Third Semester					
Theory					
Sl. No.	Category	Subject Code	Subject Name	L-T-P	Credit
1	BSC	22CM3BS02T	Mathmatics-III	3-0-0	3
2	HSMC	22CM3HS01T 22CM3HS02T	Organisational Behaviour Engineering Economics and Costings	3-0-0	3
3	ESC	22CM3ES01T	Data Structure using C	3-0-0	3
4	ESC	22ME3ES02T	Mechanics of Solids	3-0-0	3
5	PCC	22ME3PC01T	Engineering Thermodynamics	3-0-0	3
6	PCC	22ME3PC02T	Introduction to Physical Metallurgy and Engineering Materials	3-0-0	3
7	MC	22CM3MC01T	Environmental Science and Engineering		0
Total Credit (Theory)					18
Practical					
1	ESC	22CM3ES01L	Data Structure using C Laboratory	0-0-2	1
2	ESC	22ME3ES02L	Mechanics of Solids Laboratory	0-0-2	1
3	PCC	22ME3PC01L	Engineering Thermodynamics Laboratory	0-0-2	1
4	PCC	22ME3PC02L	Introduction to Physical Metallurgy and Engineering Materials Laboratory	0-0-2	1
5	PSI	22CM3PS01L	Summer Internship/ Summer Training/ MOOC Certification	0-0-2	1
Total Credit (Practical)					5
Total Semester Credit					23

Course Code:	Course Name:	L-T-P:	Credit:
22CM3BS02T	Mathematics-III	3- 0- 0	03

Course Objectives: The course should enable the students to:

1. Enrich the knowledge of numerical analysis to find the root and interpolating polynomial.
2. Apply the concept to find numerical differentiation and integration. Solve first order ordinary differential equation.
3. Apply the concept of Numerical analysis to enrich the knowledge of complex numbers, and complex functions.
4. Apply the knowledge of complex analysis to solve various integrations.

Syllabus:

Module – I: Root Finding and Interpolation [8 Hours]

Root Finding: Introduction, Root finding by Bisection Method, Newton-Raphson Method, Regula-Falsi Method, Secant method, Fixed point method.

Interpolation: Lagrange, Newton forward and Backward, Divided Difference Method.

Module – II: Numerical Differentiation and Integration [8 Hours]

Differentiation: Derivative using Newton's forward and backward difference formula.

Integration: Trapezoidal Method, Simpson's 1/3rd and 3/8th rules, Gauss-Quadrature 2 - p o i n t & 3- point method.

Module – III: Numerical Solution of Ordinary Differential Equation [7 Hours]

First Order Differential equation by Taylor's series Method, Euler's method, Modified Euler's method, Runge-Kutta 4th order, Predicator & Corrector methods (Adams-Bashforth Method of order 4).

Module – IV: Complex Functions, Line Integral [9 Hours]

Complex Functions: Analytic function, C-R equation, Laplace equation, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic function.

Complex Integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of Analytic functions.

Module – V: Power series, Taylor series, Laurent series, Residue [8 Hours]

Sequences, Series, Power series, Functions given by power series, Taylor and Maclaurin series, Laurent series, Singularities and Zeros, Residues, Residue integration method.

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Willey.
   (Chapter: 13, 14, 15 (15.1 – 15.4), 16 (16.1 – 16.3), 19 (19.1 – 19.3, 19.5), 21 (21.1 - 21.2)

Reference Books:

1. M. K. Jain, S. R. K. Iyenger and R. K. Jain, Numerical Methods forScientific and engineering Computations, New Age International Publication (P) Ltd.
2. B. V. Raman, Higher Engineering Mathematics, Mc-Graw Hills Education.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.

Course Outcomes: On completion of this course, students are able to:

1. Use the knowledge of numerical analysis to find the root and interpolating polynomial.
2. Solve various differentiation and integration by numerical methods. Solve the first order ordinary differential equation by the concept of Numerical analysis
3. Increase the knowledge about the complex plane and complex functions
4. Solve various integrations by the help of complex analysis.

Course Code:	Course Name:	L-T-P:	Credit:
22CM3HS01T	Organisational Behaviour	3- 0- 0	03

Course Objectives:

1. Developing an understanding of the behaviour of individuals and groups inside organizations by enhancing the skills in appreciating individual, interpersonal, and group processes for increase.
2. Developing effectiveness both within and outside of organizations is the goal of any organisation.
3. Through this course students will develop theoretical and practical insights.
4. The students will develop problem-solving capabilities for effectively managing the organizational processes.

Syllabus:

Module-I: Fundamentals of OB **[6 Hours]**

Introduction: Definition, nature and scope of OB (environmental and organizational context), Relationship between OB and the individual, Impact of IT, globalization and diversity on OB.

Module-II: Foundations of Individual Behaviour **[10 Hours]**

Personality: Meaning and definition, Determinants of personality, Personality traits, Personality and OB. Perception: Meaning and definition, Perceptual process, Importance of perception in OB. Motivation: Nature and importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory. Attitude: Definition, nature and dimensions, Attitude and OB. *Learning: Nature, learning and OB.*

Module-III*: Group Dynamics* of OB-I **[8 Hours]**

Communication: Types, interactive communication in organizations, barriers to communication, strategies to improve the follow of communication. Stress and Conflict: Meaning and types of stress, Meaning and types of conflict, Effect of stress on individuals, strategies to cope with stress and conflict.

Module-IV *Group Dynamics* of OB-II **[6 Hours]**

Power and Politics: Meaning and types of power empowerment. Groups Vs. Teams- Nature of groups, dynamics of informal groups, dysfunctions of groups and teams, teams in modern work place.

Module-V Foundations of Organizational Behaviour [6 Hours]

Organizational Culture: Culture and organizational effectiveness. Organizational Change: Types of change, reasons to change, resistance to change. *Organisational Structure and Development: Concepts and process.*

Course Outcomes:

1. Students will understand the essential of maintaining the inter-personal relationships in organisations.
2. Personality factors will be effectively used to understand the communication among groups.
3. The reasons for conflict will be known and prescriptive methods can be devised to enhance higher productivity in organisations.
4. Being an employee in an organisation the importance of organisational change and culture can be known to all.

Text Book:

1. Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.

Reference Books:

1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Hitt, Miller, Colella, Wiley
3. Organizational Behaviour, K. Awathappa, HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Understanding Organizational Behaviour, Parek, Oxford

Course Code:	Course Name:	L-T-P:	Credit:
22CM3HS02T	Engineering Economics and Costing	3- 0- 0	03

Course Objectives: At the end of the course the engineering students will be able:

1. To prepare engineering students to understand the basic concepts of Engineering economics and their application.
2. To carry out numerically the effects of changes in demand and supply on price determinations of products and services.
3. To justify or reject alternative projects in the light of changing domestic and global scenario on the eve of technological innovations.
4. To analyse the macroeconomic environment and financial system of the country and its impact on business society and enterprise

Syllabus:

Module-I: **[10 Hours]**

Engineering Economics: Nature and Scope, Basic Problems of an Economy, Micro and Macro Economics; Demand: Meaning of demand, Determinants of demand, Demand function, Law of demand and its exceptions, Elasticity of demand and its measurement, (Simple numerical problems to be solved). Supply: Meaning of Supply, Determinants of Supply, Supply function, Law of Supply and its exception, Elasticity of Supply.

Module-II: **[7 Hours]**

Production: Factors of Production, Production Function; Laws of Returns: Law of Variable Proportions, Law of Returns to Scale, Cost and Revenue Concepts: Short Run Total Costs, Long Run Average Cost Curves, Total Revenue, Average Revenue and Marginal Revenue,

Module-III: **[6 Hours]**

Market Structures: Basic understanding of different Market Structures; Determination of Equilibrium Price under Perfect Market Competition and Monopoly. *Margin of safety and Break Even Analysis*: Linear Approach (Simple numerical problems to be solved).

Module-IV: **[10 Hours]**

Time Value of Money: Interest- Simple and Compound, Nominal and Effective Rate of Interest, Cash flow diagrams, Principles of Economic Equivalence, Evaluation of Engineering Projects:

Present, Future and Annual worth Method, Rate of Return Analysis; Cost-Benefit Analysis

Module-V: **[7 Hour]**

Inflation: Meaning of Inflation, Types, Causes and Measures to Control Inflation. National Income: Definition, Concepts of National Income and its measurement, Banking: Commercial Bank, Functions of Commercial Bank, Central Bank, Functions of Central Bank.

Course Outcomes:

1. Students will understand how to solve economic problems and the art of taking the right decision on scarce resources.
2. This will help to solve different microeconomic problems related to production, cost, and revenue maximization
3. Students will be understood different market structures and levels of competition and determine the price
4. This will help engineering students while evaluating and determining the cost of a project. This is also helpful in determining the value of money for future courses of action.
5. This will help to understand basic microeconomic concepts like inflation, national income, and money market.

Text Books:

1. Principles of Economics: Deviga Vengedasalam & Karun agaran Madhavan-Oxford Publication

Reference Books:

1. Engineering Economics and Costing: D. M. Methani & Suresh Chandra Das-Himalaya Publishing House
2. Engineering Economics and Costing: Sasmita Mishra-PH Learning Private Limited
3. R.Panneerselvam, ‘Engineering Economics’, PHI

4. Riggs,Bedworth and Randhwa, 'Engineering Economics', McGrow Hill Education India
5. Engineering Economics and Costing: Mahendra P. Agasty, Scitech Publications (INDIA) Pvt. Ltd.

Course Code:	Course Name:	L-T-P:	Credit:
22CM3ES01T	Data Structures using C	3- 0- 0	03

Course Objectives:

1. Implementation of different linear data structure.
2. Implementation of non-linear data structures like trees and graphs.
3. Applying different sorting and searching algorithms.

Syllabus:

Module-I: **[10 Hours]**

Abstract Data Types – Definition and Representation, ADT of rational number, ADT of Stack, Data Structure and ADT. Stack and its usages: reversing string, matching parentheses, in fix to postfix, decimal to binary number. Queue: linear & circular queue, Deque & Applications. Matrix – sparse and dense. Representation of sparse matrix, Transpose & addition of sparse matrices.

Module-II: **[8 Hours]**

Linked list and its representation: using array, using self referential structure. Singly, circular and double

linked lists. Operations on linked list – Insertion, Deletion, Traversals. Usages of Linked list – insertion sort, Addition/multiplication of polynomials. Addition/Multiplication of large numbers.

Module-III: **[12 Hours]**

Tree: Definition and Terminologies, child and parent nodes, Sub tree, root, leaf node, internal node, height of a tree. Binary, ternary, quad tree. Binary tree traversals. Reconstruction of binary tree from traversals. Binary search tree – inserting a new key, deleting a key, searching a key. AVL tree – inserting a new key into an AVL tree using rotations. B- tree : insertion and deletion using node splitting and merging.

Module-IV: **[6 Hours]**

Sorting and Searching: Bubble sort, selection sort quick sort and merge sort. Linear and binary search, Fibonacci search.

Module-V: **[6 Hours]**

Basic Graph Algorithm: Graph representation – adjacency matrix and list – pros and cons. Graph traversals – Depth First Search and Breadth First Search.

Course Outcomes:

1. Apply the basic data structure like stack, queue, linked list, tree and graph on different problems.
2. Compare and differentiate different implementation of data structure.
3. Analyzing the time complexity and space complexity of different sorting and searching algorithms and data structures implementation.

Text Books:

1. Data Structures: A Pseudocode Approach with C – Gilberg & Forouzan, 2ndEdition, Cengage, Indian Reprint 2016
2. Data Structures and Program Design in C – Kruse, Leung, 2nd Edition, Pearson, 2008.

Reference Books:

1. Data Structures Using C - Yedidyah Langsam & Moshe J. Augenstein Aaron M. Tanenbaum, 3rd Edition, Pearson, 2009
2. Algorithms and Data Structures: The basic toolbox, Kurt Mehlhorn and Peter Sanders, Springer, 2010
3. Programming and Data Structures (NPTEL) – (Vodeo lectures by Dr. Naveen Garg, IIT

Course Code:	Course Name:	L-T-P:	Credit:
22ME3ES02T	Mechanics of Solids	3- 0- 0	03

Course Objectives:

1. Understand mechanics of deformable bodies and apply them in analysis and design problems subjected to two dimensional stress systems
2. Understand behavior of structural members in flexure and Torsion
3. Evaluate slope and deflection in beams subjected to loading
4. Understand stability of columns and struts
5. Predict the stress distribution in beams, pressure vessels and shafts

Syllabus:

Module-I: **[8 Hours]**

Concept of Stress: Load, Stress, Principle of St.Venant, Principle of Superposition, Strain, Hooke's law, Modulus of Elasticity, Stress-Strain Diagrams, Working Stress, Factor of safety, Strain energy in tension and compression, Resilience, Impact loads, Analysis of Axially Loaded Members: Composite bars in tension and compression - temperature stresses in composite rods, Concept of Statically indeterminate problems. Shear stress, Complimentary shear stress, Shear strain, Modulus of rigidity, Poisson's ratio, Bulk Modulus, Relationship between elastic constants

Module-II: **[8 Hours]**

Biaxial State of Stress: Analysis of Biaxial Stress. Plane stress, Principal plane, Principal stress, Mohr's Circle for Biaxial Stress. Stresses in thin cylinders and thin spherical shells under internal pressure, wire winding of thin cylinders; Biaxial State of Strain: Two dimensional state of strain, Principal strains, Mohr's circle for strain, Calculation of principal stresses from principal strains, Strain Rossette.

Module-III: **[8 Hours]**

Shear Force and Bending Moment Diagrams: Shear force and bending moment. Types of load and Types of support. Support reactions, Relationship between bending moment and shear force, Point of inflection. Shear Force and Bending Moment diagrams.

Bending of Beams: Theory of simple bending of initially straight beams, Bending stresses, Shear stresses in bending, Distribution of normal and shear stress, Composite beams

Module-IV: **[8 Hours]**

Deflection of Beams: Differential equation of the elastic line, Slope and deflection of beams by integration method and area - moment method; Theory of Columns: Long columns, Euler's column formula, Lateral buckling, Critical Load, Slenderness ratio, Eccentric loading of short column

Module-V: **[8 Hours]**

Torsion: Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, strength of solid and hollow circular shafts. Strength of shafts in combined bending and twisting, Close - Coiled helical springs.

Course Outcomes:

After completing the course, the students will be able to

1. Identify the different engineering materials, describe their properties and predict their behavior under different types of loading.
2. Compute the stresses, strains, moments, deflections, etc. and derive the expressions used from the fundamentals.
3. Select materials, sizes and sections for various applications such as beams, shafts, pressure vessels etc. and justify the selection
4. Analyses columns and struts under various types of loading
5. Determine mechanical properties by destructive and non-destructive methods.

Text Books:

1. S. P. Timoshenko and D. H. Young, Elements of Strength of Materials, Affiliated East West Press, 5th edition, 2003, New Delhi
2. G. H. Ryder, Strength of Materials by Macmillan Publishers India Limited, 3rd edition, 2002, Chennai

Reference Books:

1. S. S. Rattan, Strength of Materials by Tata Mc Graw Hill, 3rd edition, 2017, New Delhi
2. R. Subramaniam, Strength of Materials, Oxford University Press, 3rd edition, 2016, New Delhi

Digital Learning Resources:

Course Name	Mechanics of Solids
Course Link	https://nptel.ac.in/courses/112/102/112102284/
Course Instructor	Prof. Ajeet Kumar

Course Code:	Course Name:	L-T-P:	Credit:
22ME3PC01T	Engineering Thermodynamics	3- 0- 0	03

Course Objectives:

1. This course is designed to introduce a basic application of thermodynamic laws and application of thermodynamics concept to various practical engineering problems.
2. Evaluate concept of entropy
3. States of pure substance and performance parameters for vapor power cycles based on the Rankine with reheat, regenerative and combined cycles
4. Gain the concept of gas power cycle such as Otto, Diesel and Brayton cycle with reheating and intercooling.
5. Demonstrate the ability to analyze the performance of refrigeration cycles.

Syllabus:

Module-I: **[8 Hours]**

Revision of basics of thermodynamics, first law of thermodynamics open system (steady flow), second law of thermodynamics, PMM1, PMM2, reversible and irreversible processes, heat engine, reverse heat engine, Carnot cycle.

Properties of pure substances, Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables.

Module-II **[8 Hours]**

Basic Concept of Entropy, Clausius theorem, Clausius inequality, Principle of increase of entropy, Entropy change of pure substances, isentropic processes, property diagrams involving entropy, entropy change of liquids and solids, the entropy change of ideal gases, Third law of thermodynamics, Absolute entropy. Entropy generation ,Entropy balance for closed systems and steady flow systems

Module-III **[8 Hours]**

Vapour Power Cycles: The Carnot vapor cycle and its limitations, The Rankine cycle, Means of increasing the Rankine cycle efficiency, The reheat cycle, The regenerative feed heating cycle

Module-IV **[8 Hours]**

Gas Power Cycles: Air standard cycles- Otto, Diesel, Dual Combustion and Brayton cycles, The Brayton cycle with non-isentropic flow in compressors and turbines, The Brayton cycle with regeneration, reheating and inter-cooling,

Module-V **[8 Hours]**

Refrigeration cycles: Reversed Carnot cycle, Reversed Brayton cycle (Gas refrigeration system), Vapor compression cycle, The vapor absorption cycle.

Course Outcomes:

1. Understand the basics concepts, work and heat and first law of thermodynamics
2. Apply the 2^{nd} law of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles.
3. Evaluate the pure substances and performance of steam power cycles
4. Apply the knowledge of gas power cycle in analysis of engines
5. To analyse the refrigeration cycle to have better energy saving features

Text Books:

1. P. K. Nag, Engineering Thermodynamics, Sixth Edition, Tata McGraw Hill Publishing Company, 2017, New Delhi

Reference books:

1. P. Chattopadhyay, Engineering Thermodynamics, Second Edition, OXFORD University Press, 2011, New Delhi.
2. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, Sixth Edition, John Wiley & Sons, New Delhi.
3. E. Radhakrishnan, Fundamentals of Engineering Thermodynamics, Second Edition, PHI Publication, 2005, New Delhi

Digital Learning Resources:

Course Name	Engineering Thermodynamics
Course Link	https://nptel.ac.in/courses/101/104/101104063
Course Instructor	IIT Kanpur

Course Code: 22ME3PC02T	Course Name: Introduction to Physical Metallurgy and Engineering Materials	L-T-P: 3- 0- 0	Credit: 3

Course Objectives:

1. Give basic knowledge of science behind materials & physical metallurgy.
2. Develop the understanding of how nature of atomic bonding influences the structure of the materials.
3. Introduce the concept of mechanical behavior of materials, phase & phase diagram, heat treatment, failure of materials, applications of advanced materials.
4. Develop the understanding of inter-relationship between the microstructure and materials properties.
5. Give basic knowledge of polymers and composites.

Syllabus:

Module-I **[8 Hours]**

Classification of Engineering Materials, Mechanical properties of materials. Characteristic property of metals, bonding in solids, primary bonds like ionic, covalent and metallic bond, crystal systems, common crystal structure of metals, representations of planes and directions in crystals, atomic packing in crystals, calculation of packing density, imperfection in crystals.

Module-II **[8 Hours]**

Concept of plastic deformation of metals, critical resolve shear stress, dislocation theory, deformation by slip and twin, plastic deformation in polycrystalline metals,concept of cold working preferred orientation. Annealing; recovery; recrystallization and grain growth;

Hot working. Concept of alloy formation, types of alloys, solid solutions, factors governing solids solubility viz. size factor, valency factor, crystal structure factor and chemical affinity factor; order-disorder transformation.

Module-III **[10 Hours]**

Binary phase diagrams (a) Isomorphism system, (b) Eutectic system, (c) Peritectic system, (d) Eutectoid system and (e) Peritectoid system. Allotropic transformation. Lever rule and its application, Interpretation of solidification behaviors and microstructure of different alloys belonging to those systems.

Iron-cementite phase diagrams, microstructure and properties of different alloys (alloy steels; stainless steel, tool steel, HSS, high strength low alloy steel) types of cast iron, their microstructures and typical uses. Specification of steel.

Concept of heat treatment of steels i.e. annealing, normalizing, hardening and tempering; microstructural effects brought about by these processes and their influences on mechanical properties.

Module-IV **[6 Hours]**

Plastics: Thermosetting and thermoplastics;

Ceramics: Types, structure, mechanical properties, application.

Module-V **[6 Hours]**

Composite materials: Agglomerated materials, Cermet's reinforced materials, reinforced concrete, fibre reinforced plastics, properties of composites, metal matrix composites.

Course Outcomes:

1. Analyze & Distinguish between SC, BCC, FCC & HCP structures & to understand the types of crystal structures and relate it to the final properties
2. Understand the different types of crystal imperfections i.e. point defects, line defects, surface defects
3. Explain the phase rule, term involved in it and its application & the different types of binary phase diagrams, and their construction. Apply the principles of Tie-line rule and Lever rule to find the composition of the phases present and their weight percentages
4. Understand & suggest the purpose & objectives of Heat Treatment.
5. To acquire knowledge about composite, plastics, ceramics materials, types, manufacturing methods & its applications & suggest suitable materials for the required application.

Text Books:

1. W. D. Callister, Materials Science and Engineering, Eighth Edition, Wiley and Sons Inc, 2017, New Delhi.

Reference Books:

1. Avner, Sidney H., Introduction to Physical Metallurgy, Second Edition, Tata McGraw Hill Publishing Company, 2017, New Delhi.
2. Raghavan, V., Physical Metallurgy: Principles and Practice, Third Edition, PHI Publication, 2015, New Delhi.

Digital Learning Resources:

Course Name	Introduction to Physical Metallurgy &Engineering Materials
Course Link	https://nptel.ac.in/courses/113/102/113102080/
Course Instructor	IIT Delhi

Course Code	Course Title	L-T-P	Credit
22CM3MC01T	Environmental Science and Engineering	3-0-0	0

ENVIRONMENTAL SCIENCE & ENGINEERING (2nd Year)

Course Objectives:

To provide insight about impact of the humans activities on environment and impact of environment on the humans & its health.

To understand the basic problem of anthropogenic environmental pollution

To gain comprehensive knowledge about the social problem arising out of industrialization.

To familiarize with the environmental ethics and act related to environment

Syllabus:

Module-I **[10 Hours]**

Ecological Concepts and Natural Resources: Ecological perspective and value of environment. Ecosystem: Concept, structure& Function of ecosystem; Energy cycle, Food Chain, & Food Web; Ecological pyramid, types; Biodiversity; Ecological Succession: Type of ecosystem: Forest ecosystem, Grassland ecosystem,Desert ecosystem, Aquatic ecosystem. Geochemical Cycle: Water cycle, Carbon cycle, Oxygen cycle, Nitrogen cycle, etc.,Environmental gradients, Tolerance levels of environment factor.

Module-II **[8 Hours]**

Water Pollution:Types, sources and consequences of water pollution; Ground water Contamination, Waste water treatment process: pretreatment, primary treatment, (Sedimentation, equalization and neutralization etc.), secondary treatment (Activated sludge technique and Trickling filter) tertiary treatment methods (Ion exchange, Electro-dialysis, Electrolytic recovery, reverse osmosis, etc.)

Module-III **[10 Hours]**

Air Pollution : Air pollution and pollutants, criteria pollutants& non-criteria pollutants, Acid deposition, Global climate change- Green House gases, Ozone Layer Depletion,Smog; Industrial Air Emission Control: Flue gas desulphurization, NOx removal,. Methods for control of particulate air pollutants (Mechanical device, Fabric Filtration, scrubber,

Electrostatic precipitator), other removal methods like absorption, adsorption, precipitation, etc..

Module-IV **[8 Hours]**

Solid Waste Management Source classification and composition of MSW: properties and separation, storage and transportation, MSW Management, Waste minimization of MSW, Reuse and recycling, Hazardous Waste Management, Hazardous waste and their generation, Transportation and treatment of hazardous waste: Incinerators, Inorganic waste treatment, handling of treatment plant residue. Waste minimization techniques.

Module-V **[4 Hours]**

Noise Pollution:Types, sources and consequences of noise pollution, Physical Properties of sound: sound power, sound intensity and sound pressure levels;, Noise criteria, Noise Standards, Noise measurement, Noise control Methods.

Course outcomes [co]

On Completion of this Course, the students should be able to:

The purpose of the course is to provide an overview of ecosystem and anthropogenic activities effect on natural sources. It's involves understanding the problem arising out of environmental pollution and its remedies. It's involve various case study to analyze the problem face by human due to population growth.

CO	Outcomes	Levels
6.	Able to understand the concept of environmental pollution and its effect on society	Understand Level 2
7.	Able to understand the root of the water pollution problem and adopted for its remedial.	Analyze and Evaluate: Level 3
8.	Able to understand the other environmental pollution problem and adopted for its remedial.	Analyze and Evaluate: Level 3
9.	Able to understand the problem of population growth and its effect on social issue and environment	Analyze and Evaluate: Level 3

Text Books:

1. Gerard Kiely, Environmental Engineering, Tata McGraw Hill, Special Indian Ed, 2007 New Delhi.
2. B.K. Mohapatra, *A Text Book of Environmental Engineering & Safety,* Seven Seas Publication,4th Ed, 2010, Cuttack
3. L. M. Deshmukh, *Industrial Safety Management,* Tata McGraw Hill Publication, 1st Ed, 2010, New Delhi

Reference Books:

1. Arcadio P. Sincero & Gergoria A.Sincero,*Environmental Engineering: A Design Approach,* Prentice Hall, 1996, Geogia.
2. M. L. Davis and S. J. Masen, *Principles of Environmental Engineering and Science*, McGraw Hill International Edition, 4th Ed, 2019, United Kingdom
3. Curringham & Saigo, Environmental Science, TMH, 2016, New Delhi
4. M.C. Dash & P.C. Mishra Man and Environment, Macmillan Publishers India Limited, 1st Ed, 2000, New Delhi
5. Gilbert M. Masters & Wendell P. Ela, *An Introduction to Environmental Engineering and Science,* Prentice Hall, 3rd Ed, 2008, United Kingdom.

Digital Learning Resources

Course Name	Environmental Chemistry & Analysis
Course Link	https://nptel.ac.in/courses/122/106/122106030/
Course Instructor	IIT Madras

Course Name	Environmental Engineering
Course Link	https://nptel.ac.in/courses/103/107/103107084/#
Course Instructor	IIT Roorkee

Course Name	Environmental Air Pollution
Course Link	https://nptel.ac.in/courses/105/102/105102089/#
Course Instructor	IIT Delhi

Course Name	Fundamentals of Environmental Pollution and Control
Course Link	https://nptel.ac.in/courses/123/105/123105001/#
Course Instructor	IIT Kharagpur

Course Code:	Course Name:	L-T-P:	Credit:
22CM3ES01L	Data Structure using C Laboratory	0-0-2	01

Prerequisites Programs:

1. Create a structure that stores a point in 2D. Accept 3 such points and find out the area of the triangle enclosed by these three points.
2. One array of numbers to be sorted. The no of element of the array is an user input. Create the array dynamically, accept its members and sort the array.

Programs for Evaluation Lab:

1. (Integer stack simulation) Write a structure for an integer stack, implement function push, pop, and pick, IsEmpty and IsFull function. Write a main function and call the functions based on an option entered.
2. (Palindrome checking using stack) Implement a stack of characters and create mystack.h. Write a program to check whether an entered string is a palindrome or not. One need to include mystack.h for calling the functions of character stack.
3. (Simulating circular queue) Defining structure of a circular queue (with a counter), write functions for inserting, deleting and counting no of elements present in the queue. Write functions IsFull and IsEmpty also. Write main function to call them.
4. (Infix to Postfix) Write a program to convert an infix expression into its corresponding postfixexpression. The expression contains alphabets, operators and parentheses. During the conversion allpossible checks for the correctness should be checked. [(a+b)/(c-d) would output ab+cd-/, ((a+b)^c-dwould give error as “unmatched parenthesis]
5. (Insertion sort) A singly linked list gives a better way to implement insertion sort. A flat file contains some unknown number of integers. Implement insertion sort using a singly linked list that reads the next integer from the file and insert it into a linked list in its proper position. Write a function that prints the list after all elements is properly inserted into the linked list.
6. (Polynomial addition) Represent a polynomial of a single variable using a singly linked list. Write functions createPolynomial that stores one polynomial in a singly linked list. Write a function to add two such linked lists.

7. (BST simulation) Declare a binary search tree where information at each node would be a single integer. Write functions for inserting a key, deleting a key from the tree. Write recursive traversal routines. After each insertion/deletion find all traversal results.
8. (Bubble sort) One array of numbers to be sorted. The no of element of the array is a user input. Create the array dynamically, accept its members and sort the array using bubblesort algorithm. Also count the total number of swaps.
9. (Quick sort) Write a function to implement recursive quick sort algorithm and using this function sort an array of integers. Write another function to search for a key in this sorted array using binary search.
10. (Merge Sort) Implement recursive merge sort using an array of fixed size and hence sort an array of double numbers using this function.

Course Code:22ME3ES02L	Course Name: Mechanics of Solids Laboratory	L-T-P: 0-0-2	Credit: 01

Course Objectives: The students able to

1. Determine material properties.
2. Understand fatigue phenomena.
3. Determine Surface material properties.
4. Understand spring properties
5. Determine strain and load relationship

Syllabus:

List of the Experiments:

1. Determination of tensile strength of materials by Universal Testing Machine
2. Determination of compressive strength of materials by Universal testing Machine
3. Determination of bending strength of materials by Universal Testing Machine
4. Double shear test in Universal Testing Machine
5. Determination of Impact strength of material (Charpy and Izod)
6. Determination of Hardness strength of materials (Brinnel, Rockwell and Vickers)
7. Determination of Rigidity modulus of material
8. Determination of Fatigue strength of material
9. Estimation of Spring Constant under Tension and Compression.
10. Load measurement using Load indicator, Load Cells.
11. Strain measurement using Strain Gauge.
12. Stress measurement using strain rosette.

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

1. Evaluate fatigue strength of materials under different loading conditions
2. Evaluate material properties under different loading conditions
3. Determine surface hardness of materials
4. Determine spring constant under different loading condition
5. Evaluate strain vs load relationship under different loading condition

Course Code: 22ME3PC01L	Course Name: Engineering Thermodynamics Laboratory	L-T-P: 0- 0- 2	Credit: 1

Course Objectives:

1. Design and working of steam power plant
2. Apply the laws of thermodynamics to the working of I.C engines.
3. Analyze performance of reciprocating and centrifugal compressors.
4. Gain knowledge about air-cycle.
5. Analyze various refrigeration systems with its components.

Syllabus:

List of Experiments: (Select any 8 experiments from the list of 10 experiments)

1. Model study of Steam Power cycle.
2. Port timing diagram of Two stroke I.C. Engine.
3. Valve timing diagram of Four stroke I.C. Engine.
4. Performance analysis of reciprocating air-compressor.
5. Performance analysis of Centrifugal / Axial Flow compressor.
6. Verification of Joule-Thomson coefficient.
7. Performance analysis of gas turbine.
8. Calibration of Bourdon Tube Pressure gauge and measurement of pressure using manometers.
9. Study of Vapour Compression Cycle
10. Study of Vapour Absorption Cycle

Course Outcomes:

On Completion of this Course, the students should be able to:

1. Students can describe about working principle of steam power cycle.
2. Classify the IC engines along with the working principle and combustion process.
3. Explain the working of air compressor (reciprocating and centrifugal) along with factors influencing its performance
4. Explain the performance and working of air cycles
5. Compute the cooling load for COP of refrigeration systems.

Course Code: 22ME3PC02L	Course Name: Introduction to Physical Metallurgy and Engineering Materials Laboratory	L-T-P: 0- 0- 2	Credit: 1

Course Objectives:

1. To introduce the physical origin of and demonstrate the correlation between crystal structure and properties of materials.
2. Learning the metallurgical sample preparation techniques: cutting, mounting, grinding and polishing & characterization of microstructure using optical microscope.
3. To understand how the mechanical behavior may be affected by using various heat treatment processes.
4. To measure and compare the hardness & impact toughness of several different materials.

Syllabus:

List of Experiments:

Select any 8 experiments from the list of 9 experiments

1. Study of Crystal Structures through Ball Models
2. Metallurgical Microscope: Principles and Operations
3. Specimen Preparation techniques for Metallographic Analysis
4. Microstructural Analysis of Carbon Steels & Cast Iron
5. Microstructural Analysis of Non-Ferrous Metals: Brass & Copper
6. Heat treatment of Steels
7. Jominy end quench test.
8. Hardness testing of ferrous material
9. Impact testing (Charpy/Izod)

Course Outcomes:

1. On Completion of this Course, the students should be able to:
2. Analyze & prepare SC, BCC, FCC & HCP structures using balls and sticks
3. Prepare the specimens for metallographic examination with best practice and operate the optical microscope and understand, interpret, analyze the microstructure of materials
4. Understand & suggest the purpose & objectives of Heat Treatment i.e annealing, tempering, normalizing, etc and the concept of hardenability test (Jominy test).

5. Classify the different mechanical testing methods with their inherent merits and limitations.