxford University.
4) Adel S. Sedra, Kenneth C. Smith, “Microelectronic Circuits Theory and Applications”, 5th edition Oxford University Press, 2013.


| 18UECC601 | IOT and Embedded Systems Design | (4-0-0) 4 |
|---|---|---|

**Contact Hours: 52**

**Course Learning Objectives (CLOs):**

The course focuses on architectural features and instructions of -ARM Cortex M3, Develop Programs using the various instructions of ARM Cortex M3 and C language for different applications. Develop the prototype using hardware software co-design approach.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13,14) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | **Describe** the architectural features and instructions of ARM Cortex M3. | - | 2 | 1 |
| CO-2 | **Program** ARM Cortex M3 for different applications | - | 1,2 | - |
| CO-3 | **Develop** an embedded system application using component engineering. | 3 | 2,12 | - |
| CO-4 | **Develop** the hardware software co-design and firmware design approaches. | 5 | 3,13 | 1,2 |
| CO-5 | **Demonstrate** the need of real time operating system and IoT. | 5 | 2,12 | 14 |

| POs/PSOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 1.33 | 1.8 | 2.5 | - | 3 | - | - | - | - | - | - | 2 | 2 | 1 |

**Pre-requisites:** Microcontrollers and Operating systems.

**Contents:**

**Unit-I**

**ARM Microcontroller**: Thumb-2 technology and applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, Debugging support, General Purpose Registers, Special Registers, exceptions, interrupts, stack operation, reset sequence **10 Hrs**

**Unit-II**

**ARM Cortex M3 Instruction Sets and Programming**: Assembly basics, Instruction list and description, Thumb and ARM instructions, Special instructions, Useful instructions, CMSIS, Assembly and C Language Programming **10 Hrs**

**Unit-III**

**Embedded System Components**: Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of embedded systems. Elements of an Embedded System, Differences between RISC and CISC, Harvard and Princeton architectures, Big and Little Endian formats, Memory (ROM and RAM types), Sensors, Actuators, Opt-coupler, Communication Interfaces.

**10Hrs**

## Unit-IV

**Embedded System Design Concepts**: Characteristics and Quality Attributes of Embedded Systems, Operational and non-operational quality attributes, Embedded Systems-Application and Domain specific, Hardware Software Co-Design and Program Modeling, Embedded firmware design and development **10 Hrs**

## Unit-V

**Real Time Operating Systems**: RTOS basics, Types of operating systems, Task, process and threads, Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Concept of Binary and counting semaphores, How to choose an RTOS.

**Introduction to IoT and applications:** Introduction to IoT, Illustrating the Device-to-Device/ Machine-to-Machine Integration Concept, Explaining the Aspect of Device-to-Cloud (D2C) Integration, The Emergence of the IoT Platform as a Service (PaaS),Digging into the Cloud-to-Cloud (C2C) Integration Paradigm, Describing the Sensor-to-Cloud Integration Concept, Azure IoT Hub Device Management, The Prominent IoT Realization Technologies, Architecture for IoT Using Mobile Devices, Mobile Technologies for Supporting IoT Ecosystem, Layered Architecture for IoT, Protocol Architecture of IoT

**12 Hrs**

**Reference Books**:


1) Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier), 2010.
2) Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd edition.
3) Pethuru Raj and Anupama C. Raman “The Internet of Things Enabling Technologies, Platforms and Use Cases” CRC press 2017, Taylor & Francis Group.
4) James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0-471-72180-2.
5) Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language andC”, 2nd E -Man Press LLC ©2015
6) Embedded real time systems by K.V. K. K Prasad, Dreamtech publications, 2003.

| 18UECE610 | System Verilog | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on coding guidelines for system Verilog, data types, data structures supported, subroutines, methods of testing the program. Automation with respect to input vector generation, output vector collection, assertions and coverage and overall knowledge of environment is addressed.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Establish** the relevance of System Verilog as a (Hardware Description and Verification Language) HDVL. | 1 | - | - |
| **CO-2** | **Identify** the Language constructs and their usage. | 1 | - | 4 |
| **CO-3** | **Emphasize** on the importance of utilization of Data structures (array, structure and unions). | 1 | 2,3 | 4 |
| **CO-4** | **Demonstrating** the coding skills for synthesis. | 13,14 | 3,4,5 | - |
| **CO-5** | **Demonstrate** the importance of Verification and its guidelines and **design** proper verification bed using Language strength **utilizing** different verification strategies applying assumptions, assertions and coverage. | 1,3,13,14 | 4,5 | - |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3.0 | 2 | 2.3 | 1.5 | 1 | - | - | - | - | - | - | - | 3 | 3 |

**Pre-requisites:** Verilog, Programming using C++ and Digital System Design.

**Course Contents:**

**UNIT I**

**Introduction to System Verilog:** System Verilog origins ,Generations of the System Verilog standard, Donations to System Verilog , Key System Verilog enhancements for hardware ,design, System Verilog Declaration Spaces ,

Packages ,Package definitions , Referencing package contents, Synthesis guidelines , $unit compilation-unit declarations, Coding guidelines, System Verilog identifier search rules ,Source code order, Coding guidelines for importing packages into $unit , Synthesis guidelines , Declarations in unnamed statement blocks , Local variables in unnamed blocks, Simulation time units and precision ,Verilog's timescale directive, Time values with time units , Scope-level time unit and precision , Compilation-unit time units and precision. **10 Hrs**

**UNIT II**

**System Verilog Literal Values and Built-in Data Types:** Enhanced literal value assignments 'define enhancements, System Verilog variables, Using 2-state types in RTL models ,2-state type characteristics , Relaxation of type rules, Signed and unsigned modifiers, Static and automatic variables, Deterministic variable initialization, Type casting, Constants System Verilog User-Defined and Enumerated Types, User-defined types, Enumerated types. **07 Hrs**

**UNIT III**

**System Verilog Arrays, Structures and Unions:** Structures. Unions , Arrays , The foreach array looping construct X, Array querying system functions, The $bits "sizeof" system function ,Dynamic arrays, associative arrays, sparse arrays and strings. **System Verilog Procedural Blocks, Tasks and Functions:** Verilog general purpose always procedural block, System Verilog specialized procedural blocks, Enhancements to tasks and functions **08 Hrs**

**UNIT IV**

**Verification Guidelines:** The Verification Process, The Verification Methodology Manual , Basic Test bench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus , What Should You Randomize?, Functional Coverage , Test bench Components, Layered Test bench , Building a Layered Test bench ,.12 Simulation Environment Phases, Maximum Code Reuse, Test bench Performance. **07 Hrs**

**UNIT V**

**Connecting the Test bench and Design:** Separating the Test bench and Design, The Interface Construct, Stimulus Timing, Interface Driving and Sampling, Program Block Considerations, Connecting It All Together, Top-Level Scope, Program–Module Interactions, System Verilog Assertions, The Four-Port ATM Router, The Ref Port Direction. **07 Hrs**

**Reference Books:**


1) Stuart Sutherland, Simon Davidmann, PeterFlake, Foreword by Phil Moorby "System Verilog For Design A Guide to Using System Verilog for Hardware Design and Modeling", Second Edition, Springer Publications,2006
2) Chris Spear and Greg Tumbush "System Verilog for Verification A Guide to Learning the Testbench Language Features", Third edition, Springer Publications,2012
3) Mark Zwolinski "Digital System Design with System Verilog", Pearson Education, 2009
4) Mike Mintz, Robert Ekendahl, "Hardware Verification with System Verilog: An Object-Oriented Framework", Springer Publications, 2007.


| **18UECE611** | **Advanced Digital System Design** | **(3-0-0) 3** |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses mainly on design of advanced digital systems using finite state machines (FSM) charts. It also discusses the implementation of advanced digital circuits on programmable devices of varied complexity.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Elaborate** the various concepts of digital circuit design. | 1 | 2,14 | - |
| CO-2 | **Develop** various models for arithmetic operations and sequential digital system designs. | - | 1, 2, 3, 14 | 13 |
| CO-3 | **Design** the digital systems using SM Charts and Microprogramming techniques. | - | 3, 5,13, 14 | 1,4 |
| CO-4 | **Realize** digital system design using Field Programmable Gate Arrays. | - | 2,3,13 | 1 |
| CO-5 | **Design** and **Model** various sequential circuits and memories | - | 4, 5, 14 | 1,12 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 1.6 | 2 | 2 | 1.5 | 2 | - | - | - | - | - | - | 1 | 1.6 | 2 |

**Pre-requisites:** Digital Circuit Design, HDL Programming using verilog

**Contents:**

**Unit-I**

**Review of Logic Design Fundamentals:** Combinational and Sequential Circuits, Boolean Algebra and Algebraic Simplification, Karnaugh Maps, Universal Gates, Hazards in Combinational Circuits, Flip-Flops and Latches, Fundamentals of Moore and Mealy Sequential Networks, Timings, Set-up and Hold Times, Synchronous Designs, Tristate Logic and Busses, Examples. **07 Hrs**

**Unit-II**

**Design Examples:** BCD to 7-Segment Display Decoder, A BCD Adder, 32-Bit Adders, Traffic Light Controller, State Graphs for Control Circuits, Scoreboard and Controller, Synchronization and Debouncing, A Shift-and-Add Multiplier, Array Multiplier, A Signed Integer/Fraction Multiplier, Keypad Scanner, Binary Dividers, Problems **09 Hrs**

**Unit-III**

**SM Charts and Microprogramming**: State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Implementation of the Dice Game, Microprogramming, Linked State Machines, Problems **07 Hrs**

**Unit-IV**

**Designing with Field Programmable Gate Arrays**: Implementing Functions in FPGAs, Implementing Functions Using Shannon's Decomposition, Carry Chains in FPGAs, Cascade Chains in FPGAs, Examples of Logic Blocks in Commercial FPGAs, Dedicated Memory in FPGAs, Dedicated Multipliers in FPGAs, Cost of Programmability, FPGAs and One-Hot State Assignment, FPGA Capacity: Maximum Gates versus Usable Gates, Design Translation (Synthesis), Mapping, Placement, and Routing. **08 Hrs**

**Unit-V**

**Sequential Basics:** Storage Elements, Shift Registers, Latches, Sequential Datapaths and Control, Finite-State Machines.

**Memories:** General Concepts, Memory Types, Asynchronous Static RAM, Synchronous Static RAM, Multiport Memories, Dynamic RAM, Read-Only Memories, Error Detection and Correction. **08 Hrs**

**Reference Books:**


1) Charles H. Roth, Jr., Lizy Kurian John, Byeong Kil Lee, "Digital Systems Design Using Verilog", First Edition, Cengage Learning, 2014.
2) Peter J. Ashenden. "Digital Design: An Embedded Systems Approach Using Verilog, Elsevier, 2010.
3) Samir Palnitkar, "Verilog HDL", 2/e, Pearson Education, IEEE 1364-2001 Compliant, 2015.
4) Nazeih M Botros, "HDL Programming, VHDL and Verilog", Deamtech Press, 2007.

## 18UECE612 Image Processing & Computer Vision (3-0-0) 3

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

This course introduces to the concepts of image processing and computer vision. Topics covered include radiometry, colors, various image enhancement techniques, detection of discontinuities, edge linking and boundary detection.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSO (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Describe** the basic radiometric properties and develop models of source geometry | -- | 1,2 | 12 |
| CO-2 | **Describe** image acquisition system, its representation and human color perception | -- | 1 | 12 |
| CO-3 | **Apply** suitable image enhancement techniques in spatial and frequency domain | 2 | 1, 3 | 12 |
| CO-4 | **Compare** various restoration techniques | 2 | 1, 13 | -- |
| CO-5 | **Compare** various image segmentation techniques | -- | 1,13 | -- |

| **PO's/PSO** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2.0 | 2.66 | 2 | -- | -- | -- | -- | -- | -- | -- | -- | 1 | 2 | -- |

**Pre-requisites:** Digital signal processing, Mathematics

**Contents:**

**Unit-I**

**Radiometry — Measuring light:** Light in space, Light at surfaces, Important special cases: Radiosity, Hemisperic reflectance, Lambertian and specular surfaces and models

**Sources Shadows and Shading**: Radiometric properties of light, Qualitative radiometry, Local shading models, Photometric stereo. **08 Hrs**

## Unit-II

**Colors:** The physics of color, Human color perception, Representing color, Surface color from image color.

**Digital Image Fundamentals**: Image sensing and acquisition, Image sampling and quantization, Basic relationship between pixels, Linear and non-linear operations.

**08 Hrs**

## Unit-III

**Intensity Transformation:** Basic intensity transformation functions, Image negatives, Contrast stretching, Histogram processing, Histogram equalization, Enhancement using arithmetic and Logic operations.

**Spatial and Frequency Filtering:** Spatial Filter Masks, Smoothing spatial filters, Sharpening spatial filters, Combining spatial enhancement methods, Smoothing frequency domain filters, Sharpening frequency domain filters, Homomorphic filtering. **08 Hrs**

## Unit-IV

**Fundamentals of Image Restoration:** Introduction, noise models, Restoration in the presence of noise, Linear position invariant degradation, Degradation function.

**Image Restoration Filters:** Spatial filtering, Periodic noise reduction by frequency domain filtering, Inverse filtering, Minimum mean square error filtering, Constrained least squares filtering, Geometric mean filter, Geometric transformations. **08 Hrs**

## Unit-V

**Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, Thresholding.

**Advanced Topics in Segmentation:** Region-based segmentation, Segmentation using morphological watersheds, Use of motion in segmentation. **07 Hrs**

**Reference Books:**


1) C Gonzalez and Richard E Woods, Rafael, “Digital Image Processing”, 3/e, Pearson Education, 2005.
2) K.P.Soman, “Digital Signal & Image Processing”, 1/e edition, Elsevier India, 2012
3) David Forsyth and Jean Ponce, “Computer Vision, A modern Approach ”, 2/e, Pearson Education, 2012.
4) Richard Szeliski, “Computer Vision: algorithms and applications ”, 1/e, Springer-Verlag London Limited 2010

| 18UECE613 | Operating System | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on basic components of a computer operating system, and the interactions among the various components. The course will cover an introduction on the policies for scheduling, deadlocks, memory management, synchronization, system calls, and file systems.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Explain** the services, system calls, process, inter process communication and should be able to **solve** process scheduling problems. | 3 | 1, 2 | - |
| **CO-2** | **Understand** the process synchronization, critical section, deadlock and **solve** related problems. | - | 1, 2,3 | 14 |
| **CO-3** | **Illustrate** various ways of main memory organization, techniques of Memory allocation and Paging. | - | 3,12 | - |
| **CO-4** | **Elaborate** the demand paging, File accessing methods, directory structure and solve page replacement problems. | - | 3,14 | - |
| **CO-5** | **Summarize** the disk allocation, scheduling and space management. | - | 2, | - |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 2.25 | - | - | - | - | - | - | - | - | 2 | - | 1.5 |

**Pre-requisites:** Computer organization, Programming fundamentals.

**Contents:**

**Unit-I**

**Process Scheduling:** Introduction to Operating System (OS), OS Services, System calls, Process concept, Process scheduling, Operation on processes, cooperating processes, Inter process communication. CPU scheduling- Basic concepts, scheduling criteria, Scheduling algorithms. **08 Hrs**

**Unit-II**

**Process issues:** The Critical section problem, Synchronization hardware, Semaphores, problems of synchronization, Critical regions. Deadlock - System model, Deadlock characterization, Methods for handling deadlocks - Deadlock prevention, deadlock avoidance, Deadlock detection and solution for deadlock. **09 Hrs**

**Unit-III**

**Main Memory Management:** Overview, Main memory management- Background, Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging. **07 Hrs**

**Unit-IV**

**Virtual memory**: Background, Demand paging, Process creation, Page replacement algorithms, Allocation of frames, thrashing. File System interface - File concept, Access methods, Directory structure, File system mounting, File system implementation. **08 Hrs**

**Unit-V**

**Secondary Memory Management**: Directory implementation, Allocation methods and free space management. Mass storage structures – Disk structure, Disk scheduling methods, Disk management, Swap space management**.** **07 Hrs**

**Reference Books:**


1) Abraham Silberschatz, Peter Baer Galvin, Greg Gagne – "Operating System Concepts", 6th edition, John Wiley & Sons.
2) Milan Milankovic, "Operating system concepts and design", 2nd Edition, McGraw-Hill.
3) Harvey M. Deital , "Operating systems", Addison Wesley Publications.
4) D.MDhamdhere, "Operating systems - A concept based Approach", Tata McGraw-Hill the Operating systems.


| 18UECE620 | Speech Processing | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on speech production, perception mechanism, their mathematical modeling and study of acoustic phonetics. It deals with various speech processing techniques in time and frequency domains. Concept of Homomorphic and Linear Predictive Coding analysis is also covered in the course.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13,14) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| **CO-1** | **Understand** acoustic phonetics, speech production and perception mechanism and **develop** mathematical models | 1 | 2,3 | 5,12 |
| **CO-2** | **Describe** various parameters of speech signal in time domain | - | 1 | 5,12 |
| **CO-3** | **Analyze** speech signal in Frequency domain | 1,2 | - | 5,12 |
| **CO-4** | **Apply** Homomorphic transformation to measure speech signal parameters | - | 1,2,3 | 5,12 |
| **CO-5** | **Analyze** speech signal using linear predictive coding | - | 1,2,3 | 5,12 |

| POs/PSOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2.4 | 2.2 | 2 | - | 1 | - | - | - | - | - | - | 1.0 | -- | - |

**Pre-requisites:** Digital Signal Processing

**Contents:**

**Unit-I**

**Production, perception and classification of speech sounds:** Introduction, mechanism of speech production, mechanism of hearing, acoustic phonetics, digital models for speech production - vocal tract, radiation, excitation, the complete model. **07 Hrs**

**Unit-II**

**Time-domain methods for speech processing:** Time dependent processing of speech, short-time energy and average magnitude, short-time average zero crossing rate, speech vs. silence detection, pitch period estimation using parallel processing approach, short-time autocorrelation function, short time average magnitude difference function, pitch period estimation using autocorrelation. **09 Hrs**

**Unit-III**

**Short time Fourier analysis:** Introduction, spectrographic displays, analysis by synthesis, pitch synchronous spectrum estimation, pole zero analysis, analysis synthesis systems - phase vocoder and channel vocoder. **07 Hrs**

**Unit-IV**

**Homomorphic speech processing:** Introduction, homomorphic systems for convolution, the complex cepstrum of speech, pitch detection, formant estimation, homomorphic vocoder. **08 Hrs**

**Unit-V**

**Linear predictive coding of speech**: Basic principles of linear predictive analysis, solution of LPC equations, frequency domain interpretation of linear predictive analysis, relationship between various speech parameters. **08 Hrs**

**Reference Books:**


1) L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals", Pearson Education, 2004.
2) Lawrence Rabinar and B. Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
3) D. O’Shaughnessy, “Speech Communications: Human and Machine,” Universities Press, 2001.
4) B. Gold and N. Morgan, “Speech and Audio Signal Processing: processing and perception of speech and music”, Pearson Education 2003.


| **18UECE621** | **Robotics** | **(3-0-0) 3** |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on the theory and design principles of Robotics. The course deals with utilization of Sensors, Actuators, Kinematics, Motion and Trajectory planning used in Robotics.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Identify** the different parameters of Robot and **Classify** the Robots on the considerations. | 2 | 4 | - |
| **CO-2** | **Develop** an understanding of specifications of robot and **choose** appropriate sensors, actuators and Processing platform. | 2,3 | 4 | 12 |
| **CO-3** | **Rephrase** the Kinematics of the robot, **understand** and **analyze** the kinematics using suitable model | 4 | 2 | 5 |

| | | | | |
|---|---|---|---|---|
| **CO-4** | **Understand analyze and build** differential motion-oriented robots. | 1,2,3,4,13, 14 | - | 5,7,10,1 1,12 |
| **CO-5** | Perform **analysis** of dynamic forces motions, trajectory and achieve required goals by suitable **design**. | 13,14 | - | 5,7,10,1 1,12 |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3 | 2.75 | 3 | 2.5 | 1 | - | 1 | - | - | 1 | 1 | 1 | 3 | 3 |

**Pre-requisites:** Microprocessors / Controllers, Embedded System Design

**Contents:**

**Unit-I**

**Introduction**: Brief History of Robotics, Working Definition of Robot, Growth of the Industry

**Types of Robots**: Classification by Degrees of Freedom, Classification by Robot Motion, Classification by Platform, Classification by Power Source, Classification by Intelligence, Classification by Application Area **08 Hrs**

**Unit-II**

**Introduction to Robot Mechanics**: Robot Arm Kinematics, End-Effectors, Dynamic Considerations, Obstacle Avoidance, Robot Electronic Subsystems, Robot External Sensing Systems, Motor System Design, Servo System Design, Hall-Effect Technology, Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Actuators, Pneumatic Devices, Electric Motors , Microprocessor Control of Electric Motors, Magnetostrictive Actuators, Shape-Memory Type Metals, Electroactive Polymer Actuators **08 Hrs**

**Unit-III**

**Kinematics of Robots:, Position Analysis** Robots as Mechanisms ,Conventions, Matrix Representation, Homogeneous Transformation, Matrices, Representation of Transformations, Inverse of Transformation Matrices, Forward and Inverse Kinematics of Robots Forward and Inverse Kinematic Equations: Position, Forward and Inverse Kinematic Equations: Orientation, Forward and Inverse Kinematic, Equations: Position and Orientation, Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots, The Inverse Kinematic Solution of Robots, Inverse Kinematic Programming of Robots, Degeneracy and Dexterity, The Fundamental Problem with the Denavit-Hartenberg Representation Design Projects **08 Hrs**

## Unit-IV

**Differential Motions and Velocitie**s, Differential Relationships, Jacobian, Differential versus Large-Scale Motions, Differential Motions of a Frame versus a Robot, Differential Motions of a Frame, Differential Translations, Differential Rotations about the Reference Axes ,Interpretation of the Differential, Change, Differential Changes between Frames, Differential Motions of a Robot and its Hand Frame, Calculation of the Jacobian, How to Relate the Jacobian and the Differential Operator, Inverse Jacobian, Design Projects **07 Hrs**

## Unit-V

**Dynamic Analysis and Forces** Introduction , Lagrangian Mechanics: A Short Overview , Effective Moments of Inertia , Dynamic Equations for Multiple-DOF Robots , Kinetic Energy , Potential Energy , The Lagrangian , Robot's Equations of Motion , Static Force Analysis of Robots ,Transformation of Forces and Moments between CoordinateFrames , Design Project Trajectory Planning Introduction, Path versus Trajectory ,Joint-Space versus Cartesian-Space, Descriptions , Basics of Trajectory Planning , Joint-Space Trajectory Planning , Cartesian-Space Trajectories , Continuous Trajectory Recording Design Project **08 Hrs**

**Reference Books:**


1) Harry H. Poole, "Fundamentals of Robotics Engineering", Springer Publication,1989.
2) Saeed Benjamin Niku, "Introduction to Robotics Analysis, Control, Applications", Second Edition, Wiley Publication, 2011
3) Ashitawa Goshal, "Robotics Fundamental Concepts and Analysis", Ninth Impression, Oxford University Press,2013.
4) Robert J. Schilling, "Fundamentals of Robotics Analysis and Control", Prentice Hall of India, 2003


| 18UECE622 | Data Structures using C++ | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course deals with the basics of data structures. Linked lists, stack, queues and trees etc. are included. An introductory chapter on pointers helps in the knowledge of data structures. Real life examples enhance the effectiveness of the course.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1,12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Apply** various concepts of C++ such as Arrays, Strings, Structures, Unions, Files, Pointers and Functions in solving problems. | - | 1,2,13 | 3 |
| CO-2 | **Understand and Implement** the operational aspects of linked lists (using pointers) such as creation, insertion, deletion and searching in problem solving. | - | 1,2,3 | 5,12 |
| CO-3 | **Realize and Implement** the operational aspects of stack in problem solving using Arrays and Pointers. | - | 1,2,3 | 12 |
| CO-4 | **Implement** the operational aspects of queue in problem solving using Arrays and Pointers**.** | - | 1,2,3 | 5,12 |
| CO-5 | **Implement** the operational aspects of trees using Arrays and Pointers, and Hash concept in problem solving. | - | 1,2,3 | 5,12 |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 1.8 | - | 1 | - | - | - | - | - | - | 1 | 2 | - |

**Pre-requisites:** Object Oriented Programming using C++

**Contents:**

**Unit-I**

**Structure, unions and Pointer Revisit:** Motivation for using structures. Pointer, access data from memory through pointer, pointer to structures. Motivation for dynamic memory requirement. Realizing arrays using pointer and dynamic memory allocation. Importance of memory management during allocation and de-allocation of memory. **07 Hrs**

**Unit-II**

**Lists:** Constructing dynamic data structures using self-referential structure (using the same realized linked Lists), operations on lists. Doubly Linked list. Application of Lists in sorting. **08 Hrs**

**Unit-III**

**Stack:** Realization of stack and its operations using static and dynamic structures. Application of stack in converting an expression from infix to postfix and evaluating a postfix expression, Heterogeneous stack using Unions. **08 Hrs**

**Unit-IV**

**Queues:** Realization of queues (FIFO, Double-ended queue, Priority queue) and its operations using static and dynamic data structures. **07 Hrs**

**Unit-V**

**Trees:** Types of trees and their properties, Realization of trees using static and dynamic data structures. Operations on Binary trees and their application in searching (BST and AVL Tree), Binary heap as priority.

**Hash Table:** Realizing effective hash table with proper data structure and hash function, its application. **09 Hrs**

**Reference Books:**


1) Aaron M. Tenenbaum, Yedidyah Langsam and Moche J. Augenstein, "Data Structures using C & C ++" , Pearson Education / PHI, 2006
2) E. Balagurusamy, "Programming in ANSI C", 4th edition, Tata McGraw Hill, 2008.
3) Behrouz A. Foruzan and Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", 2nd edition, Thomson, 2003.
4) Robert Kruse and Bruce Leung, "Data structures and Program Design in C", Pearson Education, 2007.


| 18UECE623 | Artificial Intelligence | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

This course focusses on overview of the main concepts in Artificial Intelligence (AI), algorithms applied in construction of intelligent systems, agents, problem solving, search, representation, reasoning, planning, communication, perception, robotics and neural networks.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13,14) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | **Discuss** the basic concepts and characteristics of AI with illustrations of current state of the art research, solving real world problems with searching approaches. | 14 | 2,3,4 | 1 |
| CO-2 | **Explain** the strengths and limitations of various state-space search algorithms along with knowledge representation, planning and constraint management. | 11 | 1,2,3,4 | 13 |
| CO-3 | **Identify** the type of an AI problem with search inference, decision making under uncertainty, game theory, etc. | - | 2,5 | 13 |
| CO-4 | **Apply** basic principles of AI in solutions that require different forms of learning and decision trees. | - | 6,12,14 | - |
| CO-5 | **Demonstrate** different language models, steps in Natural language Processing (NLP) and expert systems. | - | 14 | - |

| POs/PSOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 1.5 | 2 | 3 | 4 | 2 | 2 | | | | | 3 | 2 | 1 | 2 |

**Pre-requisites:** Discrete Mathematics, basic probability theory and Statistics Knowledge of any programming language and data structures.

**Contents:**

**Unit-I**

**Introduction:** Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of A.I. Intelligent Agents: Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents, How the components of agent programs work.

**Solving Problems by Searching:** Study and analysis of various searching algorithms. Implementation of Depth-first search Problem Solving Agents, Searching for Solutions, Uninformed and informed Search Strategies. **09 Hrs**

**Unit-II**

**Local Search Algorithms and Optimization Problems:** Local Search in Continuous Spaces, Searching with Nondeterministic Actions, Searching with Partial Observations, Introduction to adversarial Search and constraint satisfaction problems with examples.

**Logical Agents:** Knowledge agents, first-Order Logic, Inference to First-Order Logic, Classical planning, Planning and acting in the real world, knowledge representation. **08 Hrs**

**Unit-III**

**Quantifying Uncertainty:** Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Bayes' Rule and Its Use, Representing Knowledge in an Uncertain Domain, Other Approaches to Uncertain Reasoning, Rule-based methods for uncertain reasoning, representing vagueness: Fuzzy sets and fuzzy logic, Study of fuzzy logic and Decision trees, Implementation aspects of Decision trees. **07 Hrs**

**Unit-IV**

**Learning from Examples:** Forms of Learning, Supervised Learning, Learning Decision Trees, The decision tree representation, Expressiveness of decision trees, inducing decision trees from examples. **08 Hrs**

**Unit-V**

**Natural Language Processing:** Language Models, Steps in NLP, Syntactic Analysis (Parsing), Semantic interpretation, Discourse and pragmatic Processing, Text Classification. Discourse and pragmatic 24 Processing, Implementation aspects of Syntactic Analysis (Parsing)

**Expert Systems:** What is Expert system, Components of Expert System, Case studies on Expert System. **07 Hrs**

**Reference Books:**


1) Stuart Russell, Peter Norvig**,** “Artificial Intelligence: A Modern Approach” by Pearson 3rd Edition, 2015.
2) Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Tata McGraw-Hill Education Pvt. Ltd, 3rd Edition, 2017.
3) Saroj Kausik, “Artificial Intelligence”, Cengage Learning, 1st edition, 2011.

4) N P Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005.

| 18UECE630 | Cryptography | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on study of encryption/ decryption algorithms of different symmetric and asymmetric cryptographic techniques, Hash functions, Message authentication codes & Digital signature algorithms. To understand the various key distribution and management schemes.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Identify** security services, security threats and mechanisms to counter them and **Analyze** different classical encryption and decryption techniques. | 2 | 1,4 | - |
| CO-2 | **Analyze** different symmetric cryptographic standards and modular arithmetic concept. | 2 | 1 | 4 |
| CO-3 | **Evaluate** advanced encryption standard (AES). | 2 | - | 4 |
| CO-4 | **Apply** the concepts of private and public key encryption techniques and Key Management. | - | 4,14 | 2 |
| CO-5 | **Demonstrate** different authentication and digital signature algorithms and **Illustrate** Elliptic curve arithmetic. | 1 | 4,14 | - |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2.3 | 2.5 | - | 1.6 | - | - | - | - | - | - | - | - | - | 2 |

**Pre-requisites:** Communication networks and finite fields.

**Contents:**

**Unit-I**

**Introduction and Classical Encryption Techniques**: ISO-OSI Model, Services, Mechanisms and attacks, OSI security architecture, Model for network security, Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machines, Steganography. **07 Hrs**

**Unit-II**

**Block Cipher and Encryption Standards**: Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Finite fields of the form GF($2^n$). **08 Hrs**

**Unit-III**

**Advanced Encryption Standard**: Evaluation criteria for AES, The AES Key expansion, transformation functions. **07 Hrs**

**Unit-IV**

**Public Key Cryptography and Key Management**: Principles of public key cryptosystems, RSA algorithm, Key management, Diffie-Hellman key exchange. **08 Hrs**

**Unit-V**

**Elliptic Curve Arithmetic and Message Authentication**: Elliptic curve arithmetic, Elliptic curve cryptography, Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC's, Digital signature, Digital signature standard. **09 Hrs**

**Reference Books:**


1) William Stallings, "Cryptography and Network Security," 4/e, Pearson Education (Asia) Pte. Ltd. / Prentice Hall of India, 2011.
2) Behrouz A. Forouzan, "Cryptography and Network Security", TMH, 3rd Edition, 2015.
3) AtulKahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003.
4) Bernard Menezes, "Network Security and Cryptography", Cengage Learning, Cengage Learning India Pvt. Ltd, Second Impression 2011.


| 18UECE631 | Soft Computing | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on various aspects of soft computing paradigm like the neural networks, fuzzy logic and genetic algorithms. Each aspect will be explained with

the help of suitable applications. Real life examples enhance the effectiveness of the course.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs (1,12) / PSOs (13, 14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Design and analyze** neural network system for different applications. | - | 1,2,13 | 3 |
| CO-2 | **Understand and Implement** the operational aspects of unsupervised learning networks. | - | 1,2,3 | 12,5 |
| CO-3 | **Understand** the basics of fuzzy logic. | - | 1,2,3 | 12 |
| CO-4 | **Classify** the given data set, and identify using the fuzzy algorithms. | - | 1,2,3 | 12,5 |
| CO-5 | **Solve** the optimization problems using genetic algorithms. | - | 1,2,3 | 12,5 |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2 | 2 | 1.8 | - | 1 | - | - | - | - | - | - | 1 | 2 | - |

**Pre-requisites:** Basics of Set theory

**Contents:**

**Unit-I**

**Introduction:** Neural networks, application scope of neural networks, fuzzy logic, genetic algorithm, hybrid systems, soft computing, Fundamental concepts and evolution of neural networks, basic models, important terminologies of ANNs, McCulloch-Pitts neuron, linear separability, Hebb network. Supervised learning networks: Introduction, perceptron networks, adaptive linear neuron (Adaline), multiple adaptive linear neuron, back-propagation network. **09 Hrs**

**Unit-II**

**Unsupervised Learning Networks:** Introduction, fixed weight competitive nets, Kohonen self-organizing feature maps, learning vector quantization, counter propagation networks, adaptive resonance theory network. **09 Hrs**

**Unit-III**

**Introduction to Fuzzy Logic:** Fuzzy logic, classical sets (Crisp Sets), fuzzy sets. Classical relations and fuzzy Relations: Introduction, Cartesian product of relation, classical relation, fuzzy relation, tolerance and equivalence relations, Membership Functions: Introduction, features, fuzzification, methods of membership value assignments. De-fuzzification: Introduction, lambda-cuts for fuzzy sets (Alpha-Cuts), lambda-cuts for fuzzy relations, defuzzification methods.

**06 Hrs**

**Unit-IV**

**Fuzzy Classification:** Classification by equivalence relations, cluster analysis and validity, hard c-Means clustering (HCM), fuzzy c-Means clustering (CM), classification metric, hardening the fuzzy c-partition.

**Fuzzy Pattern Recognition:** Feature Analysis, partitions of the feature space, single-sample identification **06 Hrs**

**Unit-V**

**Genetic Algorithm:** Introduction, biological background, traditional optimization and search techniques, genetic algorithms and search space, genetic algorithm vs. traditional algorithms, basic technologies in genetic algorithm, simple GA, general genetic algorithm, operators in genetic algorithm, stopping condition for genetic algorithm flow, constraints in genetic algorithm, problem solving using genetic algorithm, the schema theorem, classification of genetic algorithm. **09 Hrs**

**Reference Books:**


1) S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Wiley Publications, Second Edition-2011.
2) Laurene Fausette, “Fundamentals of Neural Networks”, Pearson Education, New Delhi, 2007.
3) Rajasekaran S. And VijayalakshmiPai G A, “Neural Networks, Fuzzy logic and Genetic Algorithms: Synthesis and Applications”, PHI Learning, New Delhi, 2006.
4) Eiji Mizutani, Chuen Tsai Sun, JyhShing Roger Jang, “Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence”, Pearson Education, New Delhi, 2008.


| 18UECE632 | Automotive Electronics | (3-0-0) 3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on Electronic Engine control system, construction and operation of sensors and actuators, role of electronics in vehicle motion control, instrumentation and advanced features for safety and comfort in vehicles.

**Course Outcomes (COs):**

| Description of the Course Outcome: At the end of the course the student will be able to: | | Mapping to POs(1-12)/ PSOs (13,14) | | |
|---|---|---|---|---|
| | | Substantial Level (3) | Moderate Level (2) | Slight Level (1) |
| CO-1 | **Explain** various parts and operation of automobile system, electronic control system and microcomputer system. | - | 1 | - |
| CO-2 | **Explain** and **apply** control system approach to Engine control and **define** various performance parameters. | 3 | 7 | 2 |
| CO-3 | **Describe** the construction and operation of various sensors and actuators used in automotive control applications. | - | 5 | 13 |
| CO-4 | **Analyze** and **Explain** vehicle motion control system and automotive instrumentation systems. | - | 2 | 14 |
| CO-5 | **Describe** various advanced electronic features, communication protocols and diagnostics | 6 | 4 | 12 |

| POs/PSOs | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mapping Level | 2.0 | 1.5 | 3.0 | 2.0 | 2.0 | 3.0 | 2.0 | - | - | - | - | 1.0 | 1.0 | 1.0 |

**Pre-requisites:** Basics of Automobiles and Engines, Analog and Digital Electronic Circuits, Control systems and microcontrollers.

**Contents:**

**Unit-I**

**Automotive Fundamentals:** Evolution of Automotive Electronics, Automobile Physical configuration, The SI Engine and its operation, Engine control, Ignition system, Diesel Engine, Hybrid vehicle configuration, Drive Train, Brakes, Suspension, Steering System

**Control System Approach:** Open loop and closed loop control systems, Proportional Controller, Proportional-Integral controller, Closed Loop Limit Cycle control**.**

**Microcomputer Systems:** Microcontroller applications in automotive systems, Instrumentation applications of microcomputers, Microcomputers in control systems. **08 Hrs**

**Unit-II**

**Basics of Electronic Engine Control:** Motivation for electronic engine control, Government Test procedures, Concept of an electronic engine control system, Definition of General Terms and Engine performance terms, Engine Mapping, Control Strategy, Electronic fuel control system, Analysis of intake manifold pressure, Idle speed control, Electronic Ignition. **08 Hrs**

**Unit-III**

**Sensors and Actuators:** Control system applications of sensors and actuators, Airflow rate sensors, Engine Crankshaft angular position sensors, Throttle angle sensor, Temperature Sensors, Sensors for feedback control, Knock sensors, Engine control actuators, variable valve Timing. **08 Hrs**

**Unit-IV**

**Vehicle Motion Control:** Typical Cruise control system, Cruise control electronics, Antilock braking System, Electronic Suspension system, Electronic steering control.

**Automotive Instrumentation:** Modern Automotive Instrumentation, Input and Output Signal Conversion, Sampling, Fuel Quantity measurement, Coolant Temperature measurement, Oil Pressure measurement, Vehicle Speed measurement. **08 Hrs**

**Unit-V**

**Advanced Automotive Electronic Systems:** Occupant Protection Systems, Collision avoidance RADAR warning system, Low Tyre-pressure warning system, Sensor and Control Signal Multiplexing, Navigation.

**Communication Protocols:** CAN protocol, LIN protocol. **07 Hrs**

**Reference Books:**


1) William B. Ribbens, “Understanding Automotive Electronics”, 6/e, Newnes,2003
2) A. K. Babu, “ Automotive Electrical and Electronics”, 2/e, Khanna publishing,2016
3) Tom Denton, “Automobile Electrical and Electronic Systems”, 5/e, Institute off Motor Industry, 2017
4) Najamuz Zaman, “Automotive Electronics Design Fundamental’’ first edition, Springer 2015.


| 18UECE633 | Multimedia Communication | (3-0-0)3 |
|---|---|---|

**Contact Hours: 39**

**Course Learning Objectives (CLOs):**

The course focuses on multimedia signals and their representation, signal

compression, standards and protocols followed in representing and transmitting these signals.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Understand and Examine** representation of different media and their formats along with their authoring, versioning and management | 2,4 | - | - |
| **CO-2** | **Justify** the need for compression and **Select** the appropriate compression standard depending upon requirement **analysis**. | 1,2,4 | 3- | 12 |
| **CO-3** | **Understand and deploy** Compression standards with respect to Image, Graphics, Video and Audio | 2,4 | 13,14 | 12 |
| **CO-4** | **Explain** various networks and techniques used for multimedia communication | - | 3,4,13 | 14 |
| **CO-5** | **Identify** and **explain** multimedia communication applied in various entertainment networks | - | 3,4,13 | 6,14 |

| **POs/PSOs** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3 | 3 | 2 | 2 | - | 1 | - | - | - | - | - | 1 | 2 | 1 |

**Pre-requisites:** Digital Signal Processing, Information Theory and Coding

**Contents:**

**Unit-I**

**Media Representation and Media Formats :** Digital Images, Digital Video, Digital Audio ,Graphics, Color Theory The Color Problem , Trichromacity Theory , Color Calibration , Color Spaces , Gamma Correction and Monitor Calibration, Requirements for Multimedia Authoring Tools , Intramedia Processing , Intermedia Processing , Multimedia Authoring Paradigms and User Interfaces , Role of User Interfaces , Device-Independent Content Authoring , Distributed Authoring and Versioning , Multimedia Services and Content Management , Asset Management

**08 Hrs**

## Unit-II

**Overview of Compression :** The Need for Compression , Basics of Information Theory , A Taxonomy of Compression , Lossless Compression , Lossy Compression , Practical Issues Related to Compression Systems.

**Media Compression:** Images, Redundancy and Relevancy of Image Data, Classes of Image Compression Techniques, Lossless Image Coding, Transform Image Coding , Wavelet Based Coding (JPEG 2000) , Fractal Image Coding , Transmission Issues in Compressed Images , The Discrete Cosine Transform

**08 Hrs**

## Unit-III

**General Theory of Video Compression:** Types of Predictions, Complexity of Motion Compensation , Video-Coding Standards , VBR Encoding, CBR Encoding, and Rate Control , A Commercial Encoder, The Need for Audio Compression , Audio-Compression Theory , Audio as a Waveform , Audio Compression Using Psychoacoustics , Model-Based Audio Compression , Audio Compression Using Event Lists , Audio Coding Standards **08 Hrs**

## Unit-IV

**Graphics Compression** :The Need for Graphics Compression , 2D Graphics Objects, 3D Graphics Objects, Graphics Compression in Relation to Other Media Compression, Mesh Compression Using Connectivity Encoding, Mesh Compression Using Polyhedral Simplification, Multiresolution Techniques—Wavelet-Based Encoding, Progressive Encoding and Level of Detail ,3D Graphics Compression Standards **07 Hrs**

## Unit-V

**The OSI Architecture**: Local and Wide Area Networks, Modes of Communication, Routing , Multimedia Traffic Control , Multimedia Networking Performance and Quality of Service

**Multimedia Communication Standards and Protocols**: Wireless Versus Wired Technology, History of Wireless Development , Basics of Wireless Communications , Wireless Generations and Standards , Wireless Application Protocol (WAP) ,Problems with Wireless Communication , Quality of Service (QoS) over Wireless Networks , 2G, 3G, and Beyond 3G **08 Hrs**

**Reference Books:**

1) Parag Havaldar, Gerard Medioni, “Multimedia Syatems Algorithms Standards and Industry Practices”, Cengage Publication, 2010.

2) Ralf Steinmetz, KlaraNarstedt, “Multimedia Fundamentals - Media Coding and Content Processing”, vol.1, Pearson Education, 2004.
3) Nalin K. Sharda, "Multimedia Information Networking", PHI, 2003.
4) Fred Halsall, " Multimedia Communications-Applications, Networks, Protocols and Standards”, Pearson Education, Asia, Second Indian reprint, 2002.

| 18UECL602 | Embedded Systems Laboratory | (0-0-3)1.5 |
|---|---|---|

**Contact Hours: 36**

**Course Learning Objectives (CLOs):**

The course focuses on embedded systems design and development. Hardware-software co design process is explored in real-time system design.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| **CO-1** | **Realize** embedded system design using Integrated Development Environment (IDE). | - | 1,5 | 3,7 |
| **CO-2** | **Develop** simple embedded C applications using RTOS-APIs. | 2,5 | 3 | 7,12 |
| **CO-3** | **Construct** embedded systems using sensors and actuators. | 2,13,14 | 4,5 | 7,9, 12 |
| **CO-4** | **Execute** basic IoT applications on embedded platform. | 1,2,14 | 4,5,13 | 9,6 |
| **CO-5** | **Realize** communication protocols used in embedded systems. | 5 | 13,14 | 4 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 2.5 | 3 | 1.5 | 1.6 | 2.4 | 1 | 1 | - | 1 | - | - | 1 | 2.3 | 2.6 |

**List of Experiments:**

1. Sample Embedded C-programs.
2. Develop Embedded C-Program for the following interfacing examples
    a. ADC and DAC.
    b. LED and PWM.
    c. Real time clock and serial port.
    d. Keyboard and LCD.
    e. EPROM and interrupt.
3. Demonstrate Inter-Process Communication using Mailbox.

4. Interrupt performance characteristics of ARM Controllers.
5. Write a C program to blink LEDs on ARM Controller board.
6. Develop a system to rotate a stepper motor by $180^0$ when temperature is above set threshold.
7. Develop a system to rotate a DC motor with different rpm depending upon temperature.
8. Implement Communication protocol on ARM Controllers.
9. Local processing on the sensor nodes
10. Develop a sample IoT application by connecting devices to the cloud and vice Versa

**Reference Books**:


1) Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier), 2010.
2) Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd edition.
3) Andrew N. Sloss “Arm System Developer’s Guide” Elsevier Inc. 2004 edition, Morgan Kaufmann Publishers.
4) James K. Peckol, "Embedded systems- A contemporary design tool", John Wiley, 2008, ISBN: 978-0-471-72180-2.
5) Yifeng Zhu, “Embedded Systems with Arm Cortex-M Microcontrollers in Assembly Language andC”, 2nd E -Man Press LLC ©2015
6) Embedded real time systems by K.V. K. K Prasad, Dreamtech publications, 2003.


| 18UECL603 | VLSI Laboratory | (0-0-3) 1.5 |
|---|---|---|

**Contact Hours: 36**

**Course Learning Objectives (CLOs):**

The course focuses on exploring the theoretical concepts studied as part of subjects, CMOS VLSI Design and Analog and Mixed Mode VLSI Design in practical with the help of Cadence tool framework. The lab introduces the complete custom IC design flow and Analog and Mixed Signal (AMS) flow for Analog circuits, Digital circuits and Analog and mixed signal circuits design respectively.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|
| | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |

| | | | | |
|---|---|---|---|---|
| CO-1 | **Demonstrate** the working of digital and analog circuits and **apply** the design steps of VLSI flow to build the schematic and layouts of VLSI circuits. | 1, 2 | 5 | 13 |
| CO-2 | **Design** and **perform** the DC and transient analysis on combinational & sequential VLSI circuits. | 2 | 1,5 | - |
| CO-3 | **Design** and **Perform** the DRC, LVS and RC extraction of layout designs of combinational & sequential VLSI circuits. | 2 | 1,5 | - |
| CO-4 | **Design** analog and mixed signal circuits **and Evaluate their** performance**.** | 3,5 | 13 | - |
| CO-5 | **Compare and evaluate** the performance of VLSI circuits. | 2 | 10,13 | 1,4,14 |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 1.5 | 3 | 3 | 1 | 2.25 | - | - | - | - | 2 | - | - | 1.6 | 1 |

**List of Experiments:**

Draw the Schematic and Layout for the following digital and analog circuits mentioned below with the help of Cadence tool frame work and verify the following.

a. Schematic: i) DC Analysis ii) Transient Analysis iii) Parametric analysis

b. Layout: i) DRC ii) LVS iii) RCX

1. Design CMOS Inverter with given specifications.
2. Design CMOS two input NAND and NOR gates.
3. Design Transmission gate & Multiplexer using transmission gates.
4. Design XOR, AND & OR gates using transmission gates.
5. Design D F/F, SR F/F sequential circuits.
6. Design 2-bit up-down counter using D F/Fs.
7. Design a Common Source Amplifier with resistive load for given specifications.
8. Design a source follower circuit.
9. Design single stage Differential Amplifier with given specifications.
10. Design single stage OPAMP using common source amplifier with resistive load.

11. Design 4 bit R-2R DAC using Op-amp with given specifications.

**Reference Books:**


1) Sung Mo Kang & Yusuf Leblebici, “CMOS Digital Integrated Circuits: Analysis and Design”, 3/e, McGraw-Hill, 2008.
2) Douglas A Pucknell& Kamran Eshragian, “Basic VLSI Design”, 3/e, PHI, 2005.
3) Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw-Hill Edition 2008.
4) R. Jacob Baker, Harry W. LI, David E. Boyce, “CMOS Circuit Design, lay out and Synthesis”, IEEE press, 2005.


| 18UECL604 | Minor Project-2 | (0-0-4) 2 |
|---|---|---|

**Contact Hours: 30**

**Course Learning Objectives (CLOs):**

Minor project-2 focuses on an exposure to the project work in the domain of their interest by selecting a problem definition from an emerging area. The problem could be defined to develop prototypes for industrial needs.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1-12)/ PSOs (13,14)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Identify** and **justify** the technical aspects of the chosen project with a comprehensive and systematic approach. | 1 | 2,4 | 6,7 |
| CO-2 | **Reproduce** and **refine** technical aspects for engineering projects. | 2 | 13 | - |

| | | | | |
|---|---|---|---|---|
| CO-3 | **Work** as an individual or in a team in development of projects | 9 | 8 | - |
| CO-4 | **Implement** the solution in hardware and / or software | 3,5 | 13,14 | 11 |
| CO-5 | **Present** the work in a systematic manner | 10 | 12 | - |

| **POs/PSOs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | 3 | 2.5 | 3 | 2 | 3 | 1 | 1 | 2 | 3 | 3 | 1 | 2 | 2 | 2 |

## 18UHUL605 Soft skills/Aptitude (0-0-2) 1

**Contact Hours: 24**

**Course Learning Objectives (CLOs):**

This is included with the objectives of improving the communication skills, proficiency in English language and aptitude ability of the student to enhance the employability.

**Course Outcomes (COs):**

| **Description of the Course Outcome:** At the end of the course the student will be able to: | | **Mapping to POs(1 to 12)/PSO (1 to 3)** | | |
|---|---|---|---|---|
| | | **Substantial Level (3)** | **Moderate Level (2)** | **Slight Level (1)** |
| CO-1 | **Explain** the significance of communication in the profession. | | 10 | |
| CO-2 | **Use** the English language with proficiency | | 10 | 12 |
| CO-3 | **Solve** Aptitude related problems | | 9 | 12 |
| CO-4 | **Demonstrate** the competency in the placement activities. | | 9 | |

| **PO's** | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 | PSO-1 | PSO-2 | PSO-3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mapping Level** | | | | | | | | | 2.0 | 2.0 | | 1.0 | | | |

**Contents:**

Training on communication skills, proficiency in English language and aptitude ability involving the internal and external resource.

**Evaluation:**

Both the internal and external resource persons shall be engaged in imparting the related knowledge and shall have only CIE as the evaluation component. There shall be one test conducted at the end for 25 marks in Aptitude testing and there shall be one presentation by the student for 25 marks or any other suitable testing components. The arrangement for CIE evaluation is to be done by the department and maintain the relevant documents.