**ELECTRONICS & COMMUNICATION ENGINEERING DEPARTMENT**
**B.E. – ELECTRONICS AND COMPUTER ENGINEERING**
**2019**

## SEMESTER-I

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UCB008 | APPLIED CHEMISTRY | CF | 3 | 1 | 2 | 4.5 |
| 2 | UTA017 | COMPUTER PROGRAMMING | CF | 3 | 0 | 2 | 4 |
| 3 | UES013 | ELECTRICAL ENGINEERING | CF | 3 | 1 | 2 | 4.5 |
| 4 | UEN002 | ENERGY& ENVIRONMENT | CF | 3 | 0 | 0 | 3 |
| 5 | UMA010 | MATHEMATICS-I | CF | 3 | 1 | 0 | 3.5 |
| 6 | UES009 | MECHANICS | CF | 2 | 1 | 0 | 2.5 |
| **TOTAL** | | | | **17** | **4** | **6** | **22.0** |

*Student will attend one Lab Session of 2 hrs in a semester for a bridge project in this course.

## SEMESTER-II

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UPH004 | APPLIED PHYSICS | CF | 3 | 1 | 2 | 4.5 |
| 2 | UTA018 | OBJECT ORIENTED PROGRAMMING | CF | 3 | 0 | 2 | 4.0 |
| 3 | UEC001 | ELECTRONIC ENGINEERING | CF | 3 | 1 | 2 | 4.5 |
| 4 | UTA015 | ENGINEERING DRAWING | CF | 2 | 0 | 4 | 4.0 |
| 5 | UMA004 | MATHEMATICS-II | CF | 3 | 1 | 0 | 3.5 |
| 6 | UHU003 | PROFESSIONAL COMMUNICATION | CF | 2 | 0 | 2 | 3.0 |
| **TOTAL** | | | | **16** | **3** | **12** | **23.5** |

## SEMESTER-III

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UES012 | ENGINEERING MATERIALS | CF | 3 | 1 | 2 | 4.5 |
| 2 | UMA011 | NUMERICAL ANALYSIS | CF | 3 | 0 | 2 | 4.0 |
| 3 | UEC613 | DATA STRUCTURES AND ALGORITHMS | CP | 3 | 0 | 2 | 4.0 |
| 4 | UEC310 | INFORMATION AND COMMUNICATION THEORY | CF | 3 | 1 | 0 | 3.5 |
| 5 | UEC301 | ANALOG ELECTRONIC CIRCUITS | CP | 3 | 1 | 2 | 4.5 |
| 6 | UEC612 | DIGITAL SYSTEM DESIGN | CP | 3 | 1 | 2 | 4.5 |
| 7 | UTA013 | ENGINEERING DESIGN PROJECT – I (including 4 self effort hours) | PR | 1 | 0 | 2 | 5.0 |
| **TOTAL** | | | | **19** | **4** | **12** | **30.5** |

### SEMESTER-IV

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UES018 | MANUFACTURING TECHNOLOGY | CF | 2 | 0 | 2 | 3.0 |
| 2 | UMA035 | OPTIMIZATION TECHNIQUES | CF | 3 | 0 | 2 | 4.0 |
| 3 | UEC404 | SIGNALS AND SYSTEMS | CP | 3 | 1 | 2 | 4.5 |
| 4 | UEC608 | EMBEDDED SYSTEMS | CP | 3 | 0 | 2 | 4.0 |
| 5 | UEC533 | COMPUTER AND COMMUNICATION NETWORKS | CP | 3 | 0 | 0 | 3.0 |
| 6 | UTA025 | INNOVATION AND ENTREPRENEURSHIP | CF | 1 | 0 | 2* | 3.0 |
| 7 | UTA014 | ENGINEERING DESIGN PROJECT-II (including 6 self effort hours) | PR | 1 | 0 | 4 | 6.0 |
| | | **TOTAL** | | **16** | **1** | **13** | **27.5** |

** Alternate Week*

### SEMESTER-V

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UCS303 | OPERATING SYSTEMS | CP | 3 | 0 | 2 | 4.0 |
| 2 | UCS310 | DATABASE MANAGEMENT SYSTEMS | CP | 3 | 0 | 2 | 4.0 |
| 3 | UEC502 | DIGITAL SIGNAL PROCESSING | CP | 3 | 1 | 2 | 4.5 |
| 4 | UEC516 | THEORY OF COMPUTATION | CP | 3 | 0 | 0 | 3.0 |
| 5 | UEC607 | DIGITAL COMMUNICATION | CP | 3 | 0 | 2 | 4.0 |
| 6 | | **ELECTIVE –I** | PE | | | | 4.0 |
| | | **TOTAL** | | **15** | **1** | **8** | **27.5** |

### SEMESTER-VI

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UEC610 | COMPUTER ARCHITECTURE | CP | 3 | 0 | 0 | 3.0 |
| 2 | UEC609 | MOS CIRCUIT DESIGN | CP | 3 | 0 | 2 | 4.0 |
| 3 | UEC713 | MACHINE LEARNING | CP | 3 | 0 | 2 | 4.0 |
| 4 | UEC797 | CAPSTONE PROJECT (STARTS) | PR | 1* | 0 | 2 | - |
| 5 | | **ELECTIVE –II** | PE | | | | 3.0 |
| 6 | | **ELECTIVE –III** | PE | | | | 3.0 |
| 7 | | GENERIC ELECTIVE | GE | 3 | 0 | 0 | 3.0 |
| | | **TOTAL** | | **9** | | **6** | **20.0** |

** Alternate Week*

## SEMESTER-VII

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UEC707 | NETWORK VIRTUALIZATION AND SOFTWARE DEFINED NETWORKING | CP | 2 | 0 | 2 | 3.0 |
| 2 | UEC715 | IOT BASED SYSTEMS | CP | 3 | 0 | 2 | 4.0 |
| 3 | UHU005 | HUMANITIES FOR ENGINEERS | CF | 2 | 0 | 2 | 3.0 |
| 5 | | **ELECTIVE –IV** | PE | | | | 3.0 |
| 6 | UEC797 | CAPSTONE PROJECT | PR | 1* | 0 | 2 | 8.0 |
| **TOTAL** | | | | | | | **21.0** |

** Alternate Week*

## SEMESTER-VIII

| Sr. No. | Course No. | TITLE | CODE | L | T | P | Cr |
|---|---|---|---|---|---|---|---|
| 1 | UEC900 | PROJECT SEMESTER | PR | | | 15 | 15.0 |
| **OR** | | | | | | | |
| 1 | | ELECTIVE –V | PE | | | | 3.0 |
| 2 | | ELECTIVE –VI | PE | | | | 3.0 |
| 3 | UEC897 | PROJECT | PR | | | | 9.0 |
| **OR** | | | | | | | |
| 1 | UEC901 | START-UP SEMESTER | PR | | | | 15.0 |
| **TOTAL** | | | | | | | **15.0** |

## Elective-I

| S. N. | Course No. | Course Name | CODE | L | T | P | Cr. |
|---|---|---|---|---|---|---|---|
| 1 | UCS523 | COMPUTER AND NETWORK SECURITY | PE | 3 | 0 | 2 | 4.0 |
| 2 | UEC512 | LINEAR INTEGRATED CIRCUITS AND APPLICATIONS | PE | 3 | 0 | 2 | 4.0 |
| 3 | UEC709 | FIBER OPTIC COMMUNICATION | PE | 3 | 0 | 2 | 4.0 |
| 4 | UEC618 | DIGITAL IMAGE PROCESSING | PE | 3 | 0 | 2 | 4.0 |
| 5 | UCS501 | ALGORITHM ANALYSIS AND DESIGN | PE | 3 | 0 | 2 | 4.0 |
| 6 | UCS802 | COMPILER CONSTRUCTION | PE | 3 | 0 | 2 | 4.0 |
| 7 | UCS642 | AUGMENTED AND VIRTUAL REALITY | PE | 3 | 0 | 2 | 4.0 |
| 8 | UCS503 | SOFTWARE ENGINEERING | PE | 3 | 0 | 2 | 4.0 |
| 9 | | VT Data Science-I | | | | | |

**Elective-II**

| S. N. | Course No. | Course Name | CODE | L | T | P | Cr. |
|---|---|---|---|---|---|---|---|
| 1 | UEC619 | ELCTROMAGNETIC FIELD THEORY AND TRANSMISSION LINES | PE | 3 | 0 | 0 | 3.0 |
| 2 | UEC620 | DEEP LEARNING FOR COMPUTER VISION | PE | 2 | 0 | 2 | 3.0 |
| 3 | UCS001 | INTRODUCTION TO CYBER SECURITY | PE | 3 | 0 | 0 | 3.0 |
| 4 | UEC631 | WIRELESS AND MOBILE NETWORKS | PE | 3 | 0 | 0 | 3.0 |
| | UEC632 | ANALOG COMMUNICATION SYSTEMS | PE | 2 | 0 | 2 | 3.0 |
| 5 | UEC633 | CRYPTOGRAPHY | PE | 2 | 0 | 2 | 3.0 |
| 6 | UEC634 | CLOUD COMPUTING TECHNOLOGY | PE | 2 | 0 | 2 | 3.0 |
| 7 | | VT Data Science-II | | | | | |

**Elective-III**

| S. N. | Course No. | Course Name | CODE | L | T | P | Cr. |
|---|---|---|---|---|---|---|---|
| 1 | UEC731 | GRAPHICS AND VISUAL COMPUTING | PE | 3 | 0 | 0 | 3.0 |
| 2 | UCS754 | BLOCKCHAIN TECHNOLOGY | PE | 2 | 0 | 2 | 3.0 |
| 3 | UEC858 | MODERN CONTROL THEORY | PE | 3 | 0 | 0 | 3.0 |
| 4 | UEC821 | VIDEO SIGNAL PROCESSING | PE | 2 | 0 | 2 | 3.0 |
| 5 | UEC732 | NATURAL LANGUAGE PROCESSING AND APPLICATIONS | PE | 2 | 0 | 2 | 3.0 |
| 6 | UEC733 | AUDIO & SPEECH PROCESSING | PE | 3 | 0 | 0 | 3.0 |
| 7 | | VT Data Science-III | | | | | |

**Elective-IV**

| S. N. | Course No. | Course Name | CODE | L | T | P | Cr. |
|---|---|---|---|---|---|---|---|
| 1 | UEC645 | PARALLEL & DISTRIBUTED COMPUTING | PE | 3 | 0 | 0 | 3.0 |
| 2 | UEC823 | SOFT COMPUTING | PE | 2 | 0 | 2 | 3.0 |
| 3 | UEC734 | QUANTUM COMPUTING | PE | 3 | 0 | 0 | 3.0 |
| 4 | UEC735 | BIG DATA ANALYTICS | PE | 2 | 0 | 2 | 3.0 |
| 5 | UEC736 | VLSI SIGNAL PROCESSING | PE | 3 | 0 | 0 | 3.0 |
| 6 | | VT Data Science-IV | | | | | |

**Elective-V**

| S. N. | Course No. | Course Name | CODE | L | T | P | Cr. |
|---|---|---|---|---|---|---|---|
| 1 | UEC857 | VLSI INTERCONNECT | PE | 3 | 0 | 0 | 3.0 |
| 2 | UEC825 | MEMS | PE | 3 | 0 | 0 | 3.0 |
| 3 | UEC752 | IC FABRICATION | PE | 3 | 0 | 0 | 3.0 |

**Elective-VI**

| S. N. | Course No. | Course Name | CODE | L | T | P | Cr. |
|---|---|---|---|---|---|---|---|
| 1 | UEC824 | ASIC and FPGA | PE | 3 | 0 | 0 | 3.0 |
| 2 | UEC751 | DSP PROCESSORS | PE | 2 | 0 | 2 | 3.0 |
| 3 | UEC866 | VIRTUAL INSTRUMENTATION ENGINEERING | PE | 2 | 0 | 2 | 3.0 |

## List of ELC Activities for BE (ENC) – 2019 Batch

| Semester | ELC Activity |
|---|---|
| **I** | PCB Design |
| **II** | PCB Fabrication |
| **III** | IOT based Automation |
| **IV** | Robotic Arm |
| **V** | HDL implementation of Digital Clock |

**SEMESTER WISE CREDITS FOR BE (ELECTRONICS AND COMPUTER ENGINEERING)**

| SEMESTER | CREDITS |
|---|---|
| FIRST | 22.0 |
| SECOND | 23.5 |
| THIRD | 30.5 |
| FOURTH | 27.5 |
| FIFTH | 27.5 |
| SIXTH | 20.0 |
| SEVENTH | 21.0 |
| EIGHTH | 15.0 |
| **TOTAL CREDITS** | **187.0** |

# UCB008: APPLIED CHEMISTRY

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course objective:** The course aims at elucidating principles of applied chemistry in industrial systems, water treatment, engineering materials and analytical techniques.

**Electrochemistry:** Specific, equivalent and molar conductivity of electrolytic solutions, migration of ions, transference number and its determination by Hittorf's method, conductometric titrations, types of electrodes, concentration cells, liquid junction potential.

**Phase Rule:** States of matter, phase, component and degree of freedom, Gibb's phase rule, one component and two component systems.

**Water Treatment and Analysis:** Hardness and alkalinity of water: units and determination, external and internal methods of softening of water: carbonate, phosphate, calgon and colloidal conditioning, lime-soda process, zeolite process, ion exchange process, mixed bed deionizer, desalination of brackish water.

**Fuels:** Classification of fuels, calorific value, cetane and octane number, fuel quality, comparison of solid liquid and gaseous fuels, properties of fuel, alternative fuels: biofuels, power alcohol, synthetic petrol.

**Chemistry of Polymers:** Overview of polymers, types of polymerization, molecular weight determination, tacticity of polymers, catalysis in polymerization, conducting, biodegradable and inorganic polymers.

**Atomic spectroscopy:** Introduction to spectroscopy, atomic absorption spectrophotometry and flame photometry, quantitative methods.

**Molecular Spectroscopy**: Beer-Lambert`s Law, molecular spectroscopy, principle, instrumentation and applications of UV-Vis and IR spectroscopy.

**Laboratory Work**

**Electrochemical measurements**: Experiments involving use of pH meter, conductivity meter, potentiometer.

**Acid and Bases**: Determination of mixture of bases.

**Spectroscopic techniques**: Colorimeter, UV-Vis spectrophotometer.

**Water and its treatment**: Determination of hardness, alkalinity, chloride, chromium, iron and copper in aqueous medium.

**Course Learning Outcomes:** The students will be able to reflect on:

1. concepts of electrodes in electrochemical cells, migration of ions, liquid junction potential and conductometric titrations.
2. atomic and molecular spectroscopy fundamentals like Beer`s law, flame photometry, atomic absorption spectrophotometry, UV-Vis and IR.
3. water and its treatment methods like lime soda and ion exchange.
4. concept of phase rule, fuel quality parameters and alternative fuels.
5. polymerization, molecular weight determination and applications as biodegradable and conducting polymers.
6. laboratory techniques like pH metry, potentiometry, colourimetry, conductometry and volumetry.

**Text Books**

1. Ramesh, S. and Vairam S. Engineering Chemistry, Wiley India (2012) 1st ed.
2. Puri, B.R., Sharma,L.R., and Pathania, M.S. Principles of Physical Chemistry, Vishal Publishing Co. (2008).
3. Aggarwal, S. Engineering Chemistry: Fundamentals and Applications, Cambridge University Press (2015).

**Reference Books**

1. Brown, H., Chemistry for Engineering Students, Thompson, 1st ed
2. Sivasankar, B., Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd, New Delhi (2008).
3. Shulz, M.J. Engineering Chemistry, Cengage Learnings (2007) 1st ed.

## Evaluation Scheme

| S No | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 40 |
| 3 | Sessional (Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 35 |

## UTA017: COMPUTER PROGRAMMING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course objective:** This course is designed to explore computing and to show students the art of computer programming. Students will learn some of the design principles for writing good programs.

**Computers Fundamentals:** Binary Number System, Computer memory, Computer Software.
**Algorithms and Programming Languages:** Algorithm, Flowcharts, Generation of Programming Languages.
**C Language:** Structure of C Program, Life Cycle of Program from Source code to Executable, Compiling and Executing C Code, Keywords, Identifiers, Primitive Data types in C, variables, constants, input/output statements in C, operators, type conversion and type casting. Conditional branching statements, iterative statements, nested loops, break and continue statements.
**Functions:** Declaration, Definition, Call and return, Call by value, Call by reference, showcase stack usage with help of debugger, Scope of variables, Storage classes, Recursive functions, Recursion vs Iteration.
**Arrays, Strings and Pointers:** One-dimensional, Two-dimensional and Multi-dimensional arrays, operations on array: traversal, insertion, deletion, merging and searching, Inter-function communication via arrays: passing a row, passing the entire array, matrices. Reading, writing and manipulating Strings, understanding computer memory, accessing via pointers, pointers to arrays, dynamic allocation, drawback of pointers.
**Structures and Union:** Defining a Structure, Declaring a structure variables, Accessing Structure Elements, and Union.
**File Handling:** Defining and Opening a File, Closing a File, Reading from a File, Writing into a File.

**Laboratory work:**
To implement Programs for various kinds of programming constructs in C Language.

**Course learning outcomes (CLOs):**
On completion of this course, the students will be able to:

1. Comprehend and analyze the concepts of number system, memory, compilation and debugging of the programs in C language.
2. Understanding of the fundamental data types, operators and console I/O functions as an aspect of programs.
3. Design and create programs involving control flow statements, arrays, strings and implement the concept of dynamics of memory allocations.
4. Evaluate and analyze the programing concepts based on user define data types and file handling using C language.

**Text Books:**

*1.* Brian W. Kernighan Dennis M. Ritchie, C Programming Language, 2nd ed, 2012.
*2.* Balagurusamy G., Programming in ANSI C, 8$^{th}$ ed., 2019

**Reference Books:**

*1.* Kanetkar Y., Let Us C, 16$^{th}$ ed.,2017

**Evaluation scheme**

| Sr. no. | Evaluation Elements | Weights (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 40 |
| 3. | Sessionals<br>(May include Assignments/Projects/Tutorials/Quiz/Lab evaluations) | 35 |

## UEN002: ENERGY & ENVIRONMENT

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objectives:** The exposure to this course would facilitate the students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the value of regional and global natural and energy resources; and emphasize on need for conservation of energy and environment.

**Introduction:** Natural Resources & its types, Concept of sustainability and sustainable use of natural resources, Pollution based environmental issues and case studies

**Conventions on Climate Change:** Origin of Conference of Parties (COPs), United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC); Kyoto Protocol, instruments of protocol – CDM, JI and IET; Montreal Action Plan; Paris Agreement and post-Paris scenario.

**Air Pollution:** Origin, Sources and effects of air pollution; Primary and secondary meteorological parameters; Wind roses; Atmospheric Stability; Inversion; Plume behavior; Management of air pollution: Source reduction and Air Pollution Control Devices for particulates and gaseous pollutants in stationary and mobile sources.

**Water Pollution:** Origin, Sources of water pollution, Category of water pollutants, Physico-Chemical characteristics, Components of wastewater treatment systems, Advanced treatment technologies.

**Solid waste management:** Introduction to solid waste management, Sources, characteristics of municipal and industrial solid waste, Solid waste management methods: Incineration, composting, Biomethanation, landfill, E-waste management, Basal convention.

**Energy Resources:** Classification of Energy Resources; Conventional energy, resources-Coal, petroleum and natural gas, nuclear energy, hydroelectric power; Non- conventional energy resources- Biomass energy, Thermo-chemical conversion and biochemical conversion route; Generation of Biogas and biodiesel as fuels; Solar energy-active and passive solar energy absorption systems; Type of collectors; Thermal and photo conversion applications; Wind energy.

**Facilitated through Online Platforms**

**Ecology and Environment:** Concept of an ecosystem; structural and functional units of an ecosystem; Food Chain, Food Web, Trophic Structures and Pyramids; Energy flow; Ecological Succession; Types, Characteristics, Biodiversity, Biopiracy.

**Human Population and the Environment:** Population growth, variation among nations; Population explosion – Family Welfare Programmes; Environment and human health; Human Rights; Value Education; Women and Child Welfare; Role of Information Technology in Environment and Human Health, Environmental Ethics.

**Course Learning Outcomes (CLOs):**

**On the completion of course, students will be able to:**

1. Comprehend the interdisciplinary context with reference to the environmental issues and case studies
2. Assess the impact of anthropogenic activities on the various elements of environment and apply suitable techniques to mitigate their impact.
3. Conceptualise and explain the structural and functional features of ecological systems
4. Correlate environmental concerns with the conventional energy sources associated and assess the uses and limitations of non-conventional energy technologies

**Recommended Books**


1. Moaveni, S., Energy, Environment and Sustainability, Cengage (2018)
2. Down to Earth, Environment Reader for Universities, CSE Publication (2018)
3. Chapman, J.L. and Reiss, M.J., Ecology - Principles and Application, Cambridge University Press (LPE) (1999).
4. Eastop, T.P. and Croft, D.R. Energy Efficiency for Engineers and Technologists, Longman and Harow (2006).
5. O'Callagan, P.W., Energy Management, McGraw Hill Book Co. Ltd. (1993).
6. Peavy H.S. and Rowe D.R. Environmental Engineering, McGraw Hill (2013).


**Evaluation Scheme:**

| **S.No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 50 |
| 3. | Sessionals/Quizzes Evaluations | 20 |

## UES009: MECHANICS

| L | T | P | Cr |
|---|---|---|---|
| 2 | 1 | 0 | 2.5 |

**Course Objectives:** The objective of this module is to help students develop the techniques needed to solve general engineering mechanics problems. Students will learn to describe physical systems mathematically so that their behavior can be predicted.

**Review of Newton's law of motion and vector algebra.**
**Equilibrium of Bodies:** Free-body diagrams, conditions of equilibrium, torque due to a force, statical determinacy.
**Plane Trusses:** Forces in members of a truss by method of joints and method of sections.
**Friction:** Sliding, belt, screw and rolling.
**Properties of Plane Surfaces:** First moment of area, centroid, second moment of area etc.
**Shear Force and Bending Moment Diagrams**: Types of load on beams, classification of beams; axial, shear force and bending moment diagrams: simply supported, overhung and cantilever beams subjected to any combination of point loads, uniformly distributed and varying load and moment.
**Virtual Work:** Principle of virtual work, calculation of virtual displacement and virtual work.
**Experimental Project Assignment/ Micro Project: S**tudents in groups of 4/5 will do project on Model Bridge Experiment: This will involve construction of a model bridge using steel wire and wood.

**Course Learning Outcomes (CLO):**
The students will be able to:
1. Determine resultants in plane force systems
2. Identify and quantify all forces associated with a static framework
3. Draw Shear Force Diagram and Bending Moment Diagram in various kinds of beams subjected to different kinds of loads

**Text Books:**
1. Shames, I. H. Engineering Mechanics: Dynamics, Pearson Education India (2006).
2. Beer, Johnston, Clausen and Staab, Vector Mechanics for Engineers, Dynamics, McGraw-Hill Higher Education (2003).

**Reference Books:**
1. Hibler, T.A., Engineering Mechanics: Statics and Dynamics, Prentice Hall (2012).
2. Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill Education Private Limited, (2006).

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weights (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals ( May include Assignments/Projects/Tutorials/Quiz | 25 |

## UES013: ELECTRICAL ENGINEERING

| L | T | P | Cr. |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objective:** To introduce concepts of DC and AC circuits and electromagnetism. To make the students understand the concepts and working of single-phase transformers, DC motor and generators.

**DC Circuits**: Kirchhoff's voltage and current laws; power dissipation; Voltage source and current source; Mesh and Nodal analysis; Star-delta transformation; Superposition theorem; Thevenin's theorem; Norton's theorem; Maximum power transfer theorem; Millman's theorem and Reciprocity theorem; Transient response of series RL and RC circuits.

**Steady state analysis of DC Circuits:** The ideal capacitor, permittivity; the multi-plate capacitor, variable capacitor; capacitor charging and discharging, current-voltage relationship, time-constant, rise-time, fall-time; inductor energisation and de-energisation, inductance current-voltage relationship, time-constant; Transient response of RL, RC and RLC Circuits.

**AC Circuits:** Sinusoidal sources, RC, RL and RLC circuits, Concept of Phasors, Phasor representation of circuit elements, Complex notation representation, Single phase AC Series and parallel circuits, power dissipation in ac circuits, power factor correction, Resonance in series and parallel circuits, Balanced and unbalanced 3-phase circuit - voltage, current and power relations, 3-phase power measurement, Comparison of single phase and three phase supply systems.

**Electromagnetism:** Electromagnetic induction, Dot convention, Equivalent inductance, Analysis of Magnetic circuits, AC excitation of magnetic circuit, Iron Losses, Fringing and stacking, applications: solenoids and relays.

**Single Phase Transformers:** Constructional features of transformer, operating principle and applications, equivalent circuit, phasor analysis and calculation of performance indices.

**Motors and Generators:** DC motor operating principle, construction, energy transfer, speed-torque relationship, conversion efficiency, applications, DC generator operating principle, reversal of energy transfer, emf and speed relationship, applications.

**Laboratory Work:** Network laws and theorems, Measurement of R,L,C parameters, A.C. series and parallel circuits, Measurement of power in 3 phase circuits, Reactance calculation of variable reactance choke coil, open circuit and short circuit tests on single phase transformer, Starting of rotating machines.

**Course Learning Outcome (CLO):**

After the completion of the course the students will be able to:

1. Apply networks laws and theorems to solve electric circuits.
2. Analyze transient and steady state response of DC circuits.
3. Signify AC quantities through phasor and compute AC system behaviour during steady state.
4. Explain and analyse the behaviour of transformer.
5. Elucidate the principle and characteristics of DC motor and DC generator**.**

**Text Books:**

1. Hughes, E., Smith, I.M., Hiley, J. and Brown, K., Electrical and Electronic Technology, PHI (2008).
2. Nagrath, I.J. and Kothari, D.P., Basic Electrical Engineering, Tata McGraw Hill (2002).
3. Naidu, M.S. and Kamashaiah, S., Introduction to Electrical Engineering, Tata McGraw Hill (2007).

**Reference Books:**

1. Chakraborti, A., Basic Electrical Engineering, Tata McGraw–Hill (2008).
2. Del Toro, V., Electrical Engineering Fundamentals, Prentice–Hall of India Private Limited (2004)

**Evaluation Scheme:**

| S N | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 40 |

## UMA010: MATHEMATICS - I

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 0 | 3.5 |

**Course Objectives**: To provide students with skills and knowledge in sequence and series, advanced calculus, calculus of several variables and complex analysis which would enable them to devise solutions for given situations they may encounter in their engineering profession.

**Partial Differentiation:** Functions of several variables, Limits and continuity, Chain rule, Change of variables, Partial differentiation of implicit functions, Directional derivatives and its properties, Maxima and minima by using second order derivatives

**Multiple Integrals: :** Double integral (Cartesian), Change of order of integration in double integral, Polar coordinates, graphing of polar curves, Change of variables (Cartesian to polar), Applications of double integrals to areas and volumes, evaluation of triple integral (Cartesian).

**Sequences and Series:** Introduction to sequences and Infinite series, Tests for convergence/divergence, Limit comparison test, Ratio test, Root test, Cauchy integral test, Alternating series, Absolute convergence and conditional convergence.

**Series Expansions:** Power series, Taylor series, Convergence of Taylor series, Error estimates, Term by term differentiation and integration.

**Complex analysis**: Introduction to complex numbers, geometrical interpretation, functions of complex variables, examples of elementary functions like exponential, trigonometric and hyperbolic functions, elementary calculus on the complex plane (limits, continuity, differentiability), Cauchy-Riemann equations, analytic functions, harmonic functions.

**Course Learning Outcomes:** Upon completion of this course, the students will be able to

1) examine functions of several variables, define and compute partial derivatives, directional derivatives and their use in finding maxima and minima in some engineering problems.
2) evaluate multiple integrals in Cartesian and Polar coordinates, and their applications to engineering problems.
3) determine the convergence/divergence of infinite series, approximation of functions using power and Taylor's series expansion and error estimation.
4) represent complex numbers in Cartesian and Polar forms and test the analyticity of complex functions by using Cauchy-Riemann equations.

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**Text Books:**

1) Thomas, G.B. and Finney, R.L., Calculus and Analytic Geometry, Pearson Education (2007), 9th ed.
2) Stewart James, Essential Calculus; Thomson Publishers (2007), 6th ed.
3) Kasana, H.S., Complex Variables: Theory and Applications, Prentice Hall India, 2005 (2nd edition).

**Reference Books:**

1) Wider David V, Advanced Calculus: Early Transcendentals, Cengage Learning (2007).
2) Apostol Tom M, Calculus, Vol I and II, John Wiley (2003).
3) Brown J.W and Chruchill R.V, Complex variables and applications, MacGraw Hill, (7th edition)

**Evaluation Scheme:**

| Sr.No. | Evaluation Elements | Weight age (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May include assignments/quizzes) | 25 |

## UPH004: APPLIED PHYSICS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives:** To introduce the student to the basic physical laws of oscillators, acoustics of buildings, ultrasonics, electromagnetic waves, wave optics, lasers, and quantum mechanics and demonstrate their applications in technology. To introduce the student to measurement principles and their application to investigate physical phenomena

**Oscillations and Waves:** Oscillatory motion and damping, Applications - Electromagnetic damping – eddy current; **Acoustics:** Reverberation time, absorption coefficient, Sabine's and Eyring's formulae (Qualitative idea), Applications - Designing of hall for speech, concert, and opera; **Ultrasonics:** Production and Detection of Ultrasonic waves, Applications - green energy, sound signaling, dispersion of fog, remote sensing, Car's airbag sensor.
**Electromagnetic Waves:** Scalar and vector fields; Gradient, divergence, and curl; Stokes' and Green's theorems; Concept of Displacement current; Maxwell's equations; Electromagnetic wave equations in free space and conducting media, Application - skin depth.
**Optics: Interference:** Parallel and wedge-shape thin films, Newton rings, Applications as Non-reflecting coatings, Measurement of wavelength and refractive index. **Diffraction:** Single and Double slit diffraction, and Diffraction grating, Applications - Dispersive and Resolving Powers. **Polarization:** Production, detection, Applications – Anti-glare automobile headlights, Adjustable tint windows. **Lasers:** Basic concepts, Laser properties,Ruby, HeNe, and Semiconductor lasers, Applications – Optical communication and Optical alignment.
**Quantum Mechanics:** Wave function, Steady State Schrodinger wave equation, Expectation value, Infinite potential well, Tunneling effect (Qualitative idea), Application - Quantum computing.

**Laboratory Work:**
1 Determination of damping effect on oscillatory motion due to various media.
2 Determination of velocity of ultrasonic waves in liquids by stationary wave method.
3 Determination of wavelength of sodium light using Newton's rings method.
4 Determination of dispersive power of sodium-D lines using diffraction grating.
5 Determination of specific rotation of cane sugar solution.
6 Study and proof of Malus' law in polarization.
7 Determination of beam divergence and beam intensity of a given laser.
8 Determination of displacement and conducting currents through a dielectric.
9 Determination of Planck's constant.

**Micro project:** Students will be given physics-based projects/assignments using computer simulations, etc.

**Course Outcomes:**
Upon completion of this course, students will be able to:
1. Understand damped and simple harmonic motion, the role of reverberation in designing a hall and generation and detection of ultrasonic waves.

2. Use Maxwell's equations to describe propagation of EM waves in a medium.
3. Demonstrate interference, diffraction and polarization of light.
4. Explain the working principle of Lasers.
5. Use the concept of wave function to find probability of a particle confined in a box.

**Text Books**

1 Beiser, A., Concept of Modern Physics, Tata McGraw Hill (2007) 6$^{th}$ ed.
2 Griffiths, D.J., Introduction to Electrodynamics, Prentice Hall of India (1999) 3$^{rd}$ ed.
3 Jenkins, F.A. and White, H.E., Fundamentals of Optics, McGraw Hill (2001) 4$^{th}$ ed.

**Reference Books**

1 Wehr, M.R, Richards, J.A., Adair, T.W., Physics of The Atom, Narosa Publishing House (1990) 4$^{th}$ ed.
2 Verma, N.K., Physics for Engineers, Prentice Hall of India (2014)1$^{st}$ ed.
3 Pedrotti, Frank L., Pedrotti, Leno S., and Pedrotti, Leno M., Introduction to Optics, Pearson Prentice Hall$^{TM}$ (2008) 3$^{rd}$ ed.

**Scheme of evaluation**

| **Event** | Weightage |
|---|---:|
| Mid-Sem Test | 25 |
| Tut/Sessional | 7 |
| Lab + Project | 25 |
| Quiz | 8 |
| End-Sem Test | 35 |
| **Total** | **100** |

## UTA018: OBJECT ORIENTED PROGRAMMING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objectives:** To become familiar with object oriented programming concepts and be able to apply these concepts in solving diverse range of applications.

**Object Oriented Programming with C++:** Class declaration, creating objects, accessing objects members, nested member functions, memory allocation for class, objects, static data members and functions. Array of objects, dynamic memory allocation, this pointer, nested classes, friend functions, constructors and destructors, constructor overloading, copy constructors, operator overloading and type conversions.
**Inheritance and Polymorphism:** Single inheritance, multi-level inheritance, multiple inheritance, runtime polymorphism, virtual constructors and destructors.
**File handling:** Stream in C++, Files modes, File pointer and manipulators, type of files, accepting command line arguments.
**Templates and Exception Handling:** Use of templates, function templates, class templates, handling exceptions.
**Introduction to Windows Programming in C++:** Writing program for Windows, using COM in Windows Program, Windows Graphics, User Input

**Laboratory work:**
To implement Programs for various kinds of programming constructs in C++ Language.

### Course learning outcomes (CLOs):

On completion of this course, the students will be able to:

1. Write, compile and debug programs in C++, use different data types, operators and I/O function in a computer program.
2. Comprehend the concepts of classes, objects and apply basics of object oriented programming, polymorphism and inheritance.
3. Demonstrate use of file handling.
4. Demonstrate use of templates and exception handling.
5. Demonstrate use of windows programming concepts using C++.

### Evaluation scheme

| Sr. no. | Evaluation Elements | Weights (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 40 |
| 3. | Sessionals<br>(May include Assignments/Projects/Tutorials/Quiz/Lab evaluations) | 35 |

## UEC001: ELECTRONIC ENGINEERING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objective:** To enhance comprehension capabilities of students through understanding of electronic devices, various logic gates, SOP, POS and their minimization techniques, various logic families and information on different IC's and working of combinational circuits and their applications.

**Semiconductor Devices:** p- n junction diode: Ideal diode, V-I characteristics of diode, Diode small signal model, Diode switching characteristics, Zener diode

**Electronics Devices and Circuits:** PN Diode as a rectifier, Clipper and clamper, Operation of Bipolar Junction Transistor and Transistor Biasing, CB, CE, CC (Relationship between α, β, γ) circuit configuration Input-output characteristics, Transistor as a switch, as an Amplifier and its frequency Response, Introduction to Field Effect Transistor and its characteristics, N and P channel MOS transistors, CMOS inverter, NAND and NOR gates, General CMOS Logic, TTL and CMOS logic families,

**Operational Amplifier Circuits**: The ideal operational amplifier, The inverting, non-inverting amplifiers, Op-Amp Characteristics, Applications of Op-amp.

**Digital Systems and Binary Numbers:** Introduction to Digital signals and systems, Number systems, Positive and negative representation of numbers, Binary arithmetic, Definitions and basic theorems of Boolean Algebra**,** Algebraic simplification, Sum of products and product of sums formulations (SOP and POS), Gate primitives, AND, OR, NOT and Universal Gate, Minimization of logic functions, Karnaugh Maps.

**Combinational and Sequential Logic:** Code converters, multiplexors, decoders, Addition circuits and priority encoder, Master-slave and edge-triggered flip-flops, Synchronous and Asynchronous counters, Registers, IEEE Representation of Digital ICs.

**Laboratory Work:**
Familiarization with CRO, DSO and Electronic Components, Diodes characteristics - Input-Output and Switching, BJT and MOSFET Characteristics, Zener diode as voltage regulator, Rectifiers, Clippers and Clampers, adder circuit implementation, Multiplexer & its application, Latches/Flip-flops, up/down counters.

**Course learning outcomes (CLO):** The student will be able to:

1. Demonstrate the use of semiconductor diodes in various applications.
2. Discuss and explain the working of transistors and operational Amplifiers, their configurations and applications.
3. Recognize and apply the number systems and Boolean algebra.
4. Reduce Boolean expressions and implement them with Logic Gates.
5. Analyze, design and implement combinational and sequential circuits.

**Text Books:**


1. Boylestad, R.L. and Nashelsky, L., Electronic Devices & Circuit Theory, Perason (2009).
2. M. M. Mano and M.D. Ciletti, Digital Design, Pearson, Prentice Hall, 2013.

**Reference Books:**

1. Milliman, J. and Halkias, C.C., Electronic Devices and Circuits, Tata McGraw Hill, 2007.
2. Donald D Givone, Digital Principles and Design, McGraw-Hill, 2003.
3. John F Wakerly, Digital Design: Principles and Practices, Pearson, (2000).
4. N Storey, Electronics: A Systems Approach, Pearson, Prentice Hall, (2009).

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 35 |
| 3. | Sessional (May include Assignments/Projects/Tutorials/Quiz(es)/Lab Evaluations) | 40 |

## UTA015: ENGINEERING DRAWING

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 4 | 4.0 |

**Course Objectives:** This module is dedicated to graphics and includes two sections: manual drawing and AutoCAD. This course is aimed at to make the student understand dimensioned projections, learn how to create two-dimensional images of objects using first and third angle orthographic projection as well as isometric, perspective and auxiliary projection, to interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism and to create and edit drawings using drafting software AutoCAD.

**Engineering Drawing**

1. Introduction
2. Orthographic Projection: First angle and third angle projection system
3. Isometric Projections
4. Auxiliary Projections
5. Perspective Projections
6. Introduction to Mechanical Drawing
7. Sketching engineering objects
8. Sections, dimensions and tolerances

**AutoCAD**

1. Management of screen menus commands
2. Introduction to drawing entities
3. Co-ordinate systems: Cartesian, polar and relative coordinates
4. Drawing limits, units of measurement and scale
5. Layering: organizing and maintaining the integrity of drawings
6. Design of prototype drawings as templates.
7. Editing/modifying drawing entities: selection of objects, object snap modes, editing commands,
8. Dimensioning: use of annotations, dimension types, properties and placement, adding text to drawing

**Micro Projects /Assignments:**

1. Completing the views - Identification and drawing of missing lines in the projection of objects
2. Missing views – using two views to draw the projection of the object in the third view, primarily restricting to Elevation, Plan and Profile views
3. Projects related to orthographic and isometric projections
    a. Using wax blocks or soap bars to develop three dimensional object from given orthographic projections
    b. Using wax blocks or soap bars to develop three dimensional object, section it and color the section
    c. Use of AUTOCAD as a complementary tool for drawing the projections of the objects created in (1) and (2).
4. Develop the lateral surface of different objects involving individual or a combination of solids like Prism, Cone, Pyramid, Cylinder, Sphere etc.

5. To draw the detailed and assembly drawings of simple engineering objects/systems with due sectioning (where ever required) along with bill of materials. e.g. Rivet joints, simple bearing, wooden joints, Two plates connected with nut and bolt etc.

**Course Learning Outcomes (CLO):**

Upon completion of this module, students will be able to:

1. creatively comprehend geometrical details of common engineering objects
2. draw dimensioned orthographic and isometric projections of simple engineering objects
3. draw sectional views of simple engineering objects.
4. interpret the meaning and intent of toleranced dimensions and geometric tolerance symbolism
5. create and edit dimensioned drawings of simple engineering objects using AutoCAD
6. organize drawing objects using layers and setting up of templates in AutoCAD

**Text Books:**

1. Jolhe, D.A., Engineering Drawing, Tata McGraw Hill, 2008
2. Davies, B. L., Yarwood, A., Engineering Drawing and Computer Graphics, Van Nostrand Reinhold (UK), 1986

**Reference Books:**

1. Gill, P.S., Geometrical Drawings, S.K. Kataria & Sons, Delhi (2008).
2. Gill, P.S., Machine Drawings, S.K. Kataria & Sons, Delhi (2013).
3. Mohan, K.R., Engineering Graphics, Dhanpat Rai Publishing Company (P) Ltd, Delhi (2002).
4. French, T. E., Vierck, C. J. and Foster, R. J., Fundamental of Engineering Drawing & Graphics Technology, McGraw Hill Book Company, New Delhi (1986).
5. Rowan, J. and Sidwell , E. H., Graphics for Engineers, Edward Arnold, London (1968).

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | Mid semester test (formal written test) | 25 |
| 2 | End semester test (formal written test) | 40 |
| 3 | Sessional: (may include the Following)<br>Continuous evaluation of drawing assignments in tutorial/ regular practice of AutoCAD tutorial exercises & Individual independent project work/drawing and AutoCAD assignment | 35 |

## UMA004-Mathematics - II

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 0 | 3.5 |

**Course Objectives**: To introduce students the theory and concepts of differential equations, linear algebra, Laplace transformations and Fourier series which will equip them with adequate knowledge of mathematics to formulate and solve problems analytically.

**Linear Algebra:** Row reduced echelon form, Solution of system of linear equations, Matrix inversion, Linear spaces, Subspaces, Basis and dimension, Linear transformation and its matrix representation, Eigen-values, Eigen-vectors and Diagonalisation, Inner product spaces and Gram-Schmidt orthogonalisation process.

**Ordinary Differential Equations**: Review of first order differential equations, Exact differential equations, Second and higher order differential equations, Solution techniques using one known solution, Cauchy - Euler equation, Method of undetermined coefficients, Variation of parameters method, Engineering applications of differential equations.

**Laplace Transform:** Definition and existence of Laplace transforms and its inverse, Properties of the Laplace transforms, Unit step function, Impulse function, Applications to solve initial and boundary value problems.

**Fourier Series:** Introduction, Fourier series on arbitrary intervals, Half range expansions, Applications of Fourier series to solve wave equation and heat equation.

**Course Learning Outcomes**: Upon completion of this course, the students will be able to:

1. solve the differential equations of first and 2nd order and basic application problems described by these equations.
2. find the Laplace transformations and inverse Laplace transformations for various functions. Using the concept of Laplace transform students will be able to solve the initial value and boundary value problems.
3. find the Fourier series expansions of periodic functions and subsequently will be able to solve heat and wave equations.
4. solve systems of linear equations by using elementary row operations.
5. identify the vector spaces/subspaces and to compute their bases/orthonormal bases. Further, students will be able to express linear transformation in terms of matrix and find the eigen values and eigen vectors.

**Text Books:**

1) Simmons, G.F., Differential Equations (With Applications and Historical Notes), Tata McGraw Hill (2009).

2) Krishnamurthy, V.K., Mainra, V.P. and Arora, J.L., An introduction to Linear Algebra, Affiliated East West Press (1976).

**Reference Books:**

1) Kreyszig Erwin, Advanced Engineering Mathematics, John Wiley (2006), 8th ed.
2) Jain, R.K. and Iyenger, S.R.K , Advanced Engineering Mathematics, Narosa Publishing House(2011), 11th ed.

**Evaluation Scheme:**

| Sr.No. | Evaluation Elements | Weight age (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May include assignments/quizzes) | 25 |

## UHU 003: Professional Communication

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course objective:** To introduce the students to effective professional communication. The student will be exposed to effective communication strategies and different modes of communication. The student will be able to analyze his/ her communication behavior and that of the others. By learning and adopting the right strategies, the student will be able to apply effective communication skills, professionally and socially.

**Effective communication:** Meaning, Barriers,Types of communication and Essentials.Interpersonal Communication skills.
**Effective Spoken Communication:** Understanding essentials of spoken communication,Public speaking, Discussion Techniques,Presentation strategies.
**Effective Professional and Technical writing:** Paragraph development, Forms of writing,Abstraction and Summarization of a text;Technicalities of letter writing,internal and external organizational communication.Technical reports and proposals.
**Effective non verbal communication:** Knowledge and adoption of the right non verbal cues of body language, interpretation of the body language in professional context. Understanding Proxemics and other forms of non verbal communication.
**Communicating for Employment:** Designing Effective Job Application letter and resumes.
**Communication Networks in organizations:**Types, barriers and overcoming the barriers.

**Laboratory work :**

1. Needs-assessment of spoken and written communication and feedback.
2. Training for Group Discussions through simulations and role plays.
3. Technical report writing on survey based projects.
4. Project based team presentations.

**Course learning outcome (CLO):**

1. Apply communication concepts for effective interpersonal communication.
2. Select the most appropriate media of communication for a given situation.
3. Speak assertively and effectively.
4. Write objective organizational correspondence.
5. Design effective resumes,reports and proposals .

**Text Books:**


1. Lesikar R.V and Flately M.E., Basic Business Communication Skills for the Empowering the Internet Generation. Tata Mc Graw Hill. New Delhi (2006).
2. Raman,M & Sharma, S.,Technical Communication Principles and Practice, Oxford University Press New Delhi.(2011).
3. Mukherjee H.S.,Business Communication-Connecting at Work,Oxford University Press New Delhi, (2013).

**Reference Books:**

1. Butterfield, Jeff.,Soft Skills for everyone,Cengage Learning New Delhi,(2013).
2. Robbins, S.P., & Hunsaker, P.L.,Training in Interpersonal Skills,Prentice Hall of India New Delhi,(2008).
3. DiSianza,J.J & Legge,N.J.,Business and Prfofessional Communication,Pearson Education India New Delhi,(2009).

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 35 |
| 3. | Sessionals (Group Discussions; professional presentations;poster presentatios ,public speaking;technical reports) | 40 |

## UES012 – ENGINEERING MATERIALS

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | **2** | **4.5** |

**Course Objective:** To provide basic understanding of engineering materials, their structure and the influence of structure on mechanical, chemical, electrical and magnetic properties.

**Structure of solids:** Classification of engineering materials, Structure-property relationship in engineering materials, Crystalline and non-crystalline materials, Miller Indices, Crystal planes and directions, Determination of crystal structure using X-rays, Inorganic solids, Silicate structures and their applications. Defects; Point, line and surface defects.

**Mechanical properties of materials:** Elastic, Anelastic and Viscoelastic behaviour, Engineering stress and engineering strain relationship, True stress - true strain relationship, review of mechanical properties, Plastic deformation by twinning and slip, Movement of dislocations, Critical shear stress, Strengthening mechanism, and Creep.

**Equilibrium diagram:** Solids solutions and alloys, Gibbs phase rule, Unary and binary eutectic phase diagram, Examples and applications of phase diagrams like Iron - Iron carbide phase diagram.

**Electrical and magnetic materials:** Conducting and resister materials, and their engineering application; Semiconducting materials, their properties and applications; Magnetic materials, Soft and hard magnetic materials and applications; Superconductors; Dielectric materials, their properties and applications. Smart materials: Sensors and actuators, piezoelectric, magnetostrictive and electrostrictive materials.

**Corrosion process:** Corrosion, Cause of corrosion, Types of corrosion, Protection against corrosion.

**Materials selection:** Overview of properties of engineering materials, Selection of materials for different engineering applications.

**Laboratory Work and Micro-Project:**

Note: The micro-project will be assigned to the group(s) of students at the beginning of the semester. Based on the topic of the project the student will perform any of the six experiments from the following list:

1. To determine Curie temperature of a ferrite sample and to study temperature dependence of permeability in the vicinity of Curie temperature.
2. To study cooling curve of a binary alloy.
3. Determination of the elastic modulus and ultimate strength of a given fiber strand.
4. To determine the dielectric constant of a PCB laminate.
5. Detection of flaws using ultrasonic flaw detector (UFD).
6. To determine fiber and void fraction of a glass fiber reinforced composite specimen.
7. To investigate creep of a given wire at room temperature.
8. To estimate the Hall coefficient, carrier concentration and mobility in a semiconductor crystal.

9. To estimate the band-gap energy of a semiconductor using four probe technique.
10. To measure grain size and study the effect of grain size on hardness of the given metallic specimens.

**Course Outcomes:** Student will be able to:
1. classify engineering materials based on its structure.
2. draw crystallographic planes and directions.
3. distinguish between elastic and plastic behavior of materials.
4. distinguish between isomorphous and eutectic phase diagram.
5. classify materials based on their electrical and magnetic properties.
6. propose a solution to prevent corrosion.

***Text Books:***

1. W.D. Callister , Materials Science and Engineering; John Wiley & Sons, Singapore, 2002.
2. W.F. Smith, Principles of Materials Science and Engineering: An Introduction; Tata Mc-Graw Hill, 2008.
3. V. Raghavan, Introduction to Materials Science and Engineering; PHI, Delhi, 2005.


***Reference Books:***

1. S. O. Kasap, Principles of Electronic Engineering Materials; Tata Mc-Graw Hill, 2007.
2. L. H. Van Vlack, Elements of Material Science and Engineering; Thomas Press, India, 1998.
3. K. G. Budinski, Engineering Materials – Properties and selection, Prentince Hall India, 1996


**Evaluation Scheme**

| **Event** | Weightage |
|---|---:|
| Mid-Sem Test | 25 |
| Tut/Sessional | 5 |
| Lab + Project | 25 |
| Quiz | 10 |
| End-Sem Test | 35 |
| **Total** | **100** |

# UMA007: NUMERICAL ANALYSIS

## (For all branches except ELE and EIC)

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objectives**: The main objective of this course is to motivate the students to understand and learn various numerical techniques to solve mathematical problems representing various engineering, physical and real-life problems.

**Floating-Point Numbers**: Floating-point representation, rounding, chopping, error analysis, conditioning and stability.

**Non-Linear Equations**: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and order of convergence.

**Linear Systems and Eigen-Values**: Gauss elimination method using pivoting strategies, LU decomposition, Gauss-Seidel and successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for Eigen-values and Eigen-vectors.

**Interpolation and Approximations**: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis, least square approximations.

**Numerical Integration**: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.

**Differential Equations**: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order differential equations.

**Laboratory Work:** Lab experiments will be set in consonance with materials covered in the theory. Implementation of numerical techniques using **MATLAB**.

**Course learning outcomes (CLOs)**: Upon completion of this course, the student will be able to:

1. Understand the errors, source of error and its effect on any numerical computations and also analysis the efficiency of any numerical algorithms.
2. Learn how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.
3. Solve system of linear equations numerically using direct and iterative methods.

4. Understand how to approximate the functions using interpolating polynomials.
5. Learn how to solve definite integrals and initial value problems numerically.

**Text Books:**


**1.** Gerald F. C. and Wheatley O. P., Applied Numerical Analysis, Pearson, (2003) 7th Edition, 2. Jain K. M., Iyengar K. R. S. and Jain K. R., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers (2012), 6th edition.

**2.** Steven C. Chappra, Numerical Methods for Engineers, McGraw-Hill Higher Education; 7th edition (1 March 2014)


**Reference Books:**


**3.** Mathew H. J., Numerical Methods for Mathematics, Science and Engineering, Prentice Hall, (1992) 2nd edition.

**4.** Burden L. R. and Faires D. J. Numerical Analysis, Brooks Cole (2011), 9th edition.

**5.** Atkinson K. and Han H., Elementary Numerical Analysis, John Willey & Sons (2004), 3rd edition.


**Evaluation Scheme:**

| Sr.No. | Evaluation Elements | Weight age (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 40 |
| 3. | Sessionals (May include assignments/quizzes) | 15 |
| 4 | Laboratory evaluation | 20 |

## UEC613: DATA STRUCTURES AND ALGORITHMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course objectives:** to become familiar with different types of data structures and their applications and learn different types of algorithmic techniques and strategies.

**Linear data structures:** arrays, records, strings and string processing, references and aliasing, linked lists, strategies for choosing the appropriate data structure, abstract data types and their implementation: stacks, queues, priority queues, sets, maps.

**Basic Analysis**: Differences among best, expected, and worst case behaviors of an algorithm, Asymptotic analysis of upper and expected complexity bounds, Big O notation: formal definition and use, Little o, big omega and big theta notation, Complexity classes, such as constant, logarithmic, linear, quadratic, and exponential, Time and space trade-offs in algorithms, Recurrence relations , Analysis of iterative and recursive algorithms.

**Searching and Sorting:** Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Shell Sort, Quick Sort, Heap Sort, Merge Sort, Counting Sort, Radix Sort.

**Algorithmic Strategies with examples and problem solving**: Brute-force algorithms with examples, Greedy algorithms with examples, Divide-and-conquer algorithms with examples, Recursive backtracking, Dynamic Programming with examples, Branch-and-bound with examples, Heuristics, Reduction: transform-and-conquer with examples.

**Non-Linear Data Structures And Sorting Algorithms:** Hash tables, including strategies for avoiding and resolving collisions, Binary search trees, Common operations on binary search trees such as select min, max, insert, delete, iterate over tree, Graphs and graph algorithms, Representations of graphs, Depth- and breadth-first traversals, Heaps, Graphs and graph algorithms, Shortest-path algorithms (Dijkstra and Floyd) , Minimum spanning tree (Prim and Kruskal).

**Laboratory work:** Implementation of Arrays, Recursion, Stacks, Queues, Lists, Binary trees, Sorting techniques, Searching techniques. Implementation of all the algorithmic techniques.

**Project:** It will contain a Project which should include designing a new data structure/algorithm/ language/tool to solve new problems & implementation. It can also involve creating visualizations for the existing data structures and algorithms. Quantum of project should reflect at least 60 hours of Work excluding any learning for the new techniques and technologies. It should be given to group of 2-4 students. Project should have continuous evaluation and should be spread over different components. There should be a formal project report. Evaluation components may include a poster, video presentation as well as concept of peer evaluation and reflection component.

**Course learning outcome (CLOs):** The students will be able to

1. Implement the basic data structures and solve problems using fundamental algorithms.
2. Implement various search and sorting techniques.
3. Analyze the complexity of algorithms, to provide justification for that selection, and to implement the algorithm in a particular context.
4. Analyse, evaluate and choose appropriate data structure and algorithmic technique to solve real-world problems.

**Text Books:**

1. Corman, Leiserson & Rivest, Introduction to Algorithms, MIT Press (2009), 3rd Ed.
2. Narasimha Karumanchi, Data Structures and Algorithms Made Easy" (2014), 2nd Ed.

**Reference Books:**

1. Sahni, Sartaj, Data Structures, Algorithms and Applications in C++, Universities Press (2005), 2nd ed.

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 20 |
| 2 | EST | 40 |
| 3 | Sessionals (Assignments/Projects/ Tutorials/Quizzes/Lab Evaluations) | 40 |

# UEC310: INFORMATION AND COMMUNICATION THEORY

| L | T | P | Cr. |
|---|---|---|---|
| 3 | 1 | 0 | 3.5 |

**Course Objectives:** To gain knowledge and understand the concepts of probability theory, random variables, stochastic processes and Information theory. To familiarize the students with the applications of probabilistic/stochastic techniques/methods in communication engineering and information theory.

**Details of Contents:**

**Probability Theory:** Review of Probability, Bernoulli Trials, Bernoulli's Theorem, Concepts of Random Variables, Distribution and Probability Density Functions, Conditional Distributions, Binomial Random variables Functions of One Random Variable, its Distribution, Mean and Variance, Moments, Characteristic Functions; Two Functions of Two Random Variables, Joint Moments, Joint Characteristic Functions, Conditional Distributions, Conditional Expected Values, Normality, Center Limit Theorem, and Bayes' Theorem

**Stochastic Processes:** Systems with Stochastic Inputs, Power Spectral Analysis of I/O Signals, Poisson Points, Cyclostationary Processes, Poisson Sum Formula, Ergodicity, Mean Square Estimation, Markov Chains, and Random-Walk Model

**Estimation & Hypothesis Testing:** Time and Ensemble Averages, Covariance Functions. Simple Binary Hypothesis Tests, Decision Criteria, Neyman Pearson Tests, Bayes' Criteria, z-Score, and p-Value Test

**Information Theory:** Introduction, Information measure and entropy, Information source, Markov source, Adjoint of an information source, Joint and Conditional Information measure, Joint and conditional information measure of a Markov source, Instantaneous codes, Kraft-Mcmillan inquality, Shannon first theorem, Coding strategies and Huffman coding, Introduction to information channels, mutual information and channel capacity, Shannon second theorem, channel capacity calculations for different channels, Differential entropy, Rate distortion theory

**Statistical Modeling of Noise:** Probability Density of a Jointly-Gaussian Random Vector, Wide-Sense-Stationary (WSS) Processes, Poisson Process Noise, Noise Statistics in Linear Time-Invariant Systems, Noise Power Spectral Densities, Signal-to-Noise-Ratio in Presence of AWGN and Interferences.

**Text Books:**

1. Athanasios Papoulis, Probability Random Variables and Stochastic Processes, McGraw-Hill (1984)

2. John N. Daigle, Queueing Theory with Applications to Packet Telecommunication, Springer (2005)

3. Bernard Sklar, Digital Communications: Fundamentals and Applications, Prentice Hall (2001)

**Reference Books:**

1. P.Z. Peebles, Probability, Random Variables, and Random Signal Principles, McGraw-Hill (1980)

2. Dimitri P. Bertsekas, Robert G. Gallager, Data Networks, Prentice-Hall (1987)

3. A. Larson and B.O. Schubert, Stochastic Processes, vol. I and II, Holden-Day (1979)

4. W. Gardener, Stochastic Processes, McGraw Hill (1986)

5. IEEE Transactions on Information Theory

6. David J. C. Mackay, "Information Theory, Inference and Learning Algorithms", Cambridge University Press, 2003

**Course Learning Outcomes:**

At the end of this course, the students will be able to

- apply the probabilistic concepts as well as properties of the random variables
- perform the spectral analysis of stationary stochastic processes, for the modeling of real-time desired signals and spurious-signals/noise
- incorporate the estimation and hypothesis testing principles to find remedial solutions
- utilize the features/characteristics of queueing theory in communication systems
- employ information theory and coding concepts, to improve information symbol transmission rate, and also use it for data compression

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 4. | MST | 30 |
| 5. | EST | 40 |
| 6. | Sessional (Including assignments, quiz & micro-project etc.) | 30 |

## UEC301: Analog Electronic Circuits

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | **2** | **4.5** |

**Course Objective:** The aim of this course is to familiarize the student with the analysis and design of basic transistor amplifier circuits, oscillators and wave shaping circuits.

**Transistor Biasing and Thermal Stabilization**: The Operating Point, Biasing Stability, Self-Biasing or Emitter Bias, Stabilization against Variations in $I_{co}$, $V_{BE}$, and β, General Remarks on Collector-Current Stability, Bias Compensation, Thermal Runaway, Thermal Stability, The FET Small-Signal Model, The metal-oxide-semiconductor FET (MOSFET), The low-frequency common-source and common-drain amplifiers, Biasing FET

**Transistor at Low and High Frequencies:** Low frequency h-parameter model of BJT, The Hybrid-pi (II) Common-emitter Transistor Model, Hybrid-II conductances, The Hybrid-II Capacitances, Variation of Hybrid-II parameters, The CE short-circuit current gain, The gain-bandwidth product.

**Multistage Amplifiers**: Classification of amplifiers, Distortion in amplifiers, Frequency response of an amplifier, Step Response of an amplifier, Bandpass of cascaded stages, The RC-coupled amplifier, Low-frequency response of an RC-coupled stage, Effect of an emitter Bypass capacitor on low-frequency response.

**Power Amplifiers:** Class A, B, AB, Push pull & Class C amplifiers, Comparison of their Efficiencies, Types of distortion.

**Feedback Amplifiers**: Classification of Amplifiers, The feedback concept, The transfer gain with feedback, General characteristics of negative-feedback amplifiers, Input resistance, Output resistance, Method of Analysis of a Feedback Amplifier, Voltage-series feedback, Current-series feedback, Current-shunt feedback, Voltage-shunt feedback

**Stability and Oscillators:** Sinusoidal Oscillator, The phase-shift oscillator, Resonant-circuit oscillators, A General form of oscillator circuit, The Wien Bridge oscillator, Crystal oscillator, Frequency Stability

**Wave shaping circuits:** Multi-vibratotrs (Astable, Mono-stable, Bi-Stable), High pass and low pass filters using R-C Circuits & their response to step input, Pulse input, Square input and Ramp Input, Schmitt Trigger.

**Laboratory Work:** Frequency response analysis of RC coupled amplifier, Tuned amplifiers, Push-pull amplifier, Feedback amplifier. Hartley and Colpitts Oscillator. RC Phase shift oscillator. Study of Multi-vibrators (Astable, Mono-stable, Bi-stable Multi-vibrator). Clipper and Clamper circuit, Schmitt Trigger.

**Course learning outcome (CLO):** The student will be able to:

1. Determine operating point and various stability factors of transistor.
2. Analyse low and high frequency transistor model.

3. Analyse the performance of multistage, feedback and power amplifiers.
4. Design oscillator circuits and analyse its performance.
5. Analyse various filters and multi-vibrators circuits.

**Text Books:**


1. Milliman, J. and Halkias, C.C., Intergrated Electronics, Tata McGraw Hill (2007).
2. Milliman, J. &Taub, H., Pulse, Digital and switching waveforms, Tata McGraw Hill (2007).


**Reference Books**


1. Malvino, L., Electronic principles, Tata McGraw Hill (1998).
2. Cathey, J. J., 2000 Solved Examples in Electronics, McGraw Hill (1991).


**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 35 |
| 3. | Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 40 |

## UEC612: DIGITAL SYSTEM DESIGN

| L | T | P | Cr |
|---|---|---|---|
| **3** | **1** | **2** | **4.5** |

**Course Objectives:** To familiarize the student with the analysis, design and evaluation of digital systems of medium complexity that are based on SSI, MSI and Programmable logic devices. Also, to familiarize the students with the issues in the design of iterative networks, timing analysis of synchronous and asynchronous systems.

**Binary Codes:** Review of special binary codes, Error detection and correction codes.

**Combinational Circuits:** Q. M. Method, Variable Map Method, Ripple carry adder, BCD adder, High speed adder, Subtractor, Code conversion, Magnitude comparators, Applications of Encoders, Decoders, MUX, DEMUX, Implementations using ROM, PLA, PAL. Standard ICs and their applications.Using combinational modules to design digital systems, Iterative networks.

**Sequential Circuits:** Various types of latches and flip-flops and their conversions, Universal Shift Registers, Counters – Ring, Johnson, Design of Counters, Timing issues, Setup and hold times, operating frequency limitations, Static Timing Analysis, Standard ICs for their applications, Finite State Machines – Moore and Mealy, Design of Synchronous and Asynchronous sequential circuits, Races and hazards, hazard free design.

**Logic Circuits:** DTL, TTL, MOS, CMOS logic families their comparison, Detailed study of TTL & CMOS logic families and their characteristics i.e. Fan-in, Fan-out, Unit load, Propagation delay, Power dissipation, Current & voltage parameters, Tristate Logic, Interfacing of TTL & CMOS logic families, reading and analyzing Datasheets, Performance estimation of digital systems.

**Laboratory Work:** To study standard ICs and their usage, To study latches and Flip-flops, Design of registers and asynchronous/synchronous up/down counters, Variable modulus counters, Design of Finite State Machines, Study of timing waveforms, Usage of IC tester.

**Course Learning Outcomes:** The student will be able to:

1. Perform Logic Minimization for single/multiple output function(s).
2. Generate multiple digital solutions to a verbally described problem.
3. Evaluate the performance of a given Digital circuit/system.
4. Draw the timing diagrams for the identified signals in a digital circuit.
5. Assess the performance of a given digital circuit with Mealy and Moore configurations.
6. Perform static timing analysis of the digital circuits/systems.
7. Compare the performance of a given digital circuits/systems with respect to their speed, power consumption, number of ICs, and cost.

**Text Books:**

1. Fletcher, W.I., Engineering Approach to Digital Design, Prentice Hall of India (2007) 4th ed.
2. Wakerly, J.F., Digital Design Principles and Practices, Prentice Hall of India (2013) 5thed.

**Reference Books:**

*1.* Givone D. D., Digital Principles and Design, Tata McGraw Hill (2007) 2nd ed.
*2.* Tocci, R.J., Digital Systems: Principles and Applications, Prentice-Hall (2006) 10th ed.
*3.* Mano, M.M. and Clitti M. D., Digital Design, Prentice Hall (2001) 3rd ed.

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations) | 40 |

## UTA013: ENGINEERING DESIGN PROJECT-I (including 6 self effort hours)

| L | T | P | Cr |
|---|---|---|---|
| 1 | 0 | 2 | 5 |

**Course Objectives:** To develop design skills according to a Conceive-Design-Implement-Operate (CDIO) compliant methodology. To apply engineering sciences through learning-by-doing project work. To provide a framework to encourage creativity and innovation. To develop team work and communication skills through group-based activity. To foster self-directed learning and critical evaluation.

To provide a basis for the technical aspects of the project a small number of lectures are incorporated into the module. As the students would have received little in the way of formal engineering instruction at this early stage in the degree course, the level of the lectures is to be introductory with an emphasis on the physical aspects of the subject matter as applied to the 'Mangonel' project. The lecture series include subject areas such as Materials, Structures, Dynamics and Digital Electronics delivered by experts in the field.

This module is delivered using a combination of introductory lectures and participation by the students in 15 "activities". The activities are executed to support the syllabus of the course and might take place in specialised laboratories or on the open ground used for firing the Mangonel. Students work in groups throughout the semester to encourage teamwork, cooperation and to avail of the different skills of its members. In the end the students work in sub-groups to do the Mangonel throwing arm redesign project. They assemble and operate a Mangonel, based on the lectures and tutorials assignments of mechanical engineering they experiment with the working, critically analyse the effect of design changes and implement the final project in a competition. Presentation of the group assembly, redesign and individual reflection of the project is assessed in the end.

**Breakup of lecture details to be taken up by MED:**

| Lec No. | Topic | Contents |
|---|---|---|
| Lec 1 | Introduction | The Mangonel Project. History. Spreadsheet. |
| Lec 2 | PROJECTILE MOTION | no DRAG, Design spread sheet simulator for it. |
| Lec 3 | PROJECTILE MOTION | with DRAG, Design spread sheet simulator for it. |
| Lec 4 | STRUCTURES FAILURE | STATIC LOADS |
| Lec 5 | STRUCTURES FAILURE | DYNAMIC LOADS |
| Lec 6 | REDESIGNING THE MANGONEL | Design constraints and limitations of materials for redesigning the Mangonel for competition as a |
| Lec 7 | MANUFACTURING | Manufacturing and assembling the Mangonel. |
| Lec 8 | SIMULATION IN ENGINEERING DESIGN | Simulation as an Analysis Tool in Engineering Design. |
| Lec 9 | ROLE OF MODELLING & PROTOTYPING | The Role of Modelling in Engineering Design. |

**Breakup of lecture details to be taken up by ECED:**

| Lec No. | Topic | Contents |
|---|---|---|
| Lec 1-5 | Digital Electronics | Prototype, Architecture, Using the Integrated Development Environment (IDE) to Prepare an Arduino Sketch, structuring an Arduino Program, Using Simple Primitive Types (Variables), Simple programming examples. Definition of a sensor and actuator. |

**Tutorial Assignment / Laboratory Work:**
Associated Laboratory/Project Program: T- Mechanical Tutorial, L- Electronics Laboratory, W- Mechanical Workshop of "Mangonel" assembly, redesign, operation and reflection.

| Title for the weekly work in 15 weeks | Code |
|---|---|
| Using a spread sheet to develop a simulator | T1 |
| Dynamics of projectile launched by a Mangonel - No Drag | T2 |
| Dynamics of projectile launched by a Mangonel - With Drag | T3 |
| Design against failure under static actions | T4 |
| Design against failure under dynamic actions | T5 |
| Electronics hardware and Arduino controller | L1 |
| Electronics hardware and Arduino controller | L2 |
| Programming the Arduino Controller | L3 |
| Programming the Arduino Controller | L4 |
| Final project of sensors, electronics hardware and programmed Arduino controller based measurement of angular velocity of the "Mangonel" throwing arm. | L5 |
| Assembly of the Mangonel by group | W1 |
| Assembly of the Mangonel by group | W2 |
| Innovative redesign of the Mangonel and its testing by group | W3 |
| Innovative redesign of the Mangonel and its testing by group | W4 |
| Final inter group competition to assess best redesign and understanding of the "Mangonel". | W5 |

**Project:** The Project will facilitate the design, construction and analysis of a "Mangonel". In addition to some introductory lectures, the content of the students' work during the semester will consist of:

1. the assembly of a Mangonel from a Bill Of Materials (BOM), detailed engineering drawings of parts, assembly instructions, and few prefabricated parts ;
2. the development of a software tool to allow the trajectory of a "missile" to be studied as a function of various operating parameters in conditions of no-drag and drag due to air;
3. a structural analysis of certain key components of the Mangonel for static and dynamic stresses using values of material properties which will be experimentally determined;
4. the development of a micro-electronic system to allow the angular velocity of the throwing arm to be determined;

5. testing the Mangonel;
6. redesigning the throwing arm of the Mangonel to optimise for distance without compromising its structural integrity;
7. an inter-group competition at the end of the semester with evaluation of the group redesign strategies.

**Course Learning Outcomes (CLO):**

Upon completion of this module, students will be able to:

1. simulate trajectories of a mass with and without aerodynamic drag using a spreadsheet based software tool to allow trajectories be optimized;
2. perform a test to acquire an engineering material property of strength in bending and analyze the throwing arm of the "Mangonel" under conditions of static and dynamic loading;
3. develop and test software code to process sensor data;
4. design, construct and test an electronic hardware solution to process sensor data;
5. construct and operate a Roman catapult "Mangonel" using tools, materials and assembly instructions, in a group, for a competition;
6. operate and evaluate the innovative redesign of elements of the "Mangonel" for functional and structural performance;

**Text Books:**

1. Michael Mc Roberts, Beginning Arduino, Technology in action publications.
2. Alan G. Smith, Introduction to Arduino: A piece of cake, Create Space Independent Publishing Platform (2011)

**Reference Book:**

1. John Boxall, Arduino Workshop - A Hands-On Introduction with 65 Projects, No Starch Press (2013)

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | - |
| 2 | EST | - |
| 3 | Sessional: (may include the following)<br><br>Mechanical Tutorial Assignments<br><br>Electronics Hardware and software Practical work in Laboratory<br><br>Assessment of Mechanical contents in Lectures and Tutorials and Electronics contents in Lectures and Practical.<br><br>Project (Assembly of the "Mangonel", innovative redesign with reflection, prototype competition, Final Presentation and viva-voce | <br><br>30<br><br>30<br><br>10<br><br>30 |

## UES018: Manufacturing Technology

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3.0 |

**Course Objectives:** The course introduces the basic concepts of manufacturing via machining, joining and assembly, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tool. The course also introduces the concept of metrology and measurement of parts. The course also provides students with skill, knowledge and hands on experience to work on different vacuum-based deposition techniques, understanding of nucleation and growth of thin films and their different characterization for various electronic application.

## Part A (Common to all)

**Machining Processes:** Principles of metal cutting, Cutting tools, Cutting tool materials and applications, Geometry of single point cutting tool, Introduction to multi-point machining processes – milling, drilling and grinding, Tool Life, Introduction to computerized numerical control (CNC) machines, G and M code programming for simple turning and milling operations, introduction of canned cycles.

**Joining Processes:** Electric arc, Resistance welding, Soldering, Brazing.

## Part B (Program Specific)

**Thin Films Deposition Techniques:** Introduction to vacuum systems, different vacuum pumps and pressure gauges, vacuum leak detection and its solution, Physical Vapour Deposition (PVD), Chemical Vapor Deposition (CVD), Radio Frequency (RF) Sputtering, Direct Current (DC) Sputtering, Thermal Evaporation, Metallization, film thickness measurements, Oxidation techniques and systems, Oxidation of polysilicon.

**Device Manufacturing:** Metal Semiconductor Junctions: Ohmic and Schottky, Metal Oxide Semiconductor (MOS) Device, Application of thin films in different areas such as electronics, medical, defence, sports, auto mobiles etc. Characterization of thin films, MOS device-based characterization, Conductivity measurements, two probe vs four probe resistivity method, CV characterization.

**Course learning outcome (CLOs):**

After completion of this course, the students will be able to:

1. Develop simple CNC code, and use it to produce components while working in groups.
2. Analyse various machining processes and calculate relevant quantities such as velocities, forces.
3. Recognise cutting tool wear and identify possible causes and solutions.
4. Appropriately select the deposition techniques for various electronic application.

5. Analyse and understand the requirements to achieve sound welded joint while welding different similar and dissimilar engineering materials.
6. Perform the device manufacturing and its characterization.

**Text Books / Reference Books**


1. *Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).*
2. *Taha H.A., Operations Research-An Introduction, PHI (2007).*
3. *Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)*
4. *Bazaarra Mokhtar S., Jarvis John J. and ShiraliHanif D., Linear Programming and Network flows, John Wiley and Sons (1990)*
5. *Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).*
6. *M. Ohring, "Materials science of thin films", Academic press (2001).*
7. *L. Holland, "Vacuum deposition of thin films", Chapman and Hall.*


**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 20 |
| 2. | EST | 40 (10+30) |
| 3. | Sessional (Assignments/Practical/Tutorials/Quizzes) | 40 (20+20) |

## UMA035-OPTIMIZATION TECHNIQUES (all branches except for Mechanical)

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objective:** The main objective of the course is to formulate mathematical models and to understand solution methods for real life optimal decision problems. The emphasis will be on basic study of linear and non-linear programming problems, Integer programming problem, Transportation problem, Two person zero sum games with economic applications and project management techniques using CPM.

**Scope of Operations Research:** Introduction to linear and non-linear programming formulation of different models.

**Linear Programming:** Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex method, Exceptional cases in LP, Duality theory, Dual simplex method, Sensitivity analysis.

**Integer Programming:** Branch and bound technique, Gomory's Cutting plane method.

**Network Models:** Construction of networks, Network computations, Free Floats, Critical path method (CPM), optimal scheduling (crashing). Initial basic feasible solutions of balanced and unbalanced transportation problems, optimal solutions, assignment problem.

**Multiobjective Programming:** Introduction to multiobjective linear programming, efficient solution, efficient frontier.

**Nonlinear Programming:**

**Unconstrained Optimization:** unimodal functions, Fibonacci search method, Steepest Descent method, Conjugate Gradient method

**Constrained Optimization:** Concept of convexity and concavity, Maxima and minima of functions of n-variables, Lagrange multipliers, Karush-Kuhn-Tucker conditions for constrained optimization

**Course learning outcome:** Upon Completion of this course, the students would be able to:

1) formulate the linear and nonlinear programming problems.
2) solve linear programming problems using Simplex method and its variants.
3) construct and optimize various network models.
4) solve multiobjective linear programming problems.
5) solve nonlinear programming problems.

**Text Books:**


1) Chandra, S., Jayadeva, Mehra, A., Numerical Optimization and Applications, Narosa Publishing House, (2013).
2) Taha H.A., Operations Research-An Introduction, PHI (2007).


**Recommended Books:**


1) Pant J. C., Introduction to optimization: Operations Research, Jain Brothers (2004)
2) BazaarraMokhtar S., Jarvis John J. and ShiraliHanif D., Linear Programming and Network flows, John Wiley and Sons (1990)
3) Swarup, K., Gupta, P. K., Mammohan, Operations Research, Sultan Chand & Sons, (2010).
4) H.S. Kasana and K.D. Kumar, Introductory Operations research, Springer publication, (2004)
5) Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, Second edn. (2005).


**Evaluation Scheme:**

| Sr.No. | Evaluation Elements | Weight age (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May includeassignments/quizzes/projects) | 25 |

## UTA025: INNOVATION AND ENTREPRENEURSHIP

| L | T | P | Cr. |
|---|---|---|---|
| **1** | **0** | **2*** | **3.0** |

**Course Objectives:** This course aims to provide the students with a basic understanding in the field of entrepreneurship, entrepreneurial perspectives, concepts and frameworks useful for analyzing entrepreneurial opportunities, understanding eco-system stakeholders and comprehending entrepreneurial decision making. It also intends to build competence with respect business model canvas and build understanding with respect to the domain of startup venture finance.

**Introduction to Entrepreneurship:** Entrepreneurs; entrepreneurial personality and intentions - characteristics, traits and behavioral; entrepreneurial challenges.

**Entrepreneurial Opportunities:** Opportunities- discovery/ creation, Pattern identification and recognition for venture creation: prototype and exemplar model, reverse engineering.

**Entrepreneurial Process and Decision Making:** Entrepreneurial ecosystem, Ideation, development and exploitation of opportunities; Negotiation, decision making process and approaches, - Effectuation and Causation.

**Crafting business models and Lean Start-ups**: Introduction to business models; Creating value propositions - conventional industry logic, value innovation logic; customer focused innovation; building and analyzing business models; Business model canvas, Introduction to lean startups, Business Pitching.

**Organizing Business and Entrepreneurial Finance:** Forms of business organizations; organizational structures; Evolution of organization, sources and selection of venture finance options and its managerial implications. Policy Initiatives and focus; role of institutions in promoting entrepreneurship.

**Course learning outcomes (CLO):**

Upon successful completion of the course, the students should be able to:

1. Explain the fundamentals behind the entrepreneurial personality and their intentions
2. Discover/create and evaluate opportunities.
3. Identify various stakeholders for the idea and develop value proposition for the same.
4. Describe various Business Models and design a business model canvas.
5. Analyse and select suitable finance and revenue models for start-up venture.

***Text Books:***


1. *Ries, Eric(2011), The lean Start-up: How constant innovation creates radically successful businesses, Penguin Books Limited.*
2. *Blank, Steve (2013), The Startup Owner's Manual: The Step by Step Guide for Building a Great Company, K&S Ranch.*
3. *S. Carter and D. Jones-Evans, Enterprise and small business- Principal Practice and Policy, Pearson Education (2006)*


***Reference Books:***


1. *T. H. Byers, R. C. Dorf, A. Nelson, Technology Ventures: From Idea to Enterprise, McGraw Hill (2013)*
2. *Osterwalder, Alex and Pigneur, Yves (2010) Business Model Generation.*
3. *Kachru, Upendra, India Land of a Billion Entrepreneurs, Pearson*

4. *Bagchi, Subroto, (2008), Go Kiss the World: Life Lessons For the Young Professional, Portfolio Penguin*
5. *Bagchi, Subroto, (2012). MBA At 16: A Teenager's Guide to Business, Penguin Books*
6. *Bansal, Rashmi, Stay Hungry Stay Foolish, CIIE, IIM Ahmedabad*
7. *Bansal, Rashmi, (2013). Follow Every Rainbow, Westland.*
8. *Mitra, Sramana (2008), Entrepreneur Journeys (Volume 1), Booksurge Publishing*
9. *Abrams, R. (2006). Six-week Start-up, Prentice-Hall of India.*
10. *Verstraete, T. and Laffitte, E.J. (2011). A Business Model of Entrepreneurship, Edward Elgar Publishing.*
11. *Johnson, Steven (2011). Where Good Ideas comes from, Penguin Books Limited.*
12. *Gabor, Michael E. (2013), Awakening the Entrepreneur Within, Primento.*
13. *Guillebeau, Chris (2012), The $100 startup: Fire your Boss, Do what you love and work better to live more, Pan Macmillan*
14. *Kelley, Tom (2011),The ten faces of innovation, Currency Doubleday*
15. *Prasad, Rohit (2013), Start-up sutra: what the angels won't tell you about business and life, Hachette India.*

**Evaluation scheme:**

| Sr.No. | Evaluation Elements | Weight age (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May include assignments/quizzes) | 25 |

# UEC404: SIGNALS AND SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objective:** The aim of this subject is to develop analytical capability of students, by which they would be able to handle signal processing related problems and projects. The knowledge of various transforms will help students to work in multi-disciplinary fields of engineering in group activities.

**Representation of Signals and Systems:** Signals, Basic Continuous and discrete Time signals and systems, Energy and power signals, System modelling concepts, Linear time invariant systems, Representation of signals in terms of impulses, Discrete time LTI systems continuous time LTI systems, Properties of LTI systems, Systems described by differential and difference equations, Sampling theorem, Quantization.

**Fourier Analysis:** Continuous and discrete time Fourier series, Trigonometric and exponential Fourier series, Properties of Fourier series, Continuous and discrete time Fourier transforms and its properties, Analysis of discrete time signals and systems, Linear Convolution, Circular Convolution, Correlation, Autocorrelation.

**Z-Transform**: Definition of Z-transform and Properties of Z-transform, Inverse Z-transform - Power series, partial fraction expansion, residue method and their comparison, Relation between Z.T. and F.T, Discrete time convolution, Time domain and frequency domain analysis, Solution of difference equation, Applications of Z-transforms.

**Introduction to Fast Fourier Transforms**: Discrete Fourier transform, Properties of DFT, Fast Fourier transforms, Divide and Conquer Approach, Decimation in time and decimation in frequency, Radix-n FFT algorithms, Comparison of computational complexity.

**Laboratory work:**
Basics of MATLAB, Signal generation, Properties of signals and systems, Linear and Circular convolution, Correlation, Z-transform, DFT / IDFT, FFT algorithms using MATLAB.

**Course learning outcome (CLO):** The student will be able to:
1. Analyze the properties of continuous and discrete time signals and systems.
2. Represent signals and systems in the frequency domain using Fourier tools.
3. Apply Z-transform to analyze discrete time signals and system.
4. Obtain the fast Fourier transform of a sequence and measure its computational efficiency.

**Text Books:**
1. Oppenheim, A.V. and Willsky, A.S., Signal & Systems, Prentice Hall of India (1997).
2. Kani, A.N. Signals and Systems, McGraw Hill Higher Education,(2011)
3. Proakis, J.G. and Manolakis, D.G., Digital Signal Processing Principles Algorithm & Applications, Prentice Hall, (2007).

**Reference Books:**

1. Roberts, M.J., Signals and Systems: Analysis using Transform Methods and MATLAB, Tata McGraw-Hill,(2012)
2. Lathi, B.P., Signal Processing and Linear Systems, Berkeley Cambridge Press, 1998

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | **25** |
| 2. | EST | **45** |
| 3. | Sessionals (May include Assignments / Projects / Tutorials / Quizes / Lab Evaluations) | **30** |

## UEC608: EMBEDDED SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objective**: The objective of this course is to equip students with the necessary fundamental knowledge and skills that enable them to design basic embedded systems. It covers architecture, programming of ARM processor and it's interfacing with peripheral devices.

**Introduction to Embedded Systems**: Definition, Embedded Systems Vs General Computing Systems, Classification of Embedded Systems, Major application areas. General purpose processor architecture and organization, Von-Neumann and Harvard architectures, CISC and RISC architectures, Big and Little endian processors, Processor design trade-offs, Processor cores: soft and hard.

**Introduction to ARM Processor:** The ARM design philosophy, ARM core data flow model, Architecture, Register set, ARM7TDMI Interface signals, General Purpose Input Output Registers, Memory Interface, Bus Cycle types, Pipeline, ARM processors family, Operational Modes, Instruction Format, Data forwarding.

**Programming based on ARM7TDMI**: ARM Instruction set, condition codes, Addressing modes, Interrupts, Exceptions and Vector Table. Assembly Language Programming, Thumb state, Thumb Programmers model, Thumb Applications, ARM coprocessor interface and Instructions.

**ARM Tools and Interfacing of Peripherals:** ARM Development Environment, Arm Procedure Call Standard (APCS), Example C/C++ programs, Embedded software development, Image structure, linker inputs and outputs, Protocols (I2C, SPI), Memory Protection Unit (MPU). Physical Vs Virtual Memory, Paging, Segmentation. The Advanced Microcontroller Bus Architecture (AMBA), DMA, Peripherals, Interfacing of peripherals with ARM.

**Laboratory Work:** Introduction to Kiel Software, Introduction to ARM processor kit, Programming examples of ARM processor. Interfacing of LED, Seven Segment Display, Stepper Motor, LCD with ARM7TDMI processor.

**Course Learning Outcomes (CLO):**

The student will be able to:

1. Explain embedded system, its processor architecture and distinguish it from general computing system.
2. Describe ARM processor internal architecture, assembly instructions, their format and Develop ARM processor-based assembly language program for a given statement.

3. Describe how thumb mode operations are designed and various coprocessors are interfaced in an embedded system.
4. Interface various hardware peripherals in embedded systems.
5. Recognize issues to be handled in any processor software tool chain for embedded system development especially using C/C++.

**Text Books:**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer organization and embedded systems, Sixth Edition, McGraw Hill, 2012.

2. ARM System on Chip Architecture–Steve Furber–2nd Ed., 2000, Addison Wesley Professional.

**Reference Books:**

1. Introduction to Embedded Systems, Shibu K V, Mc Graw-Hill

2.Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MCGraw-Hill.

3. Andrew N. Sloss, ARM System Developer's Guide Designing and Optimizing System Software, Morgan Kaufman Publication (2010)

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC533: COMPUTER AND COMMUNICATION NETWORKS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objective**: To introduce basic concepts of Data communication with different models. Enumerate the physical layer, Data Link Layer, Network Layer, Transport Layer and Application Layer, explanation of the function(s) of each layer. Familiarization with cryptography and network security.

**Syllabus break-up**:

**Overview of Data Communication and Networking:** Data communications, Networks, The Internet, Protocols and standards, Layered tasks, OSI model, TCP /IP protocol Architecture and its addressing, Data Rate Limits, Circuit switching, Packet Switching, Message Switching.

**Data link layer:** Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Point to point protocol, PPP stack, on, IEEE Standards: 802.3 to 802.6 and 802.11, FDDI, Bluetooth; Introduction to Virtual circuit switching including frame relay, X.25, ATM and Softswitch Architecture; Telephone networks, DSL technology, Cable modem, SONET/SDH. Connecting devices, Backbone network, Virtual LAN, Cellular telephony, Satellite networks.

**Queueing Theory:** An Introduction to Queues and Queueing Theory, Basic Queueing Theory - I (Analysis of M/M/-/- Type Queues), Basic Queueing Theory - II (Departures, Method of Stages, Batch Arrivals, Burke's theorem and Network of queues, Little theorem, M/G/1 Queues, Reservations Systems M/G/1 Queues with Priority

**Network layer:** Internetworks, Logical Addressing, Subnetting, Routing, ARP, IP, ICMP, IGMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing, Multicast routing protocols.

**Transport layer:** Process to process delivery, User datagram protocol (UDP), Transmission control protocol (TCP), Data traffic, Congestion, Congestion control, Quality of service, Techniques to improve QOS, Integrated services, Differentiated services, QOS in switched networks.

**Application layer**: Client server model, Socket interface, Name space, Domain name space, Distribution of name space, DNS in the internet, Resolution, DNS messages, DDNS, Encapsulation, Electronic mail, File transfer, HTTP, World wide web (WWW), Network Management System, Cryptography, Network Security, Simple Network management Protocol (SNMP), Simple Mail Transfer protocol (SMTP)

**Course Learning Outcomes (CLO):**

The student will be able to:

6. Understand the layered architecture of Internet's reference models: OSI & TCP/IP and basis of physical layer and media.
7. Acquire knowledge about design issues, framing, error detection and correction, channel allocation techniques and link layer protocols.
8. Incorporate the data traffic with queueing models.
9. Identify various routing algorithms, elements of transport protocols, congestion control, QOS, internetworking, IP and IP addressing mechanism.
10. Describe various communication applications like email, web browser, familiarization with cryptography and network security.

**Text Books:**

*1.* Ferouzan, Behrouz A., Data Communications and Networking, TATA McGraw Hill (2017) 5th Edition.
*2.* Tanenbaum, Andrew S., Computer Networks, PHI (2013) 5th Edition.
*3.* D. Gross and C. Harris, Fundamentals of Queueing Theory, 3rd Edition, Wiley, 1998. (WSE Edition, 2004).

**Reference Books:**

*1.* Stallings William, Data and Computer Communication, Pearson Education (2017) 10th Edition.
*2.* James F. Kurose, Computer networking: A top-down approach, Pearson Education (2017), 6th Edition.
*3.* Athanasios Papoulis, Probability Random Variables and Stochastic Processes, McGraw-Hill (2002), 4th Edition.

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

**UTA-014 Engineering Design Project-II**
**(Including 6 self effort hours)**

| L | T | P | Cr |
|---|---|---|---|
| 1 | 0 | 4 | 6.0 |

**Course objective:** The project will introduce students to the challenge of electronic systems design & integration. The project is an example of '*hardware and software co-design'* and the scale of the task is such that it will require teamwork as a coordinated effort.

**Hardware overview of Arduino:**

- ❖ Introduction to Arduino Board: Technical specifications, accessories and applications.
- ❖ Introduction to Eagle (PCB layout tool) software.

**Sensors and selection criterion:**

- ❖ Concepts of sensors, their technical specifications, selection criterion, working principle and applications such as IR sensors, ultrasonic sensors.

**Active and passive components:**

- ❖ Familiarization with hardware components, input and output devices, their technical specifications, selection criterion, working principle and applications such as-
    - Active and passive components: Transistor (MOSFET), diode (LED), LCD, potentiometer, capacitors, DC motor, Breadboard, general PCB etc.
    - Instruments: CRO, multimeter, Logic probe, solder iron, desolder iron
    - Serial communication: Concept of RS232 communication , Xbee
- ❖ Introduction of ATtiny microcontroller based PWM circuit programming.

**Programming of Arduino:**

- ❖ Introduction to Arduino: Setting up the programming environment and basic introduction to the Arduino micro-controller
- ❖ Programming Concepts: Understanding and Using Variables, If-Else Statement, Comparison Operators and Conditions, For Loop Iteration, Arrays, Switch Case Statement and Using a Keyboard for Data Collection, While Statement, Using Buttons, Reading Analog and Digital Pins, Serial Port Communication, Introduction programming of different type of sensors and communication modules, DC Motors controlling.

**Basics of C#:**

- ❖ Introduction: MS.NET Framework Introduction, Visual Studio Overview and Installation
- ❖ Programming Basics: Console programming, Variables and Expressions, Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Assignment Operators, Expressions, Control Structures, Characters, Strings, String Input, serial port communication: Read and write data using serial port.
- ❖ Software code optimization, software version control

**Laboratory Work:**

Schematic circuit drawing and PCB layout design on CAD tools, implementing hardware module of IR sensor, Transmitter and Receiver circuit on PCB.

**Bronze Challenge**: Single buggy around track twice in clockwise direction, under full supervisory control. Able to detect an obstacle. Parks safely. Able to communicate state of the track and buggy at each gantry stop to the console.
**Silver Challenge**: Two buggies, both one loop around, track in opposite directions under full supervisory, control. Able to detect an obstacle. Both park safely. Able to communicate state of the track and buggy at each gantry stop with console.
**Gold Challenge**: Same as silver but user must be able to enter the number of loops around the track beforehand to make the code generalized.

**Course learning outcome (CLO):** The student will be able to:

1. Recognize issues to be addressed in a combined hardware and software system design.
2. Draw the schematic diagram of an electronic circuit and design its PCB layout using CAD Tools.
3. Apply hands-on experience in electronic circuit implementation and its testing.
4. Demonstrate programming skills by integrating coding, optimization and debugging for different challenges.
5. Develop group working, including task sub-division and integration of individual contributions from the team.

***Text Books:***

1. ***Michael McRoberts, Beginning Arduino, Technology in action publications, 2nd Edition.***
2. ***Alan G. Smith, Introduction to Arduino: A piece of cake, CreateSpace Independent Publishing Platform (2011).***

***Reference Books:***

1. ***John Boxall, Arduino Workshop - a Hands-On Introduction with 65 Projects, No Starch Press; 1 edition (2013).***

**Evaluation Scheme:**

| S. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | Evaluation-1 (ECE lab) | 20 |
| 2. | Evaluation-2 (CSE lab) | 20 |
| 3. | Quiz | 10 |
| 4. | Evaluation-3 (ECE+CSE lab) | 50 |

## UCS303: OPERATING SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objectives:** To understand the role, responsibilities, and the algorithms involved for achieving various functionalities of an Operating System.

**Introduction and System Structures:** Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments, Operating-System Services, User and Operating-System Interface, System Calls, Types of System Calls, System Programs, Operating-System Design and Implementation, Operating-System Structure.

**Process Management:** Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication, Multi-threaded programming: Multicore Programming, Multithreading Models, Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Algorithm Evaluation.

**Deadlock:** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

**Memory Management:** Basic Hardware, Address Binding, Logical and Physical Address, Dynamic linking and loading, Shared Libraries, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table, Virtual Memory Management: Demand Paging, Copy-on-Write, Page Replacement, Allocation of Frames, Thrashing, Allocating Kernel Memory.

**File Systems:** File Concept, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection, File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

**Disk Management:** Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap-Space Management, RAID Structure.

**Protection and Security:** Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix, Implementation of the Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, The Security Problem, Program Threats, System and Network Threats, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks.

**Concurrency:** The Critical-Section Problem, Peterson’s Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors.

**Laboratory work:** To explore detailed architecture and shell commands in Linux/Unix environment, and to simulate CPU scheduling, Paging, Disk-scheduling and process synchronization algorithms.

**Course learning outcomes (CLOs):**
After the completion of the course, the student will be able to:
1. Explain the basic of an operating system *viz.* system programs, system calls, user mode and kernel mode.
2. Select a particular CPU scheduling algorithms for specific situation, and analyze the environment leading to deadlock and its rectification.
3. Explicate memory management techniques *viz.* caching, paging, segmentation, virtual memory, and thrashing.
4. Understand the concepts related to file systems, disk-scheduling, and security, protection.
5. Comprehend the concepts related to concurrency.

**Text Books:**
1. *Silberschatz A., Galvin B. P. and Gagne G., Operating System Concepts, John Wiley & Sons Inc (2013) 9th ed.*
2. *Stallings W., Operating Systems Internals and Design Principles, Prentice Hall (2018) 9th ed.*

**Reference Books:**
1. *Bovet P. D., Cesati M., Understanding the Linux Kernel, O'Reilly Media (2006), 3rd ed.*
2. *Kifer M., Smolka A. S., Introduction to Operating System Design and Implementation: The OSP 2 Approach, Springer (2007).*

**Evaluation scheme**

| Sr. No. | Evaluation Elements | Weights (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 45 |
| 3. | Sessional<br>(May include Assignments/Quiz/Lab evaluations) | 30 |

## UCS310: DATABASE MANAGEMENT SYSTEM

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objectives:** To become familiar with different types of data structures and their applications and learn different types of algorithmic techniques and strategies.

**Introduction:** Data, data processing requirement, desirable characteristics of an ideal data processing system, traditional file based system, its drawback, concept of data dependency, Definition of database, database management system, 3-schema architecture, database terminology, benefits of DBMS.

**Relational Database:** Relational data model: Introduction to relational database theory: definition of relation, keys, relational model integrity rules.

**Database Analysis:** Conceptual data modeling using E-R data model -entities, attributes, relationships, generalization, specialization, specifying constraints, Conversion of ER Models to Tables, Practical problems based on E-R data model.

**Relational Database Design:** Normalization- 1NF, 2NF, 3NF, BCNF, 4NF and 5NF. Concept of De-normalization and practical problems based on these forms.

**Transaction Management and Concurrency control:** Concept of Transaction, States of Transaction and its properties, Need of Concurrency control, concept of Lock, Two phase locking protocol.

**Recovery Management:** Need of Recovery Management, Concept of Stable Storage, Log Based Recovery Mechanism, Checkpoint.

**Database Implementation:** Introduction to SQL, DDL aspect of SQL, DML aspect of SQL – update, insert, delete & various form of SELECT- simple, using special operators, aggregate functions, group by clause, sub query, joins, co-related sub query, union clause, exist operator. PL/SQL - cursor, stored function, stored procedure, triggers, error handling, and package.

**Laboratory work:** Students will perform SQL commands to demonstrate the usage of DDL and DML, joining of tables, grouping of data and will implement PL/SQL constructs. They will also implement one project.

**Project:** It will contain database designing & implementation, should be given to group of 2-4 students. While doing projects emphasis should be more on back-end programming like use of SQL, concept of stored procedure, function, triggers, cursors, package etc. Project should have continuous evaluation and should be spread over different components.

**Course learning outcomes (CLOs):**
On completion of this course, the students will be able to:

1. Analyze the Information Systems as socio-technical systems, its need and advantages as compared to traditional file-based systems.
2. Analyze and design database using E-R data model by identifying entities, attributes and relationships.
3. Apply and create Relational Database Design process with Normalization and De-normalization of data.
4. Comprehend the concepts of transaction management, concurrence control and recovery management.
5. Demonstrate use of SQL and PL/SQL to implementation database applications.

***Text Books:***

1. *.Silverschatz A., Korth F. H. and Sudarshan S., Database System Concepts, Tata McGraw Hill (2010) 6th ed.*
2. *Elmasri R. and Navathe B. S., Fundamentals of Database Systems, Pearson (2016) 7th ed.*

***Reference Books:***

1. *Bayross I., SQL, PL/SQL the Programming Language of Oracle, BPB Publications (2009) 4th ed.*
2. *HofferJ.,Venkataraman, R. and Topi, H., Modern Database Management, Pearson (2016) 12th ed.*

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessionals (Assignments/Projects/ Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC502: DIGITAL SIGNAL PROCESSING

| L | T | P | Cr. |
|---|---|---|---|
| 3 | 1 | 2 | 4.5 |

**Course Objective:** The subject of discrete-time signal processing constitutes an important part of communication and computer engineering. The signals are processed to generate a sequence of numbers that represent samples of a continuous variable in a domain such as time, space, or frequency. Major objective is to apply various mathematical and computational algorithms to continuous-time and discrete-time signals to produce a modified signal that's of higher quality than the original signal, which in turn improves the efficiency of underlying systems. Its utility to analyze the vital characteristics of signals and systems in time- and frequency-domain makes it an inevitable module of engineering practice.

**Course Content Details:**

**Brief Review of Transforms:** Introduction to sampling theorem**,** Concept of frequency in continuous-time and discrete-time signals, Brief details about Laplace-transform, z-transform, CTFT, DTFT and DFT, decimation-in-time and decimation-in-frequency FFT algorithms.

**Discrete-time Signals' and Systems' Frequency Response Analysis:** Power density spectrum of periodic signals, Energy density spectrum of aperiodic signals, Cepstrum, Concept of bandwidth, LTI systems as frequency-selective filters (LPF, HPF, BPF, digital resonators, notch filters, comb filters and all pass filters), inverse systems and deconvolution.

**Implementation of Discrete-time Systems:** LTI systems characterized by constant-coefficient difference equations and their impulse response attributes. Structures for FIR systems, Structures for IIR systems, Recursive and nonrecursive realizations, Linear filtering methods based on DFT, and Goertzel algorithm.

**Design of FIR Filters:** Causality and its implications, Characteristics of practical frequency-selective filters, Symmetric and antisymmetric FIR filters, Design of linear-phase FIR filters using window method (Hamming, Hanning, Kaiser etc.), Design of FIR filters using frequency-sampling method.

**Design of IIR Filters:** Characteristics of commonly used analog filters, Design of IIR filters from analog filters by approximation of derivatives, Design by impulse invariance, Design by bilinear transformation.

**Multirate Signal Processing:** Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Polyphase filter structures for decimation and interpolation, sampling rate conversion with cascaded integrator comb filters, Introduction to digital filter banks.

**Optimum Filtering and Equalization:** Wiener filtering, Linear prediction and Concept of equalization.

**Laboratory Work:** MATLAB software based lab practicals related to DSP and its applications.

**Micro-Project/Assignment:** To be assigned by concerned instructor/course-coordinator.

**Course Learning Outcomes (CLOs):**

The students will be able to

- analyze discrete-time signals and systems in frequency-domain
- employ linear time-invariant systems for discrete-time signal processing
- design and implement FIR frequency-selective filters
- design and implement IIR frequency-selective filters
- tackle engineering system problems using multirate signal processing and optimum filtering approaches

**Text Books:**


1. **D.G. Manolakis and J.G. Proakis, Digital Signal Processing: Principles, Algorithms, and Applications. 4th ed., India: Pearson Education (Paperback), 2007.**
2. **A.V. Oppenheim, R.W. Schafer, and J.R. Buck, Discrete-time Signal Processing. 2nd ed., India: Pearson Education (Paperback), 2007.**


**Reference Books:**


1. **V.K. Ingle and J.G. Proakis, Digital Signal Processing using MATLAB. 2nd ed., India: Thomson Learning, 2007.**

2. **S. Salivahanan and A. Vallavaraj, Digital Signal Processing. 2nd ed., New York, U.S.A.: Tata McGraw-Hill, 2011.**


**Evaluation Scheme:**

| S.No. | Evaluation Components | Weightage (%) |
|---|---|---|
| **1.** | MST | 25 |
| **2.** | EST | 45 |
| **3.** | Sessional (May include Lab experiments/ Tutorials/Assignments/Micro-project/Quiz) | 30 |

# UEC607: Digital Communication

| L | T | P | Cr. |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objectives:** The aim of this course is to build the foundation for communication system design focusing on the challenges of digital communication. The intended objective is to impart knowledge to the engineering students about the transmission/reception of data over physical layer through any channel. They will be able to identify the physical interpretation of mathematical expressions/modelling, while dealing with communication systems in the presence of noise, interference and fading.

**Details of Contents:**

**Introduction to Pulse Modulation Systems:** Basic model of digital communication system, Bandpass and lowpass signal and system representations, lowpass equivalent of bandpass signals, Sampling theorem for baseband and bandpass signals, quantization, companding, signal reconstruction filter, Shannon-Hartley channel capacity theorem, Bandwidth – SNR tradeoff and bounds, Difference between analog pulse modulation and digital pulse modulation techniques, Details about PCM, Differential-PCM, DM, Adaptive-DM, time-division-multiplexed system (T- & E-type), and output SNR calculations

**Digital Formats and Baseband Shaping for Data Transmission:** NRZ, RZ, Manchester formats, Power spectra of discrete-PAM signals, ISI, Nyquist's criterion for distortionless baseband transmission with ideal and practical solutions, generalized correlative coding and its types, and eye pattern

**Fundamentals of Detection and Estimation:** Gram-Schmidt orthogonalization procedure, MAP criterion, maximum likelihood (ML) decision rule, Correlator and , Matched filter receiver structures, ML estimation procedure, probability of bit-error & symbol-error calculations for digital modulation techniques under AWGN channel.

**Digital Modulation Schemes With & Without Memory:** Details about Binary-ASK, BFSK, BPSK, QPSK, M-ary ASK, M-ary FSK, M-ary PSK, M-ary QAM; MSK, generalized continuous-phase-FSK; Differential-PSK, phase-locked-loop, and carrier recovery procedures

**Channel Coding :** Block-code generation, its types and decoding procedures, convolutional code generation, its types and Viterbi decoding procedure, error detection and correction concepts in decoding, Trellis codes.

**Multiple Access Techniques:** Brief introduction about TDMA, FDMA, WDMA, CDMA, and OFDMA systems

**Laboratory Work:** Practical/experiments based on the hardware using communication kits, and simulation with the help of available simulation packages.

**Text Books:**


1. John G. Proakis,Masoud Salehi, Communiaction System Engineering, PHI, 2nd Edition, 2002
2. John G Proakis, Digital Communications, McGraw-Hill, Third Edition (1994)

3. Simon Haykin, Digital Communications, Wiley, Student Edition (1988)
4. Bernard Sklar, Digital Communications: Fundamentals and Applications, Prentice Hall (2001)

**Reference Books:**

1. Taub & Schilling, Principles of Communication Systems, McGraw-Hill Publications, Second Edition (1998)
2. Simon Haykin, Communication Systems, Wiley, Fourth Edition (2006)
3. B.P. Lathi, Modern Analog and Digital Communication Systems, Oxford University Press, Third Edition (1998)

**Course Learning Outcomes:**

Upon completion of this course, the students will be able to:

1. Evaluate different modulation techniques in the presence of AWGN working under the various capacity constraints.
2. Incorporate digital formats and M-ary baseband modulations to improve bandwidth efficiency.
3. Perform statistical analysis of the transmitted and received modulated waveforms from estimation and detection point of view.
4. Improve the overall performance of digital communication systems by interference suppression/ excision and by implementing the signal-to-noise-ratio enhancement techniques.
5. Analyze the concepts of correlative coding and channel coding to mitigate the effects of interference and noise in the channel.

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 40 |
| 3. | Sessional (Including lab, assignments, quiz & micro-project etc.) | 30 |

## UEC516: THEORY OF COMPUTATION

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objectives:**

The learning objectives of this course are to introduce students to the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notions of algorithm, decidability, complexity, and computability. This course will enhance and develop students' ability to understand and conduct mathematical proofs for computation and algorithms.

**Automata and Language Theory**

Finite automata, Descriptive and recursive definition of languages, regular expressions (RE), Deterministic Finite Automata (DFA), DFA based on length of string, modulo operator, cartesian product, interpretation of a string as binary number, start and end symbols, substring, Free languages, Transition Graph (TG), Generalized Transition Graph, Context-free grammars, formal definition of a Context-free grammar (CFG), Examples of context-free grammars, Designing context-free grammars, Ambiguity, Chomsky normal form, Context free language (CFL), Pushdown Automata, Examples of pushdown Automata, Equivalence with context-free grammars, Non-context-free languages, The pumping lemma for context-free languages.

**Computability Theory**

Turing machines, Formal definition of turing machine, Examples of turing machines, Variants of turing machines, Multitape turing machines, Nondeterministic turing machine, Enumerators, Equivalence with other models, The definition of algorithm, Hilbert’s problem Terminology of describing turing machines, decidability, halting problem, reducibility, recursion theorem

**Complexity Theory**

Time and space measures, hierarchy theorems, complexity classes P, NP, L, NL, PSPACE, BPP and IP, complete problems, P versus NP conjecture, quantiers and games, provably hard problems, relativized computation and oracles, probabilistic computation, interactive proof systems. Possible advanced topic as time permitsThe Cook-Levin Theorem, Additional NP Complete problems, The vertex cover problem, The Hamiltonian path problem, The subset sum problem

**Course learning outcomes (CLOs):**

On completion of this course, the students will be able to

- understand the concept of abstract machines and their power to recognize the languages.
- apply finite state automata for modeling and solving computing problems.
- design context free grammars for formal languages.

- analyse concept of reductions and how it can be used to order problems by their computational complexity

**Text Books:**

1. John E. Hopcroft, Rajeev Motwani and Jeffery D. Ullman, Automata Theory, Languages, and Computation (3rd. Edition), Pearson Education, 2008.
2. Michael Sipser, Introduction to the Theory of Computation, Books/Cole Thomson Learning, 2001.
3. JE Hopcroft and JD Ullman, Introduction to Automata Theory, Languages, and Computation, Addison-Wesley, 1979.

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations) | 25 |

## UEC 610: COMPUTER ARCHITECURE

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objectives:**

To introduce the concept of instruction level parallelism followed in the modern RISC based computers by introducing the basic RISC based DLX architecture. To make the students understand and implement various performance enhancement methods like memory optimization, Multiprocessor configurations, Pipelining and evaluate performance of these machines by using evaluation methods like CPU time Equation, MIPS rating and Amdahl's law. To enhance the coding skills and interfacing of I/O devices using interrupts to the processor. To introduce the concepts of multiprocessors and multithreading and cache coherence amongst them.

**Fundamentals of Computer Design:** Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Historical Perspective, Von-Neuman Architecture, Harvard Architecture. CISC and RISC architectures, Performance metrics (Amdahl's law, CPU time equation, MIPS rating and dependability). Control Unit; Hardwired and micro-programmed Control unit.

**Instruction Set Principles:** Classification of Instruction set architectures, Memory Addressing, Operations in the instruction set, Type and Size of operands, Encoding an Instruction set, Program Execution, Role of registers, Evaluation stacks and data buffers, The role of compilers, The DLX Architecture, Addressing modes of DLX architecture, Instruction format, DLX operations, Effectiveness of DLX.

**Pipelining and Parallelism:** Idea of pipelining, The basic pipeline for DLX, Pipeline Hazards, Data hazards, Control Hazards, Design issues of Pipeline Implementation, Multicycle operations, The MIPS pipeline, Instruction level parallelism, Pipeline Scheduling and Loop Unrolling, Data, Branch Prediction, Name and Control Dependences, Overcoming data hazards with dynamic scheduling, Superscalar DLX Architecture, The VLIW Approach.

**Memory Hierarchy Design:**Introduction, Cache memory, Cache Organization, multilevel memories Write Policies, Reducing Cache Misses, Cache Associativity Techniques, Reducing Cache Miss Penalty, Reducing Hit Time, Main Memory Technology, Fast Address Translation, Translation Lookaside buffer , Virtual memory, Crosscutting issues in the design of Memory Hierarchies, Cache Coherence.

**Multiprocessors:** Characteristics of Multiprocessor Architectures, Centralized Shared Memory Architectures, Distributed Shared Memory Architectures, Synchronization, Models of Memory Consistency.

**Input / Output Organization and Buses:**Accessing I/O Devices, Interrupts, Handling Multiple Devices, Controlling device Requests, Exceptions, Direct Memory Access, Bus arbitration policies, Synchronous and Asynchronous buses, Parallel port, Serial port, Standard

I/O interfaces, Peripheral Component Interconnect (PCI) bus and its architecture, SCSI Bus, Universal Synchronous Bus (USB) Interface.

**Course Learning Outcomes:** After having completed the course, the student will be able to:

1. Evaluate the performance of a RISC based machine with an enhancement applied and make a decision about the applicability of that respective enhancement as a design engineer (performance metrics).
2. Display a sterling understanding of the instruction set and coding of a RISC based processor.
3. Display an understanding of the concept of pipelining and parallelism pipelining in a modern RISC processor and describe how hazards are resolved.
4. Display wide understanding of how memory is organized and managed in a modern digital computer, including cache, virtual and physical memory and address translation.
5. Understand the concept of multiple processors , cache coherence and I/O device interfacing

**Text Books**

1. Hennessy, J. L., Patterson, D. A., Computer Architecture: A Quantitative Approach, Elsevier (2009) 4th ed and 2nd ed.
2. Hamacher, V., Carl, Vranesic, Z.G. and Zaky, S.G., Computer Organization, McGraw-Hill (2002) 2nd ed.

**Reference Books**

1. Murdocca, M. J. and Heuring, V.P., Principles of Computer Architecture, Prentice Hall (1999) 3rd ed.
2. Stephen, A.S., Halstead, R. H., Computation Structure, MIT Press (1999) 2nd ed.

**Evaluation Scheme:**

| **S.No** | **Evaluation Elements** | **Weightage** |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessional (Tutorial + Minor Project +Quiz) | 25 |

## UEC609: MOS Circuit Design

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objective**: **Course objective:** The course aims to present the principles and techniques of both MOS based digital and analog circuit design, with the fundamentals of MOS device physics, processing techniques and transistor level characteristics of MOS based circuits, both in theoretical and practical aspects.

**Syllabus break-up**:

**MOS Transistor Theory:** MOS Structure and its operation, I-V Characteristics, Threshold Voltage Equation, Body Effect, Second Order Effects, Scaling Theory, Short-Channel Effects.

**NMOS & CMOS Process technology**: Evolution of ICs. Masking sequence of NMOS and CMOS Structures, Latch up in CMOS, Electrical Design Rules, Stick Diagram, Layout Design.

**Circuit Characterization:** Resistive Load & Active Load MOS Inverters, NMOS Inverters, CMOS Inverters : Static Characteristics, Switching Characteristics, Interconnect Parasitics, Propagation Delay, Static and Dynamic Power Dissipation, Noise Margin, Logic Threshold Voltage, Logical effort, Driving large loads.

**Combinational Circuits:** CMOS Logic Circuits, CMOS logic Styles, Realization of simple gates, Complex logic circuits, Pass Gate, Transmission Gate and analysis of dynamic behavior.

**Operation of MOS Circuits:** MOS transistor small-signal models, Transconductance, Modeling the Body Effect and channel length modulation effect, biasing concept, MOS as an Amplifier.

**Laboratory Work:** Familiarization with Circuit design/simulation tools (Mentor Tools) for schematic and layout entry, Circuit simulation using SPICE. DC transfer Characteristics of Inverters, Transient response, Calculating propagation delays, rise and fall times, Circuit design of inverters, Complex gates with given constraints.

**Course Learning Outcomes (CLO): Maximum 5 CLO’S**

The student will be able to:

1. Use MOS structures in basic digital and analog circuits.
2. Describe the general processing steps required to fabricate MOS and CMOS transistor.

3. Analyze the static and dynamic performance of CMOS inverter and other CMOS logic gates
4. Implement the various CMOS logic circuits.
5. Analyze MOS transistor as an amplifier.

**Text Books:**

1. Kang ,Sung-Mo (Steve) &Leblebici, Yusuf., CMOS Digital Integrated Circuits Analysis & Design, McGraw Hill, (1999) 2nd ed.

2. A. S. Sedra and K. C. Smith, MICROELECTRONIC CIRCUITS. 4th ed. New York, NY: Oxford University Press, 1998.

**Reference Books:**

1. Jan Rabaey, A. Chandrakasan&Nikolic, B., Digital Integrated Circuits – A Design Perspective, Pearson, (2003) 2nd ed.
2. CMOS VLSI Design: A Circuits and Systems Perspective, 4th ed., Neil Weste and David Harris, Pearson Addison Wesley, 2011.
3. Pucknell D. A., &Eshraghian, K., Basic VLSI Design, Prentice Hall of India, (2007) 3rd ed.
4.Gregorian, R. and Temes, G.C., Analog MOS Integrated Circuits for Signal Processing, John Wiley (2004).

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC 713:MACHINE LEARNING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objective:** To familiarize the students with machine learning and introduce major algorithms pertaining to real world problems. Students will be able to design and implement machine learning solutions to classification, regression, and clustering problems; and be able to evaluate and interpret the results of the algorithms.

**Course Content Details:**

**Machine Learning Preliminaries:** Biological vs. Machine learning, Learning with a teacher, Learning without a teacher, Connectionist approach to machine learning, Data visualization, Input and Output feature spaces, Pattern spaces, Classification with decision boundaries, Regression, Logistic Regression, Error criteria, Activation functions, Introduction to Python programming, Data types and overview of Machine Learning Libraries.

**Data Preprocessing & Supervised Learning:** Data scaling and preprocessing, Normalization,Data partitioning into training, test and validation sets, Cluster analysis, Dimensionality reduction, Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), Independent Component Analysis (ICA) for blind signal separation, Naïve Bayes classifier, Decision trees, Random Forest, K-nearsest neighbor classifier.

**Neural Networks and Learning Machines:** McCulloch-Pitts model of a neuron, Implementation of logic functions using a neural networks, Perceptron as a Bayesian classifier in Gaussian environment, Back propagation algorithm, Solution of typical classification problems with vanilla neural networks, Radial Basis Function Neural Networks, Support vector Machines (SVMs), Boltzmann Machines, Recurrent Neural Networks (RNN), Hopfield networks, Gated Recurrent Units (GRUs), Deep Belief Networks.

**Unsupervised and Semi Supervised Learning Algorithms:** K-means clustering, Self-organizing Maps (SOM), Gaussian Mixture Models, Hebbian Learning, Reinforcement learning using Markov Decision Process, Unsupervised Feature Learning using Convolutional Neural Networks (CNN), Generative models.

**Deep Learning:** Need and scope of Deep Learning, Deep convolutional networks, Deep belief networks, Deep Boltzmann Machines, Deep Reinforcemt learning, Deep Networks in computer vision, image and video processing, Natural Language Processing (NLP) using deep nets, Auto encoders, LSTM networks for NLP applications, Generalized Adversarial Networks (GANs).

**Laboratory Work:**

1. Classification of benchmark data using the following classifiers and performance comparison thereof:
   (i) Decision tree.
   (ii) Random forest.
   (iii) k-means clustering.

    (iv) SVM.
    (v) Backpropagation algorithm trained single hidden layer MLP.
    (vi) Convolutional Neural Network.
2. Classification of benchmark images using the following classifiers and performance comparison thereof:
    (i) Convolutional Neural Network.
    (ii) Popular Recurrent Neural Networks.
3. E-mail spam identification using CNN.
4. CNN for a Regression problem.

**Minor Project:** To be assigned by concerned instructor/course-coordinator

**Course Learning Outcomes(CLOs): At the end of the course the student will be able to**

- Implement basic machine learning techniques under appropriate computing language environment.
- Apply various data pre-processing techniques and find ways of selecting suitable model parameters for different supervised machine learning models.
- Solve problems associated with Neural Network based learning and identify current real world problems based on it.
- Apply a variety of unsupervised learning algorithms to benchmark data.
- Identify the appropriate deep learning algorithms for various types of learning tasks.

**Text Books:**

1. **Neural Networks and Learning Machines, Simon Hykin, Third Edition, Prantice Hall**
2. **Introduction to Machine Learning with Python, Andreas C. Muller and Sarah Guido, O'Reilly**

**Reference Book:**

1. **Machine Learning, The art and science of algorithms that make sense of data, Peter Flach, Cambridge University Press**

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 25% |
| 2. | EST | 45% |
| 3. | Sessional (May include Assignments/Projects/Quizzes) | 30% |

## UEC707: NETWORK VIRTUALIZATION AND SOFTWARE DEFINED NETWORKING

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course Objective**: To have a deep understanding of two important, emerging network technologies: Software Defined Networking (SDN) and Network Functions Virtualization (NFV). Use SDN emulator (Mininet) to set up and test network topologies.

**Software Defined Network:** History of programmable networks and Evolution of Software Defined Networking (SDN), IETF Forces, Active Networking. Separation of Control and Data Plane - Concepts, Advantages and Disadvantages, OpenFlow, protocol, 4D network architecture. Traditional Networking versus SDN.

**Control & Data Plane:** Overview, distributed and centralized control plane & data plane. Control plane: Existing SDN Controllers including Floodlight and Open Daylight projects. Customization of Control Plane: Switching and Firewall.

Data Plane**:** Software-based and Hardware-based; Programmable Network Hardware.

**Network Virtualization:** Concepts, Applications, Existing Network Virtualization Framework (VMWare and others), Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

**Network Programmability**: Introduction, Northbound Application Programming Interface, Current Languages and Tools.

**Data Center Networks**: Packet, Optical and Wireless Architectures Network Topologies

**Use Cases of SDNs:** Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.

**Laboratory Work:**

1. Set up and get familiar with SDN emulator – Mininet and set up a virtual network
2. Basic mininet operations
3. Manually control the switch
4. Move the rules to SDN controller
5. Set different forwarding rules for each switch in the controller

**Course Learning Outcomes (CLO): Maximum 5 CLO'S**

The student will be able to:

1. Understand the SDN architecture and analyse the advantages of programmable networks over traditional networks
2. Analyse the SDN layers and plane oriented view, decoupled control plane and data plane
3. Understand network virtualization , Network Functions Virtualization components and how they work together
4. Apply the SDN and NVF concepts to analyse use case like data center network and others
5. Design and implement networking problems using SDN-friendly network emulator

**Text Books:**

1. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10:1-4493-4230-2.

2. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844

**Reference Books:**

1. Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.
2. Doherty, Jim. SDN and NFV simplified: a visual guide to understanding software defined networks and network function virtualization. Addison-Wesley Professional, 2016.

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

# UEC715: IOT based Systems

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objective**: The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

**Introduction to IoT:** Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.

**Elements of IoT:** Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API's (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

**IoT Application:** Development Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.

**IoT Case Studies:** IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation

**Laboratory Work:**

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.

12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

**Course Learning Outcomes (CLO):**

The student will be able to:

11. Understand internet of Things and its hardware and software components
12. Understand the design aspects of hardware and software components of IoT
13. Design Interface for I/O devices, sensors & communication modules
14. Analyze and process of data from sensors
15. Apply IoT knowledge to Implement basic IoT applications on embedded platform

**Text Books:**

1. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
2. Vijay Madisetti, Arshdeep Bahga, Ïnternet of Things, “A Hands on Approach”, University Press

**Reference Books:**

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
2. Adrian McEwen, “Designing the Internet of Things”, Wiley
3. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill
4. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UHU005: Humanities for Engineers

| L | T | P | Cr |
|---|---|---|---|
| **2** | **0** | **2** | **3** |

**Course Objectives (COs)**: The objective of this course is to introduce values and ethical principles, that will serve as a guide to behavior on a personal level and in professional life. The course is designed to help the students to theorize about how leaders and managers should behave to motivate and manage employees; to help conceptualize conflict management strategies that managers can use to resolve organizational conflict effectively. It also provides background of demand and elasticity of demand to help in devising pricing strategy; to make strategic decisions using game theory and to apply techniques of project evaluation.

**Detailed Content:**

***Unit 1: Human Values and Ethics***

Values: Introduction to Values, Allport-Vernon-Lindzey Study of Values, Rokeach Value Survey, Instrumental and Terminal Values.

Moral and Ethical Values: Types of Morality, Kant's Principles of Morality, Factors for taking ethical decisions,

Kohlberg's Theory of Moral Development

Professional Ethics: Profession: Attributes and Ethos, Whistle-blowing.

***Unit 2: Organizational Behavior***

Introduction to the Field of Organizational Behaviour

Individual Behaviour, Personality, and Values

Perceiving Ourselves and Others in Organizations

Workplace Emotions, Attitudes, and Stress

Foundations of Employee Motivation and Leadership

Performance Appraisal

Conflict and Negotiation in the Workplace

**Unit 3: Economics**

Demand, Supply & Elasticity **–** Introduction to Economics, Demand & its Determinants, Elasticity and its types

Production & Cost Analysis – Short run & Long Run Production Functions, Short run & Long run cost functions, Economies & Diseconomies of Scale

Competitive Analysis & Profit Maximization **–** Perfect competition, Monopoly, Monopolistic & Oligopoly Markets

Strategy & Game Theory **–** Pure Strategy & Mixed Strategy Games, Dominance, Nash Equilibrium, & Prisoner's Dilemma

Capital Budgeting – Capital Projects, Net Present Value (NPV) & IRR techniques.

***Practical:***

1. Practical application of these concepts by means of Discussions, Role-plays and Presentations,
2. Analysis of Case Studies on ethics in business and whistle-blowing, leadership, managerial decision- making.
3. Survey Analysis
4. Capital Budgeting assignment

**Course learning Outcomes (CLOs**)

**The student after completing the course will be able to:**

1. comprehend ethical principles and values and apply them as a guide to behavior in personal and professional life.
2. apply tools and techniques to manage and motivate employees.
3. analyse and apply conflict management strategies that managers can use to resolve organizational conflict effectively.
4. devise pricing strategy for decision-making.
5. apply techniques for project evaluation.

**Text Books**

1. A. N. Tripathi, Human Values, New Age International (P) Ltd. (2009).
2. Robbins, S. P/ Judge, T. A/ Sanghi, S Organizational Behavior Pearson, New Delhi, (2009).
3. Petersen, H.C., Lewis, W.C. and Jain, S.K., Managerial Economics, Pearson (2006).

**Reference Books**

1. McKenna E. F. Business psychology and organisational behaviour. Psychology Press, New York (2006).
2. Furnham A. The Psychology of Behaviour at Work: The Individual in the organization. Psychology Press, UK (2003).
3. Salvatore, D and Srivastava, R., Managerial Economics, Oxford University Press (2010).
4. Pindyck, R and Rubinfiled, D., Microeconomics, Pearson (2017).

**Evaluation Scheme:**

| | |
|---|---|
| **Mid Semester Exam** | **25** |
| **End Semester Exam** | **45** |
| **Sessional** | **30** |

## UCS523: COMPUTER AND NETWORK SECURITY

| L | T | P | Cr |
|---|---|---|---|
| **3** | **0** | **2** | **4** |

**Course Objectives:** This course is designed to impart a critical theoretical and detailed practical knowledge of a range of computer network security technologies as well as network security tools.

**Introduction:** Security Attacks, Security Services, Security Mechanisms and Principles, Security goals, Malicious software, Worms, Viruses, Trojans, Spyware, Botnets

**Basic of Cryptography:** Symmetric and asymmetric cryptography, cryptographic hash functions, authentication and key establishment, Message Authentication Codes (MACs), digital signatures, PKI.

**Security Vulnerabilities:** DoS attacks, Buffer Overflow, Race Conditions, Access Control Problems, Spoofing and Sniffing attacks, ARP Poisoning, Social Engineering and countermeasures.

**Internet Security:** TCP/IP Security, Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, Secure Shell (SSH), IPsec, Email Security, DNS Security, DNSSEC, Authentication Protocols

**Web Security:** Phishing attack, SQL Injection, Securing databases and database access, Cross Site Scripting Attacks, Cookies, Session Hijacking, E-commerce security

**System Security:** Firewalls, Types: Packet filter (stateless, stateful), Application layer proxies, Firewall Location and Configurations, Intruders, Intrusion Detection System, Anomaly and misuse detection.

**Wireless Network Security:** IEEE 802.11i Wireless LAN Security, Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP End-to-End Security

**Laboratory work:** Insert malicious shell code into a program file and check its malicious or benign status, create Client Server program to send data across systems as two variants clear text data and encrypted data with different set of encryption algorithms, demonstrate Buffer Overflow and showcase EIP and other register status, perform ARP poisoning, SQL Injection and demonstrate its countermeasure methods, implement stateful firewall using IPTables, showcase different set of security protocol implementation of Wireless LAN,

**Course learning outcomes (CLOs):** After the completion of the course, the student will be able to:

1. Comprehend and implement various cryptographic algorithms to protect the confidential data.
2. Identify network vulnerabilities and apply various security mechanisms to protect networks from security attacks.
3. Apply security tools to locate and fix security leaks in a computer network/software.

4. Secure a web server and web application.
5. Configure firewalls and Intrusion Detection System.

**Text Books:**

1. Stallings, W., Network Security Essentials, Prentice Hall (2017) 6th Edition.
2. Cheswick, R., W., Bellovin, M., S., and Rubin, D., A., Firewalls and Internet Security, AddisonWesley Professional (2003) 2nd Edition.

**Reference Books:**

1. Graves, K., Certified Ethical Hacking Study Guide,Sybex (2010) 1st Edition.
2. Stallings, W., Cryptography and Network Security, Prentice Hall (2013), 6th Edition.

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC512: LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objective**: To enhance comprehension capabilities of students through understanding of operational amplifiers, frequency response, various applications of operational amplifiers, active filters, oscillators, analog to digital and digital to analog converters and few special function integrated circuits.

**Introduction to Differential Amplifiers**: Differential amplifier, Configurations of differential amplifier, Analysis of single-input balanced-output, single-input unbalanced-output, dual-input balanced-output and dual-input unbalanced-output differential amplifiers.

**Operational Amplifier (Op-amp)**: Various characteristics of Op-amp, CMRR, PSRR, internal structure of Op-amp, ideal Op-amp inverting and non-inverting configuration, ideal open-loop and closed-loop operation of Op-amp, feedback configurations: voltage-series feedback amplifier, voltage-shunt feedback amplifier, differential amplifiers with one & two Op-amps.

**Frequency Response of an Op-amp**: Introduction to frequency response, compensating networks, frequency response of internally compensated Op-amp, frequency response of non-compensated Op-amp, closed-loop frequency response.

**General Applications**: DC & AC Amplifiers, peaking amplifier, summing, scaling and averaging amplifier, instrumentation amplifier, integrator, differentiator, log and antilog amplifiers, comparator, zero- crossing detector, Schmitt trigger, sample-and-hold circuit, clippers and clampers.

**Active Filters and Oscillators**: Butterworth filters, band-pass filters, band-reject filters, all-pass filters, phase shift oscillator, Wien-bridge Oscillator, voltage-controlled oscillator (VCO), square wave generator.

**Specialized IC Applications**: Introduction, 555 timer circuit, monostable and astable multivibrator using IC 555, phase-locked loop (PLL), voltage regulators.

### Laboratory Work:

Inverting and non-inverting characteristics of an Op-amp measurement of Op-amp parameters, Op-amp as an integrator & differentiator, comparator, Schmitt trigger, converters (ADC, DAC), square wave generator, sawtooth waveform generator, precision half wave and full wave rectifiers, log-antilog amplifier, 555 as an astable, monostable and bi-stable multivibrators, active filters.

### Course Learning Outcomes (CLO): Maximum 5 CLO'S

The student will be able to:

16. Identify different configurations of Op-amp, analyse the parameters of Op-amp and observe the frequency response of Op-amp,
17. Describe, analyse & demonstrate different applications based on operational-amplifier,
18. Comprehend different applications of Op-amp based active filters and oscillators,
19. Demonstrate applications of waveform generators, timers and voltage regulators.

### Text Books:


1. Ramakant A. Gayakwad, 'OP-AMP and Linear IC's', Prentice Hal, 1999.

2. Sergio Franco, 'Design with operational amplifiers and analog integrated circuits', McGraw-Hill, 2002.

## Reference Books:

3. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2000.
4. J. Michael Jacob, 'Applications and Design with Analog Integrated Circuits', Prentice Hall of India, 2002.

## Evaluation Scheme:

| Sr. No. | Evaluation Elements | Weightage (%) |
| --- | --- | --- |
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (may include Assignments/Quizzes) | 30 |

## UEC709: FIBER OPTIC COMMUNICATION

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objectives:** To understand fiber optic communication system, transmitter section, medium- the optical fiber, reciever section, analyze system based on important parameters for characterizing optical fiber, optical source, detector and amplifier, fundamentals and advances in lasers, LEDs, photodiodes.

**Optical Fibers and Their Characteristics**: Introduction to high frequency communication, nature of light, advantages of optical communication, fiber structures, wave guiding, basic optical laws and definitions, optical fiber modes and configuration, mode theory for circular waveguides, single mode fibers, graded index fiber, fiber materials, fabrication and mechanical properties, fiber optic cables; joints, splices, connectors, attenuation, signal distortion, nonlinear properties, dispersion and polarization mode dispersion in optical fibers, mode coupling, specialty optical fibers, design optimization of single mode fibers.

**Optical Sources and Amplifiers**: Light emitting diodes, semiconductor laser, various configurations of semiconductor laser, performance parameters of LEDs and semiconductor lasers, light source linearity, modal partition and reflection noise, reliability consideration; power launching and coupling, optical amplifiers: erbium doped fiber amplifier, semiconductor optical amplifier, Raman amplifier.

**Photodetectors:** Operating principle and physical properties of photodiodes, pin and avalance photodiodes, photodetector noise, response time, avalanche multiplication noise, temperature effect on avalanche gain, photodiode material.

**Optical Communication Systems:** Optical receiver operation- fundamental receiver operation, digital receiver performance calculation, preamplifier types, analog receivers. digital transmission systems- point to point links, line coding, eye pattern, noise effects on system performance. analog system: overview of analog links, carrier to noise ratio, multichannel transmission techniques, WDM: basics and components, LAN, coherent optical fiber communication- classification of coherent system, requirements on semiconductor lasers, modulation techniques, polarization control requirements.

**LABORATORY WORK :** Basic optical communication link experiments (analog & digital), measurement of numerical aperture, splicing, multiplexing experiments, bending losses, measurement with OTDR, design and performance analysis using simulation tools.

**Course Learning Outcomes (CLOs):**
The students will be able to:

1. Identify and formulate the types, basic properties and transmission characteristics of optical fibers.
2. Analyse different types of optical sources and amplifiers for efficient optical fiber communication.
3. Analyse and formulate pin and avalanche photodetectors in optical fiber communication systems.

4. Realize the analog and digital fiber optic communication systems and networks with different modulation techniques.

**Test Books:**

1. Keiser, Gred, Optical Fiber Communications, Tata McGraw-Hill, (2013) 5th ed.

2. Senior, John M., and Yousif Jamro, M., Optical fiber communications: principles and practice, Prentice Hall, (2009) 3rd ed.

**Reference Books:**

1. Ajoy Kumar Ghatak and K. Thyagarajan, Optical Electronics, Cambridge University Press (2012) 2nd ed.
2. Bahaa E. A. Saleh, Malvin C. Teich, Fundamentals of Photonics, John Wiley & Sons, (2019) 3rd ed.

**Evaluation Scheme:**

| S. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessional (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 25 |

## UEC618: DIGITAL IMAGE PROCESSING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objective**: To introduce the concepts of image processing and basic analytical methods to be used in image processing. To familiarize students with image enhancement and restoration techniques, to explain different image compression techniques. To introduce segmentation and morphological processing techniques.

**Introduction:** Fundamentals of Image formation, components of image processing system, image sampling and quantization

**Image transforms:** Discrete Fourier transforms, Discrete cosine transform, sine transform, Hadamard transform, Haar transform, Slant transform, KL transform, wavelet transform

**Image enhancement in the spatial domain:** Basic grey level transformation, histogram processing, arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters

**Image restoration:** A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the image enhance in frequency domain

**Image Compression:** Need of image compression, image compression models, error-free compression, lossy predictive coding, image compression standards

**Morphological Image Processing:** Preliminaries, dilation, erosion, open and closing, basic morphologic algorithms, The Hit-or-Miss Transformation

**Image Segmentation:** Detection of discontinuous, edge linking and boundary detection, thresholding, Hough Transform Line Detection and Linking, region–based segmentation.

**Object Recognition:** Patterns and patterns classes, matching, classifiers.

**Laboratory Work:** Demonstrate the use of Image Processing Toolbox on MATLAB to create interactive image processing applications like image enhancement, image compression, image segmentation, feature extraction, image classification.

**Course Learning Outcomes (CLO):**

After the successful completion of the course, the students will be able to:

1. Describe the fundamentals of digital image and its processing
2. Realize image enhancement techniques in spatial and frequency domain.
3. Analyze the mathematical modelling of image restoration and compression
4. Apply the concept of image segmentation.
5. Analyze object detection and recognition techniques.

**Textbooks:**

1. Digital Image Processing, Rafeal C. Gonzalez, Richard E. Woods, Second Edition, Pearson Education/PHI
2. Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Laurene V. Fausett, 1st Edition, 1993

**Reference Books:**

1. Image Processing, Analysis, and Machine Vision, Milan Sonka, Vaclav Hlavac, Roger Boyle, CL Engineering, 3rd Edition
2. Handbook of Face Recognition, Li, Stan Z., Jain, Anil, Springer, 2011
3. Frontiers in Pattern Recognition and Artificial Intelligence

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 40 |

## UCS501: ALGORITHM ANALYSIS AND DESIGN

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objectives**: To learn the representation of data in ways that allows its access efficiently, and analyzes the efficiency of algorithms.

**Fundamentals**: Review of asymptotic, Review of basic data structures, Review of basic algorithms

**Sorting and searching**: Review of classical sorting, Interpolation Search, Specialized sorting methods, Deterministic Kth selection, Lower bounds on max & min, Majority detection, Meta algorithms

**Advanced data structures**: Skip lists, Amortized analysis, Fibonacci heaps.

**Graph algorithms**: Lowest common ancestor, Minimum spanning trees, Shortest paths trees, Radius-cost tradeoffs, Steiner trees, Minimum matchings, Network flows, Degree-constrained trees

**Numerical algorithms**: Linear programming, Matrix multiplication, Karatsuba's algorithm

**Distributed algorithms**: Distributed models, Asynchronous consensus impossibility, Leader election in a ring, Leader election in graphs, Distributed MSTs

**Topology and Geometric algorithms**: Geometric Graphs, Surface, Homology, Plane-Sweep, Delaunay Triangulations, Alpha Shapes

**String matching**: Naive string matching algorithm, Knuth-Morris-Pratt Algorithm, Boyer - Moore Algorithm.

**NP-completeness**: Polynomial time and intractability, Space and time complexity, Problem reductions, NP -completeness of satisfiability, Independent sets, Graph colorability, Travelling salesperson problem, Approximation heuristics

**Course Learning Outcomes** (CLO):
The student will be able to:
1. Implement different sorting and searching algorithm.
2. Implement graph and numerical algorithms.
3. Implement distributed and geometric algorithms.
4. Understand and implement String matching.
5. Understand NP completeness.

**Text Books:**

1. J Kleinberg, E Tardos, Algorithm Design, Addison-Wesley.
2. TH Cormen, CF Leiserson, RL Rivest, C Stein, Introduction to Algorithms, 3rd Ed., MIT Press.
3. AV Aho, J Hopcroft, JD Ullman, The Design and Analysis of Algorithms, Addison-Wesley.

**Reference Books:**

1. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe Augenstein, Data Structures Using C.

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UCS802: COMPILER CONSTRUCTION

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4 |

**Course Objectives:** To Gain the working knowledge of the major phases of compilation and develop the ability to use formal attributed grammars for specifying the syntax and semantics of programming languages. Learn about function and complexities of modern compilers and design a significant portion of a compiler.

**Introduction to compiling:** Compilers, Analysis of the source program, the phases of Compiler, Compilation and Interpretation, Bootstrapping and Cross compiler.

**Lexical Analysis:** Need of Lexical analyzer, Tokens and regular expressions, Generation of lexical analyzer from DFA, Introduction to LEX and program writing in LEX.

**Syntax Analysis**: Need for syntax analysis and its scope, Context free grammar, Top down parsing, bottom up parsing, backtracking and their automatic generation, LL(1) Parser, LR Parser, LR(0) items, SLR(1), LALR(1), Canonical Parsing, Introduction to YACC and Integration with LEX.

**Error Analysis:** Introduction to error analysis, detection, reporting and recovery from compilation errors, Classification of error-lexical, syntactic and semantic.

**Static semantics and Intermediate Code generation:** Need for various static semantic analyses in declaration processing, name and scope analysis, S-attribute def. and their evaluation in different parsing, Semantic analysis through S-attribute grammar, L-attribute def. and their evaluation.

**Run time Environment:** Need for runtime memory management, Address resolution of runtime objects at compile time, Type checking, Language features influencing run time memory management, Parameter passing mechanism, Division of memory into code, stack, heap and static, Activation record, Dynamic memory management, garbage collection.

**Code Generation**: Code generation for expressions, Issues in efficient code generation, Sethi Ullman algorithm.

**Code Optimization:** Need for code optimizations, Local and global optimization, Control flow analysis, Data flow analysis, performing global optimizations, Graph coloring in optimization, Live ranges of run time values.

**Laboratory work:** Construct a lexical analyzer using Flex. Construct a parser using Bison/ any programming language. Build simple compilers from parsing to intermediate representation to code generation and simple optimization**.**

**Course learning outcomes (CLOs):**
After the completion of the course, the student will be able to:

1. Comprehend the working of major phases of compiler.
2. Apply top-down and bottom-up parsing techniques for the Parser construction.

3. Classify various parameters passing scheme, explain memory management techniques.
4. Apply code optimization techniques on HLL.

**Text Books:**

1. *Aho V. A., Ullman D. J., Sethi R. and Lam S. M., Compilers Principles, Techniques and Tools, Pearson Education (2007), 2nd ed.*
2. *Levine J., Mason T., Brown D., Lex and Yacc, O'Reilly (2012), 2nd ed.*

**Reference Books:**

1. *Kenneth C. L., Compiler Construction and Practices, Thomson Publication (1997), 2nd ed.*
2. *Dhamdhere, Compiler Construction, Macmillan Publication (2008), Edition 2nd ed.*

**Evaluation scheme**

| Sr. no. | Evaluation Elements | Weights (%) |
|---|---|---|
| 1. | MST | 25 |
| 2. | EST | 45 |
| 3. | Sessionals (May include Assignments/Projects/Tutorials/Quiz/Lab evaluations) | 30 |

## UCS642: AUGMENTED AND VIRTUAL REALITY

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 2 | 4.0 |

**Course Objectives:** To understand the basic concepts of Augmented and Virtual Reality. The student must be able to apply the various concepts of Augmented and Virtual Reality in other application areas.

**Introduction of Virtual Reality:** Fundamental concept and components of Virtual Reality, primary features and present development on Virtual Reality

**Multiple Modals of Input and Output Interface in Virtual Reality:** Input -- Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices

**Visual Computation in Virtual Reality:** Fundamentals of computer graphics, software and hardware technology on stereoscopic display, advanced techniques in CG: Management of large scale environments & real time rendering

**Environment Modeling in Virtual Reality:** Geometric Modeling, Behavior Simulation, Physically Based Simulation.

**Interactive Techniques in Virtual Reality:** Body Track, Hand Gesture, 3D Menus, Object Grasp.

**Introduction of Augmented Reality (AR):** System structure of Augmented Reality, key technology in AR.

**Development Tools and Frameworks in Virtual Reality:** Frameworks of software development tools in VR, X3D Standard, Vega, MultiGen, Virtools etc.

Application of VR in Digital Entertainment: VR technology in film & TV production, VR technology in physical exercises and games, demonstration of digital entertainment by VR.

**Laboratory Work:** To implement various techniques studied during course.

**Course learning outcomes (CLOs):** After the completion of the course, the student will be able to:

1. Analyze the components of AR and VR systems, its current and upcoming trends, types, platforms, and devices.
2. Assess and compare technologies in the context of AR and VR systems design.
3. Implement various techniques and algorithms used to solve complex computing problems in AR and VR systems.
4. Develop interactive augmented reality applications for PC and Mobile based devices using a variety of input devices.
5. Demonstrate the knowledge of the research literature in augmented reality for both compositing and interactive applications.

**Text Books:**

1. Doug A. B., Kruijff E., LaViola J. J. and Poupyrev I. , 3D User Interfaces: Theory and Practice , Addison-Wesley (2005,2011p) 2nd ed.
2. Parisi T., Learning Virtual Reality, O'Reilly (2016) 1st ed. 3. Schmalstieg D. and Hollerer T., AugmentedAnd Virtual Reality, Addison-Wesley (2016).

**Reference Books:**

1. Whyte J., Virtual Reality and the Built Environment, Architectural Press (2002).
2. Aukstakalnis S., Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Addison-Wesley (2016).

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessionals (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UCS503: SOFTWARE ENGINEERING

| L | T | P | Cr |
|---|---|---|---|
| **3** | **0** | **2** | **4.0** |

**Course objective:** To plan and manage large scale software and learn emerging trends in software engineering.

**Software Engineering and Processes:** Introduction to Software Engineering, Software Evolution, Software Characteristics, Software Crisis: Problems and Causes, Software process models -Waterfall, Iterative, Incremental and Evolutionary process models

**Requirements Engineering:** Problem Analysis, Requirement Elicitation and Validation, Requirement Analysis Approaches- Structured Analysis Vs Object Oriented Analysis, Flow modeling through Data Flow Diagram and Data Dictionary, Data Modeling through E-R Diagram, Requirements modeling through UML, based on Scenario, Behavioral and Class modeling, documenting Software Requirement Specification (SRS)

**Software Design and construction**: System design principles like levels of abstraction, separation of concerns, information hiding, coupling and cohesion, Structured design (top-down or functional decomposition), object-oriented design, event driven design, component-level design, test driven design, data design at various levels, architecture design like Model View Controller, Client – Server architecture. Coding Practices: Techniques, Refactoring, Integration Strategies, Internal Documentation.

**Software Verification and Validation:** Levels of Testing, Functional Testing, Structural Testing, Test Plan, Test Case Specification, Software Testing Strategies, Verification & Validation, Unit and Integration Testing, Alpha & Beta Testing, White box and black box testing techniques, System Testing and Overview of Debugging.

**Agile Software Development:** Agile Manifesto, Twelve Practices of eXtreme Programming (XP), XP values, XP practices, velocity, spikes, working of Scrum, product backlog, sprint backlog, Adaptive Software Development(ASD), Feature Driven Development (FDD), Test Driven Development, Dynamic System Development Method(DSDM), and Crystal Methodology, Agile Requirement and Design**:** User Stories, Story Boards, UI Sketching and Story Cards.

**Software Project Management:** Overview of Project Management: Scope, Time and Cost estimations**.**

**Laboratory work:** Implementation of Software Engineering concepts and exposure to CASE tools like Rational Software Suit through projects.

**Course learning outcomes (CLOs):**
On completion of this course, the students will be able to

1. Analyze software development process models for software development life cycle
2. Elicit, describe, and evaluate a system's requirements and analyze them using various UML models
3. Demonstrate the use of design principles in designing data, architecture, user and component level design
4. Test the system by planning appropriate test cases and applying relevant test strategies
5. Comprehend the use of agile development methodologies including UI sketching, user stories, story cards and backlog management.

***Text Books:***

*1. Pressman R., Software Engineering, A Practitioner's Approach, McGraw Hill International, 7th ed. (2010).*

*2. Sommerville I., Software Engineering, Addison-Wesley Publishing Company, 9th ed.(2011).*

***Reference Books:***

*1. Jalote P., An integrated Approach to Software Engineering, Narosa, 3rd ed. (2005).*

*2.Booch G.,Rambaugh J., Jacobson I., The Unified Modeling Language User Guide, 2nd ed. (2005).*

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessionals (Assignments/Projects/ Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC619: ELECTROMAGNETIC THEORY AND TRANSMISSION LINES

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective**:

a. To introduce the student to the fundamental theory and concepts of Electromagnetic waves and transmission lines, and their practical applications

b. To study the propagation, reflection, and transmission of plane waves in bounded and unbounded media.

**Review of Vector Analysis:** Distinguish between scalars & vectors, Dot and Cross products, coordinate systems-Types, Cartesian Co-ordinate system Cylindrical Co-ordinate system, Transformation between Cartesian and Cylindrical Spherical Coordinate system, Transformation among the three co-ordinate systems ,Vector Calculus, Del operator, Gradient, Curl and Laplacian

**Electrostatics** : Coulomb's law, Electric field intensity, Electric Field strength due to infinite line charge, surface charge and Volume Charge Density, Potential, Potential at a Point Potential Difference Potential Gradient, Equipotential, Surface, Potential due to Electric Dipole, Electric Flux, Faraday's Electric Flux Density, Gauss's Law and its Proof, Gauss's Law in Point Form, relation between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Convection and Conduction, Currents, Dielectric Constant, Isotropic and Homogeneous Dielectrics, Continuity, Equation, Relaxation Time, Poisson's and Laplace's Equations, Uniqueness Theorem

**Magneto statics**: Biot Savart's law , Ampere's circuit law and applications, Magnetic flux density, Maxwell's two equations magneto static fields, Magnetic scalar and vector potentials, Forces due to magnetic fields, problems, Ampere's force law, Inductances and magnetic energy,

**Maxwell's** Faraday's Law and Transformer emf, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Conditions at a Boundary Surface: Dielectric- Dielectric, Dielectric-Conductor, conductor - Interfaces

**EM Wave Characteristics**: Wave equations for conducting and perfect dielectric media, Uniform plane waveforms – Definition, All relations between E&H, sinusoidal variations, Wave propagation in lossless and conducting media, Conductors & dielectrics – Characterization, Wave propagation in good conductors and good dielectrics, Polarization, Reflection and refraction of plane waves-Normal incidence for perfect conductor, Normal Incidence for perfect dielectric, oblique Incidence for perfect conductor, oblique Incidence for perfect dielectric, Brewster angle, critical angle and total internal reflection, Surface impedance, poynting vector and poynting theorem, Applications of poynting theorem, Power loss in a plane conductor

**Transmission Lines**: Transmission Types, Parameters, Transmission Line Equations, Primary and Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Loss less /Low Loss Characterization, Distortion – Condition for Distortion lessness and Minimum Attenuation, Reflection Coefficient, VSWR, UHF Lines as Circuit Elements, λ/4, λ2, λ/8 Lines – Impedance Transformations, Smith Chart– configuration and applications, Single and double stub matching

**TEXT BOOKS**

1. William H.Hayat and J. A.Buck, 'Engineering Electromagnetics',7th ed, Tata McGraw Hill.
2. Gottapu sasibhushanarao. " Electromagnetic Field Theory and Transmission Lines" Wiley.

**REFERENCE BOOKS :**

1. Matthew N.O. Sadiku, "Elements of Electromagnetics" – 3rd ed., Oxford Univ. Press, 2001.
2. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating System"2nd ed, PHI, 2000.
3. John D Kraus, "Electromagnetics" 4th ed., Mcgraw-Hill.

**Course Learning Outcomes (CLO):** Upon successful completion of the course, students will be able to

1. Define and recognize different co-ordinate systems and apply different techniques of vector calculus to understand different concepts of electromagnetic field theory
2. Apply vector calculus to static and time varying electric-magnetic fields in different engineering situations.
3. Analyze Maxwell's equation in different forms (differential and integral) and apply them to diverse engineering problems.
4. Examine the phenomena of wave propagation in different media and its interfaces.
5. Analyze basic transmission line parameters

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC620: DEEP LEARNING FOR COMPUTER VISION

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3.0 |

**Course Objective**: Introduction to deep learning fundamentals, various types of learning, convolutional networks, recurrent neural networks and their applications to solve real world problems.

**Introduction**: Introduction to Machine Learning, Introduction to Neural Networks.

**Fundamentals**: Introduction to Deep Learning, Deep Supervised Learning.

**Convolutional Neural Networks**: History of Convolutional Networks, Convolutional Networks and Computer Vision, Audio and Other Domains, Structural Prediction and Natural Language Processing.

**Energy-based Learning**: Energy-based Models, Energy based Inference, Decision Making versus Probabilistic Modeling, Energy Based training, Loss functions, Unsupervised Learning, Sparse Coding.

**Learning with Memory**: Recurrent Neural Network Basics, Advanced Recurrent Neural Networks, Sequences Modeling with Deep Learning, Embedding Methods for NLP: Unsupervised and Supervised Embeddings, Embedding Methods for NLP: Embeddings for Multi-relational Data, Deep Natural Language Processing.

**Future Challenges**: Applications of deep learning in big data analysis, medical image and data analysis, etc. Latest models of deep learning.

**Laboratory**: Application of deep learning algorithms using Python.

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

1. Understand the fundamentals of deep learning,
2. Apply convolutional neural networks, recurrent neural networks for image and language processing,
3. Understand Energy based learning,
4. Analyse and apply the concepts of deep learning to solve real world problems.

**Books/References:**


1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.


### Evaluation Scheme:

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UCS001: INTRODUCTION TO CYBER SECURITY

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective:** In this course, the student will learn about the essential building blocks and basic concepts around cyber security such as Confidentiality, Integrity, Availability, Authentication, Authorization, Vulnerability, Threat & Risk and so on.

**Introduction:** Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography

**Programs and Programming:** Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures

**Web Security:** User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks

**Operating Systems Security**: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit

**Network Security:** Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management

**Cloud Computing and Security:** Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS

**Privacy:** Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed

**Management and Incidents:** Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster

**Legal Issues and Ethics:** Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics

**Emerging Topics:** The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

**Course Learning Outcomes:** After completion of this course, the students will be able to:

1. Understand the broad set of technical, social & political aspects of Cyber Security and security management methods to maintain security protection
2. Appreciate the vulnerabilities and threats posed by criminals, terrorist and nation states to national infrastructure
3. Understand the nature of secure software development and operating systems
4. Recognize the role security management plays in cyber security defense and legal and social issues at play in developing solutions.

**Text Books:**

1. Pfleeger, C.P., Security in Computing, Prentice Hall, 2010, 5th edition.
2. Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996.

**Reference Books:**

1. Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.
2. Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology, 2011.

## Evaluation Scheme:

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC631: Wireless and Mobile Networking

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective:** This course will cover state-of-the-art topics in wireless networking and mobile computing. The objective of the course is to introduce students to recent advances in mobile networking and sensing, with an emphasis on practical design aspects of mobile systems.

**Introduction to Wireless Communication Systems:** History of Wireless Communication and Future Trends, Narrowband, Wideband, Ultra-Wideband Communication Systems, Description of 2G, 3G, 4G and Hybrid Communication Systems, Brief Introduction of Digital Modulation Techniques, Wireless channel impairments and mitigation techniques, Cognitive radio self-organising networks and spectrum sharing

**Cellular Concepts and System Design Fundamentals:** Introduction to Cellular Concepts and Cellular System Design Fundamentals, Frequency Reuse, Cell size: Merits and demerits Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Trunking and Grade of Service, Cell Splitting, Sectoring, Repeaters and Microcell Zone Concepts.

**Mobile architectures:** Convergence of mobile and fixed architectures: backhaul, fronthaul, midhaul and protocol convergence , LTE, LTE-A, LTE-A-PRO, Introduction to 5G, 5G Architecture, 5G Mobile Edge Computing, FOG computing, 5G Radio Access Technologies, Concept of New Radio (NR), mmWave Propagation, Principles of MIMO systems, Massive MIMO, Distributed MIMO, Programmability and Softwarization, Network Function Virtualization, (NFV), Software Defined networking (SDN), Role of NFV and SDN in 5G, 5G and Internet of Things

**Wireless local area networks**: IEEE: 802.11, 802,11a, 80.11b, 802.11g, 80211.n, HetNet and small cell deployments,  Network Coding, Network Security, Optical networks for backbone, Visible Light communication

**Future mobile networks:** Drone networking, Multi-UAV networks, architectures and civilian applications, Communication challenges and protocols for micro UAVs, Connected and autonomous cars, Wireless technologies for Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications, Automotive surrounding sensing with GHz and THz signals

**Course Learning Outcomes:** After completion of this course, the students will be able to:

1. Understand the structure of current 4G cellular networks (including LTE) and the requirements of 5G cellular networks
2. Analyze the performance of IEEE 802.11 Wi-Fi.
3. Evaluate the basic foundations of wide variety of common wireless networking standards
4. Describe modern network architecture paradigms.

**Text Books:**

1. Wireless Communications: Principles and Practice, by Theodore S. Rappaport, Prentice Hall.
2. Wireless Networking Complete, by Pei Zheng et al., Morgan Kaufman

**Reference Books:**

1. 802.11n: A Survival Guide, by Matthew Gast, O'Reilly Media.
2. 802.11ac: A Survival Guide, by Matthew Gast, O'Reilly Media.
   4. Wireless Networking Complete, by Pei Zheng et al., Morgan Kaufmann.

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC632: ANALOG COMMUNICATION SYSTEMS

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course Objective:** The aim of this course is to build fundamental understanding of a communication system and its performance metrics. The course will describe the theory of modulation and its different counterparts with the help of mathematical analysis of their various characteristics. The generation of AM, FM and PM waves will be described. The course will also focus on the design of AM and FM receivers and will deal with various types of noises in the communication channel.

**Introduction to Communication systems:** Introduction to Communication system, analog and digital messages, signal to noise ratio, Noise, Resistor noise, Multiple resistor noise sources, Noise Temperature, Noise bandwidth, Effective input noise temperature, channel bandwidth, rate of communication, modulation, necessity for modulation, signal distortion over a communication channel, signal energy and signal energy density, signal power, power spectral density,

**Amplitude Modulation:** Baseband and carrier communication, Theory of amplitude modulation, DSB-AM, SSB-AM, Vestigial sideband transmission, carrier acquisition, , power calculations, Square law modulation, Amplitude modulation in amplifier circuits, Suppressed carrier AM generation (Balanced Modulator) ring Modulator, Product Modulator/balanced Modulator.

**AM Reception:** Super heterodyne Receiver, RF Amplifier, Image Frequency Rejection, AM diode detector, AM receiver using a phase locked loop (PLL), AM receiver characteristics.

**Angle Modulation:** Concept of instantaneous frequency, bandwidth of angle modulated waves, Theory of frequency modulation, Mathematical analysis of FM, Spectra of FM signals, Narrow band FM, Wide band FM, Phase modulation, Phase modulation obtained from frequency modulation, FM allocation standards, Generation of FM by direct method, Indirect generation of FM, The Armstrong method RC phase shift method, Comparison of AM, FM and PM

**FM/PM Reception:** Direct methods of Frequency demodulation, Ratio detector, Indirect method of FM demodulation, Pre-emphasis / de-emphasis, Limiters, The FM receiver

**Analog Pulse Modulation:** Introduction, Pulse amplitude modulation (PAM), Pulse Time Modulation (PTM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM).

**Laboratory work:** Study of AM modulators / demodulators: (Balanced modulator, Ring modulator) / (Balanced modulator Super heterodyne Receiver), Study of FM/PM modulators/demodulators: (direct method, Varactor diode Modulator, Indirect generation of FM) / (Balanced stop detector, Foster seely of phase discriminator, Ratio detector), FM stereo receiver.

**Course learning outcome (CLOs):** The students will be able to

1. Analyze energy and power spectral density of the signal.
2. Express the basic concepts of analog modulation schemes
3. Evaluate analog modulated waveform in time /frequency domain and also find modulation index.
4. Analyze about performance of analog communication systems

**Text Books:**

1. Kennedy, G., Electronic Communication Systems, McGraw-Hill (2008) 4th ed.
2. Lathi.B.P.,Modern Digital and Analog Communications Systems 3rd ed.

**Reference Books:**

1. Taub, H., Principles of Communication Systems, McGraw-Hill (2008) 3rd ed.
2. Haykin, S., Communication Systems, John Willey (2009) 4th ed.
3. Proakis, J. G. and Salehi, M., Fundamentals of Communication Systems, Dorling Kindersley (2008) 2nd ed.

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 25 |

## UEC633: CRYPTOGRAPHY

| L | T | P | Cr |
|---|---|---|---|
| **2** | **0** | **2** | **3.0** |

**Course Objective**: This course is designed to impart a critical theoretical and detailed practical knowledge of cryptographic algorithms and techniques. To recognize typical vulnerabilities and safeguards used for wireless communication.

**Syllabus break-up**:

**Basic of Cryptography:** Symmetric and asymmetric cryptography, cryptographic hash functions, Authenticated encryption, Key generation and distribution, Key management, Message Authentication Codes (MACs), Message integrity,

**Symmetric cryptography:** Introduction to DES, TDES and AES algorithms, Blowfish and Twofish.

**Public key cryptography:** Introduction to Diffie-Hellman, RSA, ECC, ElGamal and DSA.

**Digital signatures**: How to sign using RSA, Hash based signatures, certificates, certificate transparency, certificate revocation.

**Security Vulnerabilities:** security against active attacks, Attacks under Message Indistinguishability (Chosen Plaintext Attack and Chosen Ciphertext Attacks), middle channel and side channel attacks, Access Control Problems, Spoofing and Sniffing attacks, Social Engineering and countermeasures.

**Wireless Network Security:** IEEE 802.11i Wireless LAN Security, Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP End-to-End Security.

**Laboratory Work:** Write program to send data across systems as two variants clear text data and encrypted data with different set of encryption algorithms, Showcase different set of security protocol implementation of Wireless LAN.

**Course Learning Outcomes (CLO):**

The student will be able to:

1. Implement various cryptographic algorithms to protect the confidential data.
2. Identify network vulnerabilities and apply various security mechanisms to protect networks from security attacks.
3. Apply security tools to locate and fix security leaks in a computer network/software.
4. Secure a web server and web application.

**Text Books:**


1. Stallings, W., Network Security Essentials, Prentice Hall (2017) 6thEdition.
2. Cheswick, R., W., Bellovin, M., S., and Rubin, D., A., Firewalls and Internet Security, Addison-Wesley Professional (2003) 2ndEdition.


**Reference Books:**


1. Graves, K., Certified Ethical Hacking Study Guide,Sybex (2010) 1stEdition.
2. Stallings, W., Cryptography and Network Security, Prentice Hall (2013), 6th Edition.


**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC634: CLOUD COMPUTING TECHNOLOGY

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3.0 |

**Course Objective:** To appreciate the benefits of Cloud computing and apply Cloud paradigms for evolving businesses. To familiarize with cloud architectural models and resource allocation strategies. The student should comprehensively be exposed to Cloud based services.

**Introduction**: Basics of the emerging Cloud computing paradigm, Cloud computing history and evolution, Cloud enabling technologies, practical applications of Cloud computing for various industries, the economics and benefits of Cloud computing.

**Cloud Computing Architecture:** Cloud Architecture model, Types of Clouds: Public rivate & Hybrid Clouds, Resource management and scheduling, QoS (Quality of Service) and Resource Allocation, Clustering.

**Cloud Computing delivery Models:** Cloud based services: Iaas , PaaS and SaaS Infrastructure as a Service (IaaS):Introduction to IaaS, Resource Virtualization i.e. Server, Storage and Network virtualization Platform as a Service (PaaS):Introduction to PaaS, Cloud platform & Management of Computation and Storage, Azure, Hadoop, and Google App. Software as a Service (SaaS):Introduction to SaaS, Cloud Services, Web services, Web 2.0, Web OS Case studies related to IaaS, PaaS and SaaS.

**Data Processing in Cloud:** Introduction to Map Reduce for Simplified data processing on Large clusters, Design of data applications based on Map Reduce in Apache Hadoop

**Advanced Technologies:** Advanced web technologies (AJAX and Mashup), distributed computing models and technologies (Hadoop and MapReduce), Introduction to Open Source Clouds like Virtual Computing Lab (Apache VCL), Eucalyptus

**Cloud Issues and Challenges:** Cloud computing issues and challenges like Cloud provider Lock-in, Security etc.

**Introduction to Python Runtime Environment**: The Datastore, Development Workflow

**Course learning outcome (CLOs):**

Upon completion of this course, the student will be able to:

1. Familiarization with Cloud architectures.
2. Knowledge of data processing in Cloud.
3. Ability to apply clustering algorithms to process big data real time.
4. Ability to address security issues in Cloud environment.
5. Understand the nuances of Cloud based services.

**Text Books:**


1. Rajkumar Buyya, James Broberg and Goscinski Author Name, Cloud Computing Principles and Paradigms, John Wiley and Sons 2012, Second Edition

2. Gerard Blokdijk, Ivanka Menken,The Complete Cornerstone Guide to Cloud Computing Best Practices, Emereo Pvt Ltd, 2009, Second Edition

**Reference Books:**

1. Anthony Velte, Toby Velte and Robert Elsenpeter , Cloud Computing: A practical Approach Tata McGrawHill, 2010, Second Edition
2. Judith Hurwitz, Robin Bllor, Marcia Kaufmann, Fern Halper, Cloud cOmputing for Dummies, 2009, Third Edition

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 25 |

## UEC731: GRAPHICS AND VISUAL COMPUTING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective**: Detailed study of computer graphics, 2 D and 3 D transformations, representations and visualization.

### Syllabus break-up:

**Fundamentals of Computer Graphics:** Applications of computer Graphics in various, Video Display Devices, Random scan displays, raster scan displays, DVST, Flat Panel displays, I/O Devices.

**Graphics Primitives:** Algorithms for drawing Line, circle, ellipse, arcs & sectors, Boundary Fill & Flood Fill algorithm, Color Tables

**Transformations & Projections:** 2D & 3D Scaling, Translation, rotation, shearing & reflection, Composite transformation, Window to View port transformation, Orthographic and Perspective Projections.

**Clipping:** CohenSutherland, Liang Barsky, Nicholl-Lee-Nicholl Line clipping algorithms, Sutherland Hodgeman, Weiler Atherton Polygon clipping algorithm.

**Three Dimensional Object Representations:** 3D Modeling transformations, Parallel & Perspective projection, Clipping in 3D. Curved lines & Surfaces, Spline representations, Spline specifications, Bezier Curves & surfaces, B-spline curves & surfaces, Rational splines, Displaying Spline curves & surfaces.

**Basic Rendering:** Rendering in nature, Polygonal representation, Affine and coordinate system transformations, Visibility and occlusion, depth buffering, Painter's algorithm, ray tracing, forward and backward rendering equations, Phong Shading per pixel per vertex Shading.

**Visualization:** Visualization of 2D/3D scalar fields: color mapping, iso surfaces. Direct volume data rendering: ray-casting, transfer functions, segmentation. Visualization of: Vector fields and flow data, Time-varying data, High-dimensional data: dimension reduction, parallel coordinates, Non-spatial data: multi-variate, tree/graph structured, text Perceptual and cognitive foundations, Evaluation of visualization methods, Applications of visualization, Basic Animation Techniques like traditional, keyframing.

**Course Learning Outcomes (CLO):** The student will be able to:

1. Comprehend the concepts related to basics of computer graphics and visualization.
2. Demonstrate various graphics primitives and 2-D, 3-D geometric transformations
3. Understand various clipping techniques
4. Comprehend the concepts related three dimensional object representations.
5. Implement various hidden surface removal techniques.

**Text Books:**

1. Donald D Hearn, M. Pauline Baker, Computer Graphics C version, Pearson Education
2. Dave Shreiner, Mason Woo, Jackie Neider, Tom Davis, OpenGL Programming Guide: The Official Guide to Learning OpenGL, (2013).

**Reference Books:**

1. James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes, Computer Graphics: Principles & Practice in C, Addison Wesley Longman.
2. Zhigang Xiang, Roy A Plastock, Computer Graphics, Schaums Outline, TMH

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UCS754: BLOCKCHAIN TECHNOLOGY

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3.0 |

**Course Objective**:

This course covers the conceptual and application aspects of fast growing and latest technology Blockchain. The popularity of digital cryptocurrencies has led the foundation of Blockchain, it is a public digital ledger which share the information in a secure way. The various applications of Blockchain are business process management, smart contracts, IoT and so on. In this course fundamental design and architectural primitives of Blockchain, the system and the security aspects will be covered.

**Syllabus break-up**:

**Introduction to Blockchain:** Blockchain Theory, Immutable Ledger, Smart Networks, Cryptographic Wallets, Blockchain Global Peer to peer software network, Cryptocurrency, Bitcoin mining, Bitcoin scalability, Blockchain risks: Technical, Regulatory, Perception, Payment networks, Blockchain applications, Decoupling Decision-making and Automated execution, Smart Contracts: Bitcoin, Ethereum.

**Hyperledger Fabric:** Transaction flow, details, membership, identity management, hyperledger composer, application development and network administration,

**Blockchain use cases:** Blockchain Consensus Algorithms, Byzyantine Fault Tolerance, Applications in finance, supply chain, other industries and Government.,

**Miscellaneous:** Alt Coins, Ripple, Neo, Litecoin, Cardano, Stellar, Blockchain security and research aspects.

**Laboratory Work:** Pre-requisite for basics of Blockchain**,** Create a blockchain using Python, Create a cryptocurrency using Python, Create a Smart Contract using Python, Implementation and testing of hyperledger, execution and understanding of bitcoin, implementation, concepts and exposure to blockchain using any language. Modelling, designing and testing of application specific project and research papers.

**Course Learning Outcomes (CLO):**

The student will be able to:

1. Understand the architecture and basics of the Blockchain.
2. Know the use of digital currency and consensus of Bitcoin.
3. Deal with the digital ledger and can describe the hyperledger.
4. Use Blockchain in various applications.

**Text Books:**

1. Arvind N., Joseph B., Edward F., Andrew M., and Steven G., “Bitcoin and

Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, ISBN-13: 978-0691171692.
2. Henning D., and Create S., "Ethereum: Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations" Independent Publishing Platform, ISBN-13: 978-1523930470.

**Reference Books:**

1. Arshdeep B., and Vijay M. "Blockchain Applications: A Hands-on Approach", Vpt, ISBN-13: 978-0996025560.
2. Roger W. "The Science of the Blockchain", Create Space Independent Publishing Platform, 2016, ISBN-978-1522751830

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC858: Modern Control Theory

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective**: This course provides the insight of the fundamentals of modern control theory by analysing time and frequency response of open and closed loop systems. Furthermore, the concept is extended to advanced concepts of modern control theory centred on the system stability and state space methods. Emphasis is placed on concepts of controllability and observability in addition to fundamentals of digital control systems.

**Syllabus break-up**:

**Mathematical Models, Block Diagrams and Signal Flow Graphs of Systems:** Introduction of mathematical models and transfer function, Construction and reduction of block diagram and signal flow graphs, Application of Mason's gain formula.

**Time-Domain Analysis of Control Systems:** Transient and steady state response, time response of first and second-order systems, sensitivity to parameter variations, steady-state errors, Types of Systems and Error Constants.

**System Stability:** Conditions for stability of linear systems, Algebraic Stability criteria - Hurwitz criterion, Routh criterion, Root locus techniques, Frequency domain analysis, Correlation between frequency response and transient response, Polar plots, Nyquist plots, Bode plots.

**Classical Controller Design Methods:** General aspects of the Closed-loop control design problem, Controller circuits design concepts for P, PD, PI and PID Controllers

**State Variable Analysis:** Introduction, state variable representation, conversion of transfer function model to state variable model, conversion of state variable model to transfer function model, Eigen values and Eigen vectors, solution of state equations. Concepts of controllability and observability,

**Digital control system:** Basic structure of digital control systems, description and analysis of Linear Time-Invariant Discrete-time systems.

**Course Learning Outcomes (CLO): Maximum 5 CLO'S**

The student will be able to:

1. Understand CLO sse and open loop control system representations in terms of block diagrams, signal flow graphs and transfer function,
2. Analyze the time and frequency response of the control systems and to establish the correlation between them,
3. Analyze the stability of the control systems and learn various methods to judge the stability criterion,
4. Understand the fundamentals of designing of P-I-D controllers,
5. Achieve knowledge about the concepts of the state space analysis and the concept of controllability and observability for classical and digital control system.

**Text Books:**

1. Nagrath, I. J., and Gopal, M., Control Systems Engineering, New Age International Publishers, 2006, 4th ed.
2. Benjamin C. Kuo, Automatic Control Systems, Pearson education, 2003
3. G F Franklin, J D Powell and M Workman, Digital Control of Dynamic Systems, 1997, 3rd ed.
4. M. Gopal, Digital Control and State Variable Methods, McGraw-Hill, 2008.

**Reference Books:**

*1.* Ogata, Katsuhiko, Modern Control Engineering, Prentice-Hall, (2010) 5th ed.
*2.* Warwick, Kevin, An Introduction to Control Systems, World Scientific Publishing Co. Ptv. Ltd, (1996) 2nd ed.
*3.* Levine, W. S., Control System Fundamentals, CRC Press, (2000) 3rd ed.
*4.* Mutambara, Arthur G. O., Design and Analysis of Control Systems, CRC Press, (1999) 2nd ed.

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (may include Assignments/Quizzes) | 25 |

## UEC821: VIDEO SIGNAL PROCESSING

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course Objective**: The goal of this course is to provide an understanding of video processing tasks as well as practical experience in accomplishing them. Students will be able to acquire knowledge of video processing e.g., video coding, compression.

**Introduction and Fundamentals:** Representation of video, analog video, spatio-temporal sampling, sampling of analog and digital video, sampling of 3-D structures, reconstruction from samples.

**Video Motion Estimation**: Real versus apparent motion, spatial-temporal constraint methods (optical flow equation), general methodologies-Block matching algorithm, Deformable block matching algorithm, Mesh based motion estimation, Global motion estimation, Region based motion estimation, Multiresolution motion estimation Feature based Motion Estimation, Direct motion Estimation.

**Video Coding**: Content dependent video coding, Region based video coding, Object based video coding, Knowledge based video coding, Semantic video coding, Scalable video coding, Applications of motion estimator in video coding.

**Digital Video Compression Standards: i**nter-frame and intra-frame compression, Lossy and Loss less compression techniques, MPEG-1 and MPEG-2 Standard, H.265/HEVC

**Laboratory Work:** Students have to write MATLAB /Python programs for dividing raw video into frames, compression, coding and reframing the video.

**Course Learning Outcomes (CLO):**

The student will be able to:

1. Understand the video sampling and reconstruction
2. Describe algorithms of video motion estimation
3. Interpret video coding and segmentation algorithms
4. Familiarize with video compression standards

**Text Books:**


1. M.Tekalp, Digital Video Processing, Prentice Hall, 2nd Edition, 2015.
2. Alan C. Bovik, The Essential Guide to Video Processing, Elsevier Science, 2nd Edition, 2009.
3. Y. Wang, J. Ostermann and Y.-Q. Zhang, Video Processing and Communications. Signal Proc. Series, Prentice Hall, 2002.
4. J. Watkinson, The Art of Digital Video, , 3rd edition, Focal Press, 2000.

**Reference Books:**

1. Iain E. Richardson, H.264 and MPEG-4 Video Compression: Video Coding for Next- generation Multimedia, John Wiley & Sons, 2nd Edition, 2003.
2. J.W. Woods, Multidimensional Signal, Image and Video Processing and Coding, Academic Press, 2nd edition, 2012.

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC 732: NATURAL LANGUAGE PROCESSING AND APPLICATIONS

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3.0 |

**Course Objective:** To familiarize the students with natural language processing (NLP) and introduce major algorithms pertaining to real world problems. Students will be able to design and implement machine learning solutions to NLP problems; and be able to evaluate and interpret the results of the algorithms.

**Preliminaries:** Historical overview of Natural Language Processing, Ambiguity and uncertainty in language, Regular languages and their limitations, Expressions for identifying and quantifying language phenomena, Basic morphology, The Turing test, Chomsky hierarchy, Finite-state automata.

**Sequences, similarity and distance metrics:** Dynamic programming for optimal alignment of sequences, String edit operations, Edit distance, and examples of use in spelling correction, and machine translation, Decision tree based algorithms in NLP.

**Context Free Grammars and Parsing:** Constituency, CFG definition, use and limitations. Chomsky Normal Form. Top-down parsing, bottom-up parsing, and the limitations of each, Non-probabilistic Parsing, Efficient CFG parsing, Probabilistic parsing, Events and counting, Joint and conditonal probability, Marginals, Independence, Bayes rule, Combining evidence, Examples of applications in natural language, Entropy, cross-entropy, information gain and their application to some language phenomena

**Language modeling and Naive Bayes:** Markov models, N-grams. Estimating the probability of a word, and smoothing. Generative models of language and their application to building an automatically-trained email spam filter, and automatically determining the language (English, Hindi etc.).

**Deep Learning for NLP:** Natural Language Processing (NLP) using deep nets, Auto encoders, LSTM networks for NLP applications, Sentiment analysis, Context analysis, Word embedding with recurrent nets, Recurrent neural networks for parts-of-speech tagging, implementation of word2vec,CBOW method in word2vec, Skip-gram method in word2vec, Negative sampling optimization in word2vec, Understand and implement, GloVe using gradient descent and alternating least squares.

**Laboratory Work:**

1. Obtain pretrained word vectors from GloVe and word2vec.
2. Text classification using word2vec and GloVe.
3. Text classification using bigram models.
4. Implementing a neural network bigram model.
5. Tensorflow/Theano Basics.
6. word2vec Tensorflow/Theano implementation.
7. Parts-of-Speech Tagging Recurrent Neural Network in Theano/Tensorflow.
8. Named Entity Recognition RNN in Theano/Tensorflow.

**Course Learning Outcomes (CLOs):** At the end of the course the student will be able to

- Comprehend nuances of linguistics and morphology and its computational underpinnings.
- Implement probabilistic/non probabilistic parsing for a given sequence of words/speech.
- Apply probabilistic language modeling for automatic identification.
- Implement deep networks and sequence models for semantics, context, and sentiment analysis.

**Text Books:**

**1.** Jurafsky & Martin "Speech and Language Processing" Pearson Education India; 2 edition (2013) ISBN-10: 9789332518414

**Reference Book:**

**1.** Manning and Schutze "Foundations of Statistical Natural Language Processing" MIT Press Cambridge, MA, USA ©1999 ISBN:0-262-13360-1

**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 4. | MST | 25% |
| 5. | EST | 45% |
| 6. | Sessional (May include Assignments/Projects/Quizzes) | 30% |

## UEC733: AUDIO & SPEECH PROCESSING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course objective:** To provide students with the knowledge of basic characteristics of speech signal in relation to production and hearing of speech by humans, to describe some basic algorithms of speech analysis in different applications, to give an overview of various applications (recognition, synthesis, coding) and to inform about practical aspects of speech algorithms implementation.

**Digital speech processing and its applications:** production and classification of speech sounds, lossless tube models, digital models for speech signals; Analysis and synthesis of pole-zero speech models, Levinson recursion, lattice synthesis filter.

**Time dependent processing of speech:** pitch period estimation, frequency domain pitch estimation; Discrete-time short-time Fourier transform and its application, phase vocoder, channel vocoder.

**Homomorphic speech processing**: waveform coders, hybrid coders and vector quantization of speech; Model based coding: Linear predictive, RELP, MELP, CELP; Speech synthesis.

**Principles of speech recognition**: spectral distance measures, dynamic time warping, word recognition using phoneme units, hidden Markov models and word recognition, speech recognition systems, speaker recognition.

**Audio coders:** Ear physiology, psychoacoustics, perception model and auditory system as filter bank; Filter bank design and modified discrete cosine transform algorithm for audio compression in MP3 and AAC coders; Standards for high-fidelity audio coding.

**Filter banks for speech processing**: Tree-structured filter banks, multicomplementary filter banks; Properties of wavelets and scaling functions, wavelet transform; Filter banks and wavelets, applications of wavelet signal processing in audio and speech coding.

**Course Learning Outcomes (CLO):** Upon completion of the course, the student will be able to:

1. Characterize the speech signal in relation to production and hearing by humans.
2. Differentiate between various mathematical techniques for speech recognition.
3. Analyze coders for speech signals.
4. Analyze the role of filter banks in speech processing.

**Text Books:**

1. L. R. Rabiner and R. W. Schaffer, “Digital Processing of Speech signals”, Prentice Hall, 2010.
2. B. Gold and N. Morgan, “Speech and Audio Signal Processing”, John Wiley and Sons Inc., 2011.

**Reference Books:**

1. T.F.Quatieri, “Discrete-Time Speech Signal Processing”, Prentice Hall, 2002.

2. L.R. Rabiner and B. H. Juang, “Fundamentals of speech recognition”, Prentice Hall, 1993.

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/ Quizes/Lab Evaluations) | 25 |

## UEC645: PARALLEL & DISTRIBUTED COMPUTING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objective**: To understand the fundamentals of parallel and distributed programming and application development in different parallel programming environments.

**Parallelism Fundamentals:** Scope and issues of parallel and distributed computing, Parallelism, Goals of parallelism, Parallelism and concurrency, Multiple simultaneous computations, Programming Constructs for creating Parallelism, communication, and coordination. Programming errors not found in sequential programming like data races, higher level races, lack of liveness.

**Parallel Architecture:** Architecture of Parallel Computer, Communication Costs, parallel computer structure, architectural classification schemes, Multicore processors, Memory Issues: Shared vs. distributed, Symmetric multiprocessing (SMP), SIMD, vector processing, GPU, coprocessing, Flynn's Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).

**Parallel Decomposition and Parallel Performance:** Need for communication and coordination/synchronization, Scheduling and contention, Independence and partitioning, Task- Based Decomposition, Data Parallel Decomposition, Actors and Reactive Processes, Load balancing, Data Management, Impact of composing multiple concurrent components, Power usage and management. Sources of Overhead in Parallel Programs, Performance metrics for parallel algorithm implementations, Performance measurement, The Effect of Granularity on Performance Power Use and Management, Cost-Performance trade-off;

**Distributed Computing:** Introduction: Definition, Relation to parallel systems, synchronous vs asynchronous execution, design issues and challenges, A Model of Distributed Computations, A Model of distributed executions, Models of communication networks, Global state of distributed system, Models of process communication.

**Communication and Coordination:** Shared Memory, Consistency, Atomicity, Message-Passing, Consensus, Conditional Actions, Critical Paths, Scalability, cache coherence in multiprocessor systems, synchronization mechanism.

**Parallel Algorithms design and Analysis:** Parallel Algorithms, Parallel Graph Algorithms, Parallel Matrix Computations, Critical paths, work and span and relation to Amdahl's law, Speed-up and scalability, Naturally parallel algorithms, Parallel algorithmic patterns like divide and conquer, map and reduce, Specific algorithms like parallel Merge Sort, Parallel graph algorithms, parallel shortest path, parallel spanning tree, Producer-consumer and pipelined algorithms.

**Course learning outcomes (CLOs):** On completion of this course, the students will be able to

1. Apply the fundamentals of parallel and distributed computing including parallel architectures and paradigms.
2. Apply parallel algorithms and key technologies.
3. Knowledge of different parallel approaches for resolving real time problems like sorting, shortest path etc.
4. Analyse the performance issues in parallel computing and trade-offs.

**Text Books:**

1. C Lin, L Snyder. Principles of Parallel Programming. USA: Addison-Wesley (2008).
2. A Grama, A Gupra, G Karypis, V Kumar. Introduction to Parallel Computing, Addison Wesley (2003).

**Reference Books:**

1. B Gaster, L Howes, D Kaeli, P Mistry, and D Schaa. Heterogeneous Computing With Opencl. Morgan Kaufmann and Elsevier (2011).
2. T Mattson, B Sanders, B Massingill. Patterns for Parallel Programming. Addison-Wesley (2004).
3. Quinn, M. J.,Parallel Programming in C with MPI and OpenMP, McGraw-Hill (2004).

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC823: SOFT COMPUTING

| L | T | P | Cr |
|---|---|---|---|
| **2** | **0** | **2** | **3.0** |

**Course objective:** To familiarize with soft computing concepts. Introduce the ideas of neural networks, fuzzy logic and use of heuristics based on human experience. Familiarize the concepts of Genetic algorithm. Apply the soft computing concepts to solve practical problems.

**Introduction:** Introduction to soft computing, Problem complexity, Problem complexity classification, Types of soft computing techniques, Softcomputing versus hard computing, Advantages of soft computing.

**Artificial Neural Networks:** Biological neuron, Artificial Neural Network, Mathematical Models, McCulloch Neural Model, Perceptron, Adaline and Madaline, Learning & Training in ANN, Hopfield Neural Network, Self-Organizing Networks, Recurrent Networks, Associative memories

**Fuzzy Logic System:** Crisp Vs Fuzzy set theory, Membership functions, Fuzzy set operations, Fuzzy rules, Mamdani and Sugeno fuzzy inference systems, Defuzzification methods.

**Genetic Algorithms:** Introduction and biological background of GA, String Encoding of chromosomes, Selection methods, Single & multi-point crossover operation, Mutation, Adjustment of strategy parameters such as Population size, Mutation & Crossover probabilities

**Tools & Applications:**

**Laboratory Work:** MATLAB Toolboxes: Fuzzy Logic Toolbox, Neural Network Toolbox, Neural network as a classifier, FLS for Antilock Breaking System (ABS), GA in route planning for Travelling Sales Person, Time-Series forecasting using ANN. Familiarization of GA toolbox MATLAB and implementing it to find optimal solution of optimization problems.

**Course Learning Outcomes:** Upon completion of this course, the student should be able to:

1. Identify the characteristics of Soft Computing Techniques
2. Analyze neural networks and their applications.
3. Demonstrate proficient performance in the application of neural nets.
4. Apply fuzzy logic and fuzzy reasoning for decision making
5. Analyze genetic algorithms and their applications.

**Text Books**

1. Jang, J.S.R., Sun, C.T., and Mizutani, E., Neuro-Fuzzy and Soft Computing, Pearson Education (2004) 2nd ed.
2. Eberhart, R., Simpson, P., and Dobbins, R., Computational Intelligence - PC Tools, AP Professional (1996) 3rd ed.

**Reference Books:**

1. Jacek M. Zurada – Introduction to Artificial Neural Systems
2. S N Sivanandam, S N Deepa – Principles of Soft Computing, Wiley Publications
3. John Yen, Reza Langari – Fuzzy Logic Intelligence, Control, and Information
4. Goldberg, Davis E., Genetic Algorithms: Search, Optimization and Machine Learning, Wesley Addison (1989) 3rd ed

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessionals (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC734: QUANTUM COMPUTING

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective:** The main objective of this course is to provide an introduction to the main ideas and techniques of the field of quantum computation (qubits, quantum gates, and qubit systems). To understand the various applications of quantum algorithms in different areas. One of the main motivations for working in quantum computing is the prospect of fast quantum algorithms to solve important computational problems. Most striking is to study quantum entanglement.

**Introduction to Quantum Mechanics:** Linear algebra, Vector spaces, Inner product Vector spaces, Definition of Hilbert space, Dimension and basis of a vector space, Linear operators, Inverse and Unitary operators, Hermitian operators, Eigenvalues and Eigenvectors, Tensor products, Commutators, Spectral decomposition theorem, Quantum states, Definition of qubits, Matrix Representation of Kets, Bras, and Operators, Wave function.

**Elements of Quantum Mechanics**: The postulates of quantum mechanics: (State space, State Evolution, Quantum measurement, Distinguishing quantum states, Projective measurements, POVM measurements, Phase), Time Evolution Operator, Stationary States: Time-Independent Potentials, Time independent and Time dependent Schrödinger Equation and Wave Packets, The Conservation of Probability, Time Evolution of ExpectationValues, The density operator, Ensembles of quantum states. Uncertainty principle, minimum uncertainty, Ehrenfest's theorem, E.P.R. paradox.

**Quantum Computation:** Multiple qubit unitary quantum gates: (CNOT, Swap, Toffoli, Fradkin, Hadamard Pauli gates), Concept of Bloch sphere, Quantum algorithms: (Deutsch–Jozsa algorithm, Shor's fast algorithms), Quantum search algorithm: Grover's algorithm, Concept of Quantum Fourier Transform. One dimensional Harmonic Oscillator quantum computer, Ion trap models.

**Quantum Communication:** Overview of Coherent States, Quantum Binary Communications Systems, The Holevo bound, Quantum Entropy, Classical information over noisy quantum channels, The quantum data processing inequality, Quantum Systems with BPSK Modulation, Overview of Squeezed States, Basic concept of Entanglement, Quantum key distribution.

**Minor Project:** Figure out how quantum algorithms work, compute the complexity of quantum search algorithm and how quantum Fourier transform works. Students should use the MATLAB or C or C++ for simulation purpose.

**Course Learning Outcomes (CLOs):**

The students will be able to

- Acquire knowledge about mathematical background of quantum mechanics.
- Identify the quantum states after taking the measurements along with unitary time evolution operator.

- Analyze the need of quantum gates and quantum circuits in current scenario. Also doing the analysis about complexity and fast conversion rate of quantum algorithms.
- Setup the general foundations of telecommunications systems using quantum mechanics and recognize the difference between Classical and Quantum Communication systems.
- Apply the knowledge of quantum entanglement states and quantum cryptography for designing a secure quantum communication system.

**Text Books**

1. Michael A. Nielsen & Isaac L. Chuang. Quantum Computation and Quantum Information. Cambridge university press, (2010)
2. Gianfranco Cariolaro. Quantum Communications. Springer (2015)
3. Griffiths, David J. Introduction to Quantum Mechanics. Upper Saddle River, Pearson Prentice Hall, (2005)

**Reference Books**

*1.* Dirac, Paul Adrien Maurice. The Principles of Quantum Mechanics. Clarendon Press, (2011)
*2.* Nouredine Zettili. Quantum Mechanics (concepts and applications). Second edition, Willey, (2009)

**Evaluation Scheme:**

| S. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 7. | MST | 30 |
| 8. | EST | 45 |
| 9. | Sessionals (May include Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 25 |

## UEC735: BIG DATA ANALYTICS

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course Objective**: Big Data Analytics course will inspire students to explore opportunities in the world of big data analytics. This course will take you from the basics of big data analytics to the advance analytical tools, methods and technology, which could be used for the big data analytics projects. It also brings together several key big data technologies used for storage, analysis and manipulation of data.

**Introduction to big data:** Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs. Reporting, Use cases

**Big-data Characteristics and issues**

Characteristics and issues in Big-Data Analytics, Challenges associated with Big-data, Bog-Data Analytical platforms, Storage and Architecture properties,

**Big data using Apache Hadoop Stack**

Introduction to Hadoop, HDFS and its architecture, Hadoop-Python framework and programming, Parallelization, MapReduce, Hadoop Client, Apache Sqoop Apache Flume, Hadoop Security, Apache Spark, Spark-Python framework, Pyspark programming and applications

**Apace Hadoop Tools:** Overview of hive and its architecture, Hive data types and File format, Hive query language (HQL), Apace Storm, Introduction to Pig, , Data types in Pig and Running Pig, Oozie, Mahout,

**Laboratory Work:** Data Engineering Hadoop ecosystem, Spark etc.

**Course Learning Outcomes (CLO):**

The student will be able to:

1. Identify the issues and challenges related to Big Data
2. Design efficient algorithms for mining the data from large volumes.
3. Analyze the HADOOP and Map Reduce technologies associated with big data analytics
4. Explore on Big Data applications Using Pig and Hive. Explore on Big Data applications Using Pig and Hive.

**Text Books:**

1. R. Shankarmani, M. Vijayalakshmi, “Big Data Analytic”, Wiley 2016
2. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CUP,2012.

**Reference Books:**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging
2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of

**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC736: VLSI SIGNAL PROCESSING

| L | T | P | Cr |
|---|---|---|---|
| **3** | **0** | **0** | **3** |

**Course Objective**: This course provides methodology to achieve VLSI architectures for various digital signal processing applications. It explores various possible high performance, low power and area efficient architectures/designs for a given signal processing algorithms.

**Introduction**: Brief review of IIR and FIR Filters, multirate signal processing, digital filter banks, concept of adaptive filters, least mean square (LMS) adaptive algorithm, Representation of DSP algorithms, signal flow, data flow and dependence graphs (DFGs).

**Algorithmic Transformation Approaches: Iteration bound**: Loop and Iteration bound, Iteration rate, critical loop, critical path analysis, **pipelining and parallel processing:** pipelining of FIR filter, parallel processing of FIR filters, pipelining and parallel processing of DSP systems for low-power consumption, **Retiming:** cut-set retiming, clock period minimization, register minimization, **Unfolding:** sample period reduction, parallel processing: bit level and word level architectures of DSP systems, **Folding:** folding transformation, register minimization technique, forward backward register allocation technique, folding Bi-quad filters.

**Algorithm Strength Reduction**: Parallel FIR filters, polyphase decomposition, fast FIR filters algorithms, discrete cosine transform and inverse discrete cosine transform, algorithm-architecture transformation, DIT fast DCT.

**Pipelined and Parallel Recursive Filters**: concept of pipeline interleaving in digital filters, look ahead pipelining in IIR filters, clustered look-ahead pipelining, scattered look-ahead pipelining, parallel processing in IIR Filters.

**Bit-level arithmetic architectures and numerical strength reduction:** parallel multipliers, bit-serial multipliers, bit-serial IIR filter, canonic signed digit arithmetic, subexpression elimination, subexpression sharing in digital filters.

**Course Learning Outcomes (CLO): Maximum 5 CLO'S**

The student will be able to:

1. Analyse signal processing operations from VLSI implementation perspective.
2. Transform DSP algorithms to high performance and low power DSP architectures using pipelining, parallel processing and retiming.
3. Achieve area efficient architectures using folding and algorithm strength reduction techniques for digital filters.
4. Develop highly area efficient and low power filter architectures using bit-serial approach or canonic-signed-digit arithmetic.

**Text Books:**

1. Parhi, K.K., VLSI Digital Signal Processing Systems: Design and Implementation, John Wiley (2007).
2. Oppenheim, A.V. and Schafer, R.W., Discrete-Time Signal Processing, Prentice Hall (2009) 2nd edition.

**Reference Books:**

1. Proakis, J.G., Digital Filters: Analysis, Design and Application, McGraw Hill (1981) 2nd ed.
2. Mitra, S.K., Digital Signal Processing. A Computer Based Approach, McGraw Hill (2007) 3rd edition

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC857: VLSI INTERCONNECT

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:** In this course the students will learn interconnect models, interconnect analysis and interconnect materials.

**Introduction:** Technology trends, Device and interconnect scaling ,Interconnect Models: RC model and RLC model, Effect of capacitive coupling, Effect of inductive coupling, Transmission line model, Power dissipation, Interconnect reliability.

**Device Models:** Introduction, device I-V characteristics, General format of device Models, device models in explicit expression, device model using a table-Lookup model and effective capacitive model.

**Interconnect analysis:** Time domain analysis: RLC network analysis, RC network analysis and responses in time domain, S domain analysis, circuit reduction via matrix approximation, Analysis using moment matching, transmission lines: step input response.

**Crosstalk analysis:** Introduction, Capacitive coupled and inductive coupled interconnect model and analysis, Transmission line based model.

**Advanced Interconnect materials**: Basic materials: Copper and aluminium. Problem with existing materials in deep submicron: Electro-migration effect, surface and grain boundary effect. CNT and GNR as interconnect materials, impedance parameters of CNT and GNR, and Optical interconnects.

**Course Learning Outcomes:**
After the completion of this course, the students are able to:

1. acquire knowledge about Technology trends, Device and interconnect scaling.
2. identify basic device and Interconnect Models.
3. perform RLC based Interconnect analysis.
4. analyse the problem with existing material in deep submicron technology nodes and understand the advanced interconnect materials
.

**TextBooks:**

1. Chung-Kang Cheng,John Lillis,Shen Lin and Norman H.Chang, “Interconnect Analysis and Synthesis”,A wiley Interscience Publication(2000).
2. Sung-Mo (Steve) Kang, Yusuf Leblebigi, “CMOS Digital integrated circuits analysis and design”, by Tata Mcgraw-Hill, (2007).

**Reference Books:**

1. L.O.Chua,C.A.Desoer,and E.S.Kuh, “Linear and Non linear circuits”,McGraw-Hill,1987.
2. R.E.Matrick, “Transmission lines for digital and communication networks”, IEEE press,1995.

3. Mauricio Marulanda, “Electronic properties of Carbon Nanotubes”,InTech publisher 2011.

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC825: MEMS

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objectives:** In this course the students will learn basic concept of MEMS devices, their working principles, equivalent circuits, modelling and characterization tools, different MEMS sensors and MEMS fabrication technologies.

**Introduction to MEMS:** Introduction to MEMS and Micro sensors, MEMS system-level design methodology, Equivalent Circuit representation of MEMS, Signal Conditioning Circuits.

**Principles of Physical and Chemical Sensors:** Sensor classification, Sensing mechanism of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors.

**Sensor Technology:** Concept of clean room, Vacuum systems, Thin Film Materials and processes (Lithography, oxidation, sputtering, diffusion, CVD, micro machining, Wafer bonding, Wire bonding and Packaging.

**Sensor Modeling**: Numerical modeling techniques, Model equations, different effects on modelling (mechanical, electrical, thermal, magnetic, optical, chemical and biological and example of modelling.

**Sensor Applications**: Pressure Sensor with embedded electronics, Accelerometer, RF MEMS Switch and Bio MEMS.

**Future Aspects of MEMS**: NEMS, MOEMS, BIO-MEMS, RF MEMS, OPTICAL MEMS.

**Course Learning Outcomes:**
The student will be able to
1. Acquire knowledge about MEMS & Micro Sensors.
2. Describe working principles of MEMS devices.
3. Understand various micro fabrication technologies.
4. Acquire knowledge about Device Modelling and its applications

**Text Books:**
1. Franssila Sami, Introduction to Micro Fabrication, WILEY, 2nd Edition, 2010
2. NadimMaluf, An Introduction to MicroelectromechanicalSyatemsEngineering,Artech House, 3rd edition, 2000.
3. MahalikNitaigourPremchand,MEMS, McGraw-Hill, 2007.

**Reference Books:**


1. Senturia Stephen D., Microsystem Design, Springer US, (2013).
2. Madou Marc J., Fundamentals of Microfabrication, CRC Press, (2002).
3. StephrnBeeby, Graham Ensell, Michael Kraft, Neil White, MEMS Mechanical Sensors, artech House (2004).
4. Chang Liu, Foundations of MEMS, Pearson Education Inc., (2012)
5. Tai Ran Hsu,MEMS& Micro systems Design and Manufacture Tata McGraw Hill, NewDelhi, 2002.


**Evaluation Scheme:**

| S.No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1. | MST | 30 |
| 2. | EST | 45 |
| 3. | Sessionals (May include<br>Assignments/Projects/Tutorials/Quizes/Lab Evaluations) | 25 |

## UEC752: IC Fabrication

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3.0 |

**Course Objective**:

- To gain knowledge about crystal growth and wafer preparation techniques.
- Understanding of different integral steps needed for IC components fabrication.
- Fabrication steps of bipolar and field effect transistors.
- Various packaging techniques of ICs.

**Evolution of Integrated Circuits:** Introduction, Impact of ICs on Industry, Moore's Law, Advantages over discrete components, Monolithic and Hybrid ICs, Scales of integration and related issues.

**Growth of Single Crystals wafers:** Crystal growth using Czochralski's method, Float Zone method and Bridgeman technique, Zone refining, characteristics and crystal evaluation, Wafer Shaping operations, Slicing, polishing and etching.

**Epitaxy Film Formation:** Importance of epitaxial layer growth, Types of epitaxy: Vapor Phase Epitaxy (VPE), Molecular Beam Epitaxy (MBE), Metal Organic Chemical Vapor Deposition (MOCVD) Defects in epitaxial layers and their removal,

**Diffusion:** Impurity diffusion in a semiconductor crystal. Fick's Laws, Gaussian and Complementary Error Function Distribution of Impurities. Properties of diffusion, Ion-implantation.

**Subsequent Processes:** Wet and Dry Oxidation, Metallization using Physical Vapor Deposition (PVD), RF Sputtering, DC Sputtering, Clean room: Standards, Photolithography, Electron beam and X-Ray lithography, Positive & Negative Photo resists, dry and wet Etching.

**Fabrication of different devices:** Design of junction diode, Bipolar Junction Transistor, Metal Oxide Semiconductor Field Effect Transistor, Polysilicon gates, CMOS Fabrication.

**Packaging of IC's:** Mountings in packages using Dual-in-line (DIP), Decawatt Package (DPAK) packages. Packages using surface-mount-technology (SMT).

**Course Learning Outcomes (CLO):** The student will be able to:

1. Acquire knowledge about crystal growth and wafer preparation techniques.
2. Learn about different process used in ICs Fabrication.
3. Fabricate different Semiconductor Devices.
4. Understand the various IC packaging techniques.

**Text Books:**

1. Sze, S. M., VLSI Technology, Wiley Eastern, USA (1999) 2nd ed.
2. Sze, S. M., Semiconductor Devices, Physics & Technology, (2001) 3rd ed.

**Reference Books:**

1. Pucknell and Eshraghian, Basic VLSI Design, (2000) 2nd edition
2. Nagchoudhri, D., Principles of Microelectronics Technology (2002) 4th edition.

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC824: ASIC and FPGA

| L | T | P | Cr |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objective**: **Course objective:** This course covers the different types of programming technologies and logic devices, the design flow of different types of ASIC and the architecture of different types of FPGA. To gain knowledge about partitioning, floor planning, placement and routing of ASIC.

**HDL**: Logic design Review, Behaviour, Dataflow, Structural modeling, Control statements, FSM modeling.

**CMOS Review:** Classical, CMOS (Deep Sub-micron), ASIC Methodologies (classical) ASIC Methodologies (aggressive).

**Combinational Circuit Design:** Components of Combinational Design - Multiplexer and Decoder, Multiplexer Based Design of Combinational Circuits, Implementation of Full Adder using Multiplexer, Decoder Implementation of Full Adder using Decoder.

**Programmable Logic Devices:** Types of Programmable Logic Devices, Combinational Logic Examples, PROM - Fixed AND Array and Programmable OR Array, Implementation of Functions using PROM, PLA - Programmable Logic Array (PLA) – Implementation Examples.

**Programmable Array Logic**: PAL - Programmable Array Logic, Comparison of PROM, PLA and PAL, Implementation of a Function using PAL, Types of PAL Outputs, Device Examples.

**Introduction to Sequential Circuits:** R-S Latch and Clocked R-S Latch, D Flip Flop, J-K Flip Flop, Master Slave Operation, Edge Triggered Operation.

**FPGA:** Programmable logic FPGA, Configuration logic blocks, Function Generator, ROM implementation, RAM implementation, Time skew buffers, FPGA Design tools, Network-on-chip, Adaptive System-on-chip.

**System Design Examples using FPGA Board**: Design Applications using FPGA Board - Traffic Light Controller and Real Time clock, XSV FPGA Board Features, Testing of FPGA Board, Setting the XSV Board Oscillator Frequency, Downloading Configuration Bit Streams.

**Logic Synthesis:** Fundamentals, Logic synthesis, Physical design compilation, Simulation, implementation. Floor planning, Placement and Routing, Commercial EDA tools for synthesis.

**Course Learning Outcomes (CLO):** The student will be able to:

1. utilize the top-down design methodology in the design of complex digital devices such as FPGAs/ ASICs.
2. learn modern hardware/software design tools to develop modern digital Systems
3. design and implement different Field Programmable Gate Array (FPGA) based logics
4. perform the logic synthesis of digital circuits.

**Text Books:**


1. Smith, Michael., Application-Specific Integrated Circuits, Addison-Wesley Professional, (2008) Ist ed.
2. Wolf, W., FPGA-based System Design, PH/Pearson, (2004) Cheap ed.


**Reference Books:**


1. Steve Kilts, Advanced FPGA Design, Wiley Inter-Science, John Wiley & Sons, (2007) 4th ed.


**Evaluation Scheme:**

| **Sr. No.** | **Evaluation Elements** | **Weightage (%)** |
|---|---|---|
| 1 | MST | 30 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 25 |

## UEC751: DSP PROCESSORS

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3 |

**Course Objective**: Student will acquire the knowledge of building blocks of DSP processors, Architectural, programming issues of third generation DSP processors and their interfacing.

**An Introduction to DSP Processors:** Advantages of DSP, characteristics of DSP systems, classes of DSP applications, DSP processor embodiment and alternatives, Fixed Vs Floating point processors, fixed point and Floating point Data Paths.

**DSP Architecture:** An introduction to Harvard Architecture, Differentiation between Von-Neumann and Harvard Architecture, Quantization and finite word length effects, Bus Structure, Central Processing Unit, ALU, Accumulators, Barrel Shifters, MAC unit, Compare, Select, and Store Unit (CSSU), data addressing and program memory addressing.

**Memory Architecture:** Memory structures, features for reducing memory access required, wait states, external memory interfaces, memory mapping, data memory, program memory and I/O memory, memory mapped registers.

**Addressing Modes & Instruction Set:** Addressing Modes, Instruction types, various types registers, orthogonality, assembly language and application development.

**Execution Control and Pipelining:** Hardware looping, interrupts, stacks, pipelining and performance, pipelining depth, interlocking, branching effects, interrupt effects, instruction pipelining.

**Peripherals:** Serial ports, timers, parallel ports, bit I/O port, host ports, communication ports, on-chip A/D and D/A converters, external interrupts, on chip debugging facilities, power consumption and management.

**Third Generation Processors:** Architecture and instruction set of TMS320C3X, TMS320C5X, TMS320C6X, ADSP 21XX DSP Chips, some example programs.

**Recent Trends in DSP System Design:** FPGA-Based DSP System Design, advanced development tools for FPGA, Development tools for Programmable DSPs, An introduction to Code Composer Studio.

**Laboratory Work:** Introduction to code composer studio, Using CCS write program to compute factorial, dot product of two arrays, Generate Sine, Square and Ramp wave of varying frequency and amplitude, Design various FIR and IIR filters, Interfacing of LED, LCD, Audio and Video Devices with the DSP processor.

**Course Learning Outcomes (CLO):**

The student will be able to:

1. Describe basics of DSP architecture, memory interfacing and instructions.

2. Explain the concept of Execution Control and Pipelining for DSP processors.

3. Identify features of third generation DSP processors, their architecture and execute some programs.

4. Use programming language techniques and interface third generation DSP programmable devices with memories and I/O devices.

**Text Books:**

1. Lapsley, P., Bier, J., Shoham, A. and Lee, E.A., DSP Processor Fundamentals: Architecture and Features, IEEE Press Series on Signal Processing, IEEE (2000).

2. Venkataramani, B. and Bhaskar, M., Digital Signal Processor: Architecture, Programming and Applications, Tata McGraw Hill (2003).

**Reference Books:**

1 Padmanabhan, K., Ananthi, S. and Vijayarajeswaran, R., A practical Approach to Digital Signal Processing, New Age International Pvt. Ltd (2001).

4. TI DSP reference set (www.ti.com).

5. Babast, J., Digital Signal Processing Applications using the ADSP-2100 family, PHI (1992).

**Evaluation Scheme:**

| Sr. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 45 |
| 3 | Sessional (May include Assignments/Projects/Tutorials/Quizzes/Lab Evaluations) | 30 |

## UEC866 - VIRTUAL INSTRUMENTATION ENGINEERING

| L | T | P | Cr |
|---|---|---|---|
| 2 | 0 | 2 | 3.0 |

**Course Objective:** The objective of this course is to introduce the concept of virtual instrumentation and to develop basic VI programs using loops, case structures etc. including its applications in image, signal processing and motion control.

**Review of Virtual Instrumentation:** Historical perspective, Block diagram and Architecture of Virtual Instruments

**Data-flow Techniques:** Graphical programming in data flow, Comparison with conventional programming.

**VI Programming Techniques:** VIs and sub-VIs, Loops and Charts, Arrays, Clusters and graphs, Case and sequence structures, Formula nodes, Local and global variables, Strings and file I/O.

**Data Acquisition Basics:** ADC, DAC, DIO, Counters and timers.

**Common Instrumentation Interfaces:** RS232C/ RS485, GPIB, PC Hardware structure, DMA software and hardware installation.

**Use of Analysis Tools:** Advanced analysis tools such as Fourier transforms, Power spectrum, Correlation methods, Windowing and filtering and their applications in signal and image processing, Motion Control.

**Additional Topics:** System buses, Interface buses: PCMCIA, VXI, SCXl, PXI, etc.

**Laboratory Work:** Components of Lab VIEW, Celsius to Fahrenheit conversion, Debugging, Sub-VI, Multiplot charts, Case structures, ASCII files, Function Generator, Property Node, Formula node, Shift registers, Array, Strings, Clusters, DC voltage measurement using DAQ

**Course Learning Outcomes (CLO):** After the completion of the course student will be able to :

1. demonstrate the working of LabVIEW.
2. explain the various types of structures used in LabVIEW.
3. analyze and design different type of programs based on data acquisition.
4. demonstrate the use of LabVIEW for signal processing, image processing etc.
5. use different analysis tools

**Text Books:**


1. Johnson, G., LabVIEW Graphical Programming, McGraw-Hill (2006).
2. Sokoloft, L., Basic Concepts of LabVIEW 4, Prentice Hall Inc. (2004).
3. Wells, L.K. and Travis, J., LabVIEW for Everyone, Prentice Hall Inc. (1996).


**Reference Book:**


1. Gupta, S. and Gupta, J.P., PC Interfacing for Data Acquisition and Process Control, Instrument Society of America (1988).


**Evaluation Scheme:**

| S. No. | Evaluation Elements | Weightage (%) |
|---|---|---|
| 1 | MST | 25 |
| 2 | EST | 35 |
| 3 | Sessional (May include Assignments//Quizes/Lab Evaluations) | 40 |