OmDayal Group of Institutions

Department of ME/CE/EE

Subject Code: BS-M102	Category: Basic Science Course
Subject Name: Mathematics – IB	Semester: **I**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Calculus (Integration):** Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	8
2	**Calculus (Differentiation):** Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.	6
3	**Sequence and Series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval's theorem	11
4	**Multivariate Calculus:** Limit, continuity and partial derivatives, Directional derivatives, Total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, Curl and Divergence.	9
5	**Matrices:** Inverse and rank of a matrix, Rank-nullity theorem; System of linear equations; Symmetric, Skew-symmetric and Orthogonal matrices; Determinants; Eigenvalues and Eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	8

Course Outcomes:

After completing the course the student will be able to

1. Apply the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals.
2. Understand the domain of applications of mean value theorems to engineering problems.
3. Learn the tools of power series and Fourier series to analyse engineering problems and apply the concept of convergence of infinite series in many approximation techniques in engineering disciplines
4. Apply the knowledge for addressing the real life problems which comprises of several variables or attributes and identify extremum points of different surfaces of higher dimensions.
5. Understand the different types of matrices, concept of rank, methods of matrix inversion and their applications.

OmDayal Group of Institutions

Department of Computer Science and Engineering

Subject Code: BS-M101	Category: Basic Science Course
Subject Name: Mathematics – I A	Semester: **I**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Calculus (Integration):** Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions	8
2	**Calculus (Dif erentiation):** Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.	6
3	**Matrices:** Matrices, Vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix, Gauss elimination and Gauss-Jordan elimination.	7
4	**Vector Spaces:** Vector Space, linear dependence of vectors, Basis, Dimension; Linear transformations (maps), Range and Kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Rank-Nullity theorem, composition of linear maps, Matrix associated with a linear map.	9
5	**Vector Spaces** (Continued): Eigenvalues, Eigenvectors, Symmetric, Skew-symmetric, and Orthogonal Matrices, Eigenbases. Diagonalization; Inner product spaces, Gram-Schmidt orthogonalization.	10

Course Outcomes:

1. Apply the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals.
2. Understand the domain of applications of mean value theorems to engineering problems.
3. Learn different types of matrices, concept of rank, methods of matrix inversion and their applications.
4. Understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.
5. Learn and apply the concept of eigen values, eigen vectors, diagonalization of matrices and orthogonalization in inner product spaces for understanding physical and engineering problem.

OmDayal Group of Institutions

Department of Computer Science

Subject Code: **BS-PH101/ BS-PH201**	Category: **Basic Science Courses**
Subject Name: **Physics-I**	Semester: **First/ Second**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand basic concepts of mechanics, optics and its applications, electricity, magnetism and qualitative understanding of concepts of quantum physics and statistical mechanics.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Mechanics:** Problems including constraints & friction. Basic ideas of vector calculus and partial Differential equations. Potential energy function F = -grad V, equipotential surfaces and meaning of gradient. Conservative and non-conservative forces. Conservation laws of energy & momentum. Non-inertial frames of reference. Harmonic oscillator; Damped harmonic motion forced oscillations and resonance. Motion of a rigid body in a plane and in 3D. Angular velocity vector. Moment of inertia.	7
2	**Optics:** Distinction between interference and diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits (only the expressions for max;min, & intensity and qualitative discussion of fringes); diffraction grating(resolution formulac only), characteristics of diffration grating and its applications. Polarisation: Introduction, polarisation by reflection, polarisation by double reflection, scattering of light, circular and elliptical polarisation, optical activity. Lasers: Principles and working of laser : population inversion, pumping, various modes, threshold population inversion with examples.	5
3	**Electromagnetism and Dielectric Magnetic Properties of Materials:** Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar dielectrics, internal fields in a solid, Clausius-Mossotti equation(expression only), applications of dielectrics. Magnetisation , permeability and susceptibility, classification of magnetic materials, ferromagnetism, magnetic domains and hysteresis, applications.	8
4	**Quantum Mechanics:** Introduction to quantum physics, black body radiation, explanation using the photon concept, Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator, hydrogen atom.	16
5	**Statistical Mechanics:** Macrostate, Microstate, Density of states, Qualitative treatment of Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics.	8

Course Outcomes:

1. Upon completion of this course, students will be able to understand the Basic concepts of mechanics, effect of various types of forces on a body, causes and effects of vibration.
2. Students will be able to interpret the intensity variation of light due to Polarization, interference and diffraction, transverse nature of Light-Polarization, Bragg's Law and introduction to the principles of lasers, types of lasers and applications.
3. Upon completion of this course, students will be able to understand the magnetic and dielectric properties of various material and also properties of materials such as, permeability, polarization, etc .
4. Students will be familiar with some of the basic laws related to quantum mechanics as well as simple quantum mechanics calculations.
5. Upon completion of this course, students will be able to understand the application of statistical Mechanics in case of Engineering Thermodynamics.

OmDayal Group of Institutions

Department of Chemistry

Course Code : BS-CH101	**Category :** Basic Science Courses
Course Title : Chemistry-I	**Semester** : First
L-T-P : **3-1-0**	**Credit:4**

Course Objectives:

To motivate students to understand the basic concepts of atomic and molecular structure, spectroscopic techniques and applications, free energy and equilibrium, periodic properties of elements and stereochemistry and structures of compounds and study the different types of organic reactions

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Atomic and molecular structure:** Schrodinger equation. Particle in box solutions and their applications for simple sample. Molecular orbitals of diatomic molecules (e.g. H_2). Energy level diagrams of diatomic. Pi-molecular orbital of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.	10
2	**Spectroscopic techniques and applications** Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering	8
3	**Intermolecular forces and potential energy surfaces** Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena	4
4	**Use of free energy in chemical equilibria** First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.	8
5	**Periodic properties** Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries	4
6	**Stereochemistry** Representations of 3 dimensional structures, structural isomers and	4

	stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds	
7	**Organic reactions and synthesis of a drug molecule** Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	4

Course Outcomes:

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energylevels in various spectroscopic techniques
4. Rationalize periodic properties such as ionization potential, electro negativity, oxidation states andelectro negativity.
5. List major chemical reactions that are used in the synthesis of molecules.

Course Code : ES-EE101	**Category :** Engineering Science Courses
Course Title : Basic Electrical Engineering	**Semester** : First
L-T-P : **3-1-0**	**Credit: 4**
Pre-Requisites:	

Detailed contents:

Module 1: DC Circuits (8 hours)

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module 2: AC Circuits (8 hours)

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module 3: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module 4: Electrical Machines (8 hours)

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction
and working of synchronous generators.

Module 5: Power Converters (6 hours)

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module 6: Electrical Installations (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Outcomes

1. To understand and analyze basic electric and magnetic circuits
2. To study the working principles of electrical machines and power converters.
3. To introduce the components of low voltage electrical installations

OmDayal Group of Institutions

Department of Computer Science & Engineering

Subject Code: ES-CS201	Category: Engineering Science Courses
Subject Name: Programming for Problem Solving	Semester: **II**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

The course is designed to provide complete knowledge of C language. Students will be able to develop logics which will help them to create programs, applications in C. Also by learning the basic programming constructs they can easily switch over to any other language in future. The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves a lab component which is designed to give the student hands-on experience with the concept.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) . Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code	4
2	Arithmetic expressions and precedence	2
3	Conditional Branching and Loops .Writing and evaluation of conditionals and consequent branching .Iteration and loops	6
4	Arrays (1-D, 2-D), Character arrays and Strings	6
5	Basic Algorithms. Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)	6
6	Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference	5
7	Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.	5
8	Structures, Defining structures and Array of Structures	4
9	Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)	2
10	File handling.	2

Course Outcomes: (No of CO should be same as number of modules. However, the maximum no. of COs should be 5.If No. of modules is more than 5 then merge the COs)

1. To formulate simple algorithms for arithmetic and logical problems. To translate the algorithms to programs (in C language)..
2. To test and execute the programs and correct syntax and logical errors. To implement conditional branching, iteration and recursion
3. To decompose a problem into functions and synthesize a complete program using divide and conquer approach. To use arrays, pointers and structures to formulate algorithms and programs.
4. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems
5. To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

OmDayal Group of Institutions

Department of ME/CE/EE

Subject Code: BS-M202	Category: Basic Science Course
Subject Name: Mathematics – IIB	Semester: **II**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Multivariate Calculus (Integration):** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, change of variables (Cartesian to Polar), Applications: Areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), Orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	11
2	**First order ordinary differential equations:** Exact, linear and Bernoulli's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	5
3	**Ordinary differential equations of higher orders:** Second order linear differential equations with constant coefficients, Use of D- operators, Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.	9
4	**Complex Variable – Differentiation**: Differentiation of complex functions, Cauchy-Riemann equations, Analytic functions, Harmonic functions, determination of harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithmic) and their properties; Conformal mappings, Mobius transformations and their properties	6
5	Complex Variable – Integration Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, Zeros of analytic functions, Singularities, Laurent's series; Residues, Cauchy residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour	9

Course Outcomes

1. Learn the methods for evaluating multiple integrals and their applications to different physical problems.

2. Understand different techniques to solve first and second order ordinary differential equations with its formulation to address the modelling of systems and problems of engineering sciences.
3. Learn different tools of differentiation and integration of functions of a complex variable that are used with various other techniques for solving engineering problems.
4. Apply different types of transformations between two 2- dimensional planes for analysis of physical or engineering problems.
5. Understand different techniques to solve Cauchy-Riemann equations, Analytic functions, Harmonic functions, determination of harmonic conjugate, elementary analytic functions and used with various other techniques for solving engineering problems.

OmDayal Group of Institutions

Department of Computer Science and Engineering

Subject Code: BS-M201	Category: Basic Science Course
Subject Name: Mathematics – II A	Semester: **II**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Basic Probability:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the Multinomial distribution, Poisson approximation to the Binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.	11
2	**Continuous Probability Distributions:** Continuous random variables and their properties, Distribution functions and densities, Normal, Exponential and Gamma densities..	4
3	**Bivariate Distributions:** Bivariate distributions and their properties, distribution of sums and quotients, Conditional densities, Bayes' rule.	5
4	**Basic Statistics:** Measures of Central tendency, Moments, Skewness and Kurtosis, Probability distributions: Binomial, Poisson and Normal and evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.	8
5	**Applied Statistics:** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.	8
6	**Small samples:** Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	4

Course Outcomes:

1. Learn the ideas of probability and random variables, various discrete and continuous probability distributions with their properties and their applications in physical and engineering environment.
2. Understand the basic ideas of statistics with different characterisation of a univariate and bivariate data set.
3. Apply statistical tools for analysing data samples and drawing inference on a given data set.

4. Learn the basic ideas of curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves and their applications in physical and engineering environment.
5. Understand the ideas of different types of Testing of significance and their different type of problems.

OmDayal Group of Institutions
Department of Chemistry

Course Code : BSC401	**Category :** Basic Science Courses
Course Title : **Biology**	**Semester** : Third
Contacts:2L+1T	**Credit:3**

Course Objectives:

To introduce modern biology with an emphasis on evolution of biology as a multi-disciplinary field and to make students aware of application of engineering principles in biology and engineering robust solution inspired by biological examples.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction** Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlightthe fundamental importance of observations in any scientific inquiry	2
2	**Classification:** Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructureprokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.	3
3	**Genetics** Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using	4

	human genetics.	
4	**Biomolecules** Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	4
5	**Enzymes** Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	**Information Transfer** Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefrom single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4
7	**Macromolecular analysis:** Purpose: To analyze biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
8	**Metabolism** Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4
9	**Microbiology** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

Course Outcomes:

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of geneticmaterial from parent to offspring and identify DNA as a genetic material in the molecular basis of information transfer.
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine and analyse biological processes at the reductionistic level
5. Classify enzymes and distinguish between different mechanisms of enzyme action.

OmDayal Group of Institutions

Department of Computer Science and Engineering

Subject Code: BSc 301	Category: Basic Science Course
Subject Name: Mathematics-III	Semester: **III**
L-T-P: **2-0-0**	Credit:**2**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.	8
2	Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.	7
3	Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar). Theorems of Green, Gauss and Stokes (Statement only) and related problems.	8
4	First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution. Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation.	9
5	Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph. Matrix Representation: Incidence & Adjacency matrix. Tree: Basic Concept of tree, Binary tree, Spanning Tree, KrusKal and Prim's algorithm for finding the minimal spanning tree.	8

Course Outcomes:

1. To learn and to check the convergence of the infinite series.
2. To understand and apply the concept of function of several variables.
3. To implement multiple integrals and solve the different types problems of multiple integral.
4. To understand and to solve Ordinary Differential Equations.
5. To understand the concept of Graph and trees

OmDayal Group of Institutions

Department of Computer Science & Engineering

Subject Code: PCC-CS301	Category: **Professional Core courses**
Subject Name: Data Structure & Algorithm	Semester: **III**
L-T-P: **3-1-0**	Credit:**3**

Course Objectives:

To learn the basics of abstract data types, learn the principles of linear and nonlinear Data structures and build an application using sorting and Searching. This subject will follow the organizing or Structuring data is vital to the design and implementation of efficient algorithms and program development

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	10
2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	9
3	Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis	10
4	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	9

Course Outcomes:

1. Differentiate how the choices of data structure & algorithm methods impact the Performance of program.
2. Solve problems based upon different data structure & also write programs
3. Identify appropriate data structure & algorithmic methods in solving problem

4. Discuss the computational efficiency of the principal algorithms for sorting, searching and Hashing
5. Compare and contrast the benefits of dynamic and static data structures implementations

OmDayal Group of Institutions

Department ofComputer Science & Engineering

Subject Code: **PC-CS302**	Category: **Professional Core courses**
Subject Name: **Computer Organization**	Semester: **III**
L-T-P: **3-1-0**	Credit:**3**

Course Objectives:

1. To prepare students to perform the analysis and design of various digital electronic circuits.
2. To know how Computer Systems work & its basic principles
3. To know how I/O devices are being accessed and its principles etc

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes.Commonly used number systems. Fixed and floating point representation of numbers.	8
2	Overflow and underflow. Design of adders - ripple carry and carry look ahead principles. Design of ALU. Fixed point multiplication - Booth's algorithm.Fixed point division - Restoring and non-restoring algorithms. Floating point - IEEE 754 standard.	8
3	Memory unit design with special emphasis onimplementation of CPU-memoryinterfacing.Memory organization, static and dynamic memory, memory hierarchy, associative memory.Cache memory, Virtual memory. Data path design for read/write access.	10
4	Design of control unit - hardwired and microprogrammed control. Introduction to instruction pipelining.Introduction to RISC architectures. RISC vs CISC architectures. I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA.	10

Course Outcomes:

On completion of the course students will be able to

1. Understand basic structure of digital computer, stored program concept and different arithmetic and control unit operations.
2. Understand basic structure of different combinational circuits-multiplexer, decoder, encoder etc.
3. Perform different operations with sequential circuits.
4. Understand memory and I/O operations.

OmDayal Group of Institutions

Department of Computer Science and Engineering

Subject Code: PCC-CS401	Category: Professional core courses
Subject Name: Discrete Mathematics	Semester: **IV**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well- Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.	8
2	Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination	
3	Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	8
4	Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form	7
5	Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances	8

Course Outcomes:

On completion of the course students will be able to: -

1. Express a logic sentence in terms of predicates, quantifiers, and logical connectives.

2. Derive the solution for a given problem using deductive logic and prove the solution on based of a logical inference.
3. Classify its algebraic structure for a given a mathematical problem.
4. Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
5. Develop the given problem as graph networks and solve with techniques of graph theory.

OmDayal Group of Institutions

Department ofComputer Science & Engineering

Subject Code: **PC-CS402**	Category: **Professional Core courses**
Subject Name: **Computer Architecture**	Semester: **IV**
L-T-P: **3-1-0**	Credit:**3**

Course Objectives:

i. To learn the basics of stored program concepts
ii. To learn the principles of pipelining
iii. To learn mechanism of data storage
iv. To distinguish between the concepts of serial, parallel, pipeline architecture.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance. Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques; Compiler techniques for improving performance.	12
2	Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies.	8
3	Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super- pipelined and VLIW processor architectures. Array and vector processors.	6
4	Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared- memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared- memory architecture. Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.	12

Course Outcomes:

On completion of the course students will be able to

1. Learn pipelining concepts with a prior knowledge of stored program methods
2. Learn about memory hierarchy and mapping techniques
3. Study of parallel architecture and interconnection network
4. Learn about instruction level parallelism

OmDayal Group of Institutions

Department of Computer Science & Engineering

Subject Code: **PCC-CS403**	Category: **Professional Core courses**
Subject Name: **Formal Language & Automata Theory**	Semester: **IV**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To analyze the different formal languages, grammars, automata, find out the relationship among them and design different types of automata.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	6
2	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)	7
3	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs	6
4	Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	6
5	Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators	6
6	Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages	6

Course Outcomes:

On completion of the course students will be able to

1. Write a formal notation for strings, languages and machines and understand Chomsky hierarchy.
2. Design finite automata to accept a set of strings of a language and find the relation between regular language and finite automata.
3. Design push down automata to accept a set of strings of a language and find the relation between context free language and push down automata.
4. Design linear bounded automata, Turing machine and equivalent languages and grammars.
5. Distinguish between computability and non-computability and Decidability and Undecidability.

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Department of Computer Sc Engineering

Subject Code: **PCC-CS404**	Category: **Professional Core courses**
Subject Name: Design and Analysis of Algorithms	Semester: **IV**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. The aim of this module is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them.
2. Through the complexity measures, different range of behaviours of algorithms and the notion of tractable and intractable problems will be understood.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem	8
2	Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and- Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	8
3	Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	6
4	Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P,NP, NP- complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques	10
5	Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	4

Course Outcomes:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms

2. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.

4. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.

5. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

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Department ofComputer Science & Engineering

Subject Code: **PCC-CS 501**	Category: **Professional Core courses**
Subject Name: **Compiler Design**	Semester: **V**
L-T-P: **3-1-0**	Credit:**3**

Course Objectives:

The Objectives of this course is to explore the principles, algorithms, and data structures involved in the design and construction of compilers. Topics include context-free grammars, lexical analysis, parsing techniques, symbol tables, error recovery, code generation, and code optimization.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction to Compiling: Compilers, Analysis of the source program, The phases of the compiler, Cousins of the co	3
2	The role of the lexical analyser, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyser generator (Lex).	6
3	The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Nonrecursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques	9
4	Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.	5
5	Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions	4
6	Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	5
7	Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples)	4

8	Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimi	5
9	Issues in the design of code generator, a simple code generator, Register allocation & assignment	4

Course Outcomes:

1. Understand compilation concept and its different phases.
2. Understand the techniques to remove ambiguity from a grammar.
3. Design Parse Trees and Context Free Grammars
4. Understanding different parsing techniques.
5. Code Generation and code optimization techniques.

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Department of Computer Science and Engineering

Subject Code: **PCC-CS502**	Category: **Professional Core courses**
Subject Name: **Operating Systems**	Semester: **V**
L-T-P: **3-3-0**	Credit: **3**

Course Objectives:

1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Concept of Operating Systems, Generation of Operating Systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine Case study on UNIX Operating System, WINDOWS Operating System.	3
2	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching **Threads:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads **Process Scheduling:** Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS scheduling FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF	10
3	**Inter-Process Communication**: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem Dinning Philosopher Problem etc. **Deadlock:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, **Deadlock Avoidance:** Banker's algorithm, Deadlock detection and Recovery.	10

4	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU). **I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. **Disk Management:** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	14

Course Outcomes:

1. Create processes and threads by the operating system.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.
4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

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Department of Computer Science & Engineering

Subject Code: **PCC-CS503**	Category: **Professional Core courses**
Subject Name: **Object Oriented Programming**	Semester: **V**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To analyze, design and develop Object Oriented Programming system using Java language.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.	8
2	Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance.	8
3	Inheritance in OO design. Design patterns. Introduction and classification. The iterator pattern.	8
4	Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.	6
5	Generic types and collections GUIs. Graphical programming with Scale and Swing . The software development process	6

Course Outcomes:

On completion of the course students will be able to

1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.
4. Implement the OO language features
5. Design applications with an event-driven graphical user interface.

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Department of Computer Science & Engineering

Subject Code: **ESC-501**	Category: **Engineering Science Courses**
Subject Name: **Software Engineering**	Semester: **V**
L-T-P: **3-1-0**	Credit:**3**

Course Objectives:

1. To provide the idea of decomposing the given problem into Analysis, Design, Implementation, Testing and Maintenance phases.
2. To provide an idea of using various process models in the software industry according to given circumstances.
3. To gain the knowledge of how Analysis, Design, Implementation, Testing and Maintenance processes are conducted in a software project.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model	10
2	System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	5
3	Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.	12
4	Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.	7
5	Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.	10

Course Outcomes:

On completion of the course

1. Students will be able to decompose the given project in various phases of a life-cycle.
2. Students will be able to choose appropriate process model depending on the user requirements.
3. Students will be able to perform various life cycle activities like Analysis, Design, Implementation, Testing and Maintenance.
4. Students will be able to know various processes used in all the phases of the product.
5. Students can apply the knowledge, techniques, and skills in the development of a software product.

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Department of Computer Sc Engineering

Subject Code: **PEC-IT-501-B**	Category: **Professional Elective courses**
Subject Name: **Artificial intelligence**	Semester: **V**
L-T-P: **3-0-0**	Credit:**4**

Course Objectives:

1. To provide a strong foundation of fundamental concepts in Artificial Intelligence
2. To provide a basic exposition to the goals and methods of Artificial Intelligence
3. To enable the student to apply these techniques in applications which involve perception, reasoning and learning.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving : Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	6
2	Search techniques: Solving problems by searching : problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies: Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search: Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening	13
3	Knowledge & reasoning : Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.	6
4	Using predicate logic: Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural-deduction. Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	6
5	Natural Language processing : Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. Learning: Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. Expert Systems : Representing and using domain knowledge, expert system shells, knowledge acquisition.	9

Course Outcomes:

1. Understand the various searching techniques, constraint satisfaction problem and example problems- game playing techniques.

2. Apply these techniques in applications which involve perception, reasoning and learning. 3. Explain the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.

4. Acquire the knowledge of real world Knowledge representation.

5. Analyze and design a real world problem for implementation and understand the dynamic behaviour of a system. 6. Use different machine learning techniques to design AI machine and enveloping applications for real world problems.

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Department of Computer Science & Engineering

Subject Code: PCC-CS601	Category: Professional Core courses
Subject Name: Database Management Systems	Semester: VI
L-T-P: 3-1-0	Credit:3

Course Objectives:

1. To understand the different issues involved in the design and implementation of a database system
2. To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3. To understand and use data manipulation language to query, update, and manage a Database
4. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
6. To understand the different issues involved in the design and implementation of a database system

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Database system architecture:** Data Abstraction, Data Independence,Data Definition Language(DDL),Data Manipulation Language(DML). **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations .	9
2	**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQLserver. **Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Losslessdesign. **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. .	13
3	**Storage strategies**: Indices, B-trees, hashing	3
4	**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi- version and optimistic Concurrency Control schemes, Database recovery .	5
5	**Database Security:** Authentication, Authorization and access	3

	control, DAC, MAC and RBAC models, Intrusion detection, SQL injection	
6	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	3

Course Outcomes:

1. For a given query write relational algebra expressions for that query and optimize the developed expressions
2. For a given specification of the requirement design the databases using E R method and normalization.
3. For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.
4. For a given query optimize its execution using Query optimization algorithms
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

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Department of Computer Sc Engineering

Subject Code: **PCC-CS602**	Category: **Professional Core courses**
Subject Name: Computer Network	Semester: **VI**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do network programming.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	9
2	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA	8
3	Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	14
4	Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	8
5	Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	8

Course Outcomes:

1. Recognize the technological trends of Computer Networking.
2. Discuss the key technological components of the Network.
3. Evaluate the challenges in building networks and solutions to those.

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Department of Computer Science & Engineering

Subject Code: **PEC-IT602B**	Category: **Professional Elective courses**
Subject Name: Data Warehousing & Data Mining	Semester: **IV**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives: This course gives an introduction to methods and theory for design, development of data warehouses and data analysis using data mining.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods	8
2	Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns	8
3	Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis	8
4	Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis; modulation for communication, filtering, feedback control systems	11
5	Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining	9
6	Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis	5

Course Outcomes:

On completion of the course students will be able to

1. Design, develop data warehousing system.
2. Study the technique to classification, prediction and clustering method.
3. Understand the concept of mining time series data, data stream, graph, social network analysis etc.
4. Understanding the concept of mining web link structure, multimedia data on web, web documents and web usage.
5. Study the recent trends in distributed data warehousing and data mining.

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Department of Computer Science and Engineering

Subject Code: OEC-IT601A	Category: Open elective courses
Subject Name: Numerical Methods	Semester: **VI**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Approximation in numerical computation:** Truncation and rounding errors, Fixed and floating point arithmetic, Propagation of errors.	2
2	**Interpolation:** Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.	8
3	**Numerical integration:** Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.	3
4	**Numerical solution of a system of linear equations:** Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.	8
5	**Numerical solution of Algebraic equation:** Bisection method, Regula-Falsi method, Newton-Raphson method.	3
6	**Numerical solution of ordinary differential equation:** Euler's method, Runge-Kutta methods, Predictor Corrector methods and Finite Difference method.	2

Course Outcomes:

1. Understand the concept of errors in computation.
2. To learn the method of interpolation to find out the functional value at a point otherthan the given points.
3. To integrate and to find the solution of ODE for complex cases.
4. To solve the transcendental equations having infinite roots.
5. To solve a systems of linear equations with decimal coefficients

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Department of Computer Science & Engineering

Subject Code: **PEC-CS701E**	Category: **Professional Elective Courses**
Subject Name: Machine Learning	Semester: **VII**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To explore, evaluate, and apply different supervised, unsupervised, ensemble, online, distributed machine learning algorithms.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	10
2	Unsupervised Learning Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)	7
3	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6
4	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9
5	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9
6	Recent trends in various learning techniques of machine learning and classification methods	5

Course Outcomes:

On completion of the course students will be able to

1. Explore supervised learning paradigms of machine learning.
2. Explore unsupervised learning paradigms of machine learning.
3. Evaluate machine learning algorithms.
4. To explore Deep learning technique and various feature extraction strategies.
5. Explore online learning, distributed learning and recent trends of machine learning.

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Department ofComputer Science & Engineering

Subject Code: **PEC-CS 702E**	Category: **Professional Elective courses**
Subject Name: **Cyber Security**	Semester: **VII**
L-T-P: **3-1-0**	Credit:**3**

Course Objectives:

To motivate the students to understand the basic facts about the cyber security and crime. Also to motivate them to know about the challenges and threats while implementing cyber security in practical.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction and Importance and challenges in Cyber Security, Getting idea about Cyberspace, Cyber threats, Cyberwarfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cybersecurity - Organizational Implications.	6
2	Introduction to Hackers and Cyber Crimes: Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors.	7
3	Ethical Hacking and Social Engineering: Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies.	8
4	Cyber Forensics and Auditing: Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013	10
5	Cyber Ethics and Laws: Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. at Network Layer-IPSec.	5

Course Outcomes:

1. Getting familiar with the basics of cyber security and its challenges and basic terms.
2. Knowing about the different types of attacks and challenges can be possible.
3. Having idea ethical hacking and social engineering in detail.
4. Get introduced to cyber forensic and auditing- get idea about the types of authentication, forensic fraud and challenges.
5. Also have some idea about cyber law and crimes, cyber cerificates.

OmDayal Group of Institutions

Department of Computer Science and Engineering

Subject Code: **OEC-CS802A**	Category: **OPEN ELECTIVE COURSE**
Subject Name: **E-Commerce & ERP**	Semester: **VIII**
L-T-P: **3-0-0**	Credit: **3**

Course Objectives:

1. Define E-Marketplaces and list their components.
2. List the Major types of Electronic Markets and describe their features.
3. Describe the types of Intermediaries in EC and their roles.
4. Describe electronic Cat
5. Catalogs, shopping cart, and search Engines.
6. Describe the various types of Auctions and list their characteristics.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Overview, Definitions, Advantages & Disadvantages of E – Commerce, Threats of E –Commerce, Managerial Prospective, Rules & Regulations For Controlling E – Commerce, Cyber Laws	3
2	Technologies : Relationship Between E – Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol : Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce Business Models of e – commerce : Model Based On Transaction Type, Model Based On Transaction Party - B2B, B2C, C2B, C2C, E – Governance	7
3	E – strategy: Overview, Strategic Methods for developing E – commerce. Four C's: (Convergence, Collaborative Computing, Content Management & Call Center). Convergence: Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing: Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security. Content Management : Definition of content, Authoring Tools & Content Management, Content – partnership, repositories, convergence, providers, Web Traffic & Traffic Management ; Content Marketing. Call Center : Definition, Need, Tasks Handled, Mode of Operation, Equipment ,Strength & Weaknesses of Call Centre, Customer Premises Equipment (CPE). Supply Chain Management : E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power	11
	E – Payment Mechanism: Payment through card system, E – Cheque, E –	

4	Cash, E – Payment Threats & Protections. E – Marketing:. Home –shopping, E-Marketing, Tele-marketing Electronic Data Interchange (EDI) : Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA). Risk of E – Commerce : Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures	8
5	Enterprise Resource Planning (ERP) : Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse . Business Modules: Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales Distribution Repackage, ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP	10

Course Outcomes:

1. Understand the basic concepts and technologies used in the field of management information systems
2. Have the knowledge of the different types of management information systems and understand the processes of developing and implementing information systems
3. Be aware of the ethical, social, and security issues of information systems
4. Analyze the impact of E-commerce on business models and strategy
5. Explain the process that should be followed in building an E-commerce presence

OmDayal Group of Institutions
Department of Chemistry

Course Code : BS-BIO301	**Category :** Basic Science Courses
Course Title : **Biology**	**Semester** : Third
L-T-P : 3-0-0	**Credit:3**

Course Objectives:

To introduce modern biology with an emphasis on evolution of biology as a multi-disciplinary field and to make students aware of application of engineering principles in biology and engineering robust solution inspired by biological examples.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction** Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlightthe fundamental importance of observations in any scientific inquiry	2
2	**Classification:** Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructureprokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.	3
3	**Genetics** Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using	4

	human genetics.	
4	**Biomolecules** Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	4
5	**Enzymes** Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	**Information Transfer** Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefrom single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4
7	**Macromolecular analysis:** Purpose: To analyze biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
8	**Metabolism** Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4
9	**Microbiology** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

Course Outcomes:

1. Describe how biological observations of 18th Century that lead to major discoveries.
2. Convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Highlight the concepts of recessiveness and dominance during the passage of geneticmaterial from parent to offspring and identify DNA as a genetic material in the molecular basis of information transfer.
4. Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine and analyse biological processes at the reductionistic level
5. Classify enzymes and distinguish between different mechanisms of enzyme action.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ES-ECE301**	Category: **Engineering Science Courses**
Subject Name: **Basic electronics engineering**	Semester: **III**
L-T-P: **3-0-0**	Credit: 3

Course Objectives:

To provide an overview of electronic device components to Mechanical engineering students

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	7
2	Semiconductor Devices and Applications: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	6
3	Timing Circuits and Oscillators: RC-timing circuits, IC 555 and its applications as table and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.	6
4	Digital Electronics Fundamentals: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/sub tractor, multiplexers, De-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.	7
5	Electronic Communication Systems: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	6

Course Outcomes:

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

1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: BS-M301	Category: Basic Science Course
Subject Name: Mathematics – III	Semester: **III**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variable.	14
2	Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random varibales and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	12
3	Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	12

Course Outcomes:

Upon completion of the course students will:-

1. Students will be able to solve field problems in Engineering involving PDEs.

2. Learn the ideas of probability and random variables, various discrete and continuous probability distributions with their properties and their applications in physical and engineering environment.
3. Understand the basic ideas of statistics with different characterization of a univariate and bivariate data set.
4. Apply statistical tools for analysing data samples and drawing inference on a given data set.
5. Students can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ES-ME301**	Category: **Engineering Science Courses**
Subject Name: **Engineering Mechanics**	Semester: **III**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

1. To provide an introductory treatment of Mechanics to all the students of engineering with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.
2. To provide a working knowledge of statics and dynamics with emphasis on force equilibrium and free body diagrams.
3. To determine a wide range of simple, practical structural problems, and an understanding of the mechanical behaviour of materials under various load conditions.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Module 1: Introduction to Engineering Mechanics covering, Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space —Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminacy;	3
2	Module 2: Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;	4
3	Module 3: Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines;	4
4	Module 4: Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook;	5
5	Module 5: Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium;	5
6	Module 6: Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D	5

	curvilinear motion; Relative and constrained motion; Newton's 2nd law, (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. lmpulse-momentum (linear, angular); Impact (Direct and oblique);	
7	Module 7:1ntroduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation;	5
8	Module 8: Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;	5
9	Tutorials from the above modules covering, to find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack;	12

Course Outcomes:

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

1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
2. Apply basic knowledge of maths and physics to solve real-world problems.
3. Understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts).
4. Understand dynamics concepts – force, momentum, work and energy, the work-energy principle, impulse-momentum principle and the coefficient of restitution and solve dynamic problems.
5. Extend all of concepts of linear kinetics to systems in general plane motion (application of Euler’s Equation) and get introduction to friction and vibration.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME301**	Category: **Professional Core courses**
Subject Name: **Thermodynamics**	Semester: **III**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

1. To learn about work and heat interactions, and balance of energy between system and itssurroundings
2. To learn about application of I law to various energy conversion devices
3. To evaluate the changes in properties of substances in various processes
4. To understand the difference between high grade and low grade energies and II lawlimitations on energy conversion.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.	5
2	Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	5
3	Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	8
4	First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.	5
5	Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	5

6	Clausius inequality; Definition of entropy S ; Demonstration that entropy Sis a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in Ts coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for	8

Course Outcomes:

1. After completing this course, the students will be able to apply energy balance to systemsand control volumes, in situations involving heat and work interactions
2. Students can evaluate changes in thermodynamic properties of substances
3. The students will be able to evaluate the performance of energy conversion devices
4. The students will be able to differentiate between high grade and low-grade energies.
5. The students will be able to understand the concept of entropy generation.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME302**	Category: **Professional Core courses**
Subject Name: **Manufacturing Processes**	Semester: **III**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Conventional Manufacturing Processes: Casting and moulding metal casting processes and equipment, Heat transfer and solidification, riser design, casting defects and residual stresses.	10
2	Introduction to bulk sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (Forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.	10
3	Machining: Single and multi-point machining, Orthogonal Machining, cutting tool geometry of STTP, milling cutter and Drill, Conversion of rake and clearance angle within ASA and ISO systems, Various force components, Chip formation, Tool wear and Tool life, surface finish and integrity, machinability, cutting tool materials. Cutting Fluids, Coating, Turning, Drilling, Milling and Finishing Processes, Introduction to CNC machining.	14
4	Joining/Fastening Processes: Physics of Welding, Brazing and Soldering; Design consideration in welding, Solid and Liquid state joining processes: Adhesive bonding.	8

Course Outcomes:

1. Upon completion of this course, students will be able to understand the different casting methods and design the mould for making different products.
2. Students will be able to understand the different forming methods and force analysis for making different products
3. Upon completion of this course, students will be able to understand different Machining processes and cutting force analysis for different conventional machining processes.
4. Students will be able to understand different conventional and unconventional Joining processes.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ES-ME401**	Category: **Engineering Science Courses**
Subject Name: **Material Engineering**	Semester: **IV**
L-T-P: **3-0-0**	Credit: **3**

Course Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams
3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolvedshear stress.	6
2	Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress- strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.	6
3	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von- mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr- Coulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture withfatigue, Introduction to nondestructive testing (NDT)	8
4	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and micro-structural aspects of ledeburite, austenite, ferrite and cementite, cast iron.	6
5	Heat treatment of Steel: Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-C alloys andmicrostructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo- nitriding, flame and induction hardening, vacuum and plasma hardening	6
6	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys	8

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. Able to understand the defects in crystal structure.
3. Understand how to tailor material properties of ferrous and non-ferrous alloys
4. How to quantify mechanical integrity and failure in materials
5. Understand the different techniques of heat treatment of steel.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: PC-ME401	Category: **Professional Core courses**
Subject Name: Applied Thermodynamics	Semester: **IV**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

1) To learn about the 1st Law for reacting systems and heating value of fuels
2) To learn about gas and vapour cycles and their first law and second law efficiencies
3) To understand the properties of dry and wet air and principles of psychometry
4) To learn about gas dynamics of air flow and steam through nozzles
5) To learn about the reciprocating compressors with and without intercooling
6) To analyze the performance of steam turbines

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction solid, liquid and gaseous fuels – stoichometry, exhaust gas analysis, First law of analysis of combustion reactions- Heat calculations using enthalpy tables – Adiabatic Flame Temperature. Chemical Equilibrium and equilibrium composition calculations using free energy	8
2	Vapor power cycles, Rankine cycles with superheat, Reheat and Regeneration. Exergy analysis. Super Critical and Ultra Super Critical. Rankine Cycle – Gas power cycles, Air Standard Otto, Diesel and Dual Cycles. Air Standard, Brayton Cycle, effects of reheat, regeneration and intercooling. Combined gas and vapour power cycles, refrigerants and their properties.	12
3	Properties of wet and dry air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	4
4	Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation- Compressible flow in diffusers, efficiency of nozzle and diffuser.	8
5	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.	5
6	Analysis of steam turbines, velocity and pressure compounding of steam turbines	3

Course Outcomes:

1. Upon completion of this course, students will be able to understand the first law of analysis of combustion and do heat calculations using enthalpy tables.

2. Students will be able to solve various types of sums based on Vapour power cycles like Rankine and Brayton cycle.
3. Upon completion of this course, students will be able to use psychometric charts and understand processes involving heating, humidification and dehumidification.
4. Students will be able to understand Compressible flow, Stagnation properties, isentropic flow through nozzles, sonic, hyper sonic and sub sonic flow.
5. Students will be able to understand and identify various types of compressors and do analysis of steam turbines.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME402**	Category: **Professional Core courses**
Subject Name: **Fluid Mechanics & Fluid Machines**	Semester: **IV**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Definition of fluid, Newton's law of viscosity, Units and dimensions- Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.	9
2	Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli, concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.	9
3	Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.	6
4	Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.	8
5	Classification of water turbines, heads and efficiencies, velocity triangles Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.	8

Course Outcomes:

On successful completion of this course, student should be able to:

1. Students will learn the basic properties of fluid
2. They will be able to mathematically analyze simple flow situations.
3. They will learn the dimensional analysis.
4. They will be able to evaluate the performance of pumps.
5. They will be able to evaluate the performance of turbines.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME403**	Category: **Professional Core Courses**
Subject Name: **Strength of Materials**	Semester: **IV**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads and to calculate the elastic deformation occurring in these simple geometries for different types of loading.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Deformation in solids – Hooke's law, stress and strain – tension, compression and shear stress – elastic constants and their relations – volumetric, linear and shear strains – principal stresses and principal planes – Mohr's circle;	8
2	Beams and types transvers loading on beams – shear force and bend moment diagrams – Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads;	8
3	Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Buckling of columns, Euler's theory, critical loads for different types of constraints;	10
4	Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs;	8
5	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure;	8

Course Outcomes:

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

1. Understand the concepts of mechanics of deformable bodies.
2. Analyse different types of loading in different types of beams.
3. Analyse problems of slope and deflection in beams and columns.
4. Understand the concept of torsion in circular shafts and helical springs.
5. Understand the stress-strain distribution in thin and thick pressure vessels.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME404**	Category: **Professional Core courses**
Subject Name: **Metrology & Instrumentation**	Semester: **IV**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

1. To understand the working of linear and angular measuring instruments.
2. To familiarize with the working of optical measuring instruments and fundamentals of limits and limit gauges.
3. To give basic idea about various methods for measurement of screw thread and surface finish parameters.
4. To give an exposure to advanced measuring devices and machine tool metrology.
5. To provide students an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
6. To provide basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Concept of measurement:-Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement- Precision, accuracy, sensitivity, calibration, resolution. Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length- Line standard, End standards, Wavelength standard; Various Shop floor standards. Linear Measurement – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges and Vernier calliper; screw gauge. Comparatorsmechanical, electrical, optical and pneumatic. Angular Measurement – Bevel protractor; Sine Bar, principle and use of sine bar, sine centre; Angle gauges. Sprit level; Angle Dekkor; Clinometers.	8
2	Limits and Limit gauges – Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system and Shaft basis system. Tolerance, allowance and deviation (as per BIS). Limit Gauges – GO and NO GO gauges; types of limit gauges. Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance. Optical Measuring Instruments: - Benefits of light waves as standards; Monochromatic light; Principle of Interference. Interference band, optical flat, surface measurement. Interferometers – NPL, Pitter-NPL, auto collimator.	8
3	Screw thread measurement – Screw thread terminology; Measurement of major diameter; root diameter; pitch; effective diameter with two wire method and three wire method. Measurement of flank angle and form by profile projector and microscope. Measurement of surface texture – roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and Ra value, Rt, Rz etc. Methods of measuring surface	8

	roughness – Stylus probe, Tomlinson surface meter, Talysurf; surface roughness measurement – assessment length, roughness width cut-off, sampling length and evaluation length.	
4	Introduction to Digital Measurement– significance of Digital measurement; methods; Classification. Stages in generalized measuring system– SensorTransducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities; Active and Passive transducers. Performance characteristic of measuring devices. Drift, Resolution, Threshold, Hysteresis, Static calibration. Dynamic characteristics- different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Transducers– Working, Classification of transducers. Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations	8
5	Strain and Stress Measurement- Electrical resistance strain gaugePrinciple, operation. Measurement of Force and Torque– Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells– force measurement using piezoelectric quartz crystal. Torque Measurement– Dynamometers– Mechanical, Hydraulic and Electrical. Vibration measurement– Vibrometers and Accelerometers. Temperature Measurement– Use of Thermal Expansion– Liquid-in-glass thermometers, Bimetallic strip thermometer, Pressure thermometers. Thermocouples– Resistance Temperature Detectors (RTD); Thermistors; Pyrometers.	

Course Outcomes:

Upon successful completion of the course, student will have

1. Understand the working of linear and angular measuring instruments.

2. Know the fundamentals of limits and limit gauges, various methods for measurement of screw thread and surface roughness parameters and the working of optical measuring instruments.

3. Acquire an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.

4. Understand different instruments used in measurement system.

5. Get basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME501**	Category: **Professional Core Courses**
Subject Name: **Heat Transfer**	Semester: **V**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction heat transfer by the use of Heissler charts.	14
2	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convectionheat transfer- Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	10
3	Interaction of radiation with materials, definitions of radioactive properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.	9
4	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε - NTU methods.	7
5	Boiling and Condensation heat transfer, Pool boiling curve.	4
6	Introduction to mass transfer, Similarity between heat and mass transfer.	4

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyse a conduction type heat transfer problem
2. After completing the course, the students will be able to formulate and analyse a convection type heat transfer problem
3. After completing the course, the students will be able to formulate and analyse a radiation type heat transfer problem
4. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
5. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **PC-ME502**	Category: **Professional Core Courses**
Subject Name: **Solid Mechanics**	Semester: **V**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

The objective is to present the mathematical and physical principles in understanding the linear continuum behaviour of solids.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions;	12
2	Constitutive equations: Generalized Hooke's law, Linear elasticity, Material symmetry; Boundary Value Problems: concepts of uniqueness and superposition;	10
3	Plane stress and plane strain problems, introduction to governing equations in cylindrical and spherical coordinates, axisymmetric problems;	10
4	Application to thick cylinders, rotating discs, torsion of noncircular cross-sections, stress concentration problems, thermoelasticity, 2-D contact problems;	9
5	Solutions using potentials. Energy methods. Introduction to plasticity;	7

Course Outcomes:

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

1. Understand the concept of stress and strain in solid deformable bodies.
2. Develop relationships among stress, strain and deformation for linearly elastic solid and generate the governing equations in cartesian, cylindrical and spherical coordinates.
3. Solve plane stress and plane strain problems.
4. Solve asymmetric and axisymmetric, torsional, bending and thermoelastic problems.
5. Understand the properties of ideally plastic solid and apply the concepts of energy methods in solving structural problems.

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Department of Mechanical Engineering

Subject Code: **PC-ME 503**	Category: **Professional Core Courses**
Subject Name: **Kinematics and Theory of Machines**	Semester: **V**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To be able to design some linkage mechanisms and cam systems to generate specified output motion
4. To understand the kinematics of gear trains

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains. Limit positions- Mechanical advantage- Transmission angle Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.	6
2	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Corioli's component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation.	7
3	Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent camspressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.	5
4	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.	6
5	Surface contacts- sliding and rolling friction- friction drives bearings and lubrication, Friction clutches- Belt and Rope drives Friction in brakes.	6
6	Vibrations– Free and forced vibration of undamped and damped Single DOF systems, Resonance, Transmissibility Ratio, Effect of damping, Vibration Isolation, Critical Speed of Shafts.	6

7	Balancing of Reciprocating and Rotating Masses- Static balancing, Unbalance of force or moment, Dynamic balancing of rotating masses- graphical and analytical methods; Swaying couple; Hammer blow.	4
8	Governors- Use and classification; Study and analysis of Porter, Proell and Wilson-Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors.	3
9	Flywheel- Inertia force and inertia torque in reciprocating engine, correction couple (torque), Turning moment diagram and flywheel design.	3
10	Gyroscope- Gyroscopic couple and precessional motion, Effect of gyroscopic couple on aeroplane and ship, Stability of two wheel and four wheel vehicles taking turn.	2

Course Outcomes:

On successful completion of this course, student should be able to:

1. Learn various mechanisms and do velocity and acceleration analysis of these mechanisms.
2. Apply the principles of gyroscopic effects and stabilization on various transport vehicles and applications of various governors.
3. Learn about gears, cams, bearings and flywheel and their applications.
4. Apply the principles of balancing of masses to various links, mechanisms and engines.
5. Learn various principles of vibrations of different systems.

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Department of Mechanical Engineering

Subject Code: **HM HU501**	Category: **Humanities and social science**
Subject Name: **Humanities I (Effective technical communication)**	Semester: **V**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

The course aims to teach students the principles of technical communication for their academic and professional needs, focusing on essential written and oral skills for presenting technical information effectively.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media	7
2	Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization	8
3	Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity	6
4	Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	8
5	Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity	7

Course Outcomes:

On successful completion of this course, student should be able to:

1. Understand the dynamics of Verbal and Non Verbal aspects of technical communication
2. Practice multi-step writing process to plan, draft, and revise reports, correspondence, and presentations.
3. Illustrate and examine the knowledge of ethical aspects of engineering
4. Demonstrate and explain social and professional etiquettes
5. Plan self-development and practice self-assessment to function on multi-disciplinary teams.

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Department of Mechanical Engineering

Subject Code: **PC-ME601**	Category: **Professional Core courses**
Subject Name: **Manufacturing Technology**	Semester: **VI**
L-T-P: **4-0-0**	Credit:**4**

Course Objectives:

To impart knowledge to make students able to demonstrate the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components. Also students will be able to understand the principles of working of NC, CNC machine tools and rapid prototyping.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; Press tools: Configuration, design of die and punch; principles of forging die design.	12
2	Metrology: Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and work piece quality.	8
3	Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices.	6
4	NC/CNC Machine Tools and Systems Types of automation: Fixed (or hard) and programmable (or flexible); need, advantages and applications of flexible automation over fixed automation. Components and Their Functions in NC/CNC Machines MCU, DPU and CLU, Feed drives using stepper/ servo motors and recirculating ball screw-nut system, Automatic Tool Changers- Tool Turret and Tool Magazine, Automatic pallet Changer. Basic systems of NC and CNC machines Coordinate system, Control– open loop and closed loop, Dimensioning– absolute and incremental, Point–to–point and contour motion, Linear and circular Interpolation. CNC Machine Tools and Integrated Automation Structure and working principle of CNC lathe, milling machine, Examples and use of CNC machines, Machining Centre (Vertical and Horizontal), Integrated Automation systems (DNC- Direct and Distributed or BTR and Dedicated system, FMS- FFMS, FMC and FMM)– characteristics and applications.	8
5	Part Programming for CNC machines Manual Part Programming using ISO G and M Codes in CNC lathe and milling machine for	8

	simple jobs, Canned cycle. Computer Aided Part Programming using MACRO statements in APT for simple jobs in CNC lathe and milling machine.	
6	Rapid Prototyping Overview of Rapid Prototyping, Basic Process-CAD Model Creation, Conversion to STL format, Slicing the STL File, Layer by layer construction. Use of CMM and 3-D Camera for making virtual model. Principles, systems, relative advantages and applications of the common RP methods, such as Stereo lithography (SLG), Selective laser sintering (SLS), Fused deposition modelling (FDM), Laminated objects manufacturing (LOM), 3-D Printing.	6

Course Outcomes:

Upon successful completion of the course, student will have

1. To describe machines and related tools for manufacturing various components.
2. To understand the relationship between process and system in manufacturing domain.
3. To understand the cutting tool development.
4. To experiment on CNC machine tools.
5. To demonstrate rapid prototyping methods.

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Department of Mechanical Engineering

Subject Code: **PC-ME602**	Category: **Professional Core Courses**
Subject Name: **Design of Machine Elements**	Semester: **VI**
L-T-P: **3-1-0**	Credit: **4**

Course Objectives:

This course seeks to provide an introduction to the design of machine elements commonly encountered in mechanical engineering practice, through

1. a strong background in mechanics of materials-based failure criteria underpinning the safety-critical design of machine components.
2. an understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
3. an overview of codes, standards and design guidelines for different elements.
4. an appreciation of parameter optimization and design iteration.
5. an appreciation of the relationships between component level design and overall machine system design and performance.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Objective and scope of Mechanical Engineering Design; Design considerations; Review and selection of materials and manufacturing processes; codes and standards;	4
2	Modes of failure; Design/allowable stress; Factor of safety (FoS); Theories of failure – maximum normal stress theory, maximum shear stress theory, Distortion energy theory. Choice of Failure criteria; Design for stability: buckling analysis – Johnson and Euler columns;	4
3	Fatigue in metals; S-N curve; Endurance limit and fatigue strength; Stress concentration factors – effect of discontinuity, fillets and notches; Effect of size, surface finish, stress concentration and degree of reliability on endurance limit; Design for finite and infinite life; Goodman, modified Goodman and Soderberg diagrams with respect to fatigue failure under variable stresses; Cumulative fatigue damage – Miner's equation;	5
4	Design of (i) Cotter joint; (ii) Knuckle joint and (iii) Fillet Welded joint of brackets under different types of loading;	6
5	Bolted joints: Metric thread, standard sizes, use of lock nuts and washers; Applications in structures including brackets, turn buckle; pre-stressed bolts; Riveted joints: Unwin's formula; Brief discussion on single, double and triple row lap joints, butt joints with single or double strap / cover plate; simple strength design; joint efficiencies;	6
6	Design of: (i) Solid and hollow shafts, strength design of shafts, design based on torsional rigidity; (ii) Shaft coupling-rigid, pin-bush and geared flexible type, alignment of coupling; (iii) Belt drives-geometrical relations, derivation of torque and power transmission by flat and V-belt drives, selection of belt from manufacturers' catalogues, pulley (iv) Chain drives – roller chains, polygonal effect, power rating, sprocket wheel, silent chain;	10

7	Design of: (i) Transmission screw, Screw jack, (ii) Helical compression spring - stress and deflection equations, stiffness, curvature effect: Wahl's factor, springs in parallel and series; (iii) multi-leaf springs: load-stress and load-deflection equations, Nipping;	8
8	Analysis and design of sliding and rolling contact bearings, Design of transmission elements: spur, helical, bevel and worm gears; Analysis of clutches and brakes;	5

Course Outcomes:

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

1. Get an overview of the design methodologies employed for the design of various machine elements.
2. Understand the theories of failure to design and analyse various mechanical components.
3. Recognize and apply the concept of fatigue phenomenon in design of components undergoing cyclic loading.
4. Understand the importance of factor of safety applying the same in designing.
5. Analyse and solve various problems related to design of machine elements.

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Department of Mechanical Engineering

Subject Code: **PE-ME601A**	Category: **Professional Elective courses**
Subject Name: **IC engines and gas turbines**	Semester: **VI**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To acquire knowledge about the IC engine cycles, classification, working Principles and tomeasure performance parameters along with heat balance sheet.
To explain different alternate fuels, gas turbines and about jet propulsion

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Basic Engine components and Nomenclature, Classification of Engines, The working principle of Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagram. **Fuels:** Fossil fuels, Chemical structure of Petroleum, Properties of SI and CI Engine Fuels, Fuel Ratings; Octane Number, Cetane Number.	6
2	**Carburetors & Fuel Injection:** Air Fuel Mixture Requirements, Construction and Working of Simple Carburetor, Calculation of Air-Fuel Ratio, Parts of Carburetor. Requirement of Injection Systems, Classification of Injection Systems, Fuel Feed pump, Injection Pumps, Working principles of Governors, Nozzles and Fuel Injector, Injection in SI and CI Engines. **Combustion and Ignition Systems in SI and CI Engines:** Normal and Abnormal Combustion in SI and CI Engines, Stages of Combustion, Detonation and Knocking.	7
3	**Performance parameters for IC Engines:** Engine Power, Engine Efficiencies, Performance Characteristics, Variables Effecting Performance Characteristics, Methods of Improving Engine Performance, Heat Balance. **Modern Automotive Engines:** Changes in Fuel injection Methods in S.I and C.I engines, Common Rail Direct Injection System, Gasoline Direct Injection, Variable Valve Technology, A brief review of Design changes to achieve high efficiency.	7
5	**Alternate Fuels For IC Engines:** Need for use of alternate fuels. Use of alcohol fuels. Biodiesel. **Biogas and Hydrogen in engines.**	3
6	**Gas Turbine:** **Introduction to Gas Turbines, Development, Classification and Application of Gas Turbines, Ideal and Actual Cycles; Effect of Inter cooling, Reheating, Regeneration, Combined cycle and**	6

	Cogeneration.	
7	**Gas Turbine Cycles for Aircraft Propulsion: Criteria of performance, Intake, and propelling nozzle efficiencies, Simple Turbojet Cycle, The turboprop engine, Thrust augmentation, Gas turbine combustion systems, Combustion chamber designs, Gas Turbine Emissions.**	7

Course Outcomes:

1. Explained basic concepts of actual cycles with analysis and to describe the fundamentalconcepts of IC engines along with its working principles.
2. Described the combustion phenomenon in SI and CI engines.
3. Evaluated the performance of IC engines and the importance of alternate fuels.
4. Classified the essential components of gas turbine along with its performance improvingmethods.
5. Illustrated the working principle of different types of Jet propulsive engines and Rockets.

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Department of Mechanical Engineering

Subject Code: **PE-ME601B**	Category: **Professional Elective courses**
Subject Name: **Ref. and Air conditioning**	Semester: **VI**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. To know about the basics of refrigeration and air-conditioning system.
2. To learn about different types of Refrigeration, Air-Conditioning and ventilation systems.
3. To know about designing a Refrigeration and Air-Conditioning system.

Course Content:

Module No.	Description of Topic	Contact Hrs.
1	Introduction: Concepts of Refrigeration and Air-Conditioning. Unit of refrigeration, Refrigerants– Desirable Properties, Nomenclature	02
2	Simple Vapour Compression Refrigeration System (Simple VCRS): Vapour compression cycle on p-h and T-s diagrams. Cycles with subcooling and superheating, their effects; Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS; dry compression and wet compression of refrigerant; actual Vapour Compression Cycle.	05
3	Air Refrigeration System (ARS): Bell-Coleman refrigerator. COP determination, actual air-refrigeration cycle.	03
4	Vapour Absorption Refrigeration System (VARS): Advantages of VARS over VCRS. Working principle of simple VARS, practical VARS. Limitations of VARS, maximum COP of a VARS, Lithium bromide-water System; Aqua-ammonia systems.	04
5	Equipment and Control: Major Refrigeration Equipment-Compressors: Types; reciprocating, rotary & centrifugal, volumetric efficiency, Condensers: types used in refrigeration systems; Evaporators: expansion devices: capillary tubes and thermostatic expansion valves.	06
6	Ventilation– Definition & Requirement, Natural & Mechanical Ventilation, Ventilation Load Calculation.	03
7	Basic definitions and principles related to Psychometry; Psychometric Charts & Their Uses; Heating, Cooling, Heating & Humidification & Cooling & Dehumidification processes. Adiabatic Saturation, Cooling Coils, By-pass Factor.	05
8	Sensible Heat Factors. Heat Load estimation: Simple cases of Cooling and Dehumidification. Duct Sizing & Design. Air-conditioning equipment: Air handling units, Cooling Towers.	08

Course Outcomes:

After completing this course, the students will

1. know about the systems of Refrigeration, Air-Conditioning and Ventilation.
2. learn about different components of VCRS systems.
3. learn about different components of Vapour absorption refrigeration systems.
4. Know about the principles related to Psychometry
5. know about designing a Refrigeration and Air-Conditioning system.

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Department of Mechanical Engineering

Subject Code: **HM-HU601**	Category: Basic Science Course
Subject Name: **Humanities II (Operations Research)**	Semester: **VI**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction to Operations Research**: Introduction, Historical Background, Scope of Operations Research, Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools, Structure of the Mathematical Model, Limitations of Operations Research	2
2	**Linear Programming:** Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Case Studies of LPP, Graphical Methods to Solve Linear Programming Problems, Applications, Advantages, Limitations. Graphical Analysis of Linear Programming Problems: Introduction, Graphical Analysis, Some Basic Definitions, Graphical Methods to Solve LPP, Some Exceptional Cases, Important Geometric Properties of LPP. Simplex Method: Introduction, Standard Form of LPP, Fundamental theorem of LPP, Solution of LPP - Simplex Method, The Simplex Algorithm, Penalty Cost Method or Big M-method, Two Phase Method, Solved Problems on Minimisation. Duality in Linear Programming Problem: Introduction, Importance of Duality Concepts, Formulation of Dual Problem, Economic Interpretation of Duality, Sensitivity Analysis.	8
3	**Transportation Problem:** Introduction, Formulation of Transportation Problem (TP), Transportation Algorithm (MODI Method), the Initial Basic Feasible Solution, Moving Towards Optimality	3
4	**Assignment Problem:** Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Travelling Salesman Problem	3
5	**Project Management Using CPM-PERT:** Project Scheduling and PERT-CPM: Introduction, Basic Difference between PERT and CPM, PERT/CPM Network Components and Precedence Relationship, Project Management – PERT, Float calculation and its importance. Cost reduction by Crashing of activity	5
6	**Queuing Theory:** Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Queue discipline, Service Mechanism, Classification of Queuing models, [M/M/1]:{//FCFS} Queue System, numerical	3

7	**Inventory Management:** Inventory classification, Different costs associated to Inventory, Inventory models with deterministic demands (EOQ, EPQ and price discount models), inventory classification systems	4
8	**Job Sequencing**: Introduction to sequencing and scheduling models: n job two machines problem, n job 3 machines problem	2
9	**Decision Theory:** Introduction, Decision under certainty, Decision under risk, Decision under uncertainty: Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, Hurwicz criterion, Decision tree	3
10	**Replacement Theory:** Introduction, Replacement of capital equipment which depreciated with time, replacement by alternative equipment, Group and individual replacement policy	3

Course Outcomes:

1. Set up decision models and use some solution methods for finding solutions of problems. and to formulate and apply LPP and solution of LPP by Graphical Method and Simplex Method.
2. Methods of solving Transportation Problems and Assignment Problems.
3. To develop the network and to find the shortest path, critical path using PERT and CPM method, maximal flow of Network analysis by Floyd's Algorithm and Fulkerson's Algorithm
4. To develop the modelling and mathematical skills to analytically determine queuing models and finding various parameters associated with the model and applications of some real life situations.
5. Introduction to Non Linear Optimization and some methods of solving NLPP.

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Department of Mechanical Engineering

Subject Code: **ME-701**	Category: **Professional Core courses**
Subject Name: **Power Plant Engineering**	Semester: **VII**
L-T-P: **4-0-0**	Credit:**4**

Course Objectives:

To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels. To expose the students to the principles of safety and environmental issues.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Power plant cycles, reheat, regenerative and binary vapor and co-generation cycles.	4
2	Boilers: Definition, classification, fire tube and water tube boilers, mountings and accessories. Draft in boilers, Performance of boiler - boilers efficiency, equivalent evaporation, Losses in boilers. Coal and combustion: Properties of coal, ultimate analysis and proximate analysis, combination calculation.	5
3	Fuel bed firing, PF firing and Fluidized bed boilers. Introduction to boiling and circulation in boilers. Power station boilers - Benson, Lamont. Supercritical boiler.	5
4	Boilers accessories: Super heater, economizer and air-pre heater. Handling of coal and ash.	5
5	Steam turbine- i) parts and classification, ii) nozzles types, flow through nozzles and nozzle efficiency. Impulse turbine - velocity diagram, work done and blade efficiency.	7
6	Pressure compounding and velocity compounding of steam turbine.	4
7	Impulse reaction turbine - Velocity diagram, degree of reaction and Parsons turbine.	4
8	Governing in Steam turbine. Condensers – Basic ideas.	5
9	Power plant economics: load curve and various factors, cost of power generation. Introduction to Hydel, Nuclear and Renewable power plants.	4

Course Outcomes:

1. Describe and analyze different types of sources and mathematical expressions related to basic thermodynamics, Rankine cycle and various terms and factors involved with power plant operation.
2. Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts
3. To properly explain concepts of the working principle of different types of firing in the boiler, its layout, safety principles and compare it with plants of other types.

4. Describe the working principle and basic components of the Steam Turbine and various types of analyses which are done on the compounding of the steam turbines.
5. Discuss the working principle and basic components of Power Plant Economics.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME702**	Category: **Professional courses**
Subject Name: **Advanced Manufacturing Technology**	Semester: **VII**
L-T-P: **4-0-0**	Credit:**4**

Course Objectives:

The objective of the course is to provide the students the knowledge of modern manufacturing processes such as Ultrasonic machining, Abrasive machining processes, Electrochemical machining, Electro discharge machining & their modifications into hybrid processes. Also to introduce them to advanced topics such as Laser beam welding/machining, Electron beam welding/machining & state of art in various research areas.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction to and scope of the subject of Advanced Manufacturing Technology	1
2	Manufacturing Systems and Automation : Job shop, Flowlines, Transfer lines, Project shop, Continuous processes, Cellular manufacturing system, Flexible Manufacturing System: Automation: (i) degree of automation and their justified application in different levels of production (ii) benefits and draw backs of employing automation (iii) examples of conventional non-automatic, semi-automatic and automatic machine tools (iv) extent of automation in transfer machines Integrated Manufacturing Production System: Steps involved in implementation, forming the linked-cell factory.	8
3	CNC machine tools and systems (i) types of automation ; fixed (or hard), programmable and flexible (ii) need and advantages of flexible automation (iii) basic principles of NC system Components and their functions in NC machines (i) Control ; MCU, DPU and CLU (ii) feed drives ; special motors and screw-nut system (iii) advantages of CNC over NC machines Basic systems of NC and CNC machines (i) coordinate system (ii) control – open loop and closed loop (iii) dimensioning – absolute and incremental CNC machine tools ; (i) structure and working principle (ii) examples and use of CNC machines (iii) machining centre (MC) – characteristics and applications. Control of tool – work travel ; (i) point – to – point and contouring (ii) interpolation – linear and circular Part programming for NC, CNC and MC systems Manual part programming (i) definition and codes used (ii) sequential steps (iii) examples ; part programming for machining in CNC lathes, drilling machines and milling. Computer aided part programming (i) definition and advantages (ii) programming languages (iii) statements in APT (iv) examples of CA part programming in APT	5

4	An overview of Non Traditional Manufacturing - Advantages over traditional, classification, characteristics of all processes: Abrasive Jet Machining (AJM) Working principle with help of layout, Applications, Effect of pressure, strand-off distance, grain size, abrasive flow rate on material removal rate (mrr) Mechanism of material removal. Advantages and limitations. Water Jet Machining: Introduction, Machining System, Basic principle, Process parameters, Applications, Advantages and Disadvantages. Ultrasonic Machining (USM) Schematic Diagram of USM- Working principle, Functions of each equipment used in the set up, Material removal process. Influence of Process parameters on (i) machining rate (ii) Surface finish and accuracy and repeatability, Applications. Plasma Arc Machining Basic principle, applications	6
5	Chemical Machining- Introduction, Blanking, Chemical Machining to multiple depths, Design factors, advantages and disadvantages. Electro-Chemical Machining- Process principle, Equipment, Applications. Electron Beam Machining Set up, Basic Principle, Applications. Electrical Discharge Machining (EDM) Diesinking- Basic principle, Schematic diagram of EDM setup, Dielectric fluid, Electrode materials. System for maintaining the spark gap constant, Effect of cutting parameterspulse-on-time, pulse off time, peak current setting, no load voltage, servo reference voltage, Applications. Wire-cut EDM: Schematic diagram, working principle Dielectric fluid, use. Advantages & Disadvantages of EDM, Applications.	6
6	Laser Beam Machining (LBM) Characteristics of Laser light, Basic mechanism of Ruby laser, Energy level diagram of Ruby laser. Carbon Dioxide laser, Energy level diagram. Commercial lasers available for machining, welding Heat treating, cladding. Hybrid Machining- Introduction, Methodology for Hybrid Machiningthermal interaction, chemical and electrochemical interaction, mechanical interaction, Electromechanical Discharge Machining (ECDM/ECAM), Electrical Discharge Machining with Ultrasonic Assistance (EDMUS).	6
7	Rapid Prototyping- Overview of Rapid Prototyping, Basic Process- CAD Model Creation, Conversion to STL format, Slice the STL File, Layer by layer construction, Clean and finish. Principles, systems, relative advantages and applications of the common RP methods ; (i) stereo lithography (SLG) (ii) selective laser sintering (SLS) (iii) fused deposition modelling (FDM) (iv) laminated objects manufacturing (LOM) (v) 3-D Inkjet Printing	6

Course Outcomes:

1. Students will be able to categorize different material removal, joining processes as per the requirements of material being used to manufacture end product.

2. Students will be able to select material processing technique with the aim of cost reduction, reducing material wastage & machining time.

3. Students will be able to identify the process parameters affecting the product quality in various advanced machining of metals/ non-metals, ceramics and composites.

4. Students will be able to combine & develop novel hybrid techniques from the state of art techniques available.

5. Students will be able to perform process analysis taking into account the various responses considered in a process.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME703A**	Category: **Professional Elective Courses**
Subject Name: **Maintenance Engineering**	Semester: V**III**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. To provide knowledge on different aspects of repair and maintenance practised in industry.
2. To make students familiar with different repair and maintenance strategies used in industry.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction:** Definitions of repair and maintenance; Importance of maintenance; Different maintenance systems- breakdown, preventive, planned; predictive maintenance through condition monitoring; Maintainability, failure pattern, availability of equipment/ systems, design for maintainability. **Total Productive Maintenance (TPM):** definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE)	8
2	**Organizational structures for maintenance:** Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, Manpower planning; Engineering stores & inventory management.	4
3	**Economic Aspect of Maintenance:** Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance audit- Procedure, tools, planning, reports.	4
4	**Function and use of Maintenance Equipment, Instruments & Tools:** Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricators and lubricants, chain pulley block, Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc.	6
5	**Lubrication: Purpose & importance:** Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals;	4
6	**Repair & Maintenance Procedures:** Repair of cracks, threads, worn shafts, keyways, bush bearing, damaged gear tooth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, electrical wiring, isolators and main switches, small induction motors;	10

	Steps for installation of a machine.	

Course Outcomes:

At the end of the course, the student will be able to:

1. Know different types of repair and maintenance procedures practised in industry.
2. Understand various condition monitoring techniques.
3. Understand different repair and maintenance strategies used in industry.
4. Understand the organizational structure of an industry for maintenance management and the economy involved in this.
5. Understand the repair methods of material handling equipments.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME 703 B**	Category: **Professional Elective courses**
Subject Name:**Renewable Energy Systems**	Semester: **VII**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

The objectives of this course is understand need of these sources due to crisis of conventional sources and the familiarize with different non conventional sources such as Solar Thermal, Solar PV, Wind, Geothermal, Biomass etc

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Principles of Renewable Energy: i) The history of energy scene ii) The energy future: energy and sustainable Development and role of renewable energy iii) Scientific Principles of renewable energy	4
2	Review of principles of thermodynamics, fluid dynamics and heat transfer	1
3	Solar radiation: i) Sun-Earth geometry ii) Extraterrestrial Solar Radiation iv) Measurement and estimation of solar radiation.	4
4	Solar Water Heating: i) Flat Plate Collectors: Heat Transfer analysis, Testing ii) Evacuated Tube Collectors	5
5	Other Solar Thermal Applications: i) Air heaters ii) Water Desalination iii) Space Cooling iv) Solar Concentrators v) Solar ponds	3
6	Photovoltaic Generation: i) Photon absorption at Silicon p-n junction ii) Solar Cell iii) Application and Systems	4
7	Wind Power: i) Turbine types & terms ii) Mechanical & Electrical Power from Wind Turbines	3
8	Biomass & Biofuels: i) Use of Biomass ii) Classification & Use of Biofuels.	3
9	Wave Power & tidal Power: Basic Concepts	3
10	Ocean Thermal Energy Conversion	2
11	Geothermal Energy	2

12	Energy Storage	2

Course Outcomes:

1. Explain renewable energy sources & systems.
2. Apply engineering techniques to build solar, wind, tidal, geothermal, biomass, fuel cell, Hydrogen and sterling engine.
3. Analyze and evaluate the implication of renewable energy. Concepts in solving numerical problems pertaining to solar radiation geometry and wind energy systems.
4. Demonstrate self -learning capability to design & establish renewable energy systems.
5. Conduct assessment of the performance of solar PV, solar thermal and biodiesel systems

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME704B**	Category: **Professional Elective courses**
Subject Name: **Advanced Welding Technology**	Semester: **VII**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. To impart knowledge about different welding processes and their applicability.
2. To make the students understand the mechanism behind weld joints.
3. To impart ideas of different testing techniques of the welded joint..

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Review of welding processes, joint design.	3
2	Process descriptions of and parametric influences on fusion welding; arc welding- SMAW, stud arc welding, GMAW, GTAW and FCAW, solid state welding processes- pressure welding, friction welding, diffusion welding; resistance welding processes.	6
3	Arc welding- different types of equipment, power sources, arc characteristics, electrode selection	5
4	Critical and precision welding processes like: PAW, LBW, EBW, USW, friction stir welding, under-water welding. Welding of plastics, ceramics and composites	5
5	Welding metallurgy, HAZ, effects of different process parameters on the characteristics of weldment. Welding fixtures, welding automation and robotic applications	6 1
6	Weldability of plain carbon steels, stainless steel, cast iron, aluminium and its alloys.	4
7	Welding defects- types, causes, inspection and remedial measures; testing of welded joints by visual inspection, dye-penetration (DP) test, ultrasonics and radiography. Safe Practices in Welding.	3 1

Course Outcomes:

1. To familiarize different types of welding processes.
2. To familiarize the basic mechanism behind weld joint and influencing factors.
3. To impart the knowledge different tests to judge soundness of the weld joint.
4. To understand the limitations of welding.
5. To understand different position of welding.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME 705C**	Category: Basic Science Course
Subject Name: Operations Research and Industrial Management	Semester: **VII**
L-T-P: **3-1-0**	Credit:**4**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction:** Brief history of development of OR; Introduction to different OR problems/ techniques: Decision theory, Linear programming, Transportation and Assignment problems, Network analysis, Sequencing, Project scheduling, Integer programming, Non-linear programming, Inventory control, Queuing or Waiting line problems, Metaheuristics.	2
2	**Decision Theory:** Structure of the problem (decision table); Decision making under uncertainty with optimistic, pessimistic and average outcome criteria; Decision making under risk with expected value and expected loss criteria; Sequential decision using decision trees.	4
3	**Linear Programming (LP);** Nature of LP problems through examples; Formulation of LP Problems; Graphical solutions of two decision variable problems; Properties of a solution to LP problems: convex solution space and extreme point solution; General form of LP model; Simplex method and its meaning; Steps of simplex method in tabular form; Solving LP problems by Simplex Method; Sensitivity analysis.	7
4	**Transportation & Assignment Problems:** Nature of a transportation or distribution problem; Tabular representation of a transportation problem; North-West Corner initial solution; Stepping stone method; Concept of dummy source or destination; Vogel's approximation method. Nature of an Assignment problem; Tabular representation; Hungarian method for solving assignment problems.	5
5	**Network Analysis:** Network models and terminologies like arcs, nodes, paths, tree, spanning tree; shortest path/route problem; The minimum spanning tree problem; The maximal flow problem.	4
6	**Waiting line Problems:** Structure of a waiting line System: Single-channel waiting line, process of arrivals, distribution of service times, queue discipline, steady stage operation; Single channel model with Poisson arrivals and exponential service time; Multiple channel model with Poisson arrival and exponential service times; Single channel model with Poisson arrivals and arbitrary service time (M/G/1); Economic analysis of waiting lines.	6
7	**Non-Linear Programming:** Graphical illustration of a non-linear programming problem; Unconstrained optimization by (i) direct search	8

	method, (ii) steepest decent method; Constrained optimization by lagrange multipliers; Integer linear programming by branch & bound technique; Dynamic programming problems and their characteristics; Bellman's principle of optimality; solving (i) Stagecoach problem, (ii) Knapsack problem.	

Course Outcomes:

1. Set up decision models and use some solution methods for finding solutions of problems. and to formulate and apply LPP and solution of LPP by Graphical Method and Simplex Method.
2. Methods of solving Transportation Problems and Assignment Problems.
3. To develop the network and to find the shortest path, critical path using PERT and CPM method, maximal flow of Network analysis by Floyd's Algorithm and Fulkerson's Algorithm
4. To develop the modelling and mathematical skills to analytically determine queuing models and finding various parameters associated with the model and applications of some real life situations.
5. Introduction to Non Linear Optimization and some methods of solving NLPP.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **HU ME801**	Category: **Humanities and social science including management course**
Subject Name: **Economics for engineers**	Semester: **VIII**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To make general awareness among budding engineers regarding basic principles of economics and that needed to use in an industry. To give basic understanding of engineering costs, estimation, depreciation analysis and basic accounting principles.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Economic Decisions Making- Overview, Problems, Role, Decision making process.	2
2	Engineering Costs & Estimation- Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring and Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power- Sizing Model, Improvement & Learning Curve, Benefits.	4
3	Present Worth Analysis: End-of-Year Convention, Viewpoint of Economic Analysis Studies, Borrowed Money Viewpoint, Effect of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.	4
4	Cash Flow & Rate of Return Analysis- Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Break Even Analysis. Economic Analysis in the Public Sector-Quantifying and Valuing Benefits & drawbacks.	4
5	Depreciation- Basic Aspects, Deterioration & Obsolescence, Depreciation and Expenses, Types of Property, Depreciation Calculation Fundamentals, Depreciation and Capital Allowance Methods, Straight Line Depreciation Declining Balance Depreciation, Common Elements of Tax Regulations For Depreciation and Capital Allowances.	4
6	Inflation and Price Change- Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes in Engineering Economic Analysis, Cash Flows that inflate at different Rates.	3
7	Accounting- Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	3

Course Outcomes:

On successful completion of this course, student should be able to:

1. To understand Economic Decisions Making criteria
2. To know basic principles of engineering costs, estimation and depreciation analysis.
3. To understand basic accounting principles.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME802b**	Category: **Professional Elective courses**
Subject Name: **Industrial Robotics**	Semester: **VIII**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. Learn about the types of robots used in material handling systems.
2. Understand the use of vision systems in automation systems.
3. Gain knowledge on the different methods of material handling.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Brief history of robotics; definition of robot; Main components of robot: manipulator, sensors, controller, power conversion unit; Robot geometry: types of joints, workspace, number of degrees of freedom; Common configurations used in arms: rectangular, cylindrical, spherical, joined; Classification of robot according to coordinate system: cartesian, cylindrical, polar, articulated or jointed; Classification of robots according to control method: non-servo, servo; Robot specifications: payload, accuracy, repeatability resolution, maximum tip speed, reach stroke:	4
2	Robot End Effector End effector: definition, gripper, tools; Gripper : main parts, source of power; Types of grippers: mechanical grippers, vacuum cups, magnetic grippers, adhesive grippers, Hooks, scoops, ladles, universal gripper; Robot Tools: Spot welding gun, pneumatic impact wrench, pneumatic nut runner, inert gas welding torch, heating torch, grinder, spray painting gun.	4
3	Robot Actuators: Definition; Characteristics: power to weight ratio, stiffness, compliance, reduction gears; Conventional actuators: hydraulic actuator, pneumatic actuator, electric motor, direct drive motor, stepper motor, servo motor; Special actuators: magnetostrictive, shape memory alloy, elastomer.	4
4	Robot Sensors: Definition; of Sensor and transducer; Calibration; Basic categories of measuring devices: analog, discrete; Main types of sensors: position, velocity, acceleration, force and pressure, torque, slip and tactile, proximity. Definition of digital image, generation of digital image; Robot Vision System: definition, use, functions, components, classification; vision cameras; Techniques of image processing and analysis: Image data reduction, segmentation, feature extraction, object recognition; Application of robot vision system.	9
5	Robot Kinematics:	7

	Definition of Robot kinematics, Tool frame and base frame. Word – coordinate system, Direct kinematics, Inverse kinematics, Describing position and orientation of an object in space, Homogenous transformation, Translational transformations, Rotational transformations, Denavit- Hartenberg representation.	
6	Robot Programming Definition of robot programming; Different methods of robot programming: teach-pendant programming, key board programming; Programming languages: VAL II, AML/2, ARM BASIC	4
7	Industrial Applications of Robots Welding, Spray painting, Grinding;Material Transfer: machine loading and unloading, Processing operation; Assembly operation; Inspection. Special applications: underwater prospecting and repairs, Mining, Space Exploration, Surgery.	4

Course Outcomes:

1. Differentiate the various types of Industrial Robots and their architecture.
2. Apply the concepts of image processing for robotic inspection systems.
3. Analyze the applications of robots in various industrial applications.
4. Design and fabricate simple grippers for pick and place application.
5. Identify the right Robot for a given industrial application.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME-802C**	Category: **Professional Elective**
Subject Name: **Energy Conservation and Management**	Semester: **VIII**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To impart basic knowledge to the students about current energy scenario, energy conservation, audit and management.
To inculcate among the students systematic knowledge and skill about assessing the energy efficiency, energy auditing and energy management.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	The Energy Resources; Finite & Renewable	3
2	The Need for Energy Conservation- estimation of Finite fuel resource; Hubbert's model for oil reserve	3
3	Total Energy Concept- CHP Cycles & their applications	6
4	Waste Heat Recovery; Waste Heat Exchangers; Commercial Waste Heat Recovery Devices- Recuperators, Regenerative Heat Exchangers, Heat Pipes	8
5	Industrial Energy Conservation- Industrial Insulations; Case Studies for HVAC, Air Compressor, Mechanical Handling & Other Systems	8
6	Energy Audit; Basic Steps; Graphical representation; Case Studies	4
7	The Economics of Energy Saving Schemes; Costs; investment analysis	4

Course Outcomes

1. Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing
2. Ability to analyse the viability of energy conservation projects
3. Capability to integrate various options and assess the business and policy environment regarding energy conservation and energy auditing
4. Advocacy of strategic and policy recommendations on energy conservation and energy auditing.
5. Students will exhibit the ability to integrate technical, economic, social and regulatory frameworks for power sector planning and resource management.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME803A**	Category: **Professional Elective Courses**
Subject Name: **Safety and Occupational Health**	Semester: **VIII**
L-T-P: **3-0-0**	Credit: **3**

Course Objectives:

1. Students will be able to recognize and evaluate occupational safety and health hazards in the workplace

2. Students will be able to determine appropriate hazard controls following the hierarchy of controls.

3. Students will furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities

4. Students will furthermore be able to analyze the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.

Course Content:

Module No.	Topics	Number of Classes
1	**Development of industrial safety: Developments in Occupational Health, Occupational Safety and Health in India**	**02**
2	**Accidents and their prevention: Theory of accident, Anatomy of an accident, How Accidents are Caused? Cost of Accidents, Principles of Accident Prevention, Techniques of Accident Prevention, Safe Work Environment, Housekeeping, Job Safety Analysis Investigation of Accidents, Ergonomics, Personal Protective Equipment, Promotion of Health and Safety, Basic Safety Programming**	**06**
3	**Fire hazard: Types of fire, Fire Hazards, Fire Explosion, fire prevention, Means of Escape in Case of Fire Inspection Safety Supervision Safety, Responsibility Safety Inspection, Fire prevention authorities, Rules Safety Training Safety, Appraisal Safety Communication Safety Audit**	**06**
4	**4. Occupational health and safety: Occupational Health, Occupational Health Services in Places of Employment, Occupational Physician Occupational Health in Developing Countries, Occupational Safety, Occupational Safety in Developing Countries, Promoting Occupational Health and Safety, Work Related Diseases, Occupational Health Hazards Recognition of Hazards, Industrial Hygiene, Occupational Diseases, basics of OHSAS 18001**	**06**
5	**Health and safety at workplaces: Health and Safety hazards, Occupational Health Requirements, Occupational Safety Requirements, Occupational Welfare Requirements, Abstracts and**	**06**

	Notices, Obligations of a Worker, Obligations of Occupier, Personal protective equipment, Causes of Accidents, Prevention of Accidents, Safety Legislation, Safety Guidelines, emergency actions, related acts (related to chemical processes, mines, workshop practices, construction work, electrical installations)	
6	**Health and safety management: Basics of Safety management, Role of safety supervisor, planning for safety, Safety Policies, Safety Promotion, Safety Committee, safety education & training, Health and Safety Process, Measuring Safety, Risk Management and Loss Control**	**04**
7	**Accident compensation** **Brief introduction to different acts –** **The Dangerous Machines (Regulations) Act, 1983, The Employers' Liability Act, 1938; The (Indian) Fatal Accidents Act, 1855; The Public Liability Insurance Act, 1991, The Workmen's Compensation Act, 1923,** **The Employees' State Insurance Act, 1948, Role of National Safety Council, International labour office.**	**06**
	TOTAL CLASSES	**36**

Course Outcomes:

By the end of this course, a student should:

1. Evaluate workplace to determine the existence of occupational safety and health hazards

2. Identify relevant regulatory and national consensus standards along with best practices that are applicable.

3. Select appropriate control methodologies based on the hierarchy of controls

4. Analyze injury and illness data for trends.

5. Understand the different labour law and company acts.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **ME803D**	Category: **Professional Elective Courses**
Subject Name: **Automobile Engineering**	Semester: **VIII**
L-T-P: **3-0-0**	Credit: **3**

Course Objectives:

1. Introduction to engineering analysis of the automobile and its sub-systems.

2. Application of engineering principles to automotive design.

3. Familiarization with modeling and analysis methods.

4. Familiarization with the automotive industry and its terminology.

Course Content:

Module No.	Topics	Number of Classes
1	Introduction: History & Development of Automobile. various sub system of Automobile.	01
2	Prime Mover: Engine for Two –Wheeler & Three- Wheeled vehicles, Engine for passenger cars, commercial and other vehicle, Fuel system for carbureted engine, MPFI engine and Diesel engine, Lubrication and cooling system.	05
3	Auto Electrical: Electric Motor as prime mover, Battery, generator, Ignition system, starting system, lighting & signaling	06
4	Steering System: Davis steering & Ackerman steering system. Rack & pinion, cam & lever, worm & sector system.	03
5	Transmission System: Flywheel & clutch. Gearbox sliding and constant mesh type, Automatic Transmission, Universal joint, Propeller shaft.	06
6	Differential & Axle: Construction & function of differential, Different types of front & rear axles.	03
7	Suspension System: Conventional and independent suspension system, application.	03
8	Brake System: Disc & drum brake, Hydraulic brake, Parking brake. Stopping distance.	03
9	Power Requirement: Various resistances such as air resistance, gradient resistance, rolling resistance. Tractive effort. Torque- Speed curve. Horse power calculation	04
10	Maintenance of Vehicle.	02
	TOTAL CLASSES	36

Course Outcomes:

On successful completion of the course, the student will be able to,

1. Demonstrate the vehicle construction, chassis, lubrication system and cooling system in automobile, 3-way catalytic converter.

2. Describe the principle and working of Carburetors, CRDI, MPFI, electronic fuel injection system and Ignition system.

3. Differentiate between clutch, gear box, rear axle drives, fluid flywheel, and torque converter.

4. Identify the wheels, tires, steering gear box, suspension system-telescopic, and leaf spring.

5. Appraise the recent trends in alternate fuels and automobile safety system.

OmDayal Group of Institutions
Department of Chemistry

Course Code : CE(BS)301	**Category :** Basic Science Courses
Course Title : **Biology (Biology for Engineers)**	**Semester** : Third
Duration: 2L+1T	**Credit:3**

Course Objectives:

To introduce modern biology with an emphasis on evolution of biology as a multi-disciplinary field and to make students aware of application of engineering principles in biology and engineering robust solution inspired by biological examples.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction** Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlightthe fundamental importance of observations in any scientific inquiry	2
2	**Classification:** Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructureprokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.	3
3	**Genetics** Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using	4

	human genetics.	
4	**Biomolecules** Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine. Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	4
4	**Macromolecular analysis:** Purpose: To analyze biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
5	**Enzymes** Enzymology: How to monitor enzyme catalyzed reactions. How does an enzyme catalyzereactions. Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	**Information Transfer** Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structurefrom single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4
7	**Macromolecular analysis** Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements	5
7	**Immunology** Purpose: How does the immune system work? What are the molecular and cellular components and pathways that protect an organism from infectious agents or cancer? This comprehensive course answers these questions as it explores the cells and molecules of the immune system. Immunology- Self vs Non-self, pathogens, human immune system, antigen-antibody reactions.	5
8	**Metabolism** Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4
9	**Microbiology** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

Course Outcomes:

1. To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.

2. To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted
3. To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and the molecular basis of coding and decoding genetic information is universal
4. To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine and to analyses biological processes at the reductionist level
5. To convey that without catalysis life would not have existed on earth and to studythe fundamental principles of energy transactions are the same in physical and biological world

Engineering Mechanics
Code: CE (ES) 301
Prerequisites: Physics, Mathematics

Course Outcomes: At the end of the course, the student will be able to:

CO1. Determine the nature of forces and its final effects and also understand the effect of friction force

CO2. Understand the basic principles of structural analysis

CO3. Understand the basic concept of centre of gravity

CO4. Understand the principle of virtual work and energy method

CO5. Understand the basic concept of particle dynamics and kinetics of rigid body

CO6. Solve simple problems of mechanical vibration

CE(ES)301	Engineering Mechanics	3L + 1T =	4 Credits
Module 1	Introduction to Engineering Mechanics Force Systems Basic concepts, Particleequilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces,Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant ofForce System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium ofCoplanar Systems and Spatial Systems; Static Indeterminacy.		6L
Module 2	Friction Types of friction, Limiting friction, Laws of Friction, Static andDynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;		3L
Module 3	Basic Structural Analysis Equilibrium in three dimensions; Method of Sections;Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zeroforce members; Beams & types of beams; Frames & Machines;		4L
Module 4	Centroid and Centre of Gravity Centroid of simple figures from first principle,centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia-Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia,Moment of inertia of standard sections and composite sections; Mass moment inertia of circularplate, Cylinder, Cone, Sphere, Hook.		5L
Module 5	Virtual Work and Energy Method- Virtual displacements, principle of virtual work forparticle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems withfriction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational),energy equation for equilibrium. Applications of energy method for equilibrium. Stability ofequilibrium.		4L
Module 6	Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular,path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potentialenergy.Impulse-momentum (linear, angular); Impact (Direct and oblique).		4L
Module 7	Introduction to Kinetics of Rigid Bodies Basic terms, general principles indynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems;D'Alembert's principle and its applications in plane motion and connected bodies; Work energyprinciple and its application in plane motion of connected bodies; Kinetics of rigid body rotation;		5L
Module 8	Mechanical Vibrations Basic terminology, free and forced vibrations,resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of freevibrations without damping and single degree of freedom system, simple problems, types ofpendulum, use of simple, compound and torsion pendulums;		5L
Tutorials	From the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free bodydiagrams various systems including block-pulley; To verify the principle of moment in the discapparatus; Helical block; To draw a load efficiency curve for a screw jack.		6L

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1							1			
CO 2	3	1	1	1					2			
CO 3	3	1							1			
CO 4	3	1	1						1			
CO 5	3	1	1	1					1			
CO 6	3	1	1	1	1				2			

1: Slightly 2: Moderately 3: Substantially

CO-PO MAPPING

Introduction to Civil Engineering
Code: CE(HS)302
Prerequisites: Basic Science knowledge

Course Outcomes:

At the end of the course, the student will be able to:

CO1. Understand basic disciplines of civil engineering, History of civil engineering and ancient monuments and the concept of national planning for construction and infrastructure development.

CO2. Understand the fundamentals of architecture & town planning, fundamentals of building materials and construction management.

CO3. Understand the fundamentals of environmental engineering and sustainability.

CO4. Understand the basic concepts of Geotechnical, hydraulics, water resource and ocean engineering.

CO5. Understand the fundamentals of Power plant structure, structural engineering, surveying and traffic & transportation engineering.

CO6. Understand the fundamentals of repairs and rehabilitation of structures.

CO7. Understand the basic principles of computational method, IT, IOT in civil engineering.

CO8. Understand the application of civil engineering knowledge in industry, basics of professionalism

CE(HS)302	Introduction to Civil Engineering(1L+1T)	2 Credits
Module 1	Basic Understanding: What is Civil Engineering/ Infrastructure? Basics of Engineering and Civil Engineering; Broad disciplines of Civil Engineering; Importance of Civil Engineering, Possible scopes for a career Tutorials Develop a matrix of various disciplines and possibleroles for engineers in each	1 L
Module 2	History of Civil engineering: Early constructions and developments over time; Ancient monuments & Modern marvels; Development of various materials of construction and methods of construction; Works of Eminent civil engineers Tutorials Identify 10 ancient monuments and ten modern marvels and list the uniqueness of each	1 L
Module 3	Overview of National Planning for Construction and Infrastructure Development; Positionof construction industry vis-à-vis other industries, five year plan outlays for construction; currentbudgets for infrastructure works Tutorials Develop a Strategic Plan for Civil Engineering worksfor next ten years based on past investments andidentify one typical on-going mega project in eacharea	1 L
Module 4	Fundamentals of Architecture & Town Planning: Aesthetics in Civil Engineering, Examples of great architecture, fundamentals of architectural design & town planning; BuildingSystems (HVAC, Acoustics, Lighting, etc.); LEED ratings; Development of Smart cities Tutorials Identify ten best civil engineering projects with highaesthetic appeal with one possible factor for each; Listdown the possible systems required for a typical SmartCity	1 L
Module 5	Fundamentals of Building Materials: Stones, bricks, mortars, Plain, Reinforced &PrestressedConcrete, Construction Chemicals; Structural Steel, High Tensile Steel, Carbon Composites;Plastics in Construction; 3D printing; Recycling of Construction & Demolition wastes Tutorials Identify three top new materials and their potential inconstruction; Visit a Concrete Lab and make a report	2 L

Module 6	Basics of Construction Management & Contracts Management: Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management Tutorials Identify 5 typical construction methods and list theiradvantages/ positive features	2 L
Module 7	Environmental Engineering & Sustainability: Water treatment systems; Effluent treatment systems; Solid waste management; Sustainability in Construction Tutorials Sustainability principles, Sustainable builtenvironment, water treatment systems, and good practicesof wastewater management. examples of Solid andhazardous waste management, Air pollution andcontrol	2L
Module 8	Geotechnical Engineering: Basics of soil mechanics, rock mechanics and geology; various types of foundations; basics of rock mechanics & tunnelling Tutorials List top five tunnel projects in India and their features;collect and study geotechnical investigation report ofany one Metro Rail (underground) project; Visit aconstruction site and make a site visit report	2 L
Module 9	Hydraulics, Hydrology &Water Resources Engineering: Fundamentals of fluid flow, basics ofwater supply systems; Underground Structures; Underground Structures Multi-purpose reservoirprojects Tutorials Identify three river interlinking projects and theirfeatures; visit a Hydraulics Lab and make a report	1 L
Module 10	Ocean Engineering: Basics of Wave and Current Systems; Sediment transport systems; Ports &Harbours and other marine structures Tutorials Identify 5 typical ports in India and list the structuresavailable in them; Visit a related/similar facility, ifpossible in nearby place and make a report	1 L
Module 11	Power Plant Structures: Chimneys, Natural & Induced Draught Colling towers, coal handling systems, ash handling systems; nuclear containment structures; hydro power projects Tutorials Collect the typical layout for a large thermal powerplant and a large hydro power plant and identify all thestructures and systems falling in them.	1 L
Module 12	Structural Engineering: Types of buildings; tall structures; various types of bridges; Water retaining structures; Other structural systems; Experimental Stress Analysis; Wind tunnel studies; Tutorials Identify 5 unique features for typical buildings,bridges, tall structures and large span structures; VisitStructures Testing Lab/facility and make a report	3 L
Module 13	Surveying & Geomatics: Traditional surveying techniques, Total Stations, Development of Digital Terrain Models; GPS, LIDAR; Tutorials Collect visual representations prepared by a TotalStation and LIDAR and compare; Study typicalGoogle street map and Google Earth Map and studyhow each can facilitate the other	1 L
Module 14	Traffic &Transportation Engineering: Investments in transport infrastructure development inIndia for different modes of transport; Developments and challenges in integrated transport development in India: road, rail, port and harbour and airport sector; PPP in transport sector; Intelligent Transport Systems; Urban Public and Freight Transportation; Road Safety underheterogeneous traffic; Sustainable and resilient pavement materials, design, construction andmanagement; Case studies and examples. Tutorials Investments in transport infrastructure; Developmentsand challenges; Intelligent Transport Systems; SmartCities, Urban Transport; Road Safety; Sustainable andresilient highway design principles; Plan a sustainabletransport system for a city; Identify keyfeatures/components in the planning and design of agreen field highway/airport/port/railway and the cost –economics.	1 L
Module 15	Repairs & Rehabilitation of Structures: Basics of corrosion phenomena and other structural distress mechanisms; some simple systems of rehabilitation of structures; Non-Destructivetesting systems; Use of carbon fibre wrapping and carbon composites in repairs. Tutorials Collect the history of a major rehabilitation project andlist the interesting features	1 L
Module 16	Computational Methods, IT, IoT in Civil Engineering: Typical software used in Civil	2 L

	Engineering- Finite Element Method, Computational Fluid Dynamics; Computational Geotechnical Methods; highway design (MX), Building Information Modelling; Highlighting typical available software systems (SAP, STAAD, ABAQUS, MATLAB, ETAB, NASTRAN, NISA, MIKE 21, MODFLOW, REVIT, TEKLA, AUTOCAD,…GEOSTUDIO, EDUSHAKE, MSP, PRIMAVERA, ArcGIS, VisSIM, …) Tutorials Visit an AutoCad lab and prepare a report; Identify teninteresting software systems used in Civil Engg andtheir key features	
Module 17	Industrial lectures: Case studies of large civil engineering projects by industry professionals, covering comprehensive planning to commissioning; Tutorials For each case study list the interesting features	2 L
Module 18	Basics of Professionalism: Professional Ethics, Entrepreneurial possibilities in Civil Engineering, Possibilities for creative & innovative working, Technical writing Skills enhancement; Facilities Management; Quality & HSE Systems in Construction Tutorials List 5 cases of violation of professional ethics and listpreventive measures; Identify 5 interesting projectsand their positive features; Write 400 word reports on one ancient monument and a modern marvel of civilengineering	3 L

Mapping of Course outcomes with Program outcomes

Program outcomes → **Course outcome↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**1**											
CO 2	**2**						**1**				**2**	
CO 3	**2**	**1**					**2**					
CO 4	**2**	**1**					**1**					
CO 5	**2**	**1**	**1**									
CO 6	**2**											
CO 7	**2**	**1**			**1**							
CO 8	**1**							**3**			**2**	

1: Slightly 2: Moderately 3: Substantially

OmDayal Group of Institutions

Department of Civil Engineering

Subject Code: CE(BS)302	Category: Basic Science Course
Subject Name: Mathematics-III (Transform & Discrete Mathematics)	Semester: **III**
L-T-P: **2-0-0**	Credit:**2**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Transform Calculus 1:-** Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials; place Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.	6
2	**Transform Calculus-2:** Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and their applications.	6
3	**Sets, relations and functions**: Basic operations on sets, Cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses	4
4	**Propositional Logic**: Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory	4
5	**Partially ordered sets**:-Complete partial ordering, chain, lattice, complete, distributive, modular and complemented lattices .Boolean and pseudo Boolean lattices	4
6	**Algebraic Structures**: Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. Error correcting code. Algebraic structures with two binary operations- ring, integral domain, and field. Boolean algebra and Boolean ring (Definitions and simple examples only).	4
7	**Introduction to Counting** Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functions.	3
8	**Introduction to Graphs**: Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.	3

Course Outcomes:

On completion of the course students will be able to

1. Develop the skill of evaluating Laplace and inverse Laplace transform to solve ODEs and PDEs.
2. On completion of the course students will express a logic sentence in terms of predicates, quantifiers, and logical connectives.
3. Derive the solution for a given problem using deductive logic and prove the solution on based of a logical inference.
4. Classify its algebraic structure for a given a mathematical problem.
5. Develop the given problem as graph networks and solve with techniques of graph theory.

CO-PO AND MAPPING

Course Name ENERGY SCIENCE & ENGINEERING

Course Code CE(ES)302

Course Credit 2

Contact Hour 2L (Total: 36L)

Prerequisite : Basic Science Subjects

Course Objective

To familiarize with the all forms of renewable energy Resources.

The objectives of this course is understand need of these sources due to crisis of conventional sources and the familiarize with non conventional sources. To impart knowledge on the atmosphere and its present condition and, global warming. To learn the green buildings concepts applicable to alternate design. To learn sufficient knowledge on energy monitoring methods and optimal regulations. To Comprehend the techniques available for energy conservation in electrical utilities.

Course Outcome

On completion of the course students will be able to

CO1. To get a familiar knowledge in various forms of energy resources.

Explain renewable energy sources & systems.

CO 2. Apply engineering techniques to build solar, wind, tidal, geothermal, biofuel, fuel cell, Hydrogen and sterling engine.

CO 3. Analyze and evaluate the implication of renewable energy. Concepts in solving numerical problems pertaining to solar radiation geometry and wind energy systems.

CO 4. Technical aspects of Global Warming will make them understand the impact they have on climate.Will be familiar with climate responsive building design and basic concepts.

CO 5. Familiarized about the energy sources, energy acts, and energy auditing and energy management methods. Perform energy audit in an Industry

CE(ES)302	Energy Science & Engineering	1L + 1T =	2 Credits
Module 1	Introduction to Energy Science Scientific principles and historical interpretation to place energy use in the context of pressing societal, environmental and climate issues; Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment. Tutorials:Compile a World map showing Energy Reserves by source, Total Energyconsumption, Per capita energy consumption and Carbon Footprint		3L
Module 2	Energy Sources Overview of energy systems, sources, transformations, efficiency, andstorage. Fossil fuels (coal, oil, oil-bearing shale and sands, coal gasification) - past, present & future,Remedies & alternatives for fossil fuels - biomass, wind, solar, nuclear, wave, tidal and hydrogen;Sustainability and environmental trade-offs of different energy systems; possibilities for energy storage or regeneration (Ex. Pumped storage hydro power projects, superconductor-based energystorages, high efficiency batteries) Tutorials:Compile a Word Map showing Alternative Energy sourceusage; Compile a Process diagram for a Pumped Storageproject; Collect details of a typical North Sea oil platform. Compile a map of India showing exiting potential and utilizedpotential for hydro power. List the pros and cons for Thermal,hydro, nuclear and solar power projects.		4L
Module 3	Energy & Environment Energy efficiency and conservation; introduction to clean energy technologies and its importance in sustainable development; Carbon footprint, energy consumptionand sustainability; introduction to the economics of energy; How the economic system determinesproduction and consumption; linkages between economic and environmental outcomes; How futureenergy use can be influenced by economic, environmental, trade, and research policy Tutorials:Study the functioning of an Electro Static Precipitator in athermal power plant; study the uses of coarse and fine Fly Ashfrom thermal power plants. Compile the safety provisions indesign and construction of a reactor containment building		5L
Module 4	Civil Engineering Projects connected with the Energy Sources Coal miningtechnologies, Oil exploration offshore platforms, Underground and under-sea oil pipelines, solarchimney project, wave energy caissons, coastal installations for tidal power, wind mill towers; hydropower stations above-ground and underground along with associated dams, tunnels, penstocks, etc.;Nuclear reactor containment buildings and associated buildings, design and construction constraintsand testing procedures for reactor containment buildings; Spent Nuclear fuel storage and disposalsystems Tutorials:Compile a process diagram for a typical underground hydropower project; Collect details of a model solar chimneyproject; collect details of a wave energy project at Vizhiniam;Collect details of the Kalpasar (Tidal energy) project		10L
Module 5	Engineering for Energy conservation Concept of Green Building and GreenArchitecture; Green building concepts (Green building encompasses everything from the choice ofbuilding materials to where a building is located, how it is designed and operated); LEED ratings;Identification of energy related enterprises that represent the breath of the industry and prioritizingthese as candidates; Embodied energy analysis and use as a tool for measuring sustainability. EnergyAudit of Facilities and optimization of energy consumption. Tutorials:Draw a typical geometrical orientation of a house in your areato avoid sun's radiation in the bed room in the evening;Identify typical examples of Indian buildings having variousLEED ratings; List various building materials with theirembodied energy content. Do an Energy Audit of yourDepartmental Building in the college		8L

Mapping of Course outcomes with Program outcomes :

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	3	3	3			1	2	1	2	3	3	3
CO 2	3	3	2									
CO 3	3	2	1	2	1			1		2	3	2
CO 4	2	1	1	1	1	-	1	-	-	-	-	-
CO 5	1	1	3	3	3	2	3	3	2	3	3	2

1.Slightly 2.Moderately 3.Substantially

Computer-Aided Civil Engineering Drawing
Code: CE (ES) 392

Prerequisites: knowledge in Geometrical Drawing, Computer Operation and Basic Engineering Drawing

Course Outcomes: At the end of the course, the student will be able to:

CO1 – Operate standard Computer Aided Design software

CO2- Study and interpret civil engineering drawing

CO3- Gain knowledge on masonry brickwork

CO4- Prepare details drawing of building

CO5- Understand and prepare 3D modelling of buildings

CE(ES)392	Computer-aided Civil Engineering Drawing	1L + 2P	2 Credits
Module 1	INTRODUCTION Introduction to concept of drawings, Interpretation of typicaldrawings, Planning drawings to show information concisely and comprehensively; optimallayout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems,reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modifycommands, Layers, Text and Dimensioning, Blocks, Drawing presentation norms andstandards.		2 L
Module 2	SYMBOLS AND SIGN CONVENTIONS Materials, Architectural, Structural, Electricaland Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawingsymbols, welding symbols; dimensioning standards		2 L
Module 3	MASONRY BONDS English Bond and Flemish Bond – Corner wall and Cross walls -One brick wall and one and half brick wall		1 L
Module 4	BUILDING DRAWING Terms, Elements of planning building drawing, Methods ofmaking line drawing and detailed drawing. Site plan, floor plan, elevation and section drawingof small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standardfittings & fixtures, finishes. Use of Notes to improve clarity		5 L
Module 5	PICTORIAL VIEW Principles of isometrics and perspective drawing. Perspective viewof building. Fundamentals of Building Information Modelling (BIM)		2 L
Drawings			
1	Buildings with load bearing walls including details of doors and windows.		6P
2	Taking standard drawings of a typical two storeyed building including all MEP,joinery, rebars, finishing and other details and writing out a description of theFacility in about 500-700 words		4P
3	RCC framed structures		6P
4	Reinforcement drawings for typical slabs, beams, columns and spread footings		6P
5	Industrial buildings - North light roof structures – Trusses		4P
6	Perspective view of one and two storey buildings		4P

Mapping of Course outcomes with Program outcomes

Program outcomes → **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**2**	**1**	**1**		**1**							
CO 2	**2**	**1**	**2**	**1**	**1**							
CO 3	**1**	**1**										
CO 4	**2**	**1**	**2**		**1**				**1**			
CO 5	**1**	**1**	**2**		**1**							

1: Slightly 2: Moderately 3: Substantially

Sub: Soil Mechanics I
Code: CE (PC)401
Contact: 2L+1T (Total: 41)
Credits: 3

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. Classify soil as per grain-size distribution curve and understand the index properties of soil.

CO 2. Apply the concept of total stress, effective stress and pore water pressure for solving geotechnical problems.

CO 3. Assess the permeability of different types of soil and solve flow problems.

CO 4. Estimate the seepage loss, factor of safety against piping failure using flownet related to any hydraulic structure.

CO 5. Determine vertical stress on a horizontal plane within a soil mass subjected to different types of loading on the ground surface and also the maximum stressed zone or isobar below a loaded area.

CO 6. Apply the concept of shear strength to analyse different geotechnical problems and determine shear strength parameters from lab and field tests.

CE(PC)401	Soil Mechanics – I	2L + 1T	3 Credits
Prerequisite	Engineering Mechanics		
Module 1	PHYSICAL PROPERTIES OF SOILS: Soil Formation Introduction, Origin of Soil, Formation and Types of soil, Formative classification, Typical Indian Soil, Some Special Types of Soils, Structure and Composition, Clay Mineralogy. Soil as a Three Phase System Basic Definitions, Weight - Volume Relationship, Measurement of Physical Properties of Soil: Insitu Density, Moisture Content, Specific Gravity, Relative density, Functional Relationships. Index Properties of Soil Introduction, Particle Size Distribution, Mechanical Analysis - Sieve Analysis, Sedimentation Analysis – Hydrometer and Pipette Methods. Consistency of Soil – Atterberg Limits, Different Indices, Discussion on Limits and Indices. Classification of Soil Classification by Structure, Particle Size Classification, Textural System, PRA System (AASHTO Classification), Unified Classification System, As per IS Code Recommendation, Field Identification of Soil, Classification by Casagrande's Plasticity Chart.		10L + 5T
Module 2	Soil Hydraulics Modes of Occurrence of Water in Soil – Free Water, Held Water, Structural Water, Capillary Water, Gravitational Water, Adsorbed Water, Pore Water, Pore Water Pressure, Effective Pressure, Total Pressure, Effective Pressure under Different Conditions and in Different Cases of Flow through Soils, Critical Hydraulic Gradient, Quick Sand Condition.		3L + 1T
Module 3:	Permeability Introduction, Darcy's Law, Coefficient of Permeability, Discharge Velocity, Seepage Velocity, Factors Affecting Permeability. Determination of Coefficient of Permeability – Constant Head and Falling Head Methods, Permeability of Stratified Soil Deposits, Field Determination of Permeability – Unconfined and Confined Aquifers.		3L + 1T
Module 4:	Seepage Analysis Introduction, Seepage, Seepage Pressure, Two Dimensional Flow, Laplace's Equations, Continuity equation, Flow Nets, Flow through Earthen Dam, Estimation of Seepage, Construction, Properties and Use of Flow Nets, Piping and Heaving, Uplift due to Seepage, Design of Fillers.		3L + 1T

Module 5:	STRESS DISTRIBUTION IN SOILS Introduction, Geostatic Stress, Boussinesq's Equation, Determination of Stress due to Point Load, Vertical Stress Distribution on a Horizontal Plane, Isobar and Pressure Bulb, Vertical Stress Distribution on a Vertical Plane, Vertical Stress under Uniformly Loaded Circular Area, Vertical Stress Beneath a Corner of a Rectangular Area, Equivalent Point Load Method, 2:1 Method, Newmark's Influence Chart, Vertical Stress Beneath Line and Strip Loads. Westergaard Analysis, Comparison of Boussinesq and Westergaard Theories, Contact Pressure	4L + 2T
Module 6	SHEARING STRENGTH OF SOILS Shear Strength of Soil Introduction, Basic Concept of Shear Resistance and Shear Strength of Soil, Mohr Circle of Stress, Sign Conventions, Mohr - Coulomb Theory, Relationship between Principal Stresses and Cohesion. Determination of Shear Parameters of Soil Stress Controlled and Strain Controlled Tests, Laboratory Determination of Soil Shear Parameters- Direct Shear Test, Triaxial Test, Classification of Shear Tests Based on Drainage Conditions, Unconfined Compression Test, Vane Shear Test as per Relevant IS Codes. Stress- Strain Relationship of Clays and Sands, Concept of Critical Void Ratio. Skempton's Pore Pressure Parameters, Sensitivity and Thixotropy of clay, Concept of Stress	5L + 3T

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2										
CO 2	3	2										
CO 3	3	2	1									
CO 4	3	2	1									
CO 5	3	2	2									
CO 6	3	2	1									

1: Slightly 2: Moderately 3: Substantially

Sub: <u>Introduction to solid mechanics</u>
Code: CE (ES)402
Contact: 2L+0T (Total: 30)
Credits: 2

<u>Pre-requisites:</u> Engineering Mechanics [CE (ES) 301], Basic Calculus

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. To identify the equilibrium conditions and elastic properties of axially loaded bars through stress-strain and force displacement curve.

CO 2. To identify the principal stress and principal plain through Mohr circle.

CO 3. TO calculate the hoop and meridi0nal stresses in thin cylinders and spherical shells.

CO 4. TO identify different degrees of freedoms for support conditions like hinge, roller and fixed constraints.

CO 5. To calculate bending moment, shear force and deflection of beams for uniformly distributed, concentrated, linearly varying and external concentrated moment.

CO6. To calculate the member forces in a plane truss using method of joint and method of sections.

CO7. To identify torsional moment and twist on a circular shaft and calculate the shear stress.

CO8. To know the concept of strain energy due to axial load, bending and shear.

CO9: TO know the buckling load of columns using Euler's theory for different support constraints.

CE(ES)402	Introduction to Solid Mechanics	2L + 0T	2 Credits
Prerequisite	Engineering Mechanics (CE(ES)301), Basic Calculus		
Module 1	Review of Basic Concepts of Stress and Strain: Normal stress, Shear stress, Bearing stress, Normal strain, Shearing strain; Hooke's law; Poisson's ratio; Stress-strain diagram of ductile and brittle materials; Elastic limit; Ultimate stress; Yielding; Modulus of elasticity; Factor of safety, Beam Statics: Support reactions, concepts of redundancy, axial force, shear force and bending moment diagrams for concentrated, uniformly distributed, linearly varying load, concentrated moments in simply supported beams, cantilever and overhanging beams		6L
Module 2	Symmetric Beam Bending: Basic kinematic assumption, moment of inertia, elastic flexure formulae and its application, Bending and shear stress for regular sections, shear centre		3L
Module 3:	Deflection of statically determinate beams: Fundamental concepts: Elastic curve, moment Curvature relationship, governing differential equation, boundary conditions: Direct integration solution		4L
Module 4:	Analysis of determinate plane trusses: Concepts of redundancy, Analysis by method of joints, method of sections		4L
Module 5:	Two Dimensional Stress Problems: Principal stresses, maximum shear stresses, Mohr's circle of stresses, construction of Mohr's circle		3L
Module 6	Introduction to thin cylindrical & spherical shells: Hoop stress and meridional - stress and volumetric changes		3L
Module 7	Torsion: Pure torsion, torsion of circular solid shaft and hollow shafts, torsional equation, torsional rigidity, closed coil helical: springs		4L
Module 8	Columns: Fundamentals, criteria for stability in equilibrium, column buckling theory, Euler's load for columns with different end conditions, limitations of Euler's theory – problems, eccentric load and secant formulae.		3L

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2										
CO 2	3	2										
CO 3	3	2										
CO 4	3	3										
CO 5	3	3										
CO 6	3	3										
CO7	3	3										
CO8	3	2										
CO9	3	2										

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

Environmental Engineering-I
Code – CE(PC) 402
Contact – 2L + 1T
Credits- 3
Prerequisites: Chemistry and Engineering Hydrology.

Course Outcomes: At the end of the course, the student will be able to:
CO1- Define the basic concepts and terminologies of water supply engineering and solid waste
CO2- Describe and differentiate the surface and groundwater sources; and composition and characteristics of municipal solid waste.
CO3- Apply the methods of quantifying water requirement and MSW generation.
CO4- Solve different mathematical problem regarding different components of water supply system
CO5- Compare between different water samples based on their physical, chemical and biological characteristics.
CO6 design different unit processes and operations involved in water treatment and MSW management.

Syllabus:

Module 1	Water Requirement Estimation Water Demand: Different types of water demand; Per capita demand; Variations in demand; Factors affecting water demand Future Demand Forecasting: Design period; Population forecasting methods
Module 2	Sources of Water Surface Water Sources; Ground Water Sources
Module 3:	Water Quality Water Quality Characteristics: Physical, Chemical, and Biological parameters Drinking Water Standards: BIS; WHO; USEPA Water Quality Indices: Basic concept and examples
Module 4:	Water Treatment Typical flow chart for surface and groundwater treatments Unit Operation and Processes: Aeration, Plain Sedimentation, Sedimentation with Coagulation and Flocculation, Water Softening, Filtration, Disinfection
Module 5:	Water Conveyance and Distribution Hydraulic design of pressure pipes; Analysis of distribution network; Storage and distribution reservoirs; Capacity of reservoirs.
Module 6	Characteristics of Municipal Solid Waste (MSW) Composition and characteristics of MSW
Module 7	Handling of MSW Generation, collection and transportation of MSW
Module 8	Engineered Systems for MSW Management Methods of reuse/ recycle, energy recovery, treatment and disposal of MSW

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1			2	3								
CO 2	3	3	3				2					
CO 3	2	2				3	2					
CO 4	3	2		3	2		2	1				
CO 5	2		2	3				2				
CO 6			3	2							1	

1: Slightly 2: Moderately 3: Substantially

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **CE(ES)401**	Category: **Engineering Science Courses**
Subject Name: **Introduction to Fluid Mechanics**	Semester: **IV**
L-T-P: **2-0-0**	Credit:**2**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Properties of fluids:** Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension	3
2	**Fluid statics:** Pressure at a point, basic equation for pressure field, pressure variation in a fluid at rest- incompressible fluid, compressible fluid, absolute pressure, gauge pressure; pressure measurements by manometers – general, inclined, inverted, micro-manometer; pressure and forces on submerged planes and curved surfaces, centre of pressure, buoyancy and floatation, Stability of submerged and floating bodies, metacentric height.	4
3	**Fluid Kinematics:** The velocity field, Eulerian and Lagrangian flow descriptions, concepts of: - one-, two- and three-dimensional flows, steady and unsteady flows, streamlines, streaklines, pathlines; The acceleration field; Control volume and system representation, Continuity Equation, Momentum Equation, Moment-ofmomentum equation, applications to pipe bends.	6
4	**Fluid Dynamics:** Application of Newton's Law along a streamline, Bernoulli Equation, Kinetic energy head, potential energy head and pressure energy head, total energy head, Pitot tube, Examples of use of Bernoulli Equation, measurement of flows - venturimeter, energy line and hydraulic grade line.	7
5	**Dimensional Analysis:** Buckingham Pi Theorem, determination of Pi terms, correlation of experimental data, examples.	3
6	**Flow through Pipes:** Laminar flow, Reynolds number, critical velocity, turbulent flow, shear stress at pipe wall, velocity distribution, loss of head for laminar flow, Darcy-Weisbach Formula, friction factor, contraction and expansion head losses. Concept of boundary layer and its growth.	7
7	**Pipeline Systems:** Pipes in series, pipes in parallel, equivalent pipes, branching pipes, pipe networks.	7
8	**Hydraulic Machines:** Basics of hydraulic machines, specific speed	3

	of pumps and turbines.	

Course Outcomes:

On successful completion of this course, student should be able to:

1. Define basic terms, values and laws in the areas of fluids properties, statics, kinematics and dynamics of fluids, and hydraulic design of pipe systems;
2. Describe methods of implementing fluid mechanics laws and phenomena while analyzing the operational parameters of hydraulic problems;
3. Practically apply tables and diagrams, and equations that define the associated laws;
4. Calculate and optimize operational parameters of hydraulic problems;
5. Explain the correlation between different operational parameters.

CO-PO AND MAPPING

CONCRETE TECHNOLOGY
Code: CE(PC)404
Contact: 2L (Total: 40L) +1T
Credits: 3

Prerequisites : Introduction to Civil Engineering CE(HS)302, Chemistry BS-CH101.

COURSE OUTCOMES:

At the end of the course, students would be able to -----

CO1. To test all the required properties of concrete materials as per IS code to ensure quality control while testing/ sampling . Identify the materials used to make concrete; including their sources, production and properties

CO2. To compute the properties of concrete at fresh and hardened state. Describe and carry out tests relevant to the use of fresh and hardened concrete

CO3. To design concrete mix with and without admixtures as per latest IS code methods.

CO4. Design the special type of concrete for specific application purposes. Classify the different types of concrete based on their applications

CO5. To identify the various concreting methods to place the concrete on site

CO6- Perform various NDT on concrete structures and to study crack repair and rehabilitation of concrete structures.

Module 1	**Cement: Manufacturing of cement, Oxides composition of cement and the calculation of compounds, Heat of hydration, Types of cement- OPC, RPC. Lowheat cement, PPC, PSC, Sulphate resisting cement, High Alumina cement,Expansive cement, White cement; Test on cement- fineness, consistency, initial setting time & final setting time, soundness test, strength test, specific gravity of cement, storage of cement.**	**5L + 3T**
Module 2	**Aggregates: Classification, Grading, alkali-aggregate reaction, deleterious substances in aggregates, physical properties, testing of aggregates- fineness modulus, bulking, specific gravity, sieve analysis, flakiness & elongation index.Quality of Water for mixing and curing - use of sea water for mixing concrete.**	**3L + 1T**
Module 3:	**Properties of fresh concrete: Workability, factors affecting workability, segregation and bleeding, tests on workability- slump test, compacting factor test, vee-bee test, flow table test.**	**3L + 1T**
Module 4:	**Properties of Hardened concrete: Tensile & compressive strength, flexural strength, stress strain characteristics, modulus of elasticity, poisson's ratio,Creep, shrinkage, permeability of concrete, micro cracking of concrete.**	**3L + 1T**
Module 5:	**Strength of concrete: curing methods, water-cement ratio. gel-space ratio,maturity of concrete,**	**3L + 1T**
Module 6	**Admixtures: types, uses, superplasticizers, plasticizers, Bonding admixtures.**	**2L + 1T**
Module 7	**Mix Design – Objective, factors influencing mix proportion - Mix design by I.S.10262-2019. (with & without admixture)**	**3L + 1T**

Module 8	**Non-destructive test: Rebound hammer and Ultra-sonic pulse velocity testing methods. Quality control - Sampling and testing, Acceptance criteria.**	**3L + 1T**
Module 9	**Special Concrete – Ferrocement - Fibre reinforced concrete - Polymer c oncrete Special Concrete – Ferrocement - Fibre reinforced concrete -**	**4L + 1T**

Mapping of Course outcomes with Program outcomes

Program outcomes → / **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1					**2**	**2**	**1**					
CO 2	**2**	**2**	**1**	**2**	**2**							
CO 3	**2**	**2**	**2**	**1**			**2**					**2**
CO 4			**2**			**2**						**2**
CO 5	**2**		**2**		**2**				**2**		**2**	
CO 6	**3**	**3**			**3**	**2**	**2**					

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

Course Name **CIVIL ENGINEERING – SOCIETAL & GLOBAL IMPACT**

Course Code CE(HS)401

Course Credit 2

Contact Hour 2L+1T (Total: 30L)

Prerequisite : Introduction to Civil Engineering and Energy science & Engineering. SKILLS:

Aware of the importance of Civil Engineering and impact on the society. Aware of the impact of Civil Engineering for various fields of human endeavour. Innovative thinking to ensure sustainability

Course Objective:

The course is designed to provide a better understanding of the impact which Civil Engineering has on the Society at large and on the global arena. Civil Engineering projects have an impact on the Infrastructure, Energy consumption and generation, Sustainability of the Environment, Aesthetics of the environment, Employment creation, Contribution to the GDP, and on a more perceptible level, the Quality of Life. It is important for the civil engineers to realise the impact which this field has and take appropriate precautions to ensure that the impact is not adverse but beneficial. The objectives of this course is understand need of these sources due to crisis of conventional sources and the familiarize with non- conventional sources

COURSE OUTCOMES (CO) :

At the end of the course, students would be able to -----

CO1. The impact which Civil Engineering projects have on the Society at large and on the global arena and using resources efficiently and effectively Outline the role of Civil engineering in evolution and revolution of mankind and globally present status of development in India.

CO2 Estimate the level of resource utilization for present and future infrastructural projects using various tools/methods.

CO3. The extent of Infrastructure, its requirements for energy and how they are met: past, present

and future. Infer the necessity of different conventional as well as futuristic infrastructural projects.

CO4. The Sustainability of the Environment, including its Aesthetics. Incorporate the goal of sustainable development to minimize the potential impacts on the global environment.

CO5. The Built Environment and factors impacting the Quality of Life. Associate various measures for enhancing the build environment, thereby improving quality of life of the occupants.

CO6. The potentials of Civil Engineering for Employment creation and its Contribution to the GDP. Evaluate the potential of Civil Engineering for employment creation and its contribution to the GDP.

Module 1	Introduction to Course and Overview; Understanding the past to look into the future: Preindustrial revolution days, Agricultural revolution, first and second industrial revolutions, IT revolution; Recent major Civil Engineering breakthroughs and innovations; Present day world and future projections, Ecosystems in Society and in Nature; the steady erosion in Sustainability; Global warming, its impact and possible causes; Evaluating future requirements for various resources; GIS and applications for monitoring systems; Human Development Index and Ecological Footprint of India Vs other countries and analysis;	3L
Module 2	Understanding the importance of Civil Engineering in shaping and impacting the world; The ancient and modern Marvels and Wonders in the field of Civil Engineering; Future Vision for Civil Engineering	3L

Module 3:	Infrastructure - Habitats, Megacities, Smart Cities, futuristic visions; Transportation (Roads, Railways & Metros, Airports, Seaports, River ways, Sea canals, Tunnels (below ground,under water); Futuristic systems (ex, Hyper Loop)); Energy generation (Hydro, Solar (Photovoltaic, Solar Chimney), Wind, Wave, Tidal, Geothermal, Thermal energy); Water pr ovisioning; Telecommunication needs (towers, above-ground and underground cabling); Awareness of various Codes & Standards governing Infrastructure de velopment; Innovations and methodologies for ensuring Sustainability;	8L
Module 4:	Environment- Traditional & futuristic methods; Solid waste management, Water purification, Wastewater treatment & Recycling, Hazardous w aste treatment; Flood control (Dams, Canals, River interlinking), Multi-purpose water projects, Atmospheric pollution; Global warming phenomena a nd Pollution Mitigation measures, Stationarity and non-stationarity; Environmental Metrics & Monitoring; Other Sustainability measures; Innovations and metho dologies	7L
Module 5:	Built environment– Facilities management, Climate control; Energy efficient built environments and LEED ratings, Recycling, Temperature/ Sound	5L

Module 6	Civil Engineering Projects – Environmental Impact Analysis procedures; Waste (materials, manpower, equipment) avoidance/ Efficiency increase; Advanced construction techniques for better sustainability; Techniques for reduction of Green House Gas emissions in various aspects of Civil Engineering Projects; New Project Management paradigms & Systems (Ex. Lean Construction), contribution of Civil Engineering to GDP, Contribution to employment(projects, facilities management), Quality of products, Health & Safety aspects for stakeholders; Innovations and methodologies for ensuring Sustainability during Project development	4L

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1					2	1	1				1	
CO 2						1	1				1	
CO 3					2	1	1				1	
CO 4					2	1	1				1	
CO 5						1	1				1	

CO 6					**1**	**1**	**1**				**1**	

1: Slightly 2: Moderately 3: Substantially

ENGINEERING GEOLOGY LABORATORY

Code: CE (ES) 493
Contact: 2P
Credits: 1

Prerequisites: Basic Sciences (Physics, Chemistry, Mathematics), Physical Geography and Introductions to Civil Engineering CE(HS)302.

Course Outcomes: At the end of the course, the student will be able to:

CO1	**Define and state the role of engineering geology in civil engineering**
CO2	**Understand origin of rocks and geologic structures**
CO3	**Apply different tools to identify rocks and minerals in hand specimen and under microscope**
CO4	**Analyse the geological structures through drawing the cross sections from the geological maps**
CO5	**Evaluate the results obtained from different geological experiments**
CO6	**Investigate the natural hazards/disasters that are caused by the geological reasons**

CE(ES)493	**Engineering Geology Laboratory**	**2P**	**1 Credits**
Course Outcome	**Upon completion of the course, the students will be able to:** 1. Define and state the role of engineering geology in civil engineering 2. Understand origin of rocks and geologic structures 3. Apply different tools to identify rocks and minerals in hand specimen and under microscope 4. Analyze the geological structures through drawing the cross sections from the geological maps 5. Evaluate the results obtained from different geological experiments 6. Investigate the natural hazards/disasters that are caused by the geological reasons		
Prerequisite	Knowledge of basic physics and chemistry		
Experiment 1	Identification of minerals in hand specimen		
Experiment 2	Identification of igneous rocks in hand specimen		
Experiment 3	Identification of sedimentary rocks in hand specimen		
Experiment 4	Identification of metamorphic rocks in hand specimen		
Experiment 5	Study of crystals with the help of crystal models		
Experiment 6	Study of geologic structures with the help of models		
Experiment 7	Interpretation of geological maps: horizontal, vertical, uniclinal, folded and faulted structures		
Experiment 8	Microscopic study of rocks and minerals		

Mapping of course outcomes with program outcomes:

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1				2	2	1	2			2
CO2	3	3	2	2	3	2	3	2	3	1		3
CO3	3	3	3	1	3	2	3	2	3	2		3
CO4	1	2	2	2	2	1	2	2	3	2		3
CO5	3	3	3	3	2			2	2			2
CO6	3	2		1		3	3	1		1		3

1: Slightly 2: Moderately 3: Substantiall

SURVEYING & GEOMATICS LABORATORY

Code: CE(PC) 493

Contact: 2P

Credits: 1

Prerequisites: Basic Sciences (Physics, Mathematics), Surveying & Geomatics [CE(PC)403].

Course Outcomes: At the end of the course, the student will be able to:

CO1: State the interdependency and advancement of different surveying methods

CO2: Comprehend the working principles of different surveying and geomatics instruments and experiments

CO3: Execute the different methods of surveying and geomatics to measure the features of interest

CO4: Examine the results obtained from the surveying and geomatics experiments

CO5: Critically appraise the different techniques of surveying and geomatics in measuring and assessing the features of interest

CO6: Design and construct solutions for real world problems related to surveying and geomatics.

CE(PC)493	Surveying & Geomatics Laboratory	2P	1 Credits
Course Outcome	**Upon completion of the course, the students will be able to:** 1. State the interdependency and advancement of different surveying methods 2. Comprehend the working principles of different surveying and geomatics instruments and experiments 3. Execute the different methods of surveying and geomatics to measure the features of interest 4. Examine the results obtained from the surveying and geomatics experiments 5. Critically appraise the different techniques of surveying and geomatics in measuring and assessing the features of interest 6. Design and construct solutions for real world problems related to surveying and geomatics.		
Prerequisite	Surveying & Geomatics [CE(PC)403]		
Experiment 1	Traverse survey by Prismatic Compass: Procedure; Computation and checks on closed traverse; Preparation of field book; Plotting the traverse; Sources of errors.		
Experiment 2	Theodolite Survey: Closed traverse by transit theodolite, Preparation of field book		
Experiment 3	Differential Levelling using Dumpy level: Collimation and Rise and Fall methods, Field book preparation		
Experiment 4	Total Station Survey: Traversing and Levelling		
Experiment 5	Visual Image Interpretation		
Experiment 6	Satellite Image Pre-processing		
Experiment 7	Digital Image Classification and Accuracy Assessment		
Experiment 8	Stereoscopic fusion of aerial photographs using mirror stereoscope		

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2				2	2		2	3	1		3
CO 2	3	3	3	3	3	1		2	3	3		3
CO 3	2	3	3	2	3	2		2	3	3		3
CO 4	2	3	3	3				2				1
CO 5	3	1			3					3		3
CO 6	3	3	3	2	3	3	1	2	3	3		3

1: Slightly 2: Moderately 3: Substantially

Sub: Concrete Technology Laboratory
Code: CE (PC) 494
Contact: 2P
Credits: 1

Pre-requisites: Concrete technology [CE (PC) 404]

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. Demonstrate the method and findings of tension and compression tests on concrete.

CO 2. Understand the concept of different tests on hardened concrete.

CO 3. Find out mix proportion of high grade of concrete.

CO 4. Measure the workability of concrete mix.

CO 5. Understand the different properties of cement.

CE(PC)494	Concrete Technology Laboratory	2P	1 Credits
Prerequisite	Concrete Technology CE(PC)404		
Test on Fine aggregates	Bulking, Specific gravity, Bulk Density, Percentage voids, Fineness Modulus. Grading curve.		
Test on Coarse aggregates	Specific gravity, Bulk Density, Percentage voids, Fineness Modulus. Grading curve.		
Test on Cement	Normal consistency, fineness, Initial setting and final setting time of cement. Specific gravity, soundness and Compressive strength of Cement.		
Test on Fresh Concrete	Concrete mix design, Various workability tests – slump, compacting factor, vee-bee test.		
Test on Hardened Concrete	Spilt-tensile strength test, Flexure test, NDT Tests (Rebound hammer and Ultra-sonic pulse velocity), Poission ratio.		

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3			1	1							
CO 2	3	2		1	1							
CO 3	3	2		1	1							
CO 4	3	2		1	1							
CO 5	3	2		1	1							

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

DESIGN OF RC STRUCTURES
Code: CE(PC) 502
Contact: 2L + 1T
Credits: 3
Prerequisites: Introduction to Solid Mechanics, Concrete Technology and Mechanics of Materials.

Course Outcomes: At the end of the course, the student will be able to:

CO1 Understand material properties and design methodologies for reinforced concrete structures

CO2 Assess different type of loads and prepare layout for reinforced concrete structures.

CO3 Identify and apply the applicable industrial design codes relevant to the design of reinforced concrete members

CO4 Analyse and design of various structural elements of reinforced concrete building like beam, slab, column, footing and staircase.

CO5 Assessment of serviceability criteria for reinforced concrete beam and slab

CO6 Prepare structural drawing and detailing and produce design calculations and drawing in appropriate professional format

Syllabus:

Module 1:	Introduction: Principles of design of reinforced concrete members - Working stress and Limit State method of design.
Module 2:	Working stress method of design: Basic concepts and IS code provisions (IS: 456 2000)for design against bending moment and shear forces - Balanced, under reinforced and overreinforced beam/ slab sections; design of singly and doubly reinforced sections.
Module 3:	Limit state method of design: Basic concepts and IS code provisions (IS: 456 2000) for design against bending moment and shear forces; concepts of bond stress and development length; Use of 'design aids for reinforced concrete' (SP:16).
Module 4:	Beam Design by LSM: Analysis, design and detailing of singly reinforced rectangular, 'T', 'L' and doubly reinforced beam sections by limit state method.
Module 5:	Slab Design by LSM : Design and detailing of one-way and two-way slab panels as per IS code provisions.
Module 6:	Continuous slab and beam design by LSM: Design and detailing of continuous beams and slabs as per IS code provisions.
Module 7:	Design of Staircases by LSM: Types; Design and detailing of reinforced concrete doglegged staircase.
Module 8	Design of Columns by LSM: Design and detailing of reinforced concrete short columns of rectangular and circular crosssections under axial load. Design of short columns subjected to axial load with moments (uniaxial and biaxial bending) – using SP 16.
Module 9	Design of Foundation by LSM: Design and detailing of reinforced concrete isolated square and rectangular isolated and combined footing for columns as per IS code provisions by limit state method Design and detailing of Pile foundation as per IS code provisions.

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	**3**	**1**	**2**	**3**				**1**				
CO 2	**3**	**1**	**2**	**3**				**1**				
CO 3	**3**	**1**	**3**	**3**				**1**				
CO 4	**3**	**1**	**3**	**3**				**1**				
CO 5	**3**	**1**	**3**	**3**				**1**				
CO 6	**3**	**1**	**3**	**3**				**1**				

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

ENGINEERING HYDROLOGY
Code: CE(PC)502
Contact: 3L + (Total: 40L)
Credits: 3

Prerequisites : Introduction to Civil Engineering CE(HS)302, CE(ES)401_Fluid Mechanics, Chemistry BS-CH101,Physics BS-PH101

COURSE OUTCOME:

At the end of the course, students would be able to -----

CO1: To study the source, occurrence, movement and distribution of water which is a prime resource for development of a nation. Demonstrated understanding of physical processes in the context of flood hydrology, including the hydrological cycle in general, and rainfall, loss and groundwater transport mechanisms in particular.

CO2: To learn about the functioning of reservoirs and estimation of storage capacities. Demonstrated understanding of the methods that can be used to measure rainfall and flow, as well as their relative advantages and disadvantages.

CO3: Demonstrated ability to obtain design rainfall intensities and hyetographs.

CO4: Demonstrated ability to select appropriate methods of determining design flows and

hydrographs in urban and rural areas.

CO5: To learn about flood hazards, estimation of design floods for various structures and methods of estimating effects of passage of floods through rivers and reservoirs. Demonstrated ability to solve engineering design problems in the context of flood hydrology and hydrogeology.

CO6- To know the basic principles of measurement of flow in rivers Derive hydrographs and predict yield of catchment.

Module 1	**Hydrology: Hydrologic Cycle, Global Water Budget, India's Water Budget.**	**1L**
Module 2	**Catchment: Definition & Descriptions, Various Types of Catchment, Factors**	**2L**
Module 3:	**Measurement of Precipitation: Precipitation, Description and Functioning of Various Types of Rain gauges, Rain gauge Network- Codal Provisions, Optimu**	**2L**
Module 4:	**Processing of Rainfall Data: Normal Rainfall, Estimation of Missing Rainfall Data, Test for Consistency of Record; Mass Curve of Rainfall, Hyetograph, Poin**	**4L**
Module 5:	**Losses from Precipitation: Evaporation – Evaporation Process, Factors affecting Evaporation, Measurement of Evaporation– Description and Functioning of Pan Evaporimeter, Pan Coefficient, Evapotranspiration: AET, PET, Measurement of**	**6L**
Module 6	**Streamflow Measurement: Importance, Direct and Indirect Metho ds, Measurement of Stage– Various Gauges and Recorders, Measurement of Velocity– Current Meters, their Functioning and Calibration; Velocity**	**12L**
Module 7	**Runoff: Description of the Process, Components of Runoff, Factors Affecting Runoff, Characteristics of Streams, Rainfall Runoff Relationships**	**2L**
Module 8	**Unit Hydrograph– Definition, Assumptions, Applications– Derivation of Unit Hydrograph, Distribution Graph, Unit Hydrograph of Different Durations–**	**4L**
Module 9	**Floods: Concept of flood as a natural hazard; Estimation of flood discharge in a river – rational method, empirical formulae, unit hydrograph method; flood**	**2L**
Module 10	**Flood Routing: Concept of flood routing in channels and through a reservoir, basic routing equations; reservoir routing – Modified Pul's method; channel**	**5L**

Mapping of Course outcomes with Program outcomes

Program outcomes → / **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1					**2**	**1**	**1**				**1**	
CO 2						**1**	**1**				**1**	
CO 3					**2**	**1**	**1**				**1**	
CO 4					**2**	**1**	**1**				**1**	
CO 5						**1**	**1**				**1**	
CO 6					**1**	**1**	**1**				**1**	

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

STRUCTURAL ANALYSIS 1

Code: CE(PC) 503
Contact: 2L + 1 T(Total: 36Hrs)
Credits: 3
Prerequisites: Introduction to Solid Mechanics, Mechanics of Materials, Engineering Mechanics, Strength of Materials

Course Outcomes: At the end of the course, the student will be able to:

CO1 Distinguish between stable and unstable and statically determinate and indeterminate

CO2 Apply equations of equilibrium to structures and compute the reactions

CO3 Calculate the internal forces in cable and arch type structures

CO4 Evaluate and draw the influence lines for reactions, shears and bending moments in beams due to moving load

CO5: use of approximate method for analysis of statically indeterminate structure.

CO6: Calculate the deflections of truss structures and beams.

Syllabus:

Module 1	Basics of Structural Analysis: Concept of static and kinematic indeterminacy, Determination of degree of indeterminacy for different types of structures. Theorem of minimum potential energy, law of conservation energy, principle of virtual work, the first and second theorems of Castigilano, Betti's law, Clark Maxwell's theorem of reciprocal deflection
Module 2	Analysis of Determinate Structures: Portal Frames, Three hinged arches, Cables
Module 3	Deflection of Determinate Structures: Energy methods. Unit Load method for beams. Deflection of trusses and Simple Portal Frames.
Module 4	Influence Line Diagram: Statically determinate beams and trusses under series of concentrated and uniformly distributed rolling loads, criteria for maximum and absolute maximum moments and shear.
Module 5	Analysis of Statically Indeterminate Beams: Theorem of three moments, Energy methods, Force method (Method of consistent deformation) [For analysis of propped cantilever, fixed beams and continuous beams (maximum two degree of indeterminacy) for simple loading case], Analysis of two hinged arch.
Module 6	Influence Line Diagram for Indeterminate Structures: Muller – Breslau principle.

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3			3				1				
CO 2	3			3				1				
CO 3	3			3				1				
CO 4	3			3				1				
CO 5	3		2	3								
CO 6	3		2	3								
CO 7	3		2	3								

1: Slightly 2: Moderately 3: Substantially

Sub: Soil Mechanics II
Code: CE(PC)504
Contact: 2L+1T (Total: 41)
Credits: 3

Pre-requisites: Soil Mechanics I [CE(PC)401]

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. Assess the compaction and consolidation characteristics of soil for solving geotechnical problems.

CO 2. Calculate earth pressure on rigid retaining walls (cantilever type) from geotechnical engineering consideration.

CO 3. Evaluate the bearing capacity of shallow foundation by applying established theory.

CO 4. Estimate settlement in soils by different methods.

CO 5. Compute safety of dams and embankments on the basis of various methods of slope stability analysis.

CE(PC)504	Soil Mechanics – II	2L + 1T	3 Credits
Course Outcome	After going through this course, the students will be able to: 1. Assess the compaction and consolidation characteristics of soil for solving geotechnical problems. 2. Calculate earth pressure on rigid retaining walls on the basis of classical earth pressure theories. 3. Analyze and design rigid retaining walls (cantilever types) from geotechnical engineering consideration. 4. Evaluate the bearing capacity of shallow foundation by applying established theory. 5. Estimate settlement in soils by different methods. 6. Compute safety of dams and embankments on the basis of various methods of slope stability analysis.		
Prerequisite	Soil Mechanics – I (CE(PC)401)		
Module 1	Consolidation of Soil Terzaghi's theory of one dimensional consolidation, Compressibility characteristics of soils, Compression index, Coefficient of compressibility and volume change, Coefficient of consolidation, Degree and rate of consolidation, Time factor, Settlement computation, Consolidometer and laboratory one dimensional consolidation test as per latest IS Code, Determination of consolidation parameters.		5L+3T

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2	2								
CO 2	3	3	2	2								
CO 3	3	3	2	1								
CO 4	3	2	1									
CO 5	3	3	1	2								

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

Environmental Engineering-I
Code – CE(PC) 505
Contact – 2L + 1T
Credits- 3
Prerequisites: Chemistry and Engineering Hydrology.

Course Outcomes: At the end of the course, the student will be able to:

CO1- Define the basic concepts and terminologies of waste water engineering and hazardous waste management.
CO2- Describe different house plumbing systems for water supply and waste water disposal.
CO3- Apply the methods of quantifying sanitary sewage and storm sewage.
CO4- Solve different mathematical problems regarding different components of sewerage system
CO5- Compare between different waste water samples based on their physical, chemical and biological characteristics.
CO6 Design different unit processes and operations involved in wastewater treatment.

Syllabus:

Module 1	Sewage and Drainage Definition of Common Terms: Sewage or Sanitary Sewage, Drainage or Storm Sewage, Sullage, Black Water, Grey Water Sewerage Systems: Separate system, Combined System, Partially Separate System; applicability, advantages and disadvantages
Module 2	Sewage and Drainage Quantity Quantity estimation for sanitary sewage; Quantity estimation for storm sewage
Module 3	Conveyance of Sewage Sewers: Shapes; Design parameters; Operation and maintenance of sewers; Sewer appurtenances Hydraulic Design of Sewers: Partial flow diagrams and Nomograms
Module 4	Wastewater Characteristics Physical, chemical and biological characteristics of municipal and domestic sewage; Effluent discharge standards
Module 5	Wastewater Treatment Primary, secondary and tertiary treatment of wastewater; aerobic an anaerobic treatment options Primary and Secondary Treatment of Domestic Wastewater: Typical Flow Chart of STP; Screen and Bar Racks; Grit Chamber; Primary and Secondary Sedimentation Tank; Activated Sludge Process; Trickling Filter
Module 6	Sludge Handling and Disposal Sludge Thickening; Sludge Digestion; Sludge Drying Bed
Module 7	Building Plumbing Introduction to various types of home plumbing systems for water supply and waste water disposal; high rise building plumbing; Pressure reducing valves; Break pressure tanks; Storage tanks; Building drainage for high rise buildings; various kinds of fixtures and fittings used
Module 8	Hazardous waste Types and nature of hazardous waste as per the HW Schedules of regulating authorities

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3		2	3			2					
CO 2	3	3	3				2					
CO 3	2	2				3	2					
CO 4	3	2		3	2		2	1				
CO 5	2		2	3				2				
CO 6	3		3	2							1	

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

Sub: Transportation Engineering

Code: CE(PC)506

Contact: 2L+1T (Total: 36L)

Credits: 3

Pre-requisites:

Class-XII level knowledge of Physics, Mathematics; Undergraduate level knowledge of Engineering Mechanics, Strength of Materials, Soil Mechanics

The objective of this course is appreciate of the need for lifelong learning through the discussion of recent changes and studies of highway and transportation engineering, also have the ability to apply knowledge of mathematics, science, and engineering to understand the design techniques and equipment used in highway engineering.

Course Outcomes (COs):

At the end of the course, the student will be able to:

CO 1. Understand the knowledge of planning, design and the fundamental properties of highway materials in highway engineering.

CO 2. Apply the knowledge of geometric design and draw appropriate conclusion

CO 3. Interpret the concept of different methods in design, construction of the pavement.

CO 4. Interpret traffic parameters by applying the knowledge in traffic planning and intersection design.

Module 1	Introduction to Highway Engineering Scope of Highway Engineering; Jayakar Committee Report: Recommendations – CRF, IRC, CRRI; Scope of Motor Vehicle Act; Recommendations of Nagpur Road conference; Road Classification as per third 20 years road development plan (1981-2001); Basic types of Road Patterns and its scope of application	2L+1T
Module 2	Highway alignment Factors controlling Highway Alignment; Engineering Surveys for Highway Alignment.	1L+1T
Module 3	Geometric Design Cross-sectional elements of highway; Design Parameters (as per IRC) – Vehicle dimensions, Carriageway width, Design speed, Frictional coefficients (Lateral and Longitudinal) etc; Design Principles of Horizontal Alignment: Camber, Sight Distance (PIEV theory, SSD, OSD, ISD); Horizontal Curves – [Radius, Super elevation, Extra widening, Set back distance, Transition curve]; Design Principles of Vertical Alignment: Gradients; Grade Compensation; Vertical Curves – Summit Curve, Valley curve.	8L+4T
Module 4	Traffic Engineering Traffic studies: Fundamental parameters of Traffic Flow (speed, flow, density, capacity) and their basic relations; Basics of Spot Speed Studies- Speed and Delay study- O & D study; Intersections and Channelization: At Grade and Grade Separated intersections; Conflict points; Salient features of Rotary; Traffic Signs; Signal Design – Basic concepts of IRC design method, 2 phase signal design by Webster method.	7L+3T
Module 5	Pavement Design Pavement materials: Bitumen, Aggregate, Subgrade soil; Types of Pavement: Flexible and Rigid pavements and their typical cross-sections; Design parameters: Wheel Load, ESWL, Tyre Pressure, CBR, Resilient Modulus & Poisson's Ratio of various layers, Subgrade Modulus etc. Design of Flexible Pavement using IRC 37:2018 Design of Rigid Pavement: Wheel Stresses, Frictional Stresses and Warping Stresses; Expansion, Contraction and Construction Joints; Design of Rigid Pavement thickness, Dowel Bar and Tie Bar; Distresses in Pavements	8L+5T
Module 6	Sustainability Scope of adoption of sustainable construction techniques by using recyclable hazardous materials- fly ash, plastics, recyclable construction materials.	1L+1T

Mapping of Course outcomes with Program outcomes

Program outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

Course outcome												
CO 1	3	3	2			2					3	
CO 2	3	3	2		2							
CO 3	3	3	3		1	1						
CO 4	3	3	2	2	2							

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

ENVIRONMENTAL ENGINEERING LAB
CODE: CE(PC)-595
CRDIT-2
Prerequisites: Knowledge of Environmental Engineering, biology for engineers, chemistry and physics Laboratory.

C**OURSE OUTCOMES: -**
At the end of the course, the student will be able to:
CO1: Experiment various physical characteristics for a given sample of water and waste water
CO2: Determine various chemical characteristics for a given sample of water and waste water
CO3: Examine the bacteriological characteristics for a given sample of water and waste water
CO4: Examine the suitability of a few treatment options for a given sample of water and waste water
CO5: Compare the determined quality parameters with standards to decide on the suitability of the use for the treated water and disposal of tested waste water.

Syllabus:

Experiment 1	Determination of turbidity for a given sample of water
Experiment 2	Determination of electrical conductivity for a given sample of water
Experiment 3	Determination of Total Solids, Suspended Solids, Dissolved Solids and Volatile Solids in a given sample of water
Experiment 4	Determination of pH for a given sample of water
Experiment 5	Determination of carbonate, bi-carbonate and hydroxide alkalinity for a given sample of water
Experiment 6	Determination of acidity for a given sample of water
Experiment 7	Determination of hardness for a given sample of water
Experiment 8	Determination of concentration of Iron in a given sample of water
Experiment 9	Determination of concentration of Chlorides in a given sample of water
Experiment 10	Determination of the Optimum Alum Dose for a given sample of water through Jar Test
Experiment 11	Determination of the Chlorine Demand and Break-Point Chlorination for a given sample of water
Experiment 12	Determination of amount of Dissolved Oxygen (DO) in a given sample of water
Experiment 13	Determination of the Biochemical Oxygen Demand (BOD) for a given sample of wastewater
Experiment 14	Determination of the Chemical Oxygen Demand (COD) for a given sample of wastewater
Experiment 15	Determination of Colliform Bacteria: presumptive test, Confirmative test and Determination of MPN

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1						3	3					
CO 2	1	3	2		1	3	3					
CO 3		3	2			3	3				1	
CO 4		3	2			2	3				1	
CO 5		3	2		1	3	3				1	

1: Slightly 2: Moderately 3: Substantially

Sub: Soil Mechanics Laboratory
Code: CE (PC) 594
Contact: 2P
Credits: 1

Pre-requisites: Soil Mechanics I [CE (PC) 401], Soil Mechanics II [CE (PC) 504]

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. Identify different types of soil by visual inspection.

CO 2. Determine natural moisture content and specific gravity of various types of soil.

CO 3. Estimate in-situ density by core-cutter method and sand replacement method.

CO 4. Analyse grain-size distribution and Atterberg limits for soil.

CO 5. Perform laboratory test to determine permeability and compaction characteristics of soil.

CO6. Determine shear strength parameter of soil by unconfined compression test and vane shear test.

CO7. Determine shear strength parameter by direct shear test.

CO8. Perform triaxial test to determine the shear strength parameter of soil.

CO9. Determine California Bearing Ratio of soil.

CO10. Prepare technical laboratory report.

CE(PC)594	Soil Mechanics Laboratory	2P	1 Credits
Course Outcome	After going through this course, the students will be able to: 1. Identify different types of soil by visual inspection. 2. Determine natural moisture content and specific gravity of various types of soil. 3. Estimate in-situ density by core cutter method and sand replacement method. 4. Analyze grain size distribution and Atterberg limits for soil. 5. Perform laboratory tests to determine permeability and compaction characteristics of soil. 6. Determine shear strength parameters of soil by unconfined compression test and vane shear test. 7. Determine shear strength parameters of soil by direct shear test. 8. Perform triaxial test to determine shear strength parameters of soil. 9. Determine California Bearing Ratio (CBR) of soil. 10. Prepare technical laboratory report		
Prerequisite	Soil Mechanics – I (CE(PC)401) and Soil Mechanics – II (CE(PC)504)		
Experiment 1	Field identification of different types of soil as per Indian Standards [collection of field samples and identifications without laboratory testing].		
Experiment 2	Determination of natural moisture content.		
Experiment 3	Determination of specific gravity of cohesionless and cohesive soils.		
Experiment 4	Determination of in-situ density by core cutter method and sand replacement method.		
Experiment 5	Determination of grain size distribution by sieve and hydrometer analysis.		
Experiment 6	Determination of Atterberg limits (liquid limit, plastic limit and shrinkage limit).		
Experiment 7	Determination of co-efficient of permeability by constant and variable head permeability tests.		
Experiment 8	Determination of compaction characteristics of soil by standard proctor compaction test.		

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3											
CO 2	3			2	3							
CO 3	3	1		2	3							
CO 4	3	2		2	3							
CO 5	3	2		2	3							
CO 6	3	3		2	3							
CO7	3	2		1	3							
CO8	3	2		1	3							
CO9	3	2		2	3							
CO10	3			3								

1: Slightly 2: Moderately 3: Substantially

Computer Applications in Civil Engineering
Code: CE(PC)597
Contact: 2P
Credits: 1

Prerequisites: ES-CS291 Programming for Problem Solving, CE(ES)392 Computer-aided Civil Engineering Drawing

Course Outcomes: At the end of the course, the student will be able to:

CO1. Use the computer as a problem-solving tool

CO2. Identify and formulate Civil Engineering problems solvable by computers.

CO3. Solve sets of linear equations and determine roots and nonlinear equations and able perform their application in civil engineering and Construct, interpret and solve simple optimization problems

CO4. Use various software used in industries for analysis and design.

CO5. Develop programs for Civil Engineering analysis and design problems.

CE(PC)597	Computer Applications in Civil Engineering	2P	1 Credits
Module 1	Introduction: Concept of problem-solving using computer, use of programming language and software for problem solving; Identification of various design and analysis problems in different fields of Civil Engineering to be solved using computers; Procedure, formulae and data related to the analysis and design of such problems.		
Module 2	Use of spreadsheets: Learning spreadsheets like MS Excel, matrix analysis, use of Goal Seek and Solver, Optimization Tools; Plotting. Applications to problems involving tabular data, CE estimation, surveying, and design problems.		
Module 3	Programming Languages: Learning at least one language: Fortran 2003/2008/2018, C++11/C++14, Python 3, VBA 7.0; Computing platforms like Matlab/Scilab/MathCAD; Solving analysis and design problems in areas like surveying, hydraulics, structural analysis, RCC design, soil mechanics and foundation, transportation, water resources, etc.		
Module 4	Use of Software: Familiarity with widely used Civil Engineering software like STAAD Pro, HEC-RAS, HEC-HMS, SWMM, Mx Roads, etc.; Solving at least two such analysis/design problems.		

Mapping of Course outcomes with Program outcomes

Program outcomes → / **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**1**	**3**							**1**
CO 2	**3**	**3**	**3**	**1**	**3**							**1**
CO 3	**3**	**3**	**3**	**1**	**3**							**1**
CO 4	**3**	**3**	**3**	**1**	**3**							**1**
CO 5	**3**	**3**	**3**	**1**	**3**							**1**

1: Slightly 2: Moderately 3: Substantially

Engineering Economics, Estimation & Costing
Code: CE ((PC) 602

Prerequisites: CE(ES)392 Computer-aided Civil Engineering Drawing

Course Outcomes: At the end of the course, the student will be able to:

CO1 – Have an idea of Economics in general, Economics of India particularly for public sector agencies and private sector businesses and Understand the measures of National Income

CO2- Perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives and Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses

CO3- Understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure

CO4- Quantify the worth of a structure by evaluating quantities of constituents, derive their cost rates and build up the overall cost of the structure.
CO5- Understand how competitive bidding works and how to submit a competitive bid proposal

Mapping of Course outcomes with Program outcomes

CE(PC)602	Engineering Economics, Estimation & Costing	2L + 0T
Module 1	Basic Principles and Methodology of Economics. Demand/Supply – elasticity – Government Policies and Application. Theory of the Firm and Market Structure. Basic Macroeconomic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes	3L
Module 2	Elements of Business/Managerial Economics and forms of organizations. Cost & Cost Control –Techniques, Types of Costs, Lifecycle costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money (present and future worth of cash flows). Business Forecasting – Elementary techniques. Statements – Cash flow, Financial. Case Study Method.	3L
Module 3:	Estimation / Measurements for various items Introduction to the process of Estimation; Use of relevant Indian Standard Specifications for the same, taking out quantities from the given requirements of the work, comparison of different alternatives, Bar bending schedules, Mass haul Diagrams, Estimating Earthwork and Foundations, Estimating Concrete and Masonry, Finishes, Interiors, MEP works; BIM and quantity take-offs; adding equipment costs; labour costs; rate analysis; Material survey-Thumb rules for computation of materials requirement for different materials for buildings, percentage breakup of the cost, cost sensitive index, market survey of basic materials. Use of Computers in quantity surveying	9L
Module 4:	Specifications Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.	3L
Module 5:	Rate analysis Purpose, importance and necessity of the same, factors affecting, task work, daily output from different equipment/ productivity.	3L
Module 6	Tender- Preparation of tender documents, importance of inviting tenders, contract types, relative merits, prequalification. general and special conditions, termination of contracts, extra work and Changes, penalty and liquidated charges, Settlement of disputes, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, etc. Preparing Bids- Bid Price buildup: Material, Labour, Equipment costs, Risks, Direct & Indirect Overheads, Profits; Bid conditions, alternative specifications; Alternative Bids. Bid process management	3L

Module 7	Valuation Values and cost, gross income, outgoing, net income, scrap value, salvage value, market value, Book Value, sinking fund, capitalised value, Y. P., depreciation, obsolescence, deferred income, freehold and leasehold property, mortgage, rent fixation, valuation table	3L
Module 8	Introduction to Acts pertaining to-Minimum wages, Workman's compensation, Contracts, Arbitration, Easement rights.	2L

Program outcomes → **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**3**										**3**	**1**
CO 2	**3**										**3**	**1**
CO 3	**3**		**1**								**2**	**1**
CO 4	**3**		**1**								**2**	**1**
CO 5	**3**										**3**	**1**

1: Slightly 2: Moderately 3: Substantially

Sub: Foundation Engineering
Code: CE (PE) 601B
Contact: 2L+0T (Total 30)
Credits: 2

Pre-requisites: Introduction to Civil Engineering[CE(HS)302], Soil Mechanics I[CE(PC)401], Soil Mechanics II[CE(PC)504]

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. Determine the load carrying capacity of pile foundation.

CO 2. Compute the efficiency and settlement of pile group.

CO 3. Understand different subsoil exploration methods and interpret field and laboratory test data to obtain design parameters for geotechnical analysis.

CO 4. Correlate bearing capacity of shallow foundation from field test data.

CO 5. Analyse and design sheet pile structure on the basis of earth pressure theories.

CO6. Understand and apply various types of ground improvement methods for solving complex geotechnical problems.

Prerequisite	Introduction to Civil Engineering (CE(HS)302), Soil Mechanics – I (CE(PC)401), Soil Mechanics – II (CE(PC)504).	
Module 1	Introduction Classification, selection- shallow and deep foundations.	2L
Module 2	Deep foundations Pile foundation: Types of piles, material, Suitability and uses, Method of installation of piles - classification of piles based on material, Installation Techniques – Selection and uses, Determination of types and lengths of piles, Load transfer mechanism, Determination of load carrying capacities of piles by static and dynamic formulae as per IS codes, Pile spacing and group action, Group efficiency, Negative skin friction, Pile load test, Settlement of pile group, Lateral load capacity of pile by IS: 2911 and Reese & Matlock methods, Uplift capacity of pile - introduction.	9L
Module 3:	Site Investigation & Soil Exploration Planning of sub-surface exploration, Methods of boring, sampling, Different types of samples, Spacing, Depth and number of exploratory borings, Bore log, Preparation of sub-soil investigation report. In-situ tests Standard penetration test, Static cone penetration test, Dynamic cone penetration test, Field vane shear test, Plate load test. Indirect methods of soil exploration Geophysical method: seismic refraction and electrical resistivity methods.	6L
Module 4:	Shallow Foundations Bearing Capacity from SPT, SCPT and Plate load Test data.	3L
Module 5:	Sheet pile structures Type of sheet pilling, Design of sheet pile, Cantilever sheet piling, Anchored sheet piling, Free earth and fixed earth support methods, Analysis with anchored bulk heads.	4L
Module 6	Introduction to Ground Improvement Techniques Introduction, Economic considerations, Consolidation by preloading and sand drains, Stone columns, Compaction by vibro-floatation, Grouting techniques and principles, Applications of geo-synthetics, Ground anchors and soil nailing.	6L

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	2									
CO 2	3	3	2									
CO 3	3	3	2	2	2							
CO 4	3	1										
CO 5	3	3	3									
CO 6	3	2			1		2					

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

STRUCTURAL ANALYSIS II

Code: CE(PE) 602B
Contact: 2L + 0 T(Total: 30Hrs)
Credits: 3
Prerequisites: Introduction to Solid Mechanics, Structural Analysis – I,

Course Outcomes: At the end of the course, the student will be able to:

CO1 Apply the Slope Deflection and Moment Distribution Method to analyze indeterminate structure

CO2 Develop and analyze the concept of suspension bridge and stiffen girders

CO3 Apply and analyze the concepts of curved beam, analysis in hooks, rings and Bow girders

CO4 Develop the concept bending in unsymmetrical beams

CO5: Develop the fundamental concept of plastic analysis using kinematic method and apply them in frame and continuous beam analysis

CO6: Develop and analyze the portal frame using portal and cantilever method, Develop and analyze the indeterminate structures (continuous beam and frame) using flexibility and stiffness matrix method.

Syllabus:

Module 1	Analysis of statically Indeterminate Structures: Moment distribution method-solution of continuous beam, effect of settlement and rotation of support, frames with or without side sway. Slope deflection method: method and application in continuous beams and frames. Suspension Bridge and stiffening girders.
Module 2	Curved Beam analysis: Hooks, rings and Bow girders. Unsymmetrical bending.
Module 3	Plastic analysis of structures: beams and portal frames.
Module 4	Approximate method of analysis of structures: Portal and Cantilever methods.
Module 5	Matrix methods of structural analysis – Stiffness and flexibility approaches for analysis of beam.

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3			3				1				
CO 2	3			3				1				
CO 3	3			3				1				
CO 4	3			3				1				
CO 5	3		2	3								
CO 6	3		2	3								

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

CONSTRUCTION ENGINEERING AND MANAGEMENT

Code: CE(PC)601

Contact: 2 L (Total: 30L)

Credits: 2

Prerequisites : Introduction to Civil Engineering, Building Construction & Concrete Technology

Course outcome:

CO1- An idea of how structures are built and projects are developed on the field. The understanding & to determine the quantity of buildings require the knowledge of drawings. This knowledge will be useful to the student to prepare the construction schedule. They should also able to present the knowledge in a way that it is understandable by others

CO2- An understanding of modern construction practices. The Construction check lists is closely associated with the knowledge of Construction materials and engineering laboratory tests for different types of works etc. The student will able to analyzes critical path, and resource allocation, towards the end of the course. A basic ability to plan, control and monitor construction projects with respect to time and cost.

CO3- Understand the various equipment related to earth moving, drilling and blasting, pile driving, pumping, stone crushing, air compressors, equipment for moving materials etc. Understand the different types of standard/special equipment used in the construction industry and learn the different sources of equipment, economic life and depreciation cost of equipment.

CO4- A good idea of basic construction dynamics- various stakeholders, project objectives, processes, resources required and project economics. The students should have the knowledge to quality control monitoring in the project, project safety management and construction project information

CO5- An idea how construction projects are administered with respect to contract structures and issues. An idea of how to optimise construction projects based on costs

CO6- . An ability to put forward ideas and understandings to others with effective communication

Module 1	Planning: General consideration, Definition of aspect, prospect, roominess, grouping, circulation, Privacy.	2L
Module 2	Regulation and Bye laws Bye Laws in respect of side space, Back and front space, Covered areas, height of building etc., Lavatory blocks , ventilation, Requirements for stairs, lifts in public assembly building, offices	4L
Module 3:	Fire Protection Fire fighting arrangements in public assembly buildings, planning , offices,and auditorium	2L

Module 4:	Planning &Scheduling of constructions Projects Planning by CPM Preparation of network, Determination of slacks or floats. Critical activities. Critical path. Project duration. Planning by PERT Expected mean time, probability of completion of project, Estimation of critical path, problems	6L
Module 5:	Construction Methods basics Types of foundations and construction methods; Basics of Formwork and Staging; Common building construction methods (conventional walls and slabs; conventional framed structure with blockwork walls; Modular construction methods for repetitive works; Precast concrete construction methods; Basics of Slip forming for tall structures; Basic construction methods for steel structures; Basics of construction methods for Bridges	4L
Module 6	Construction plants & Equipment Plants & equipment for earth moving, road constructions, excavators, dozers, scrapers, spreaders, rollers, their uses. Plants &Equipment for concrete construction Batching plants, Ready Mix Concrete, concrete mixers, Vibrators etc., quality control	3L
Module 7	Contracts Management basics Importance of contracts; Types of Contracts, parties to a contract; Common contract clauses (Notice to proceed, rights and duties of various parties, notices to be given, Contract Duration and Price. Performance parameters; Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination. Changes & variations. Dispute Resolution methods.	4L
Module 8	Management Professional practice, Definition, Rights and responsibilities of owner, engineer, Contractors, types of contract	3L
Module 9	Departmental Procedures Administration, Technical and financial sanction, operation of PWD, Tenders and its notification, EMD and SD, Acceptance of tenders, Arbritation	2L

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3		2	1		2	2	3	1		2	
CO 2			2	1		2	2	3	1		2	2
CO 3		2	2	1		2	2	3	1		2	2
CO 4												
CO 5												
CO 6												

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

WATER RESOURCE ENGINEERING

Code: CE(PC)603
Contact: 2L (Total: 31 L)
Credits: 2

Prerequisites : Physics, Mathematics, Introduction to Civil Engineering & Engineering Hydrology and Introduction to Fluid Mechanics CE(ES)401

COURSE OUTCOME:
At the end of the course, students would be able to -----
CO1: Understand the concepts of irrigation.To describe the basic principles and design parameters of the irrigation
CO2- Understand the fundamentals of flow in open channels To select the appropriate method for irrigation network based on specific field
CO3- Estimate the quantity of water required by different crops in different seasons, and accordingly the irrigation water requirement Collect data and calculate the demand of water for agricultural land.
CO4- Design channels and other irrigation structures required for irrigation, drainage, soil conservation, flood control and other water-management projects. To design the hydraulic structures like canals. To detect the water logged area due to over irrigation
CO5- Learn about groundwater resources, aquifers and wells. Apply their knowledge on ground water, well hydraulics to estimate safe yield.

Module 1	**Open Channel Flow: Channel Characteristics and parameters, Energy-depth relationships, Specific Energy concept, Critical Flow, Hydraulic Jump, Uniform flo**	**8L**
Module 2	**Irrigation: Definition, Necessity, Scope, Benefits of Irrigation; Types, techniques**	**3L**
Module 3:	**Soil-water-plant Relationship: Types of crops, cropping seasons, water requirement of crops, base period, kor period, Duty, Delta, Commanded area, Net Irrigation Requirement, Field Irrigation Requirement, Gross Irrigati**	**6L**
Module 4:	**Canal irrigation: Classification of irrigation canals, canals in alluvium; Design of unlined canals: Kennedy's method, Lacey's method; Lined canals: advantages,**	**6L**
Module 5:	**Land drainage: Water logging issues in irrigation, provision of drains, design and**	**4L**
Module 6	**Groundwater: Occurrence of groundwater– Aquifers, Various Types of Aquifers, Aquifer Parameters: Specific Yield, Specific Retention, Storage Coefficient, Transmissivity.**	**4L**

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1					2	1	1				1	
CO 2						1	1				1	
CO 3					2	1	1				1	
CO 4					2	1	1				1	
CO 5						1	1				1	

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

Design of Steel structure

Code: CE(PC) 604

Contact: 2L

Credits: 2

Prerequisites: Strength of Materials, Structural Analysis, Mathematical Methods and Engineering Mechanics.

Course Outcomes: At the end of the course, the student will be able to:

CO1. Identify the material properties of structural steel, moreover the student will identify different bolted and welded connections, analyse and design them for axial and eccentric load.

CO2 Design different steel sections subjected to axial compression and tension following IS code of practice

CO3 Comprehend the differences between laterally supported and unsupported flexural members. Designing of the flexural members using IS code of practice.

CO4 Analyse and design of rolled and built up compression members along with base connection subject to axial compression, bending and tension.

CO5 Calculate shear force and bending moment on rolled and built up girders, dimension the section and finally design it following IS design guidelines.

CO6: Identify different components of gantry system, calculate lateral and vertical loads acting on the system, dimension the components and design them.

CO7: Design different components of an industrial building.

Syllabus:

Module 1	Materials and Specification: Rolled steel sections, mechanical properties of steel and their specifications for structural use. Codes of practices. Design of Steel structures using tubular, rectangular and square section
Module 2	Structural connections: Riveted, welded and bolted including High strength friction grip bolted joints. – types of riveted & bolted joints, assumptions, failure of joints ,efficiency of joints, design of bolted ,riveted & welded joints for axial load. Eccentric connection:- Riveted & bolted joints subjected to torsion & shear, tension & shear, design of riveted, bolted & welded connection.
Module 3	Design of Tension members: Design of tension members, I.S code provisions. Permissible stresses. Design rules. Examples.
Module 4	Design of Compression members: Effective lengths about major & minor principal axes, I.S code provisions. Permissible stresses, Design rules, Design of
	one component, two components and built up compression members under axial load. Examples. Built up columns under eccentric loading: Design of lacing and batten plates, Different types of Column Bases- Slab Base , Gusseted Base. Connection details
Module 5	Design of Beams: Permissible stresses in bending, compression and tension. Design of rolled steel sections, plated beams. simple Beam end connections, beam -Column connections. I.S code provisions
Module 6	Design of Plate girders: Design of webs & flanges, Concepts of curtailment of flanges – Riveted & welded web stiffeners, web flange splices - Riveted, welded& bolted.
Module 7	Design of Gantry Girder: Design gantry girder considering lateral buckling – I.S code provisions.

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcomes ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	3	3		3	2	2	2	3		2	3
CO 2	3	1		3				1				
CO 3	3	1		3				1				
CO 4	3	1		3				1				
CO 5	3	1		3				1				
CO 6	2		3	2								
CO 7	2		3	2								

1: Slightly 2: Moderately 3: Substantially

Sub: Water Resource Engineering Laboratory
Code: CE (PC) 693
Contact: 2P
Credits: 1

Pre-requisites: Engineering Hydrology [CE (PC) 502], Water Resource Engineering [CE(PC)603]

Course Outcomes (COs)

After going through this Course, the students will be able to:

CO 1. Delineate the watershed of any reservoir using DEM.

CO 2. Determine the average rainfall over a catchment.

CO 3. Use the rain gauge properly for a specified purpose.

CO 4. Measure the rate of infiltration of water through the soil.

CO 5. Measure the sunshine hours in a particular day.

CE(PC)693	Water Resource Engineering Laboratory	2P	1 Credits
Course Outcome	On completion of the course, the students will be able to: 14. Delineate the watershed of any reservoir using DEM. 15. Determine the average rainfall over a catchment. 16. Use the raingauge properly for a specified purpose. 17. Measure the rate of infiltration of water through the soil. 18. Measure the sunshine hours in a particular day.		
Prerequisite	Engineering Hydrology CE(PC)502 & Water Resources Engineering CE(PC)603		
Experiment 1	Catchment area delineation (Manually and using DEM)		
Experiment 2	Calculation of average rainfall over a catchment area with arithmetic mean method, Thiessen polygon method and Isohyetal Method.		
Experiment 3	Use of different type of Rain gauges.		
Experiment 4	Measurement of infiltration rate using double ring infiltrometer.		
Experiment 5	Measurement of evaporation using evaporimeter.		
Experiment 6	Measurement of bright sunshine hours using sunshine recorder.		

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3				3							
CO 2	3	2			2							
CO 3	1				2							
CO 4	3	1			3							
CO 5	2				2							

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

HYDRAULIC STRUCTURES
Code: CE(PE)701C
Contact: 2L + 1T (Total: 43L)
Credits: 3

Prerequisites : Introduction to Civil Engineering CE(HS)302, Water Resources Engineering CE(PC)603, Fluid Mechanics, RCC Design of Structures

COURSE OUTCOMES:

On successful completion of this course, student should be able to: --------

CO1 : Identify the characteristics of various types of dams and their selection procedure. Plan and design diversion head works. To analyse the functioning of diversion headworks and energy dissipation.

CO2 : Perform the reconnaissance survey and, geophysical investigations necessary for selection of suitable dam site

works, falls and outlets of irrigation network.

CO3 : Estimate forces acting on a gravity dams and perform stability analysis. Analyze gravity and earth dams

CO4 : Estimate the seepage loss through embankment dams and suggest necessary remedial measure.s

CO5: Calculate the discharge through the overflow section and design the appropriate energy dissipation structures. Design spillways and energy dissipations works. Devices

CE(PE)701C	Hydraulic Structures	2L + 1T	3 Credits
Module 1	Storage Structures: Dams, Types of Dams – Embankment dams, gravity dams, various components and their functions		1L + 1T
Module 2	Selection of Dam Site: Site investigations, initial study, reconnaissance survey, geophysical investigations, preliminary selection, evaluation of selected site - various types of foundation testing, field testing and borrow pit investigations, detailed investigations; assessment of foundation characteristics and suitability; selection of type of dam		4L + 2T
Module 3:	Gravity Dam: Definition, Features of some important gravity dams, Forces acting on a gravity dam, estimation of forces due to: self-weight, water pressure on upstream and downstream face, Uplift pressure, wave pressure, silt pressure, wind pressure, earthquake forces, hydrodynamic forces; Stability analysis - load combinations, codal provisions, modes of failures - overturning, sliding, tension and compression failures, factors of safeties, principal stresses; Elementary profile of a gravity dam - forces acting, minimum base width - no tension, no sliding basis, principal stresses.		8L + 4T
	Embankment Dams: Definitions, Features of some important embankment dams; Types of embankment dams and their sectional features; Design criteria; Freeboard - necessity, estimation procedure; Seepage analysis - Laplace's flow equations, drainage blanket and rock toe, phreatic line, graphical procedure of drawing phreatic line, estimation of seepage loss; Stability analysis of embankment dams – slip circle method; Seepage Control - cut-offs, slurry trench, sheet piling, grouting, slope protection.		6L + 2T
	Diversion headworks: Necessity and uses, different types, layout and different components; weirs on permeable foundation, Creep theories, Khosla's method; Different types of modules, Canal escapes, Silt control devices		5L + 3T
Module 4:	Spillways and Energy Dissipation Structures: Necessity, types, selection, spillway gates; High overflow ogee spillway - profile, discharge computation, flow equations, factors affecting coefficient of discharge, codal provisions. stilling basins (USBR and BIS) types		4L + 2T

Mapping of Course outcomes with Program outcomes

Program outcomes →	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**

Course outcome ↓												
CO 1	**2**	**2**		**3**	**1**			**1**				
CO 2	**2**	**2**		**3**	**1**			**1**		**2**		**3**
CO 3	**3**	**1**	**1**	**3**				**1**				
CO 4	**2**	**2**		**3**								
CO 5	**2**	**2**		**3**								
CO 6												

1: Slightly 2: Moderately 3: Substantially

Prestressed Concrete
Code: CE(PC) 702A
Prerequisites : Introduction to Solid Mechanics (CE(ES)402), Structural Analysis – I (CE(PC)503), Design of RC Structures (CE(PC)501)
Course Outcomes: After going through this course, the students will be able to:

CO1: -Learn the introduction of prestressed concrete member and its deflection properties.

CO2: – Develop the design criteria of prestressed concrete section for flexure and shear properties

CO3: - Analyze the anchorage zone stress for post-tensioned members

CO4: –Impart knowledge regarding the methods of Analysis of Statically Indeterminate Structures.

CO5: - Impart knowledge regarding the composite construction of Prestress and In-situ concrete.

CO6: - Impart knowledge regarding Design of Prestressed concrete poles and sleepers and introduction of partial prestressing

CE(PE)702A	Prestressed Concrete	2L + 1T	3 Credits
Module 1	Introduction of Prestressed concrete: Materials, prestressing system, analysis of prestress and bending stress, losses Shear and torsional resistance: design of shear reinforcement, design of reinforcement for torsion shear and bending. Deflections of prestressed concrete members: Importance, factors, short term and long term deflection		8L+4T
Module 2	Shear and Torsional Resistance: Design of Shear Reinforcement, Design of Reinforcement for Torsion, Shear and Bending. Limit State Design Criteria: Inadequacy of Elastic and Ultimate Load Method, Criteria for Limit States, Strength and Serviceability. Design of Prestressed Concrete Section: for Flexure & methods by Lin and Magnel		8L+4T
Module 3	Anchorage Zone stresses in post tensioned members: Stress distribution in end block, anchorage zone reinforcement		3L+1T
Module 4	Statically Indeterminate Structures: Advantages of Continuous Member, Effect of Prestressing, Methods of Achieving Continuity and Method of Analysis of Secondary Moments		4L+2T
Module 5	Composite Construction of Prestressed and In-situ Concrete: Types, Analysis of Stresses		3L+1T
Module 6	Prestressed Concrete Poles and Sleepers: Design of Sections for Compression and Bending, Introduction to Partial Prestressing.		2L+2T

Mapping of Course outcomes with Program outcomes

Program outcomes → **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**1**	**1**	**1**								**1**
CO 2	**3**	**2**	**1**	**1**								**1**
CO 3	**3**	**3**	**3**	**1**								**1**
CO 4	**3**	**3**	**3**	**1**								**2**
CO 5	**3**	**3**	**3**	**1**								**2**
CO 6	**3**	**3**	**3**	**1**								**2**

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

AIR AND NOISE POLLUTION AND CONTROL
Code: (CEPE) 703A
Contact: 2L+1T (Total: 28L & 14T)
Credits: 3

Prerequisites: Class XII level knowledge of physics, Chemistry, Mathematics, Biology and Environmental Science; UG level knowledge of Statistics and Environmental Engineering

Course Outcomes: At the end of the course, the student will be able to:

CO1: To define the basic concepts and terminologies regarding air pollution and noise pollution

CO2: To describe physics of air pollution and noise pollution

CO3: To apply the methods of air pollution and noise pollution measurements

CO4: To analyse different concepts of air and noise pollution solving mathematical problems

CO5- To compare air and noise quality with allowable standards and limits

CO6 To choose and design paper techniques for air pollution control and noise pollution control

Syllabus:

Module 1	Air Pollutants Sources; Classification; Effects on Human, Vegetation, Material Effects of Air pollution on Atmosphere: Photochemical Smog, Ozone Layer Depletion, Acid Rain, Greenhouse Effect and Global Warming
Module 2	Air Pollution Meteorology Lapse Rate; Atmospheric Stability; Inversion; Plume Pattern
Module 3	Dispersion of Air Pollutants Point Source Gaussian Plume Model, Stability Classes, Stability Charts, Design of Stack Height
Module 4	Air Quality Methods of Measurement: Gaseous pollutants, Particulate pollutants Air Quality Standards and Indices: Ambient Air Quality Standard, NAAQS, Emission Standard, Air Quality Indices
Module 5	Air Pollution Control Control of Gaseous Pollutants: Adsorption, Absorption, Condensation Control of Particulate Pollutants: Settling chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators Control of Pollution from Automobiles
Module 6	Physics of Noise Basics of Acoustics; Sound Pressure, Power and Intensity and their Interrelations
Module 7	Measurement of Noise Noise Level; Interrelation between Noise, Pressure, Power and Intensity Levels; Noise Meter; Noise Networks; Frequency Band Analysis; Decibel
	Addition Measurement of Community Noise: L_N, L_{eq}, L_{dn},, L_{NP}
Module 8	Source and Effect of Noise Psychoacoustics and noise criteria; effects of noise on health; annoyance rating schemes
Module 9	Noise Pollution Control Noise Standards and Limits; Methods of Noise Pollution Control

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	1				2	3					
CO 2			3						1			2
CO 3		2		3			3		3			
CO 4	3							2	2			
CO 5				3					3			
CO6	3	2		2						2	2	3

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

Advanced Structural Analysis
Code: CE(PE) 704B

Prerequisites: Introduction to Solid Mechanics CE(ES) 402, Structural Analysis – I and Structural Analysis – II

Course Outcomes: At the end of the course, the student will be able to:

CO1 – Increase basic Knowledge

CO2- Apply Stiffness and Flexibility method using system approach

CO3- Understand the yield conditions from their knowledge of stress-strain relation.

CO4- solve simple plate and shell problems

Syllabus:

Module 1	Matrix methods of structural analysis: Application of matrix methods to plane truss, beams, continuous frames
Module 2	Finite difference and relaxation technique-application to simple problems.
Module 3	Theory of plate bending: Navier's Sol utions. Levy's solution. Plate buckling problem. Membrane theory of domes and cylindrical shells.
Module 4	Theory of Elasticity: Three dimensional stress and strain analysis, stress strain transformation, stress invariants, equllibrium and compatibility equations. Two dimensional problems in Cartesian and polar coordinates. Plane stress, plane stain problems, St. Venant's principle

Mapping of Course outcomes with Program outcomes

Program outcomes → / **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**3**	**3**	**3**	**3**	**2**	**1**			**1**		**1**	**1**
CO 2	**3**	**3**	**3**	**3**	**3**	**1**			**1**		**1**	**1**
CO 3	**3**	**3**	**3**	**3**	**3**	**1**			**1**		**1**	**1**
CO 4	**3**	**3**	**3**	**3**	**3**	**1**			**1**		**1**	**1**

1: Slightly 2: Moderately 3: Substantially

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: **CE 705A**	Category: **Professional elective Courses**
Subject Name: **Engineering Materials**	Semester: **VII**
L-T-P: **3-0-0**	Credit: **3**

Course Objectives:

1. Understanding of the correlation between the internal structure of materials, their mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
2. To provide a detailed interpretation of equilibrium phase diagrams
3. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.

Course Content:

Module No.	Topics	Number of Classes
1	Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.	**6**
2	Mechanical Property measurement: Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stressstrain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.	**6**
3	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Vonmises, Maximum normal stress, Mohr-Coulomb and Modified MohrCoulomb; Fracture mechanics: Introduction to Stress-intensity factor approach and Griffith criterion. Fatigue failure: High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue, Introduction to nondestructive testing (NDT)	**8**
4	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binaryphase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron.	**6**
5	Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding,	**6**

	carbonitriding, flame and induction hardening, vacuum and plasma hardening	
6	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze and cupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based superalloys and Titanium alloys	**8**
	TOTAL LECTURES	**40**

Course Outcomes:

1. Student will be able to identify crystal structures for various materials and understand the defects in such structures
2. Able to understand the defects in crystal structure.
3. Understand how to tailor material properties of ferrous and non-ferrous alloys
4. How to quantify mechanical integrity and failure in materials
5. Understand the different techniques of heat treatment of steel.

CO-PO AND MAPPING

Sub: Metro System and Engineering

Code CE(OE)701A -

Contact: 2L (Total: 31L)

Credits: 2

Pre-requisites: Basic Science, Introduction to Civil Engineering, Surveying, Transportation Engineering.The objective of this course is appreciate of the need for lifelong learning through the discussion of recent changes and studies of highway and transportation engineering, also have the ability to apply knowledge of mathematics, science, and engineering to understand the design techniques and equipment used in highway engineering.

Course Outcomes (COs):

At the end of the course, the student will be able to:

CO 1. Plan and prioritize Mass rapid Transit System networks with consideration of finance and socio-economic condition.

CO 2. Design of Mass Rapid transit System, rolling stock and understand Ventilation System. CO 3. Design Signalling & Telecommunication system for Metro Rail.

CO 4. Design of Elevated structures –Viaducts and Underground Structures- Tunnels.

Module 1	Overview of Metro Systems; Need for Metros; Routing studies; Basic P	4L
Module 2	CIVIL ENGINEERING Overview and construction methods for: Elevated and underground Stations; Viaduct spans and bridges; Underground tunnels; Depots; Co	12L
Module 3:	ELECTRONICS AND COMMUNICATION ENGINEERING	5L
Module 4:	MECHANICAL & TV + AC	5L
Module 5:	ELECTRICAL:	5L

Mapping of Course outcomes with Program outcomes

Program outcomes → / Course outcome ↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

CO 1	3	3	2			2					3	
CO 2	3	3	2		2							
CO 3	3	3	3		1	1						
CO 4	3	3	2	2	2							

1: Slightly 2: Moderately 3: Substantially

CO-PO AND MAPPING

PAVEMENT DESIGN
Code: CE(PE)705B
Contact: 2L (Total: 30L)
Credits: 2

Prerequisites : Transportation Engineering (CE(PC)506), Concrete Technology & RCC Design

COURSE OUTCOMES:

At the end of the course, students would be able to ---------

CO 1: Differentiate between different types of pavements, both structurally and functionally Expose students to the analysis concepts and procedures for stresses, strains and deflection in pavements. .

CO 2. Conduct Axle Load Survey and Estimate Design Traffic. Expose students to the general aspects of pavement structural design, flexible or rigid.

CO 3. Analyze and design bituminous and cement concrete pavement using. Introduce students to the basic types and behaviour of highway materials

CO 4. Understand the principles of Pavement Maintenance and identify various pavement under distresses .

Module 1	Pavement Design Flexible Pavement Design: Stresses and Deflections in homogeneous masses.; Burmister's two layer theory; Three layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels; McLeod method of design; AASTHO method of flexible pavement design. Low Volume Rigid Pavement: Criteria of Load, Scope and Specifications as per different Govt policies in India, Design Criteria.	13L
Module 2	Pavement Construction and Management Flexible Pavement Construction: Earthwork (Method of Alignment-wise marking using chainage), compaction of embankments, construction methods and field control checks for various types of flexible pavement materials in sub-base, base, binder and surface course layers; Construction procedure of Low Volume Rigid Pavement.	9L
Module 3	Pavement Evaluation - Pavement Distress Functional condition evaluation of pavements- Roughness, Skid Resistance, Serviceability Index; Structural evaluation of pavements –Benkelman beam and Falling Weight Deflectometer; Pavement strengthening; Design of bituminous and concrete overlays as per IRC	8L

Mapping of Course outcomes with Program outcomes

Program outcomes → **Course outcome ↓**	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO 1	**2**								**1**		**2**	
CO 2											**2**	
CO 3											**2**	
CO 4									**2**			
CO 5												
CO 6												

1: Slightly 2: Moderately 3: Substantially

OmDayal Group of Institutions

Department of Electrical Engineering

Subject Code: BS- M 301	Category: Basic Science Course
Subject Name: Mathematics – III	Semester: **III**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To motivate or challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Probability:** Basic Probability Theory: Classical definition and its limitations. Axiomatic definition. Some elementary deduction: i) P(O)=0, ii) 0≤P(A)≤1, iii) P(A')=1-P(A) etc. where the symbols have their usual meanings. Frequency interpretation of probability. Addition rule for 2 events (proof) & its extension to more than 2 events (statement only). Related problems. Conditional probability & Independent events. Extension to more than 2 events (pair wise & mutual independence). Multiplication Rule. Examples. Baye's theorem (statement only) and related problems. Random Variable & Probability Distributions. Expectation: Definition of random variable. Continuous and discrete random variables. Probability density function & probability, mass function for single variable only. Distribution function and its properties (without proof). Examples. Definitions of Expectation & Variance, properties & examples. Some important discrete distributions: Binomial & Poisson distributions and related problems. Some important continuous distributions: Uniform, Exponential, Normal distributions and related problems. Determination of Mean & Variance for Binomial, Poisson & Uniform distributions only.	8
2	**Numerical Methods:** Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors. Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation. Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms. Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method. Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method. Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method.	28
3	**Z transform:** Sequence, Representation of sequence, Basic operations on sequences, Z-transforms, Properties of Z-transforms, Change of scale, Shifting property, Inverse Z-transform, Solution of difference equation , Region of convergence.	4

Course Outcomes:

After completion of this course, the learners will be able to

1. Explain basics of probability theories, rules, distribution and properties of Z transform
2. Describe different methods of numerical analysis.
3. Solve numerical problems based on probability theories, numerical analysis and Z transform
4. Apply numerical methods to solve engineering problems.
5. Solve engineering problems using z transform and probability theory.

OmDayal Group of Institutions

Department of Electrical Engineering

Subject Code: **ES-ME 301**	Category: **Engineering Science Courses**
Subject Name: **Engineering Mechanics**	Semester: **III**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. To understand the basic mathematical tools to deal with the physical bodies.
2. To learn different mathematical techniques to analyze physical bodies.
3. To learn analysis techniques of rigid bodies.
4. To solve problem of general motion.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction to vectors and tensors and co-ordinate systems** Introduction to vectors and tensors and coordinate systems; Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigen values and Principal axes.	5
2	**Three-dimensional Rotation** Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.	4
3	**Kinematics of Rigid Body** Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two and three dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.	6
4	**Kinetics of Rigid Bodies** Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.	5
5	**Free Body Diagram (1 hour)** Free body diagrams; Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose.	1
6	**General Motion** Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.	9
7	**Bending Moment** Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.	5

8	**Torsional Motion** Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.	2
9	**Friction** Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction	3

Course Outcomes:

After completion of this course, the learners will be able to

1. Explain the co-ordinate system, principle of three dimensional rotation, kinematics and kinetics of rigid bodies.
2. Elaborate the theory of general motion, bending moment, torsional motion and friction.
3. Develop free body diagram of different arrangements.
4. Solve problems with the application of theories and principle of motion, friction and rigid bodies.
5. Analyze torsional motion and bending moment.

OmDayal Group of Institutions

Department of Chemistry

Course Code : BS301	**Category :** Basic Science Courses
Course Title : Biology For Engineers	**Semester** : Third
Duration: 6 months	**Credit:3**

Course Objectives:

To introduce modern biology with an emphasis on evolution of biology as a multi-disciplinary field and to make students aware of application of engineering principles in biology and engineering robust solution inspired by biological examples.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Introduction** Purpose: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry. Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry	2
2	**Classification:** Purpose: To convey that classification *per se* is not what biology is all about. The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructureprokaryotes or eucaryotes. (c) energy and Carbon utilization -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus.	3
3	**Biomolecules** Purpose: To convey that all forms of life has the same building blocks and yet the manifestations are as diverse as one can imagine.	4

	Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	
4	**Macromolecular analysis:** Purpose: To analyze biological processes at the reductionistic level. Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
5	**Metabolism** Purpose: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergonic reactions. Concept of Keq and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge.	4
6	**Microbiology** Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3
7	**Immunology** Purpose: How does the immune system work? What are the molecular and cellular components and pathways that protect anorganism from infectious agents or cancer? This comprehensivecourse answers these questions as it explores the cells and molecules of the immune system. Immunology- Self vs Non-self, pathogens, human immune system, antigen-antibody reactions.	5
8	**Information Transfer** Purpose: The molecular basis of coding and decoding genetic information is universal. Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination	4
9	**Cancer biology** Purpose: A basic understanding of cancer biology and treatment. The course is not designed for patients seeking treatment guidance – but it can help to understand how cancer develops and provides a framework for understanding cancer diagnosis and treatment. –cell Identification of the major types of cancer worldwide. Description of how genes contribute to the risk and growth of cancer. List and description of the ten cellular hallmarks of cancer. Definition of metastasis, and identification of the major steps in the metastatic process. Description of the role of imaging in the screening, diagnosis, staging, and treatments of cancer. Explanation of how	5

	cancer is treated.	
10	**Techniques in bio physics** Purpose: Biophysics is an interdisciplinary science that applies approaches and methods traditionally used in physics to study biological phenomena. The techniques including microscopy, spectroscopy, electrophysiology, single-molecule methods and molecular modeling	3
11	**Stem cell** Purpose: Stem cells and derived products offer great promise for new medical treatments. Learn about stem cell types, current and possible uses, ethical issues.	2

Course Outcomes:

1. Describe with examples the biological observations lead to major discoveries.
2. Explain the classification of kingdom of life/ the building blocks of life/ different techniques of bio physics used to study biological phenomena/ the role of imaging in the screening, diagnosis, staging, and treatments of cancer.
3. Identify DNA as a genetic material in the molecular basis of information transfer
4. Analyze biological processes at the reductionist level.
5. Apply thermodynamic principles to biological systems and identify microorganisms

OmDayal Group of Institutions

Department of Electrical engineering

Subject Code: **PC-EE303**	Category: **Professional Core courses**
Subject Name: **Electro Magnetic field theory**	Semester: **III**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

To motivate or challenge students to understand and develop the basic mathematical tools to deal with Electromagnetic field Problem, to understand properties and application of Electric and magnetic field to analyze electromagnetic wave propagation and to solve problem related to Electromagnetic field.

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Introduction: Co-ordinate systems and transformation, Cartesian coordinates, Circular cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems. Solution of problems	4
2	Introduction to Vector calculus: DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Strokes theorem, Laplacian of a scalar, Classification of vector fields, Helmholtz's theorem. Solution of problems	4
3	Electrostatic field: Coulomb's law, field intensity, Gauss's law, Electric potential and Potential gradient, Relation between E and V, an Electric dipole and flux lines. Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor –dielectric, Conductor-free space. Poisson's and Laplace's equation, General procedure for solving Poisson's and Laplace's equation. Solution of problems.	8
4	Magneto static fields: Biot- savart law, Ampere's circuit law, Magnetic flux density, Magnetic static and Vector potential, Forces due to magnetic field, Magnetic torque and moments, Magnetisation in material, Magnetic boundary condition, Inductor and Inductances, Magnetic energy, Force on magnetic material. Solution of problems.	8
5	Electromagnetic fields: Faraday's law, Transformer and motional emf, Displacement current, Maxwell's equations, Time varying Potential, Time harmonic fields. Solution of problems	6
6	Electromagnetic wave propagation: Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power & Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarisation. Solution of problems	6
7	Transmission line: Concept of lump & distributed parameters, Line parameters, Transmission line equation & solutions, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Solution of problems	4

Course Outcomes:

On completion of this course a students will be able to

1. Relate different coordinate systems for efficient solution of electromagnetic problems. Describe mathematical s tools to solve electromagnetic problems.
2. Explain laws applied to electromagnetic field.
3. Apply mathematical tools and laws to solve electromagnetic problems.
4. Analyze electromagnetic wave propagation
5. Estimate transmission line parameters.

Name of the course	**ELECTRIC CIRCUIT THEORY**
Course Code: PC-EE 301	**Semester: 3rd**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	**Mid Semester Exam: 15 Marks**
Tutorial: 1 hr/week	**Assignment & Quiz: 10 Marks**
Practical: 2 hrs/week	**Attendance: 05 Marks**
Credit Points: 4+1	**End Semester Exam: 70 Marks**

	Objective:
1.	To understand the structure and properties of different type of electrical circuits, networks and sources.
2.	To apply different mathematical tools & techniques for analyzing electrical networks.
3.	To apply circuit analysis techniques to simplify electrical networks..
4.	To solve problems of electrical circuits.
	Pre-Requisite
1.	Basic Electrical Engineering (ES-EE-101)
2.	Mathematics (BS-M-102, Bs-M202)

Unit	Content	Hrs	Marks
1	**Introduction**: Continuous & Discrete, Fixed & Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems. Independent & Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals	3	
2	**Graph theory and Networks equations:** Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials. Duality, Solution of Problems	4	
3	**Coupled circuits:** Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modeling of coupled circuits, Solution of problems.	3	
4	**Laplace transforms:** Impulse, Step & Sinusoidal response of RL, RC, and RLC circuits. Transient analysis of different electrical circuits with and without initial conditions. Concept of Convolution theorem and its application. Solution of Problems with DC & AC sources.	8	
5	**Fourier method of waveform analysis:** Fourier series and Fourier Transform (in continuous domain only). Application in circuit analysis, Solution of Problems	6	
6	**Network Theorems:** Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis. Network theorem: Superposition, Thevenin's, Norton's & Maximum power transfer theorem. Millman's theorem and its application in three phase unbalanced circuit analysis. Solution of Problems with DC & AC sources.	8	

7	**Two port networks analysis:** Open circuit Impedance & Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations. Driving point impedance & Admittance. Solution of Problems	4	
8	**Filter Circuits:** Analysis and synthesis of Low pass, High pass, Band pass, Band reject, All pass filters (first and second order only) using operational amplifier. Solution of Problems	4	

Text books:

1. Networks & Systems, Ashfaq Husain, Khanna Book Publishing, New Delhi
2. Networks and Systems, D. Roy Chowdhury, New Age International Publishers
3. Network Analysis and Synthesis, C.L. Wadhwa, New Age International Publishers
4. Circuit and Networks: Analysis and synthesis, A. Sudhakar & S.S. Palli4th edition. Tata Mc Graw Hill Education Pvt. Ltd.
5. Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai & Co Pvt. Ltd.

Reference books

1. Network Analysis, M.E. Valkenburg, Pearson Education .
2. Fundamental of Electric circuit theory, D. Chattopadhay & P.C. Rakshit, S. Chand
3. Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly & S.M. Durbin, The Mc Graw Hill Company.
4. Problems and Solutions of Electric Circuit Analysis, R.K. Mehta & A.K. Mal, CBS, New Delhi

Course Outcome: After completion of this course, the learners will be able to

1. describe different type of networks, sources and signals with examples.
2. explain different network theorems, coupled circuit and tools for solution of networks.
3. apply network theorems and different tools to solve network problems.
4. select suitable techniques of network analysis for efficient solution.
5. estimate parameters of two-port networks and design filter circuits.

Name of the course		**ANALOG ELECTRONICS**	
Course Code: PC-EE 302		**Semester: 3rd**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 2 hrs/week		Attendance: 05 Marks	
Credit Points: 3+1		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the structure and properties of different components of analog electronics.		
2.	To explain principle of operation of analog electronics components and circuits.		
3.	To understand the application of operational amplifier		
4.	To solve problems of analog electronic components and circuits		
5.	To analyze amplifiers, oscillators and other analog electronic circuits.		
Pre-Requisite			
1.	Physics (10+2)		
Unit	Content	Hrs	Marks
1	**Filters & Regulators**: Review of half wave and full wave rectifier**,** Capacitor filters, π-section filter, ripple factor, series and shunt voltage regulator, percentage regulation.	4	
2	**BJT circuits:** Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits	8	
3	**MOSFET circuits:** MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common- source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.	8	
4	**Feed back amplifier & Oscillators:** Concept of Feed back, Negative & Positive feedback, Voltage/Current, Series/Shunt feedback, Berkhausen criterion, Colpit , Hartley's, Phase shift, Wien bridge, & Crystal oscillators.	5	
5	**Operational amplifier:** Ideal OPAMP, Differential amplifier, Constant current source (Current mirror etc), Level shifter, CMRR, Open & closed loop circuits, importance of feedback loop (positive & negative), inverting & non-inverting amplifiers, Voltage follower/Buffer circuits.	5	

6	**Application of Operational amplifiers:** Adder, Integrator & Differentiator, Comparator, Schmitt Trigger, Instrumentation Amplifier, Log & Antilog amplifier, Trans-conductance multiplier, Precision rectifier, Voltage to current &Current to voltage converter.	5	
7	**Power amplifier:** Class A, B, AB, C, Conversion efficiency	2	
8	**Multivibrator:** Monostable, Bistable multivibrator, Monostable & Astable operation using 555 timer.	2	
9	**Special function circuits:** VCO & PLL	2	

Text books:

1. Malvino—Electronic Principles , 6/e ,TMH
2. Nagrath, Electronics: Analog and Digital, PHI, 2004
3. Mottershed, Electronics Devices & Circuits, Wiley Eastern
4. Millman & Halkias – Integrated Electronics, Tata McGraw Hill.
5. Gayakwad R.A -- OpAmps and Linear IC's, 4/e, Pearson-PHI
6. Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e,TMH
7. Coughlin and Drisscol – Operational Amplifier and Linear Integrated Circuits – Pearson Education Asia.
8. A.K. Maini, Analog Electronics, Khanna Publishing House, 2019
9. L.K. Maheswari, Analog Electronics, Laxmi Publications

Reference books

1. Nagchoudhuri , Microelectronic Devices, 1/e, Pearson Education, 2001
2. Natarajan, Microelectronics: Analysis & Design, 1/e 2005, TMH
3. Maheshwari and Anand , Analog Electronics, PHI
4. Boyle'stead , Nashelsky: & Kishore, Electronic Devices & Circuit theory, 1/e, PHI/Pearson.
5. Millman & Halkias: Basic Electronic Principles; TMH.
6. Tobey & Grame – Operational Amplifier: Design and Applications, Mc Graw Hill.

Course Outcome: After completion of this course, the learners will be able to

1. describe analog electronic components and analog electronics circuits
2. explain principle of operation of analog electronic components, filters, regulators and analog electronic circuits.
3. compute parameters and operating points of analog electronic circuits.
4. determine response of analog electronic circuits.
5. distinguish different types amplifier and different types oscillators based on application and construct operational amplifier based circuits for different applications.

Name of the course		**INDIAN CONSTOTUTION**	
Course Code: MC-EE 301		**Semester: 3rd**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 0		End Semester Exam: 70 Marks	
Objective:			
1.	To have basic knowledge about Indian Constitution.		
2.	To understand the structure and functioning of union, state and local self-government.		
3.	To understand the structure, jurisdiction and function of Indian judiciary.		
Pre-Requisite			
1.	NIL		
Unit	Content	Hrs	Marks
1	**Indian Constitution:** Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy	5	
2	**Union government and its administration:** Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. **State government and its administration:** Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions	10	
3	**Supreme court:** Organization of supreme court, procedure of the court, independence of the court, jurisdiction and power of supreme court. **High court:** Organization of high court, procedure of the court, independence of the court, jurisdiction and power of supreme court. **Subordinate courts:** constitutional provision, structure and jurisdiction. National legal services authority, Lok adalats, family courts, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features of PIL, scope of PIL, principle of PIL, guidelines for admitting PIL	10	
4	**Local Administration:**	10	

	District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.		

Text books:

1. Indian polity, M, Laxmikanth, MC Graw Hill education, 5th Edition.

Reference books

1. DD Basu, " Introduction to the constitution of India", 21st Edition, Lexis Nexis Books Publication ltd, India

Course Outcome: After completion of this course, the learners will be able to

1. describe
    - different features of Indian constitution..
    - power and functioning of Union, state and local self-government.
    - structure, jurisdiction and function of Indian Judiciary.
    - basics of PIL and guideline for admission of PIL.
    - Functioning of local administration starting from block to Municipal Corporation.
2. identify authority to redress a problem in the profession and in the society.

OmDayal Group of Institutions

Department of Mechanical Engineering

Subject Code: ES-EE-401	Category: **Professional Core courses**
Subject Name: THERMAL POWER ENGINEERING	Semester: **IV**
L-T-P: **3-0-0**	Credit:**3**

Course Objectives:

1. To learn the principle of operation of different types of boilers and Turbines
2. To learn the principle of operation of IC engines and Gas turbines
3. To acquire problem solving skills to solve problems of boilers, turbines, IC engines and Gas turbines

Course Content:

Module No	Description of Topic	Contact Hrs.
1	**Boilers:** Water Tube & Fire Tube boilers, Circulating Principles, Forced Circulation, Critical pressure, Super heaters, Reheaters, attemperators, induced draught, forced draught and secondary air Fans, Boiler performance analysis and heat balance. Combustion Systems, Environmental Protection – ESP, Cyclone Separator, Dust Collector etc.	12
2	**Turbines:** Rotary Thermodynamic devices – Steam turbines & their classifications – Impulse & Reaction type Turbines, Thermodynamics of compressible fluid-flow, equation and continuity – Isentropic flow through nozzles, velocity diagram, Blade efficiency, optimum velocity ratio, multi-staging, velocity & pressure compounding, losses in turbines, erosion of turbine blades, turbine governing, performance analysis of turbine, Condensing system.	12
3	IC Engines: IC Engines – classification, Analysis of a standard cycle, fuel characteristic of SI & CI Engine, Combustion, Engine performance Automotive Engine exhaust emission and their control	6
4	Gas Turbines: Gas turbine Analysis – Regeneration - Reheating, Isentropic efficiency Combustion efficiency.	5

Course Outcomes:

After completion of this course, the learners will be able to

1. Describe the function of different components boilers. Engines and turbines and solve numerical problems of boilers, turbines, and Gas turbines. Analyze the performance of boilers, engines and turbines. Also determine efficiency of boilers, engines and turbines.
2. Explain the principle of operation of different types of boilers, turbines, IC engines and Gas turbines.
3. Describe the function of different components of IC engines
4. Explain methods to control boiler, engines and turbines parameters and Gas Turbines.

OmDayal Group of Institutions

Department of Chemistry

Subject Code: **MC-EE-401**	Category: Basic Science Courses
Subject Name: Environmental Science	Semester: **IV**
L-T-P: **3-0-0**	Credit: **0**

Course Objectives:

The students will be able to understand the environment and its relationships with human activities and apply the fundamental knowledge of science and engineering to assess environmental and health risk. It will also help students to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues and acquire the skill to solve problem related to environment and pollution

Course Content:

Module No	Description of Topic	Contact Hrs.
1	Basic ideas of environment, basic concepts, man, society &environment, their interrelationship Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non- renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering	06
2	Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur] Biodiversity- types, importance, Endemic species, Biodiversity Hot- spot, Threats to biodiversity, Conservation of biodiversity.	06
3	Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems. Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L) Atmospheric dispersion:	11

	Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussianplume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).	
4	Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiarytreatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic	09
5	Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.	03

Course Outcomes:

After completion of this course, the learners will be able to

1. understand the natural environment and its relationships with human activities
2. apply the fundamental knowledge of science and engineering to assess environmental and healthrisk
3. develop guidelines and procedures for health and safety issues obeying the environmental lawsand regulations
4. acquire skills for scientific problem-solving related to air, water, noise & land pollution.

Semester-IV

Name of the course		**ELECTRIC MACHINE-I**	
Course Code: PC-EE-401		**Semester: 4th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To review the concept of magnetic fields and magnetic circuits		
2.	To learn the principle of production of electromagnetic force and torque.		
3.	To learn the basic principle of operation of DC machine		
4.	To learn the principle of operation and characteristics of DC motor and generator		
5.	To learn the principle of operation, connections and different tests on Transformers		
6.	To acquire problem solving skills to solve problems of DC machines and Transformers		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Circuit Theory (PC-EE-301)		
3.	Electromagnetic Field Theory (PC-EE-303)		
Unit	**Content**	**Hrs**	**Marks**
1	**Magnetic fields and magnetic circuits:** Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.	3	
2	**Electromagnetic force and torque:** B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency	5	
3	**DC machines:** Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an	8	

	armature coil. Armature winding and commutation – Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.		
4	**DC machine - motoring and generation:** Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines	7	
5	**Transformers:** Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.	12	

Text books:

1. Electrical Machines-I, P.S. Bimbhra, Khanna Publishing House (AICTE)
2. Electrical Machinery, P.S. Bimbhra, 7th Edition, Khanna Publishers
3. Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited
4. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, 2nd edition, Dhanpat Rai Publication.

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Reference books:

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electrical Machines, R.K. Srivastava, Cengage Learning
3. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition.
4. The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors.
5. Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India

Course Outcome:

After completion of this course, the learners will be able to

1. describe the function of different components of magnetic circuit, DC machines and transformers
2. explain the principle of operation of different types of DC machines and transformers
3. solve numerical problems of DC machines and transformers.
4. estimate the parameters and efficiency of transformer.
5. determine the characteristics of DC machines and recommend methods to control output of DC machines.

Name of the course		**DIGITAL ELECTRONICS**	
Course Code: PC-EE-402		**Semester: 4th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To learn the fundamentals of Digital systems and principle of operation of Logic families.		
2.	To learn the principle of operation of Combinational digital circuits.		
3.	To learn the principle of operation of sequential circuit and systems.		
4.	To learn the principle of operation of A/D and D/A converter		
5.	To learn the principle of operation of semiconductor memories and Programmable logic devices.		
6.	To acquire problem solving skills to solve problems of Digital circuits		
Pre-Requisite			
1.	Analog Electronics (PC-EE-302)		
Unit	**Content**	**Hrs**	**Marks**
1	**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.	7	
2	**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, simplification of Logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.	7	
3	**Sequential circuits and systems:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D types flipflops, applications of flipflops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of	7	

	counters.		
4	**A/D and D/A Converters:** Digital to analog converters: weighted resistor/converter, R-2R Ladder, D/A converter, specifications for D/A converters, examples of D/A converter, lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.	7	
5	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM), content addressable memory (CAM), charge de coupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).	7	

Text books:

1. Digital Principles & Application, 5th Edition, Leach & Malvino, Mc Graw Hill Company.
2. Modern Digital Electronics, 4th Edition, R.P. Jain. Tata Mc Graw Hill Company Limited
3. Fundamental of Digital Circuits, A. Anand Kumar, 4th Edition, PHI.
4. Digital Electronics, R. Anand, Khanna Publishing House (2018).

Reference books:

1. Digital Logic Design, Morries Mano, PHI.
2. Digital Integrated Electronics, H. Taub & D. Shilling, Mc Graw Hill Company.
3. Digital Electronics, James W. Bignell & Robert Donovan, Thomson Delman Learning.
4. Fundamental of logic Design, Charles H. Roth, Thomson Delman Learning.

Course Outcome:

After completion of this course, the learners will be able to

1. describe the function of different building blocks of digital electronics, semiconductor memories and programmable logic devices.
2. explain the principle of operation of combinational and sequential digital circuits, A/D and D/A converter
3. solve numerical problems of Boolean algebra, number system, combinational & sequential digital circuits and A/D and D/A converter.
4. specify applications of combinational and sequential digital circuits.
5. determine specifications of different digital circuits and design combinational and sequential digital circuits

Name of the course		**ELECTRICAL & ELECTRONICS MEASUREMENTS**	
Course Code: PC-EE-403		**Semester: 4th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To learn methods of measurement, errors in measurement and its classification.		
2.	To learn the principle of operation of analog and digital meters.		
3.	To learn the basic principle of operation of instrument transformers.		
4.	To learn the principle of operation of cathode ray oscilloscope and different sensors and transducers.		
5.	To learn the principle of measurement of power, energy and different electrical parameters		
6.	To acquire problem solving skills to solve problems on the topics studied.		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Circuit Theory (PC-EE-301)		
Unit	**Content**	**Hrs**	**Marks**
1	**Measurements:** • Method of measurement, Measurement system, Classification of instruments, Definition of accuracy, Precision, Resolution, Speed of response, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments. **Analog meters:** • General features, Construction, Principle of operation and torque equation of Moving coil, Moving iron, Electrodynamometer, Induction instruments , Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges and multipliers.	7	
2	**Instrument transformer:** • Disadvantage of shunt and multipliers, Advantage of Instrument transformers, Principle of operation of Current & Potential transformer, errors. **Measurement of Power:** • Principle of operation of Electrodynamic & Induction type wattmeter, Wattmeter errors **Measurement of Energy:** • Construction, theory and application of AC energy meter, testing of energy meters.	9	
3	**Measurement of resistance:** • Measurement of medium, low and high resistances, Megger **Potentiometer:** • Principle of operation and application of Crompton's DC potentiometer, Polar and Co-ordinate type AC potentiometer, applications	8	

	AC Bridges: • Measurement of Inductance, Capacitance and frequency by AC bridges		
4	**Cathode ray oscilloscope (CRO):** • Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO. **Electronic Instruments:** • Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator, Digital Storage oscilloscope.	7	
5	**Sensors & Transducers:** • Introduction to sensors & Transducers, Strain gauge, LVDT, Temperature transducers, Flow measurement using magnetic flow measurement.	4	

Text books:

1. A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
2. Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing
3. Sensors & Transducers, D. Patranabis, PHI, 2nd edition.

Reference books:

1. Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.
2. Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
3. Modern Electronic instrumentation & Measuring instruments, A.D. Heltric & W.C. Copper, Wheeler Publication
4. Instrument transducers, H.K.P. Neubert, Oxford University press.
5. All-in One Electronics Simplified, A.K. Maini, Khanna Book Publishing Co. (2018)

Course Outcome:

After completion of this course, the learners will be able to

1. explain the terms accuracy, precision, resolution, speed of response, errors in measurement, loading effect
2. describe methods of measurement of power, energy by instruments and resistance, capacitance and inductance by bridges and potentiometer
3. explain the principle of operation of analog meters, instrument transformer, digital multimeter, digital voltmeter, digital frequency meter, signal generator, strain gauge, LVDT and temperature transducers

4. explain the different building block, principle of operation of oscilloscope and measurement techniques of voltage, current, frequency and phase by oscilloscope
5. solve numerical problems related to analog meters, instrument transformer, measurement of power, energy, resistance, inductance and capacitance. specify applications of analog and digital measuring instruments, sensors and transducers

Name of the course		**VALUES AND ETHICS IN PROFESSION**	
Course Code: HM-EE-401		**Semester: 4th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To inculcate Human values to grow as a responsible human beings with a proper personality.		
2.	To instill Professional Ethics to maintain ethical conduct and discharge professional duties.		
Pre-Requisite			
1.	Not applicable		
Unit	**Content**	**Hrs**	**Marks**
1	**Human values:** Morals, Values, and Ethics – Integrity –Trustworthiness – Work Ethics – Service-Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self-confidence – Spirituality- Character.	5	
2	**Principles for harmony:** Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties – Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness	5	
3	**Engineering ethics and social experimentation:** History of Ethics – Need of Engineering Ethics – Senses of Engineering Ethics- Profession and Professionalism —Self Interest – Moral Autonomy – Utilitarianism – Virtue Theory – Uses of Ethical Theories – Deontology- Types of Inquiry –Kohlberg's Theory – Gilligan's Argument – Heinz's Dilemma – Comparison with Standard Experiments — Learning from the Past – Engineers as Managers – Consultants and Leaders – Balanced Outlook on Law – Role of Codes – Codes and Experimental Nature of Engineering.	8	
4	**Engineers' responsibility towards safety and risk for sustainable development:** The concept of Safety – Safety and Risk – Types of Risks – Voluntary v/s Involuntary Risk – Consequences – Risk Assessment –Accountability – Liability – Reversible Effects – Threshold Levels of Risk – Delayed v/s Immediate Risk – Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.	5	
5	**Engineers' duties and rights:** Concept of Duty – Professional Duties – Collegiality – Techniques for Achieving Collegiality – Senses of Loyalty – Consensus and Controversy – Professional and Individual Rights – Confidential and		

	Proprietary Information – Conflict of Interest-Ethical egoism – Collective Bargaining – Confidentiality – Gifts and Bribes – Problem solving-Occupational Crimes- Industrial Espionage- Price Fixing-Whistle Blowing.	7	
6	**Global issues:** Globalization and MNCs –Cross Culture Issues – Business Ethics – Media Ethics – Environmental Ethics – Endangering Lives – Bio Ethics – Computer Ethics – War Ethics – Research Ethics - Intellectual Property Rights.	5	

Text books:

1. Professional Ethics & Human Values, Premvir Kapoor, Khanna Publishing House, Delhi (AICTE Recommended Textbook).
2. A text book on professional Ethics & Human values, R.S. Naagarazan, New Age international Publishing.
3. Engineering Ethics, M. Govindarajan, S. Natarajan , V.S. Senthilkumar, Prentice Hall India.
4. Human value and professional Ethics, Jayshree Suresh, B.S. Raghvan, S. Chand Publishing

Reference books:

1. Ethics in Science and Engineering, James G. Speight & Russel Foote, Wiley.

Course Outcome:

After completion of this course, the learners will be able to

1. illustrate different aspects of human values, ethics, engineers' responsibility and duties
2. explain different principles, different theories and laws of engineering ethics and social experimentation
3. identify different factors in the light of Engineers' responsibility towards safety and risk
4. correlate ethics of different work environment.
5. explain the need for intellectual property rights.

Semester-
V

Name of the course		**ELECTRIC MACHINE-II**	
Course Code: PC-EE-501		**Semester: 5th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the arrangement of windings of AC machines.		
2.	To understand the principle of production of pulsating and revolving magnetic fields.		
3.	To understand the principle of operation and characteristics of three phase Induction machines		
4.	To understand the principle of operation and characteristics of single phase Induction machines		
5.	To understand the principle of operation and characteristics of synchronous machine		
6.	To understand the principle of operation and characteristics of special electromechanical devices.		
7.	To solve problems of Induction machines, synchronous machines and special eletromechanical devices.		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Circuit Theory (PC-EE-301)		
3.	Electromagnetic field theory (PC-EE-303)		
4.	Electric Machine-I (PC-EE-401)		
Unit	**Content**	**Hrs**	**Marks**
1	**Fundamentals of AC machine windings:** Physical arrangement of windings in stator and cylindrical rotor; slots for windings; single-turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis,3D visualization of the above winding types, Air-gap MMF distribution with fixed current through winding-concentrated and distributed, Sinusoidally distributed winding, winding distribution factor	5	
2	**Pulsating and revolving magnetic fields:** Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.	5	
3	**Induction Machines:** Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.	10	
	Single-phase induction motors:		

4	Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications	5	
5	**Synchronous machines:** Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.	10	
6	**Special Electromechanical devices:** Principle and construction of switched Reluctance motor, Permanent magnet machines, Brushless DC machines, Hysteresis motor, Stepper motor, Tacho generators.	5	

Text books:

1. Electrical Machines -II , P.S. Bimbhra, Khanna Book Publishing House.
2. Electrical Machinery, P.S. Bimbhra, Khanna Publishing House.
3. Electrical Machines, Nagrath & Kothary, TMH
4. Electrical Machines, P.K. Mukherjee and S. Chakravorti, Dhanpat Rai Publications.
5. Electrical Machines, Theory & Applications, M.N. Bandyopadhyay, PHI

Reference books:

1. Electric Machinery & Transformer, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electric Machinery & Transformes, Irving L. Kosow, PHI
3. Electric Machinery, A.E.Fitzgerald, Charles Kingsley,Jr. & Stephen D. Umans, 6th Edition, Tata McGraw Hill Edition.
4. Electrical Machines, R.K. Srivastava, Cengage Learning
5. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition
6. The performance and Design of Alternating Current Machines, M.G.Say, CBS publishers & distributors
7. Electric Machines, Charles A. Gross, CRC press.
8. Problems in Electrical Engineering, Parker smith, 9th Edition, CBS publishers & distributors.

Course Outcome:

After completion of this course, the learners will be able to

1. describe the arrangement of winding of AC machines.
2. explain the principle of operation of Induction machines, Synchronous machines and special machines.
3. solve numerical problems of Induction machines, Synchronous machines and Special machines.
4. estimate the parameters and efficiency of Induction machines and Synchronous machines.
5. determine the characteristics of Induction machines and Synchronous machines. select appropriate methods for starting , braking and speed control of Induction machines.

Name of the course		**POWER SYSTEM-I**	
Course Code: PC-EE-502		**Semester: 5th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the basic principle of generation of Electricity from different sources		
2.	To find parameters and characteristics of overhead transmission lines and cables.		
3.	To find different parameters for the construction of overhead transmission line		
4.	To determine the performance of transmission lines.		
5.	To understand the principle tariff calculation.		
6.	To solve numerical problems on the topics studied.		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Circuit Theory (PC-EE-301)		
3.	Electromagnetic field theory (PC-EE-303)		
Unit	**Content**	**Hrs**	**Marks**
1	**Basic Concepts:** Evolution of Power System and present day Scenario. Structure of power system: Bulk power grid and Micro Grid. **Generation of Electric Power:** General layout of a typical coal fired power station, Hydro electric power station, Nuclear power station, their components and working principles, comparison of different methods of power generation. Introduction to Solar & Wind energy system. **Indian Electricity Rule-1956:** General Introduction.	10	
2	**Overhead transmission line:** Choice of frequency, Choice of voltage, Types of conductors, Inductance and Capacitance of a single phase and three phase symmetrical and unsymmetrical configurations. Bundle conductors. Transposition. Concept of GMD and GMR. Influence of earth on conductor capacitance. **Overhead line construction:** Line supports, Towers, Poles, Sag, Tension and Clearance, Effect of Wind and Ice on Sag. Dampers. **Corona:** Principle of Corona formation, Critical disruptive voltage, Visual critical corona discharge potential, Corona loss, advantages & disadvantages of Corona. Methods of reduction of Corona.	12	
3	**Insulators:** Types, Voltage distribution across a suspension insulator string, String efficiency, Arching shield & rings, Methods of improving voltage distribution across Insulator strings, Electrical tests on line Insulators.	05	

4	**Cables:** Types of cables, cable components, capacitance of single core & 3 core cables, dielectric stress, optimum cable thickness, grading, dielectric loss and loss angle.	04	
5	**Performance of lines:** Short, medium (nominal, T) and long lines and their representation. A.B.C.D constants, Voltage regulation, Ferranti effect, Power equations and line compensation, Power Circle diagrams.	06	
6	**Tariff:** Guiding principle of Tariff, different types of tariff.	03	

Text book:

1. Electrical Power System, Subir Roy, Prentice Hall
2. Power Systems, A. Ambikapathy, Khanna Publishing House
3. Power System Engineering, Nagrath & Kothery, TMH
4. Elements of power system analysis, C.L. Wodhwa, New Age International.
5. Electrical Power System, Ashfaq Hussain, CBS Publishers & Distributors

Reference books

1. Electric Power transmission & Distribution, S.Sivanagaraju, S.Satyanarayana,, Pearson Education.
2. A Text book on Power system Engineering, Soni, Gupta, Bhatnagar & Chakrabarti, Dhanpat Rai & Co.
3. Electric Power distribution system Engineering, 2nd Edition, T. Gonen, CRC Press.
4. www.powermin.nic.in/acts_notification/pdf/ier**1956**.pdf

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of generation of Electric power from different sources
2. determine parameters of transmission lines and its performance
3. explain the principle of formation of corona and methods of its reduction
4. conduct electrical tests on insulators and solve numerical problems related to overhead transmission line, cable, insulators and tariff
5. analyze overhead transmission line based on short medium and long lines.

Name of the course		**CONTROL SYSTEM**	
Course Code: PC-EE-503		**Semester: 5th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs./week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To find mathematical representation of LTI systems.		
2.	To find time response of LTI systems of different orders		
3.	To find the frequency response of LTI systems of different orders		
4.	To understand stabilityof differentLTI systems.		
5.	To analyze LTIsystems with state variables.		
6.	To solve problems of mathematical modelling and stability of LTI systems		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Circuit Theory (PC-EE-301)		
3.	Electromagnetic field theory (PC-EE-303)		
4.	Electric Machine-I (PC-EE-401)		
Unit	**Content**	**Hrs**	**Marks**
1	**Introduction to control system:** Concept of feedback and Automatic control, Effects of feedback,Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts ofsensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples offeedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Propertiesof Transfer function.	04	
2	**Mathematical modeling of dynamic systems:** Translational systems, Rotational systems, Mechanicalcoupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagramrepresentation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and ACtacho-generators. Actuators. Block diagram level description of feedback control systems for positioncontrol, speed control of DC motors, temperature control, liquid level control, voltage control of anAlternator.	08	
3	**Time domain analysis:** Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. **Error Analysis:** Steady state errors in control systems due to step,	08	

	ramp and parabolic inputs. Concepts of system types and error constants.		
4	**Stability Analysis:** Root locus techniques, construction of Root Loci for simple systems. Effects ofgain on the movement of Pole and Zeros. **Frequency domain analysis of linear system:** Bode plots, Polar plots, Nichols chart, Concept ofresonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase andgain margin. Determination of margins in Bode plot. Nichols chart. M-circle and M-Contours inNichols chart.	10	
5	**Control System performance measure:** Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, PI, PD and PID control.	05	
6	**State variable Analysis:** Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.	10	

Text books:

1. Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education
2. Control System Engineering, I. J. Nagrath & M. Gopal. New AgeInternational Publication.
3. Control System Engineering, D. Roy Choudhury, PHI
4. Control System, A. Ambikapathy, Khanna Publishing House
5. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI

Reference books

1. Control Engineering Theory & Practice, Bandyopadhyaya, PHI
2. Control systems, K.R. Varmah, Mc Graw hill
3. Control System Engineering, Norman Nise, 5th Edition, John Wiley & Sons
4. Modern Control System, R.C. Dorf & R.H. Bishop, 11th Edition, PearsonEducation.
5. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado.E. Mario, PHI
6. Modeling & Control of dynamic system, Macia&Thaler, Thompson
7. Modern Control Technology Components & Systems, 3rd edition, C.T Kilian,Cengage Learning
8. Modern Control Engineering, Y. Singh & S. Janardhanan, Cengage Learning
9. Control System Engineering, R. Anandanatarajan& R. Ramesh Babu, ,SCITECH
10. Automatic Control system, A. William, Wolovich, Oxford

Course Outcome:

After completion of this course, the learners will be able to

1. developmathematical model of mechanical, electrical, thermal, fluid system and different control system components like servomotors, synchros, potentiometer, tacho-generators etc.
2. analyse stability of LTI system using routh-hurtwitz (RH) criteria, root locus techniques in time domain and bode plot and nyquist technique in frequency domain.
3. design different control law or algorithms like proportional control, proportional plus derivative(PD) control, proportional plus integration(PI) control, and proportional plus integration plus derivative (PID) control and compensators like lag, lead, lag-lead for LTI systems.
4. apply state variable techniques for analysis of linear systems and analyze the stability of linear discrete system.
5. solve numerical problems on LTI system modelling, responses, error dynamics and stability.

Name of the course	**POWER ELECTRONICS**
Course Code: PC-EE-504	**Semester: 5th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester Exam: 15 Marks
Tutorial: 0hr/week	Assignment & Quiz: 10 Marks
Practical: hrs./week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the functioning and characteristics of power switching devices.
2.	To understand the principle of operation of converters.
3.	To understand different triggering circuits and techniques of commutation of SCR
4.	To find external performance parameter of converters.
5.	To analyze methods of voltage control, improvement of power factor and reduction of harmonics of the converter
6.	To solve numerical problems of converters

Pre-Requisite	
1.	Electric Circuit Theory (PC-EE-301)
2.	Analog Electronics (PC-EE-302)
3.	Electromagnetic field theory (PC-EE-303)
4.	Digital Electronics (PC-EE-402)

Unit	**Content**	**Hrs**	**Marks**
1	**Introduction:** Concept of power electronics, application of power electronics, uncontrolled converters,advantages and disadvantages of power electronics converters, power electronics systems,power diodes, power transistors, power MOSFETS, IGBT and GTO.	04	
2	**PNPN devices:** Thyristors, brief description of members of Thyristor family with symbol, V-Icharacteristics and applications. Two transistor model of SCR, SCR turn on methods,switching characteristics, gate characteristics, ratings, SCR protection, series and paralleloperation, gate triggering circuits, different commutation techniques of SCR.	05	
3	**Phase controlled converters:** Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. External performance parameters of converters, techniques of power factor improvement, single phase and three phase dual converters	06	
	DC-DC converters:		

4	Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers.	05	
5	**Inverters:** Definition, classification of inverters based on nature of input source, wave shape of outputvoltage, method of commutation & connections. Principle of operation of single phase andthree phase bridge inverter with R and R-L loads, performance parameters of inverters,methods of voltage control and harmonic reduction of inverters.	10	
6	**Resonant Pulse Converters:** Introduction, Series Resonant inverter, Parallel Resonant inverter, Zero-Current Switching Resonant converters, Zero-Voltage Switching Resonant converter, Two quadrant Zero-Voltage Switching Resonant converter, Resonant DC link inverter.	05	
7	**Applications:** Speed control of AC and DC motors. HVDC transmission. Static circuit breaker, UPS,static VAR controller.	05	

Text books:

1. Power Electronics, M.H. Rashid,4th Edition, Pearson
2. Power Electronics, P.S. Bimbhra, Khanna Publishing House.
3. Power Electronics, V.R. Moorthi, Oxford.
4. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill.

Reference books

1. Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall
2. Power Electronics, Mohan,Undeland&Riobbins, Wiley India
3. Element of power Electronics, Phillip T Krein, Oxford.
4. Power Electronics systems, J.P. Agarwal, Pearson Education.
5. Analysis of Thyristor power conditioned motor, S.K. Pillai, University Press.
6. Power Electronics, M.S. Jamal Asgha, PHI.
7. Power Electronics : Principles and applications, J.M. Jacob, Thomson

Course Outcome:

After completion of this course, the learners will be able to

1. differentiate between signal level and power level devices.
2. construct triggering and commutation circuits of SCR.
3. explain the principle of operation of AC-DC, DC-DC and DC-AC converters.
4. analysethe performance of AC-DC, DC-DC and DC-AC converters.
5. apply methods of voltage control and harmonic reduction to inverters. solve numerical problems of switching devices, AC-DC, DC-DC and DC-AC converters.

Name of the course		**OBJECT ORIENTED PROGRAMMING**	
Course Code: OE-EE-501B		**Semester: 5th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs./week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand simple abstract data types		
2.	To understand features of object-oriented design such as encapsulation, polymorphism, inheritance		
3.	To understand common object-oriented design patterns		
4.	To design applications with an event-driven graphical user interface.		
Pre-Requisite			
1.	Programing for problem solving (ES-CS 201)		
Unit	**Content**	**Hrs**	**Marks**
1	Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.	08	
2	Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance.	08	
3	Inheritance in OO design. Design patterns. Introduction and classification. The iterator pattern.	08	
4	Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.	08	
5	Generic types and collections GUIs. Graphical programming with Scale and Swing . The software development process	08	

Text books:

1. Mastering Object-Oriented Programming Using C++, R.S. Salaria, Khanna Publishing House.
2. Object Oriented Modelling and Design,Rambaugh, James Michael, Blaha Prentice Hall India.
3. The complete reference-Java2, Patrick Naughton, Herbert Schildt, TMH
4. Core Java For Beginners, R.K. Das, VIKAS PUBLISHING
5. Java How to Program, Deitel and Deitel, 6th ED, Pearson

Reference books

1. Object Oriented System Development, Ali Bahrami, McGraw Hill.
2. Ivor Horton's Beginning Java 2 SDK – Wrox
3. Programming With Java: A Primer, E. Balagurusamy 3rd Ed., TMH

Course Outcome:

After completion of this course, the learners will be able to

1. specify simple abstract data types.
2. recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. apply common object-oriented design patterns
4. specify uses of common object oriented design patterns with examples.
5. design applications with an event-driven graphical user interface.

ame of the course		**POWER PLANT ENGINEERING**	
Course Code: PE-EE-501B		**Semester: 5th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Practical: hrs./week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand methods of selection of power plant and its economic.		
2.	To understand the principle of operation different types of power plants.		
3.	Tounderstand methods of site selection of different power plants.		
4.	To understand the cause of pollution and its remedy for power plants.		
5.	To understand methods of cooling of generators and transformers.		
6.	To solve numerical problems of load estimation, economics of power plants.		
Pre-Requisite			
1.	Electric Circuit Theory (PC-EE-301)		
2.	Electromagnetic field theory (PC-EE-303)		
3.	Electric Machine-I (PC-EE-401)		
4.	Electrical and Electronics measurement (PC-EE-403)		
Unit	**Content**	**Hrs**	**Marks**
1	**Introduction:** Power and energy, sources of energy, review of thermodynamic cycles related to powerplants, fuels and combustion calculations.Load estimation, load curves, various terms and factors involved in power plantcalculations. Effect of variable load on power plant operation, Selection of power plant. **Power plant economics and selection**: Effect of plant type on costs, rates, fixed elements, energy elements, customer elements andinvestor's profit; depreciation and replacement, theory of rates. Economics of plantselection, other considerations in plant selection.	08	
2	**Steam power plant:** General layout of steam power plant, Power plant boilers including critical and supercritical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systemssuch as coal handling system, pulverizers and coal burners, combustionsystem, draft, ash handling system, Dust collection system, Feed water treatment andcondenser and cooling towers and cooling ponds, Turbine auxiliary systems such asgoverning, feed heating, reheating, flange heating and gland leakage. Operation andmaintenance of steam power plant, heat balance and efficiency, Site selection of a steampower plant.	08	
	Diesel power plant:		

3	General layout, Components of Diesel power plant, Performance of diesel power plant, fuelsystem, lubrication system, air intake and admission system, supercharging system, exhaustsystem, diesel plant operation and efficiency, heat balance, Site selection of diesel powerplant, Comparative study of diesel power plant with steampower plant. **Gas turbine power plant:** Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels,cogeneration, auxiliary systems such as fuel, controls and lubrication, operation andmaintenance, Combined cycle power plants, Site selection of gas turbine power plant .	08	
4	**Nuclear power plant:** Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants. **Hydro electric station:** Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. **Non Conventional Power Plants:** Introduction to non-conventional power plants (Solar, wind, geothermal, tidal)etc.	10	
5	**Electrical system:** Generators and their cooling, transformers and their cooling.Instrumentation Purpose, classification, selection and application, recorders and their use,listing of various control rooms.Pollution due to power generation and its remedy	06	

Text books:

1. Power Plant Engineering, P.K. Nag, McGraw Hill.
2. Power Plant Engineering, F.T. Morse, Affiliated East-West Press Pvt. Ltd.
3. Power Plant Technology El-Vakil, McGraw Hill.

Reference books

1. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub.House.
2. An introduction to thermal power plant engineering and operation, P.K.Das and A.K. Das, Notion press.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of operational of Steam, Hydroelectric, Diesel, Gas turbine, Nuclear power and non-conventional power plant.
2. identifythe cause of pollution for power generation and its remedy.
3. suggest location to set up Steam, Hydroelectric, Diesel, Gas turbine and Nuclear power plant.
4. compare Steam, Hydroelectric, Diesel, Gas turbine, Nuclear power and non-conventional power plant.
5. suggest methods of maintenance of Steam, Gas and Hydroelectric power plants. solve numerical problems of load estimation and economics of power plants

Semester-VI

Name of the course		**POWER SYSTEM-II**	
Course Code: PC-EE-601		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the method of representation of power system components		
2.	To know about loacation and components of a distribution substation.		
3.	To understand different methods of load flow studies.		
4.	To determine faults in Electrical systems.		
5.	To understand the principle of power system stability.		
6.	To understand the principle of relays and methods of protection of power system		
7.	To solve numerical problems on the topics studied.		
Pre-Requisite			
1.	Electric Circuit Theory (PC-EE-301)		
2.	Electromagnetic field theory (PC-EE-303)		
3.	Power system-I (PC-EE-502)		
Unit	Content	Hrs	Marks
1	**Representation of Power system components:** Single-phase representation of balanced three phase networks, the one-line diagram and the impedance or reactance diagram, per unit (PU) system.	02	
2	**Distribution substation:** Types of substations, location of substations, substation equipments and accessories, earthling (system & equipment), feeder and distributors, radial and loop systems.	05	
3	**Load flow studies:** Network model formulation, formation of Ybus, load flow problem, Gauss-Siedel method, Newton-Raphson method, Decoupled load flow studies, comparison of load flow methods.	05	
4	**Faults in Electrical systems:** Transient on a transmission line, short circuit of a synchronous machine under no load & loaded condition. Symmetrical component transformation, sequence impedance and sequence network of power system, synchronous machine, transmission lines and transformers. Symmetrical component analysis of unsymmetrical faults, single line-to –ground fault, lineto-line fault, double line-to- ground fault	08	

	Power system stability: Steady state stability, transient stability,		

5	equal area criteria, swing equation, multi machine stability concept	04	
6	**Power system protection:** Protective zones, Relaying elements and quantities. Protective relays, basic requirements and type of protection, phase and amplitude comparator, grading (time & current), classification of Electromagnetic relays, Directional relay, Distant relay, Differential relay, basic aspects of static and digital relays, relay protection scheme for transformer, feeder, generators and motors. Circuit breakers, circuit breaking transients, transient recovery voltage, current chopping and resistance switching, circuit breaker rating, arc and arc extinction, circuit breaker types, oil circuit breaker, vacuum circuit breaker, air blast circuit breaker, SF6 circuit breaker and operating mechanism, advantages and disadvantages of different types	12	

Text book:

1. Modern Power System Analysis, D.P. Kothari & I.J. Nagrath, 4th Edition, Tata McGraw Hill.
2. Electrical Power Systems, Subir Ray, PHI
3. Switchgear protection and power systems, Sunil S Rao, Khanna Publications.
4. A text book on Power System Engineering, M.L.Soni, P.V.Gupta, U.S. Bhatnagar & A. Chakrabarti, Dhanpat Rai & CO.

Reference Books:

1. Protection & Switchgear, B. Bhalja, R.P. Maheshwari, N.G.Chothani, Oxford.
2. Power system protection & switchgear, B.Ram & D.N. Vishwakarma, Tata McGraw Hill.
3. Handbook of Electrical Power Distribution, G. Ramamurthy, University Press
4. Electric Power Transmission and Distribution, S. Sivanagaraju, S.Satyanarayana, Pearson Education.
5. Power Systems Stability, Vol. I,II & II, E.W. Kimbark, Wiley.
6. Power Engineering, D.P Kothari & I.J. Nagrath, Tata McGraw Hill.
7. Power Systems Analysis, A. R. Bergen & V. Vittal, Pearson Education. 8. Computer Aided Power systems analysis, Dr. G. Kusic, CEC press.

Course Outcome:

After completion of this course, the learners will be able to

1. Represent power system components in line diagrams.
2. Determine the location of distribution substation. Determine the performance of power system with the help of load flowv studies.
3. Analyse faults in Electrical systems. Determine the stabilty of Power system.
4. Explain principle of operation of different power system protection equipments.
5. Solve numerical problems related to representation, load flow, faults, stabilty and protection of power system.

Name of the course		**MICROPROCESSOR & MICRO CONTROLLER**	
Course Code: PC-EE-602		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the architecture of 8086 microprocessor.		
2.	To understand the design aspects of I/O and Memory Interfacing circuits.		
3.	To interface microprocessors with supporting chips.		
4.	To understand the architecture of 8051 microcontroller.		
5.	To design a microcontroller based system		
Pre-Requisite			
1.	Analog Electronics (PC-EE-302)		
2.	Digital Electronics (PC-EE-402)		
Unit	Content	Hrs	Marks
1	**The 8086 Microprocessor:** Introduction to 8086- Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.	08	
2	**8086 System bus structure:** 8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.	08	
3	**I/O INTERFACING**: Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller –DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.	08	
4	**Microcontroller:** Architecture of 8051 – Special Function Registers(SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.	08	
5	**Interfacing Microcontroller:** Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD & Keyboard Interfacing – ADC, DAC & Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation – Comparison	06	

	of Microprocessor, Microcontroller, PIC and ARM processors		

Text books:

1. Advanced Microprocessors and Peripheral, Koshor M Bhurchandi, Ajay Kumar Ray, 3rd Edition, MC Graw hill education.
2. Microprocessor & Interfacing, D.V. Hall, Mc Graw Hill.
3. The 8051 microcontroller, Ayala, Thomson.

Ref erence books:

1. Advanced Microprocessors, Y. Rajasree, New Age international Publishers.
2. An introduction to the Intel family of Microprocessors, James L. Antonakos, Pearson Education,
3. The 8051 Microcontroller and Embedded systems, Muhammad Ali Mazidi & J. G. Mazidi, Pearson Education.
4. The 8086 Microprocessors: Programming & Interfacing the PC, K.J.Ayala, Thomson.
5. Microprocessor & Peripherals, S.P. Chowdhury & S. Chowdhury, Scitech.
6. Microchip technology data sheet, www.microchip.comerence books

Course Outcome:

After completion of this course, the learners will be able to

1. explain the architecture of 8086 and 8051.
2. do assembly language programming of 8086, 8051
3. interface different peripheral with 8086 and 8051
4. develop micro processor/ microcontroller based systems.
5. compare microprocessor, microcontroller, PIC and ARM processors

Name of the course		**DIGITAL CONTROL SYSTEM**	
Course Code: PE-EE-601A		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the principle of sampling and reconstruction of signals.		
2.	To find Z-tranaform and inverse Z-transform of systems.		
3.	To carry out the analysis and design of digital control systems		
4.	To design compensators for digital control system to achieve desired specifications.		
5.	To represent digital control systems using state space models.		
6.	To analyze the effect sampling on stability, controllability and observability.		
7.	To design digital controllers for industrial applications.		
8.	To solve numerical problems on the topics studied.		
Pre-Requisite			
1.	Control system (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Sampling and reconstruction:** Introduction, Examples of Data control systems – Digital to Analog conversion and Analog to Digital conversion, sample and hold operations.	03	
2	**Z-transform:** Introduction, Linear difference equations, pulse response, Z – transforms, Theorems of Z – Transforms, the inverse Z – transforms, Modified Z- Transforms	05	
3	**Z- Plane analysis of discrete-time control system:** Z-Transform method for solving difference equations; Pulse transforms function, block diagram analysis of sampled – data systems, mapping between s-plane and z-plane.	05	
4	**State space analysis:** State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving discrete time state space equations, State transition matrix and it's Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations.	06	
5	**Controllability and observability:** Concepts of Controllability and Observability, Tests for controllability and Observability. Duality between Controllability and Observability, Controllability and Observability conditions for Pulse Transfer Function	04	
6	**Stabilty analysis:** Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips – Constant frequency loci, Constant damping ratio loci, Stability Analysis of	05	

	closed loop systems in the Z-Plane. Jury stablility test – Stability Analysis by use of the Bilinear Transformation and Routh Stability criterion.		
7.	**Design of discrete time control system by conventional methods:** Transient and steady – State response Analysis – Design based on the frequency response method – Bilinear Transformation and Design procedure in the w-plane, Lead, Lag and Lead-Lag compensators and digital PID controllers.	06	
8.	**State feedback controllers and observers:** Design of state feedback controller through pole placement – Necessary and sufficient conditions, Ackerman's formula. State Observers – Full order and Reduced order observers.	05	

Text book:

1. Digital Control and State Variable Methods , M. Gopal, TMH Publishers
2. Discrete-time Control Systems, K. Ogata, Pearson Education,
3. Digital Control Systems, B.C. Kuo, Wiley Publications.
4. Control System Engineering, I.J. Nagrath, M. Gopal, New age International.

Reference books

1. Digital control of dynamic systems, Gene F. Franklin, J. David Powell, and Michael Workman 3rd ed, 1998, Addison-Wesley.
2. Digital Control Systems, design, identification and implementation, Landau**,** Ioan Doré**,** Zito**,** Gianluca, Springer-Verlag London.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the principle of sampling and reconstrction of analog signal.
2. perform Z-transformation and inverse Z-tranaformation of systems.
3. analyse and design digital control systems. design compensators for digital control system to achieve desired specifications.
4. represent digital control systems using state space models.
5. analyze the effect sampling on stability, controllability and observability.

Name of the course		**ELECTRICAL MACHINE DESIGN**	
Course Code: PE-EE-601C		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the baisc principle of design of Electric machines.		
2.	To understand basics of design of Transformer, Induction machine and Synchronous machines.		
3.	To understand different factors that influence design of Electric machines.		
4.	To undertand the need and use software tools for design of Electric machines		
5.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Electric Machine-I (PC-EE-401)		
2.	Electric Machine-II (PC-EE-501)		
Unit	Content	Hrs	Marks
1	**Introduction:** Major considerations in Electrical Machine Design - Electrical Engineering Materials – Space factor – Choice of Specific Electrical and Magnetic loadings - Thermal considerations - Heat flow – Temperature rise and Insulating Materials - Rating of machines – Standard specifications.	04	
2	**Transformer:** Output Equations – Main Dimensions - kVA output for single and three phase transformers – Window space factor – Design of core and winding – Overall dimensions – Operating characteristics – No load current – Temperature rise in Transformers – Design of Tank - Methods of cooling of Transformers.	10	
3	**Induction motors:** Output equation of Induction motor – Main dimensions – Choice of Average flux density – Length of air gap- Rules for selecting rotor slots of squirrel cage machines – Design of rotor bars & slots – Design of end rings – Design of wound rotor – Magnetic leakage calculations – Leakage reactance of polyphase machines- Magnetizing current - Short circuit current – Operating characteristics- Losses and Efficiency.	10	
4	**Synchronous machines:** Output equations – choice of Electrical and Magnetic Loading – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Armature parameters – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field mmf – Design of field winding – Design of turbo alternators – Rotor design.	10	
	Computer aided Design (CAD): Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid	05	

	methods, design optimization methods, variables, constraints and objective function, problem formulation.		

Text book:

1. A Course in Electrical Machine Design, A.K. Sawhney, Dhanpat rai and sons.
2. Electrical machine design, V. rajini, V.S. Nagarajan, Pearson India education services Pvt. Ltd.
3. Computer Aided Design of Electrical Machine, K. M. V. Murthy, B.S. Publications.

Reference books

1. Design and Testing of Electrical Machines, M.V.Deshpande, PHI
2. Principles of Electrical Machine Design, 3rd Edition, S.K. sen, Oxf-Ibh
3. Computer Aided Design of Electrical Equipment, M. Ramamoorthy, East-West Press.

Course Outcome:

After completion of this course, the learners will be able to

1. specify the rating of electrical machines with standard specifications.
2. explain the principles of electrical machine design and carry out basic design of an ac machine
3. determine the various factors which influence the design of electrical, magnetic and thermal loading of electrical machines
4. explain the construction and performance characteristics of electrical machines.
5. use software tools to do design calculations.

Name of the course		**INDUSTRIAL ELECTRICAL SYSTEMS**	
Course Code: PE-EE-602C		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the electrical wiring systems with standard symbols , drawings and SLD for residential, commercial and industrial consumers		
2.	To understand various components of industrial electrical systems		
3.	To analyze and selec tthe proper size of various electrical system components		
4.	To understand methods of automation of Industrial Electrical Systems		
5.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Power system-I (PC-EE-502)		
2.	Control system (PC-EE-503)		
3.	Power Electronics (PC-EE-504)		
Unit	Content	Hrs	Marks
1	**Electrical System Components:** LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	06	
2	**Residential and Commercial Electrical Systems** :Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.	08	
3	**Illumination Systems** : Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.	06	
	Industrial Electrical Systems I: HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting		

4	of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.	06	
5	**Industrial Electrical Systems II:** DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.	06	
6.	**Industrial Electrical System Automation**: Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.	06	

Text book:

1. Electrical Wiring, Estimating & Costing, S. L. Uppal and G. C. Garg, Khanna publishers, 2008.
2. Electrical Design, Estimating & Costing, K. B. Raina, New age International, 2007.

Reference books

1. Electrical estimating and costing, S. Singh and R. D. Singh, Dhanpat Rai and Co., 1997.
2. Web site for IS Standards.
3. Residential Commercial and Industrial Systems, H. Joshi, McGraw Hill Education, 2008.

Course Outcome:

After completion of this course, the learners will be able to

1. Represent electrical wiring system for residential, commercial and industrial consumers.
2. Determine the rating of components of residential and commercial electrical systems.
3. Design lighting scheme for a residential and commercial premises.
4. Select transformer, switchgear, protection equipments for industrial electrical systems. explain methods of automation of Industrial Electrical Systems
5. Solve numerical problems related to earthing system, lighting scheme, power factor correction.

Name of the course		**DIGITAL SIGNAL PROCESSING**	
Course Code: OE-EE-601A		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand sampling and reconstruction of signal		
2.	To understand the method of Z-transform and inverse Z- transform of signal and its properties		
3.	To understand Discrete Fourier Transform		
4.	To understand methods of design of Digital filters		
5.	To understand applications of Digital signal processing		
6.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Electric circuit theory (PC-EE-301)		
2.	Control system (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Discrete-time signals and systems:** Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	06	
2	**Z-transform:** z-Transform, Region of convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z- transforms.	06	
3	**Discrete Fourier Transform :** Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	08	
4	**Design of Digital filters:** Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Bandstop and High- pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing	12	
	Applications of Digital Signal Processing: Correlation		

5	Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	06	

Text book:

1. Digital Signal Processing-A computer based approach, S. Mitra, TMH
2. Digital Signal Processing: Principles, Algorithms & Application, J.C. Proakis & M.G. Manslakis, PHI
3. Fundamental of Digital Signal Processing using MATLAB , Robert J. Schilling, S.L. Harris, Cengage Learning.

Reference books

1. Digital Signal Processing-implementation using DSP microprocessors with examples from TMS320C54XX, Avtar Singh & S. Srinivasan, Cengage Learning
2. Digital Signal Processing, Chen, OUP
3. Digital Signal Processing, Johnson, PHI
4. Digital Signal Processing using MATLAB, Ingle, Vikas.
5. Digital Signal Processing, Ifeachor, Pearson Education.
6. Digital Signal Processing, A.V. Oppenhein & R.W. Shaffer, PHI
7. Theory and application of Digital Signal Processing, L.R. Rabiner & B. Gold, PHI
8. Digital Signal Processing, Ashok Ambarder, Cengage Learning.
9. Digital Signal Processing, S. Salivahanan, A. Vallavaris & C. Gnanpruja, TMH.
10. Xilinx FPGA user manual and application notes.

Course Outcome:

After completion of this course, the learners will be able to

1. represent signals mathematically in continuous and discrete-time and in the frequency domain.
2. analyse discrete-time systems using z-transform.
3. explain the Discrete-Fourier Transform (DFT) and the FFT algorithms.
4. design digital filters for various applications.
5. apply digital signal processing for the analysis of real-life signals.

Name of the course		**COMMUNICATION ENGINEERING**	
Course Code: OE-EE-601B		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the AM, FM and PM schemes with reference to SNR		
2.	To understand the performance of ASK, FSK, PSK, BPSK, QPSK in a digital communication system		
3.	To understand the source coding and channel coding schemes for a given communication link		
4.	To understand the band width requirement and probability of error in various digital modulation systems		
5.	To understand various digital modulation methods		
6.	To solve numerical problems on the topics studied		
Pre-Requisite			
1.	Analog Electronics (PC-EE 302)		
2.	Digital Electronics (PC-EE 402)		
Unit	Content	Hrs	Marks
1	**Elements of communication system:** The elements of a communication system, origin of noise and its effect, importance of SNR in system design. Basic principle of linear (AM) modulation, Generation of AM waves, Demodulation of AM wave. Basic principle of nonlinear (FM, PM) modulation. Generation of FM waves. Demodulation of FM waves. Sampling theorem, sampling rate, impulse sampling, reconstruction from samples, Aliasing. Analog pulse modulation-PAM (natural & flat topped sampling), PWM, PPM. Basic concept of Pulse code modulation, Block diagram of PCM, Multiplexing-TDM, FDM.	12	
2	**Digital transmission:** Concept of Quantization & Quantization error, Uniform quantizer, Non-uniform quantizer, A-law and μ -law. Encoding, coding efficiency. Line coding & properties, NRZ & RZ, AMI, Manchester coding, PCM, DPCM. Base band pulse transmission, Matched filter, error rate due to noise, ISI, Raised cosine function, Nyquist criterion for distortion-less base band binary transmission, Eye pattern, Signal power in binary digital signal.	08	
3	**Digital carrier modulation & demodulation technique:** Bit rate, Baud rate, Information capacity, Shanon's limit, M-ary encoding, Introduction to the different digital modulation techniques- ASK.FSK, PSK, BPSK, QPSK, mention of 8 BPSK, 16 BPSK.	10	

	Introduction to QAM, basic of 8 QAM, 16 QAM. Basic concept of Delta modulating, Adaptive delta modulation. Introduction to the concept DPCM. Basic concept of spread spectrum modulation.		
4	**Introduction to coding theory:** Introduction, News value & Information content, Entropy, Mutual information, Information rate, Shanon-Fano algorithm for encoding, Shanon's theorem- source coding theorem, Channel coding theorem, Information capacity theorem. Basic principle of Error control & coding.	08	

Text book:

1. An Introduction to Analog and Digital communication, Simon Haykin, Wiely India.
2. Analog communication system, P. Chakrabarti, Dhanpat Rai & Co.
3. Principle of digital communication, P. Chakrabarti, Dhanpat Rai & Co.
4. Modern Digital and Analog Communication systems, B.P. Lathi, Oxford university press

Reference books

1. Digital and Analog communication Systems, Leon W Couch II, Pearson Education Asia.
2. Communication Systems, A.B. Calson, Mc Graw Hill.
3. Communication Systems, R. Anand, Khanna Publications.

Course Outcome:

After completion of this course, the learners will be able to

1. compare the performance of AM, FM and PM schemes with reference to SNR
2. explain noise as a random process and its effect on communication receivers
3. evaluate the performance of ASK, FSK, PSK, BPSK, QPSK in a digital communication system
4. identify source coding and channel coding schemes for a given communication link
5. analyze various digital modulation methods. compute band width requirement and probability of error in various digital modulation systems

Name of the course		**ECONOMICS FOR ENGINEERS**	
Course Code: HM-EE-601		**Semester: 6th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the process of economic decision making		
2.	To understand th basic financial management aspects		
3.	To develop the skills to analyze financial statements		
4.	To understand the basic of accounting		
Pre-Requisite			
1.	Basic understanding of Engineering processes		
Unit	Content	Hrs	Marks
1	Economic Decisions Making – Overview, Problems, Role, Decision making process. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - PerUnit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	06	
2	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value Of Money, Debt repayment, Nominal & Effective Interest. Present Worth Analysis : End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. Cash Flow & Rate Of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate Of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.	10	
3	Uncertainty In Future Events - Estimates And Their Use In Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation	10	

	Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.		
4	Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life Of A New Asset, Marginal Cost, Minimum Cost Life Problems. Inflation And Price Change – Definition, Effects, Causes, Price Change With Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.	08	
5	Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	06	

Text book:

1. Sociology & Economics for Engineers, Premvir Kapoor, Khanna Publishing House.
2. Engineering Economics, James L.Riggs, David D. Bedworth, Sabah U. Randhawa 4e , McGraw-Hill Education.
3. Engineering Economics Analysis, Donald Newnan, Ted Eschembach, Jerome Lavelle , OUP
4. Principle of Engineering Economic Analysis, John A. White, Kenneth E.Case,David B.Pratt , Wiley

Reference books

1. Engineering Economy, Sullivan and Wicks, Koelling, Pearson
2. Engineering Economics, R.Paneer Seelvan, PHI
3. Engineering Economics Analysis, Michael R Lindeburg, ,Professional Pub

Course Outcome:

After completion of this course, the learners will be able to

1. evaluate the economic theories, cost concepts and pricing policies
2. explain the market structures and integration concepts
3. apply the concepts of financial management for project appraisal. explain accounting systems , the impact of inflation, taxation, depreciation
4. analyze financial statements using ratio analysis
5. explain financial planning, economic basis for replacement, project scheduling, legal and regulatory issues applied to economic investment and project-management problems

Semester-VII

Name of the course		**ELECTRIC DRIVE**	
Course Code: PC-EE 701		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic concept, classification and principle of operation of Electric Drive.		
2.	To understand methods of starting and braking of Electric Drive.		
3.	To understand methods of control of speed of DC and AC Drives.		
4.	To solve problem related to Electric Drive.		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Machine-I (PC-EE-401)		
3.	Electric Machine-II(PC-EE-501)		
Unit	Content	Hrs	Marks
1	**Electric Drive:** Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi-quadrant operation of drives. Load equalization.	5	
2	**Motor power rating:** Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.	5	
3	**Stating of Electric Drives:** Effect of starting on Power supply, motor and load. Methods of stating of electric motors. Acceleration time, Energy relation during stating. Methods to reduce the Energy loss during starting. **Braking of Electric Drives:** Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking,	6	
4	**DC motor drives:** Modeling of DC motors**,** State space modeling, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor	8	

	current. Chopper controlled DC motor drives. Closed loop control of DC Drives.		
5	**Induction motor drives:** Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control.	6	
6	**Synchronous motor drives:** Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.	5	
7	Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive **Industrial application:** Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.	5	

Text books:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH
3. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.

Reference books:

1. Electric motor drives, R. Krishnan, PHI
2. Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.
3. Electric Motor & Drives. Austin Hughes, Newnes.

Course Outcome: After completion of this course, the learners will be able to

1. explain the principle of operation of Electric Drive.
2. describe different methods of starting and braking of Electric Drive.
3. model and control DC Drive
4. control speed of Induction and Synchronous motors.
5. recommend drives for different applications. estimate ratings, variables and parameters of Electric Drives.

Name of the course		**ELECTRICAL ENERGY CONSERVATION & AUDITING**	
Course Code: PE-EE 701B		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the basic of energy resources, energy security, energy conservation and pollution.		
2.	To understand the energy management concepts.		
3.	To understand energy conservation principles and measures		
4.	To learn the methods of energy audit and usage of instruments		
Pre-Requisite			
1.	Basic Electrical Engineering (ES-EE-101)		
2.	Electric Machine (PC-EE-401, PC-EE-501)		
3.	Electric Power system (PC-EE-502, PC-EE-601)		
4.	Control System (PC-EE-503)		
Unit	Content	Hrs	Marks
1	**Energy Scenario:** Commercial and Non-commercial energy, Primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.	5	
2	**Basics of Thermal Energy management :** Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.	5	
3	**Energy Management & Audit:** Definition, energy audit, need, types of energy audit. Energy management (audit) approach, understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.	6	
4	**Energy Efficiency in Electrical Systems:** Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Performance	8	

	assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.		
5	**Energy Efficiency in Industrial Systems:** Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Pumps and Pumping System: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities. Cooling Tower: Types and performance evaluation, efficient system operation, flow control strategies and energy saving opportunities, assessment of cooling towers.	10	
6	**Energy Efficient Technologies in Electrical Systems:** Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.	6	

Text books:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)
3. Electric Energy Utilization and Conservation, S. C. Tripathy, Tata McGraw Hill, 1991.

Reference books:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Course Outcome: After completion of this course, the learners will be able to

1. explain the basic of energy resources, energy security, energy conservation and pollution.
2. quantify the energy conservation opportunities in different thermal systems
3. quantify the energy conservation opportunities in different electrical systems
4. identify the common energy conservation opportunities in different energy intensive industrial equipments
5. explain the methods of energy management and audit.. analyse and report the outcome of energy audit.

Name of the course		**ARTIFICIAL INTELLIGENCE**	
Course Code: OE-EE-701A		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the basic concepts, theories and state-of-the-art techniques of artificial intelligence.		
2.	To understand basic concepts and applications of machine learning.		
3.	To learn the application of machine learning /A.I algorithms in the different fields of science, medicine, finance etc.		
Pre-Requisite			
1.	Programming for problem solving (ES-CS201)		
2.	Mathematics (BS-M301)		
3.	Data structure and algorithm(OE-EE-501A)		
Unit	Content	Hrs	Marks
1	**Introduction:** Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. **Intelligent Agents**: Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. **Problem Solving:** Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	06	
2	**Search techniques**: Solving problems by Searching: problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. **Heuristic search strategies:** Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. **Adversarial search :** Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening	12	
3	**Knowledge & reasoning:** Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation	05	

4.	**Using predicate logic:** Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Probabilistic reasoning [4] Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logic	06	
5.	**Natural Language processing:** Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. **Learning:** Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. **Expert Systems:** Representing and using domain knowledge, expert system shells, knowledge acquisition	08	

Text book:

1. Artificial Intelligence, K, Knight, E. Rich, S.B. Nair, 3rd Edition TMH
2. A classical approach to Artificial Intelligence, M.C. Trivedi, 2nd Edition, Khanna Publishing House, New Delhi
3. Introduction to Artificial Intelligence & Expert Systems, D.W. Patterson, PHI
4. Artificial Intelligence A Modern Approach, Stuart Russel, Peter Norvig, Pearson

Reference books

1. Computational Intelligence, D. Poole, Alan Mackworth, and Randy Goebe, lOUP
2. Logic & Prolog Programming, Saroj Kaushik, New Age International
3. Expert Systems principle and programming, J.C. Giarranto, Cengage Learing.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the concept of knowledge representation and predicate logic and transform the real life information in different representation
2. describe state space and its searching strategies
3. demonstrate profciency in applying scientifc method to models of machine learning
4. apply the machine learning concepts in real life problems
5. demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications

Name of the course		**DIGITAL IMAGE PROCESSING**	
Course Code: OE-EE 702B		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand fundamentals and mathematical transforms necessary for image processing.		
2.	To understand the image enhancement techniques.		
3.	To understand the image restoration procedures.		
4.	To understand the image compression procedures.		
Pre-Requisite			
1.	Digital Signal Processing (OE-EE 601A)		
Unit	Content	Hrs	Marks
1	**Introduction:** Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relationships Between Pixels- Neighbors and Connectivity of pixels in image, Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.	08	
2	**Image Enhancement In The Spatial Domain**: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods.	08	
3	**Image Enhancement In Frequency Domain:** Introduction, Fourier Transform, Discrete Fourier Transform (DFT), properties of DFT, Discrete Cosine Transform (DCT), Image filtering in frequency domain.	08	
4	**Image Segmentation:** Introduction, Detection of isolated points, line detection, Edge detection, Edge linking, Region based segmentation-Region growing, split and merge technique, local processing, regional processing, Hough transform, Segmentation using Threshold.	08	
5	**Image Compression:** Introduction, coding Redundancy , Inter-pixel redundancy, image compression model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking, DCT implementation using FFT, Run length coding.	08	

Text book:

1. Digital Image Processing, R.C Gonzalez and R. Woods, Pearson publication, 2017
2. Digital Image Processing, Anil K. Jain, Prentice-Hall, India, 1988.

Reference books:

1. Digital Image Processing, W.K. Pratt , John Wiley & Sons, 1991.
2. Digital Image Processing and Analysis, B. Chanda & D. Dutta Majumder Prentice-Hall India, 2011
3. Image Processing- Theory, Algorithms & Architecture, M. A. Sid-Ahmed, McGraw-Hill, 1994.

Course Outcome:

After completion of this course, the learners will be able to

1. explain the fundamental concepts of a digital image processing system.
2. enhance images in the spatial and frequency domain using various transforms.
3. apply different image segmentation techniques.
4. categorize various compression techniques. implement image process and analysis algorithms.
5. apply image processing algorithms in practical applications.

Name of the course		**PRINCIPLE OF MANAGEMEENT**	
Course Code: HM-EE 701		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic concept and approaches to management.		
2.	To understand planning and decision making processes. .		
3.	To understand organizational design and structure.		
4.	To understand various aspects of leadership.		
Pre-Requisite			
1.	English (HM- HU 201)		
Unit	Content	Hrs	Marks
1	**Concept & approaches to management:** Meaning & Definition of the term Management, Management as a Science or an Art, Management as a Profession, Management as a Process, Difference between Management & Administration; Levels of Management, Roles of a Manager, Quality of a good Manager, Significance of Management, Limitations of Management, Business Environment and its interaction with Management. Approaches to Management – Classical, Neo-classical and Modern Contributors to Management Thought – Taylor and Scientific Theory, Fayol's and Administrative Theory, Peter Drucker and Management Thought. Various Approaches to Management (i.e. Schools of Management Thought) Indian Management Thought	8	
2	**Planning & decision making:** Planning: Meaning, Definition, Process, Types, Principles, Significance & Limitations of Planning; Strategic Planning – Meaning & Process, MBO – Meaning, Process and Requirements for Implementation, Planning Premises – Meaning & Types, Forecasting – Meaning & Techniques. Decision Making – Meaning, Types, Process, Significance & Limitations	8	
3	**Organization design & Structure:** Organization – Meaning, Process, Principles, Organization Structure – Determinants and Forms: Line, Functional, Line & Staff, Project, Matrix and Committees; Formal and Informal Organization; Departmentation – Meaning and Bases; Span of Control – Meaning and Factors Influencing; Authority, Responsibility and Accountability; Delegation – Meaning, Process; Principles; Centralization and Decentralization – Meaning; Degree	8	

	of Decentralization; Difference between Delegation and Decentralization.		
4	**Directing:** Motivation – Meaning , Definition, Significance & Limitations; Financial and non-financial incentives of Motivation Leadership - Meaning, Definition, Significance of Leadership, Leadership styles Type, Process and Barriers of Communication, Strategies to overcome the Barriers.	8	
5	**Customer Management** – Market Planning & Research, Marketing Mix, Advertising & Brand Management. **Operations & Technology Management** – Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.	8	

Text books:

1. Essentials of Management. H. Koontz and H. Weihrich , 7th Edition, Tata McGraw Hill
2. Principles of Management, Premvir Kapoor, Khanna Publishing House, 2019
3. Principles of Management - Text and Cases, Dipak Kumar Bhattacharyya. Pearson Education India, 2011.

Reference books:

1. Management-Text & Cases, V.S.P Rao & Hari V. Krishna, Excel Books, 2005
2. Principles of Management, T. Ramaswami, Himalaya Publishing House, 2014
3. Management of Technology and Operations, R. Ray Gehani, Wiley, 1998

Course Outcome: After completion of this course, the learners will be able to

1. explain the concepts and approaches of management.
2. demonstrate the roles, skills and functions of management.
3. diagnose and solve organizational problems.
4. identify the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities.
5. apply different methods of Customer, Operation and Technology management. acquire skills of good leader in an organization.

Semester-VIII

Name of the course		**UTILIZATION OF ELECTRIC POWER**	
Course Code: PC-EE 801		**Semester: 8th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic principle of illumination and good lighting practices		
2.	To understand the method of Electric heating, Welding and Electrolytic processes.		
3.	To understand the concepts of Electrical traction systems .		
4.	To solve numerical problems on the topics studied.		
Pre-Requisite			
1.	Electric Machine (PC-EE-401, PC-EE-501)		
2.	Control System (PC-EE-503)		
3.	Power Electronics (PC-EE-504)		
Unit	Content	Hrs	Marks
1	**Electric Traction :** Requirement of an ideal traction system, Supply system for electric traction, Train movement (speed time curve, simplified speed time curve, average speed and schedule speed), Mechanism of train movement (energy consumption, tractive effort during acceleration, tractive effort on a gradient, tractive effort for resistance, power & energy output for the driving axles, factors affecting specific energy consumption, coefficient of adhesion). Electric traction motor & their control: Parallel and series operation of Series and Shunt motor with equal and unequal wheel diameter, effect of sudden change of in supply voltage, Temporary interruption of supply, Tractive effort and horse power. Use of AC series motor and Induction motor for traction. Traction motor control: DC series motor control, Multiple unit control, Braking of electric motors, Electrolysis by current through earth, current collection in traction system, Power electronic controllers in traction system.	10	
2	**Electric Lighting:** Definition of terms; laws of illumination; Luminaries; Lighting requirements; Illumination levels; lamp selection and maintenance; Lighting schemes, calculations & design – Interior lighting – industrial, Factory, residential lighting; Exterior lighting - Flood, street lighting, lighting for displays and signaling - neon signs, LED-LCD displays beacons and lighting for surveillance; Energy Conservation codes for lighting; lighting controls – daylight sensors and occupancy sensors; controller design.	8	
3	**Electric Heating :** Advantages of electrical heating, Heating methods, Resistance heating – direct and indirect resistance heating, electric ovens, their temperature range, properties of resistance heating elements, domestic water heaters and other heating	08	

	appliances and thermostat control circuit ,Induction heating; principle of core type and coreless induction furnace , Electric arc heating, direct and indirect arc heating, construction, working and applications of arc furnace, Dielectric heating, applications in various industrial fields, Infra-red heating and its applications, Microwave heating, Simple design problems of resistance heating element.		
4	**Electric Welding:** Advantages of electric welding, Welding methods, Principles of resistance welding, types –spot, projection seam and butt, welding and welding equipment used , Principle of arc production, electric arc welding, characteristics of arc, carbon arc, metal arc, hydrogen arc welding and their applications, Power supply required ,Advantages of using coated electrodes, comparison between AC and DC arc welding, welding control circuits, welding of aluminum and copper, Introduction to TIG, MIG welding	08	
5	**Electrolytic processes:** Need of electro-deposition, Laws of electrolysis, process of electro-deposition - clearing, operation, deposition of metals, polishing, buffing, Equipment and accessories for electroplating, Factors affecting electro-deposition, Principle of galvanizing and its applications, Principle of anodising and its applications, Electroplating on non-conducting materials , Manufacture of chemicals by electrolytic process and electrolysis process.	06	

Text books:

1. Generation Distribution and Utilization of Electrical Energy, C.L. Wadhawa, New Age International Publishers, 2015
2. Art and Science of Utilization of Electrical Energy, H. Partab, Dhanpat Rai & co, 2017
3. Utilisation of Electric Energy, E.Openahaw Taylor, Universities press, 1981

Reference books:

1. Generation and Utilization of Electrical Energy by S. Sivanagaruju, Pearson, 2010.
2. Utilization of Electrical Energy by J. B. Gupta, Rajeev Manglik, Rohit Manglik, Kataria Publications, 2012.

Course Outcome: After completion of this course, the learners will be able to

1. explain the fundamentals of illumination and different lighting schemes.
2. explain the fundamental of Electrolytic processes, Electric heating and Welding.
3. able to select appropriate lighting, heating and welding techniques for specific applications.
4. apply different electrolysis process for different applications.
5. explain the principle of different aspect of Electric traction and control of traction motor.

Name of the course		**ADVANCED ELECTRIC DRIVE**	
Course Code: PE-EE 801C		**Semester: 8th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0 hr/week		Assignment & Quiz: 10 Marks	
Practical: 0 hrs/week		Attendance: 05 Marks	
Credit Points: 3		End Semester Exam: 70 Marks	
Objective:			
1.	To understand basic principle of operation of Power Converters used for AC drives		
2.	To understand the method for modeling and control of Induction motor and Synchronous motor.		
3.	To understand the method of control of Permanent magnet motor drive, Switched reluctance motor drive.		
4.	To understand the principle of DSP based motion control.		
Pre-Requisite			
1.	Electric Machine (PC-EE-401, PC-EE-501)		
2.	Control System (PC-EE-503)		
3.	Power Electronics (PC-EE-504)		
Unit	Content	Hrs	Marks
1	**Power Converters for AC drives:** PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.	8	
2	**Induction motor drives:** Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control(DTC).	8	
3	**Synchronous motor drives:** Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.	5	
4	**Permanent magnet motor drives:** Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.	5	
5	**Switched reluctance motor drives:** Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.	5	
6	**DSP based motion control:** Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.	5	

Text books:

1. Modern Power Electronics and AC Drives, B. K. Bose, PHI, 2005
2. Permanent Magnet Synchronous and Brushless DC motor Drives, R. Krishnan, CRC Press, 2009
3. DSP based Electromechanical Motion Control, H. A. Taliyat and S. G. Campbell, CRC Press, 2003.

Reference books:

1. Analysis of Electric Machinery and Drive Systems, P.C. Krause, O. Wasynczuk and S.D. Sudhoff, Wiley, 2013.

Course Outcome: After completion of this course, the learners will be able to

1. explain the principle of operation of converters for AC drives.
2. model Induction and Synchronous motor by reference frame theory.
3. apply different control methods to control speed and torque of Induction and Synchronous motor.
4. explain the configurations and method of speed control of BLDC, PMSM and SRM.
5. realize basic blocks for DSP based motion control. develop appropriate scheme for speed control of Induction and Synchronous motor.

Name of the course		**SENSORS AND TRANSDUCERS**	
Course Code: OE-EE 801D		**Semester: 8th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial: 0hr/week		Assignment & Quiz: 10 Marks	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the principle of operation of Transducers and Sensors		
2.	To understand the application of Transducers and Sensors		
Pre-Requisite			
1.	Electric Circuit Theory (PC-EEE-301)		
2.	Electromagnetic Field Theory (PC-EEE-303)		
Unit	Content	Hrs	Marks
1	**Introduction**: Definition, significance of measurement and instruments. Principle of sensing & transduction, transducer classification, Transducer characteristics, emerging fields of sensor technologies.	05	
2	**Resistive transducers:** Potentiometers: types, loading error, metal and semiconductor strain gauges, types, resistance measuring methods, strain gauge applications: Load and torque measurement.	05	
3	**Inductive transducers:** Transformer type, synchros, eddy current transducers, LVDT: Construction, material, input-output characteristics. **Optical Sensors:** LDR, Photo Diode, Stroboscope, IR Sensor.	08	

4	**Capacitive transducers:** Variable distance-parallel plate type, variable area- parallel plate type, cylindrical type, differential type, variable dielectric constant type, calculation of sensitivity. Capacitive microphone, fluid level measurement. **Piezoelectric transducers:** piezoelectric effects, Materials, natural and synthetic types – their comparison, Charge and voltage co-efficient, Force and stress sensing, displacement measurement. **Magnetic Transducer:** Hall effect sensors, Magnetostrictive transducers: principle, positive and negative magnetostriction.	10	
5	**Thermal sensors:** Resistance temperature detector (RTD): principle, materials and types; Thermistor: principle, materials and types; Thermocouple, Thermoelectric effects, laws of thermocouple, thermocouple types, construction. IC temperature sensor, PTAT type sensor. **Radiation sensors:** types, characteristics and comparison. Pyroelectric type.	06	
6	**Micro-sensors and smart sensors:** Construction, characteristics and applications. Standards for smart sensor interface. **Recent Trends in Sensor Technologies:** Introduction; Film sensors (Thick film sensors, thin film sensor)	04	

Text book:

1. Transducers and Instrumentation , D.V.S. Murthy, Prentice Hall, 2008
2. Sensors and Transducers, D. Patranabis, Prentice Hall India, 2003
3. Measurement Systems - Application and Design, E.O. Doebelin, McGraw-Hill, 2008

Reference books:

1. Instrument Transducers - An Introduction to their Performance and Design", H.K.P. Neubert , Oxford University Press, 1999.
2. Measurement Systems and Sensors, WaldemarNawrocki Artech House, 2016.
3. Semiconductor sensors", S.M. Sze, Wiley - Interscience, 1994
4. Instrumentation Measurement and Analysis", B. C. Nakara&Chaudhry TATA McGraw-Hill, 2009
5. Smart Sensors and Sensing Technology, Daniel E. Suarez, Nova Science Publishers, 2011

Course Outcome:

After completion of this course, the learners will be able to

1. explain the basic principle of operation of Transducers and Sensors.
2. distinguish different sensors and transducers.
3. identify suitable transducer by comparing different industrial standards and procedures for measurement of physical parameters
4. estimate the performance of different transducers. design real life electronics and instrumentation measurement systems.
5. apply smart sensors, bio-sensors, PLC and Internet of Things to different applications.

BACHELOR IN ARCHITECTURE (B. Arch.) - 1ST SEMESTER

(Applicable from the academic session 2019-2020)

1. LANGUAGE LAB. /TECHNICAL ENGLISH (ARCH 101)

OUTCOME:

Improvement of communicative and presentation skills and prepare the students.

2. MATHEMATICS – I (ARCH 102)

OUTCOME:

Development of basic skill needed for studying related to analytical advanced subjects.

3. ENGINEERING MECHANICS (ARCH 103)

OUTCOME:

The students will be able to apply the basic principles of mechanics and structural behavior to design and analyze structural elements in future projects.

4. HISTORY OF ART & ARCHITECTURE (ARCH 104)

OUTCOME:

The students shall gain knowledge about the chronological development of Art & Architecture, the basic design elements, forms, materials, construction techniques and design principles developed under the socio-economic cultural and political influence during various time periods. The students can analyze the contributing factors for the design development of different styles during these time periods.

5. ARCHITECTURAL DESIGN I (ARCH 181)

OUTCOME:

The students will have a basic idea of generating design concepts and represent the same in Architectural drawings using composition of different design elements, forms and basic design principles. Application of anthropometric data and standards in designing of space.

6. ARCHITECTURAL GRAPHICS - I (ARCH 182)

OUTCOME:

Develop knowledge of drawing as a medium to visualize and communicate ideas.
Application of various drawing tools and accessories used in drafting and lettering techniques. Imparting knowledge of representation of three-dimensional forms in design projects using graphical presentation skills.

7. MODEL MAKING (ARCH 183)

OUTCOME:

Students will develop ability to understand and represent space by three-dimensional geometric/ abstract forms in scale. Develop skills of cutting and joining simple materials for model making.

8. NSS/ ECA / NCC/ SPORTS (ARCH 184)

OUTCOME:

The students should emerge as healthy and socially conscious citizens capable of doing hard work under pressure and respond to the requirements of the society. This would also help in imparting a sense of responsibility and team work.

BACHELOR IN ARCHITECTURE (B. Arch.) - 2nd SEMESTER

1. MATHEMATICS – II (ARCH 201)

OUTCOME:

Students will be capable to understand advanced analytic subjects in the curriculum.

2. STRENGTH OF MATERIALS (ARCH 202)

OUTCOME:

Students will understand the structural behavior of beams under different conditions.

3. HISTORY OF ARCHITECTURE-I (ARCH 203)

OUTCOME:

Students will understand the diversity of architecture in India and will gain knowledge about the design variables, construction techniques, materials and craftsmanship used in the historical buildings of Indian Subcontinent.

4. MATERIALS AND CONSTRUCTION-I (ARCH 204)

OUTCOME:

Students will learn the uses, properties and applications of various constructional materials.

5. ARCHITECTURAL DESIGN II (ARCH 281)

OUTCOME:

Students will gain basic skills for designing basic spaces and forms.

6. ARCHITECTURAL GRAPHICS –II (ARCH 282)

OUTCOME:

Students will be able to develop Architectural Design through spatial ordering mechanisms and programmatic interpretation.

7. WORKSHOP PRACTICE - (ARCH 283)

OUTCOME:

Students will acquire skills to generate different architectural elements through prototype building.

8. EDUCATIONAL TOUR (ARCH 284)

OUTCOME:

Students will get exposure to various types of historical as well as modern structures.

BACHELOR IN ARCHITECTURE (B. Arch.) - 3rd SEMESTER

1. STRUCTURE – I (ARCH 301)

OUTCOME:

Shall equip the students with knowledge of basic structure, helping them to design simple building components.

2. CLIMATOLOGY (ARCH 302)

OUTCOME:

Will be able to design climate responsive buildings considering the impact of climatic factors, comfort conditions, natural ventilation and day lighting.

3. HISTORY OF ARCHITECTURE --- II (ARCH 303)

OUTCOME:

Students will be aware of the impact of Islamic influence on the development of architectural style for future application in appropriate context.

4. MATERIALS AND CONSTRUCTION-II (ARCH 304)

OUTCOME:

The students will understand the basic components of a building with its construction details and develop the ability to integrate knowledge of properties and construction methods of these components in the design of simple projects.

5. ARCHITECTURAL DESIGN III (ARCH 381)

OUTCOME:

Students will understand the relation of space, form and site considerations to develop designs for medium sized public buildings.

6. METHODS OF CONSTRUCTION I (ARCH 382)

OUTCOME:

Students will gain knowledge of constructional details of different building components which can be applied in future projects.

7. COMPUTER EDUCATION (ARCH 383)

OUTCOME:

Getting idea about the history and basics of computer, its programming and architecture.

8. MATERIAL TESTING WORK SHOP (ARCH 384)

OUTCOME:

Gain hands on experience about properties of basic building materials.

BACHELOR IN ARCHITECTURE (B. Arch.) - 4th SEMESTER

1. STRUCTURE – II (ARCH 401)

OUTCOME:

Will equip students with knowledge of different theories for analysis of structural behaviour of structures.

2. ACOUSTICS (ARCH 402)

OUTCOME:

Students will gain knowledge of basics architectural acoustic systems in buildings and acoustic principles and treatments and be equipped to design acoustic interiors and buildings.

3. HISTORY OF ARCHITECTURE-III (ARCH 403)

OUTCOME:

Students will gain knowledge about the spatial and stylistic qualities, use of materials & technology and principles of composition associated with architecture during Classical to Renaissance period.
An understanding of architecture as an outcome of various social, political and economic upheavals, and as a response to the culture and context.

4. MATERIALS AND CONSTRUCTION --- III (ARCH 404)

OUTCOME:

The students will gain knowledge of cost effective and environmentally friendly materials, types and constructional details of building components like doors, windows and stairs and finishes for application in practical field.

5. ARCHITECTURAL DESIGN IV (ARCH 481)

OUTCOME:

Students will learn to analyze different parameters and design Institutional buildings.

6. METHODS OF CONSTRUCTION II (ARCH 482)

OUTCOME:

The students will learn to do detail drawings of the above mentioned basic components of a building.

7. COMPUTER GRAPHICS – I (ARCH 483)

OUTCOME:

The students will learn to express the representation of visual composition in 2D using digital tools, drafting, 3D visualization and rendering.

8. EDUCATIONAL TOUR (ARCH 484)

OUTCOME:

Students will learn and experience the architectural characteristics of various historical as well as contemporary buildings.

BACHELOR IN ARCHITECTURE (B. Arch.) - 5th SEMESTER

1. STRUCTURES III (ARCH 501)

OUTCOME:

Students will gain knowledge about design and detailing of concrete structural components.

2. BUILDING SERVICES I (ARCH 502)

OUTCOME:

Students will gain knowledge about water supply, sewerage, and waste disposal systems in buildings and develop the ability to conceptually plan/ design.

3. HISTORY OF ARCHITECTURE – IV (ARCH 503)

OUTCOME:

The students will have an insight into the development of Modern architecture and Arts & Crafts movement in Europe and America.

4. MATERIALS AND CONSTRUCTION -- V (ARCH 504)

OUTCOME:

The students will acquire knowledge of roofing, partitions and paneling in building construction and become familiar with advanced materials and construction techniques.

5. ARCHITECTURAL DESIGN V (ARCH 581)

OUTCOME:

The students will develop sensitivity in design approach in community oriented projects analyzing context, collective values and needs.

6. METHODS OF CONSTRUCTION III (ARCH 582)

OUTCOME:

The students will learn detail drawings of the above mentioned building components for future practical applications.

7. COMPUTER GRAPHICS II (ARCH 583)

OUTCOME:

Exposure to software like 3D Max, Sketch-up and Photoshop will help students to prepare presentation drawings in 2D and 3D.

8. SURVEY FIELD WORK (ARCH 584)

OUTCOME:

Students will develop the ability to measure, draw, and represent all the physical parameters of a site.

BACHELOR IN ARCHITECTURE (B. Arch.) - 6th SEMESTER

1. STRUCTURES IV (ARCH 601)

OUTCOME:

Students will gain knowledge of analyzing and designing steel structures.

2. BUILDING SERVICES II (ARCH 602)

OUTCOME:

The student will understand the importance and working of lighting installation in buildings, and gain the ability to design basic electrical lighting and firefighting systems.

3. HISTORY OF ARCHITECTURE – V (ARCH 603)

OUTCOME:

The students will gain knowledge of neo-vernacular and contemporary architecture.

4. LANDSCAPE DESIGN (ARCH 604)

OUTCOME:

The student will understand the scope of landscape architecture, the elements used in landscape design and the impact of human activities on the environment and also the role of architect in mitigating it.

5. ARCHITECTURAL DESIGN VI (ARCH 681)

OUTCOME:

The students will learn design methods for site planning and give appropriate/ innovative design solutions for community buildings in urban environment.

6. WORKING DRAWING (ARCH 682)

OUTCOME:

The students will learn to use architectural terms and symbols; apply construction materials and methods; identify the relationship between specifications and drawings; identify governing codes; and produce a set of sanction drawings and commercial construction drawings.

7. ESTIMATION & VALUATION (ARCH 683)

OUTCOME:

The students will be able to forecast the estimated value of a project and determine basic specifications of material and workmanship.

8. EDUCATIONAL TOUR (ARCH 684)

OUTCOME:

Students will learn and experience the architectural characteristics of various historical as well as contemporary buildings.

BACHELOR IN ARCHITECTURE (B. Arch.) - 7th SEMESTER

1. STRUCTURE IN ARCHITECTURE (ARCH 701)

OUTCOME:

Students will learn the behavioral pattern of different structural systems so as to incorporate those in their design.

2. BUILDING SERVICES III (ARCH 702)

OUTCOME:

Students will learn different air conditioning systems and types of lifts.

3. BLDG. ECONOMICS & CONST. MANAGEMENT (ARCH 703)

OUTCOME:

Students will learn to manage the economic aspect of construction.

4. URBAN PLANNING & HUMAN SETTLEMENTS (ARCH 704)

OUTCOME:

The student will gain knowledge about the nature, characteristics and evolution of human settlements and also the planning concepts of historical and contemporary towns. They will be aware of the current issues in urban planning and will be acquainted with land-use, zoning, types of development plan, etc.

5. ARCHITECTURAL DESIGN VII (ARCH 781)

OUTCOME:

The students will learn innovative design solutions for Institutional buildings/Housing in urban environment.

6. INTERIOR DESIGN (ARCH 782)

OUTCOME:

The students will gain knowledge about Ergonomics and furniture design and get an overall exposure to the ways in which interior spaces can be enriched through the design of specific components.

7. ARCHITECTURAL ILLUMINATION (ARCH 783)

OUTCOME:

The students understand the principles, laws, and recommended values of illumination in buildings with experiments for application in design projects.

BACHELOR IN ARCHITECTURE (B. Arch.) - 8th SEMESTER

1. ENERGY EFFICIENT ARCHITECTURE (ARCH 801)

OUTCOME:

Students will gain knowledge of alternative sources of energy and passive design considerations, day lighting and natural ventilation in design. They will also understand future trends in creating sustainable built environment.

2. HOUSING & COMMUNITY PLANNING (ARCH 802)

OUTCOME:

Students will have an overall view of the housing policies within India and third world countries.

3. URBAN DESIGN (ARCH 803)

OUTCOME:

Students will be aware of the evolution and characteristics of urban forms, their components and interdependencies and understand elements, principles, concepts & components of urban design.

4. DISASTER MITIGATION (ARCH 804)

OUTCOME:

The students will be aware about disasters and the strategies for disaster management and mitigation. They will also understand the design guidelines in disaster resistant construction.

5. ARCH. DESIGN VIII (ARCH 881)

OUTCOME:

The students will develop design approach in Institutional projects and also learn the details.

6. THESIS PROGRAMMING (ARCH 882)

OUTCOME:

Students will equip themselves with the all-round knowledge to take up their thesis project in their final semester.

7. OFFICE MANAGEMENT (ARCH 883)

OUTCOME

Student will gain knowledge of the role of professional and statutory bodies and understand the role of an architect and professional ethics.

BACHELOR IN ARCHITECTURE (B. Arch.) - 9th SEMESTER

1. PROFESSIONAL TRAINING (ARCH 981)

OUTCOME

Students will gain hands on knowledge of all aspects of Architectural Practice, specifically knowledge of design and details of varied types of buildings.

BACHELOR IN ARCHITECTURE (B. Arch.) - 10th SEMESTER

ELECTIVES I, II

ADVANCED STRUCTURES (ARCH 1001a)

OUTCOME

Students will understand concepts and applications of critical and advance structures for future applications.

COST EFFECTIVE BUILDING TECHNOLOGY (ARCH 1001b)

OUTCOME:

Students will learn cost effective materials and construction methods of sustainable and green building design.

BUILDING MAINTENANCE (ARCH 1001c)

OUTCOME:

Students will learn important aspects of building maintenance.

INDUSTRIAL ARCHITECTURE (ARCH 1001d)

OUTCOME:

Students will understand design aspects of industrial buildings and the codes affecting it.

BARRIER FREE ARCHITECTURE (ARCH 1001e)

OUTCOME:

Students will understand the special design considerations for barrier free architecture and the guiding norms.

ADVANCED LANDSCAPE (ARCH 1002a)

OUTCOME:

The students will understand the contemporary Landscape planning in urban scenario and assess the current trends for application in their design.

VERNACULAR ARCHITECTURE (ARCH 1002b)

OUTCOME:

The students will gain knowledge about materials and methods of construction, planning and forms of vernacular architecture in different regions of the country.

ENVIRONMENTAL PLANNING (ARCH 1002c)

OUTCOME:

The students will gain knowledge of the existing natural resources, various ecosystems the need for preserving the resources and the environmental legislations.

CONSERVATION (ARCH 1002d)

OUTCOME:

The students will understand current trends in conservation, its need and the governing laws.

RETROFITTING (ARCH 1002e)

OUTCOME:

The students will learn different methods of retrofitting for future application.

ARCHITECTURAL THESIS (ARCH 1081)

OUTCOME:

The students will learn to handle a complete architectural design project at an advanced level and give a complete solution to the problem through design and details.