PROGRAM STRUCTURE (VR20)						
B.Tech (Mechanical Engineering)(03)						
II B.Tech I Semester						
S. No	Course Code	Name of the Course	L	T	P	C
1	1000202101	Complex Variables & Statistical Methods	3	1	0	3
2	1003202100	Mechanics of Solids	3	0	0	3
3	1003202101	Material Science & Metallurgy	3	0	0	2.5
4	1003202102	Production Technology	2	0	0	2
5	1003202104	Thermodynamics	3	1	0	3
6	1005201203	Open elective -I ➢ Data Structures	3	0	0	3
	1001202140	➢ Industrial Waste and Waste Water Management	3	1	0	
	1005201200	➢ Object Oriented Programming through C++	3	0	0	
	1002202140	➢ Solar photovoltaic energy systems	3	0	0	
7	1003202110	Metallurgy & Mechanics of Solids Lab	0	0	3	1.5
8	1003202111	Production Technology Lab	0	0	3	1.5
9	1003202180	Drafting and Modelling Lab -I	0	0	4	2
11	1000202121	Environmental Science	2	0	0	0
Total Credits						21.5

DETAILED SYLLABUS
FOR
II B. TECH

I SEMESTER

II Year – I Semester	COMPLEX VARIABLES & STATISTICAL METHODS (Common for CIVIL & MECH)	L	T	P	C
1000202101		3	1	0	3

COURSE OBJECTIVES:

1. To understand Differentiation and integration of complex valued functions.
2. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem.
3. Expansion of complex functions using Taylor's and Laurent's series and to explain the fundamental concepts of probability and random variables.
4. To impact statistical methods in various applications of engineering.
5. The basic ideas of statistical methods of studying data samples, correlation and regression.

COURSE OUTCOMES:

COs	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	***Analyze*** the complex functions with reference to their analyticity.	PO1 PO2	1 2
CO2	***Analyze*** the complex integration by using Cauchy's integral formula and find Taylor's, Maclaurin's series and Laurent series expansion of complex function. ***Evaluate*** contour integrals by using Residue theorem.	PO1 PO2 PO3	2 2 3
CO3	***Explain*** the notation of random variables and ***Evaluate*** the expected value and probability of random variables. ***Evaluate*** the confidence levels and maximum errors for large and small samplings and ***Apply*** the concept of hypothesis testing for large and small samples in real life situations.	PO1 PO2 PO3 PO4	1 2 3 3
CO4	Examine correlation for bi-variate data and ***Predict*** the regression analysis.	PO1 PO2 PO3	1 2 3

UNIT- I

FUNCTIONS OF A COMPLEX VARIABLE: **[6 HOURS]**

Introduction to complex variable function - Limit – Continuity – Differentiability – Analyticity – Properties – Cauchy-Riemann equations in Cartesian and polar coordinates- Harmonic and conjugate harmonic functions – Milne – Thomson method to find analytical function.

UNIT- II

COMPLEX INTEGRATION: **[12 HOURS]**

Line integral – evaluation along a path and by indefinite integration – Cauchy's integral theorem (without proof) – Cauchy's integral formula – Generalized integral formula.

COMPLEX POWER SERIES

Radius of convergence – Expansion of a function as Taylor's series -Maclaurin's series and Laurent series (without proof) - types of singularities –Isolated singular point – Pole of order m – Essential singularity.

UNIT- III

RESIDUE: **[16 HOURS]**

Evaluation of residue by formula and by Laurent series - Residue theorem (without proof)- Evaluation of contour integrals by residue theorem of the type: (a) Improper real integrals $\int_{-\infty}^{\infty} f(x)dx$ (b) $\int_{c}^{c+2\pi} f(cos\,cos\,\theta, sin\,sin\,\theta)\ d\theta.$

RANDOM VARIABLES:

Introduction-Definition of a Random Variable-Discrete and Continuous Distributions-Binomial, Poisson and Normal distributions.

UNIT- IV

SAMPLING DISTRIBUTIONS AND TEST OF HYPOTHESIS: **[14 HOURS]**

Introduction to sampling distributions, level of significances and confidence limits. - Tests of hypothesis using Z-test -Student's t-test-F-test and χ^2-test.

UNIT- V

CORRELATION AND REGRESSION: **[10 HOURS]**

Determination of correlation coefficients, types, Pearson's coefficient of correlation, Spearman's rank correlation, Regression, Regression lines- Multiple Regression.

TEXTBOOKS:

1. Advanced Engineering Mathematics by H.K. Dass, S. Chand Publications.
2. Higher Engineering Mathematics 2e, B. V. Ramana, Tata McGraw Hill Publishing Co. Ltd.

REFERENCE BOOKS:

1. Engineering Mathematics, Greenburg, 2nd Ed, Pearson education.
2. Higher Engineering Mathematics – 43rd Edition by Dr. B. S. Grewal, Khanna Publishers, New Delhi.
3. A Textbook of Engineering Mathematics, N.P. Bali, Laxmi Publications (P) Ltd.
4. Advanced Engineering Mathematics, Erwin Kreszig, 8thEd, Wiley Student Edition.

II Year – I Semester		L	T	P	C
1003202100	**MECHANICS OF SOLIDS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

The students completing this course are expected to understand the basic terms like stress, strain, poissons ratio…etc and different stresses and deflections induced in beams, thin cylinders, thick cylinders, and columns. Further, the student shall be able to understand the shear stresses due to torsion in circular shafts.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Model & Analyze the behavior of basic structural members subjected to various loading and support conditions based on principles of equilibrium.	1 2 3 4 12	3 3 2 2 1
CO2	Understand the apply the concept of stress and strain to analyze and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.	1 2 3 4 12	3 3 2 2 1
CO3	Students will learn all the methods to analyze beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components. Students are able to analyse beams and draw correct and complete shear and bending moment diagrams for beams	1 2 3 4 6	3 3 2 2 1
CO4	Students attain a deeper understanding of the loads, stresses, and strains acting on a structure, pressure vessels, columns and their relations in the elastic behaviour	1 2 3 4 6	3 3 2 2 1

UNIT- I

SIMPLE STRESSES & STRAINS:

Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT- II

SHEAR FORCE AND BENDING MOMENT:

Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT-III

FLEXURAL STRESSES : Theory of simple bending – Assumptions – Derivation of bending equation: M/ I = f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

SHEAR STRESSES:

Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV

DEFLECTION OF BEAMS:

Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, - U.D.L uniformly varying load. Mohr's theorems – Moment area method – application to simple cases including overhanging beams, Statically indeterminate Beams and solution methods.

TORSION:

Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

UNIT-V

THIN AND THICK CYLINDERS:

Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders – Riveted boiler shells – Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.

COLUMNS:

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula

Text Books:

1. Strength of materials /GH Ryder/ Mc Millan publishers India Ltd.
2. Strength of materials by B.C. Punmia-lakshmi publications pvt.Ltd, New Delhi.

Reference Books:

1. Mechanics of Materials by Gere & Timeshenko
2. Strength of Materials -By Jindal, Umesh Publications.
3. Strength of Materials by S.Timshenko- D. VAN NOSTRAND Company- PHI Publishers
4. Strength of Materials by Andrew Pytel and Ferdinond L. Singer Longman- Harpercollins College
Division
5. Solid Mechanics, by Popov-
6. Mechanics of Materials/Gere and Timoshenko, CBS Publishers

NPTEL/MOOC: https://nptel.ac.in/course.html

II Year – I Semester		L	T	P	C
Course Code 1003202101	MATERIALS SCIENCE & METALLURGY	3	0	0	2.5

COURSE OBJECTIVES:

To understand the basic fundamentals of Material science and Physical metallurgy. The basic concepts to be taught will help for the improvement, proper selection and effective utilization of materials which is essential to satisfy the ever-increasing demands of the society.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Understand the crystalline structure of different metals and study the stability of phases in different alloy systems.	1 2 3 6 7	3 1 3 2 1
CO2	Study the behavior of ferrous and non ferrous metals and alloys and their application in different domains .	1 3 6 7	3 3 2 1
CO3	Able to understand the effect of heat treatment, addition of alloying elements on properties of ferrous metals	1 3 6 7	3 3 2 1
CO4	Grasp the methods of making of metal powders and applications of powder metallurgy and Comprehend the properties and applications of ceramic, composites and other advanced methods.	1 3 6 7	3 3 2 1

UNIT- I

Structure of Metals and Constitution of alloys: Bonds in Solids, Metallic bond, crystallization of metals, Packing Factor - SC, BCC, FCC& HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries on the Properties of metal / alloys – determination of grain size. Imperfections– point, line, surface and volume-Slip and Twinning.Necessity of alloying, types of solid solutions, Hume Rotherys rules, intermediate alloy phases, and electron compounds

Equilibrium Diagrams : Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe_3C

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UNIT- II

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys: Structure and properties of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

UNIT-III

Heat treatment of Alloys: Effect of alloying elements on Fe-Fe_3C system, Annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

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UNIT-IV

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization- Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Sintering Secondary operations- Sizing, coining, machining -Factors determining the use of powder metallurgy- Application of this process.

UNIT-V

Ceramic and composite materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures, metal – matrix composites and C
– C composites. Nanomaterials – definition, properties and applications.

TEXT BOOKS:

1. Introduction to Physical Metallurgy - Sidney H. Avener - McGrawHill
2. Essential of Materials science and engineering - Donald R.Askeland - Cengage.

REFERENCES:

1. Material Science and Metallurgy – Dr. V.D.kodgire- Everest Publishing House
2. Materials Science and engineering - Callister & Baalasubrahmanyam- Wiley Publications
3. Material Science for Engineering students – Fischer – Elsevier Publishers
4. Material science and Engineering - V. Rahghavan-PHI Publishers
5. Introduction to Material Science and Engineering – Yip-Wah Chung CRC Press
6. Material Science and Metallurgy – A V K Suryanarayana – B S Publications
7. Material Science and Metallurgy – U. C. Jindal – Pearson Publications

II Year – I Semester		L	T	P	C
1003202102	PRODUCTION TECHNOLOGY	2	0	0	2

COURSE OBJECTIVES:

To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, bulk forming, sheet metal forming and powder metallurgy and their relevance in current manufacturing industry.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Able to design the patterns and core boxes for metal casting processes.	1 2 3	3 2 2
CO2	Able to design the gating system for different metallic components	1 2 3 4	3 3 2 3
CO3	Know the different types of manufacturing processes	1 2 3	3 3 3
CO4	Be able to use forging, extrusion processes and Learn about the different types of welding processes used for special fabrication.	1 2 3	3 2 3

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT- I

CASTING: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding – molding methods - ingredients of molding sand –. Molding materials, Properties of molding sand, Testing of molding sand. Types of molding – Hand molding – Machine molding. Core – different types of cores – materials – properties of core sand – core manufacturing.

UNIT- II

Principles of Gating, Gating ratio and design of Gating systems. Risers – Types, function and design, casting design considerations. Methods of melting and types of furnaces - cupola, electric arc, resistance and induction furnace. Solidification of castings- Solidification of pure metals and alloys-Short & long freezing range alloys. Fettling. Casting defects. Basic principles and applications of special casting processes - Centrifugal casting – True, semi and centrifuging, Die casting, Investment casting and shell molding

UNIT-III

Welding : Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, Submerged arc welding, TIG & MIG welding. Electro – slag welding.
Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering & Brazing. Heat affected zones in welding; pre & post heating, Weldability of metals, welding defects – causes and remedies – destructive and nondestructive testing of welds.

UNIT-IV

Plastic deformation in metals and alloys-recovery, recrystallization and grain growth. Hot working and Cold working-Strain hardening and Annealing. Bulk forming processes: Forging - Types of Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing

UNIT-V

Sheet metal forming - Blanking and piercing, Forces and power requirement in these operations, Deep drawing, Stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools.
High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations

TEXT BOOKS:

1. Manufacturing Processes for Engineering Materials – Kalpakjian S and Steven R Schmid- Pearson Publ , 5th Edn.
2. Manufacturing Technology -Vol I- P.N. Rao- TMH

REFERENCES :

1. Manufacturing Science – A.Ghosh & A.K.Malik – East West Press Pvt. Ltd
2. Process and materials of manufacture- Lindberg- PHI
3. Production Technology- R.K. Jain- Khanna
4. Production Technology-P C Sharma-S. Chand
5. Manufacturing Processes- H.S. Shaun- Pearson
6. Manufacturing Processes- J.P. Kaushish- PHI
7. Workshop Technology -WAJ Chapman/CBS Publishers&Distributors Pvt.Ltd.
8. Production Technology-HMT- Tata McGrawHill

NPTEL/MOOC: https://nptel.ac.in/course.html

II Year – I Semester		L	T	P	C
1003202104	THERMODYNAMICS	3	1	0	3

COURSE OBJECTIVES:

To impart the knowledge of the thermodynamic laws and principles so as to enable the student to prepare an energy audit of any mechanical system that exchange heat and work with the surroundings.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Basic concepts of thermodynamics.	1 2 6 7 12	2 2 2 2 2
CO2	Laws of thermodynamics and concept of entropy	1 2 6 7 9	3 3 3 3 3
CO3	Property evaluation of vapors and their depiction in tables and charts	1 2 6 7 9	3 3 3 3 2
CO4	Evaluation of properties of perfect gas mixtures.	1 2 5 6 7 9	2 2 2 2 2 2

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT- I

Introduction: Basic Concepts : System, boundary, Surrounding, Universe, control volume, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process - Reversible, Quasi static & Irreversible Processes, cycle, Causes of Irreversibility. Energy in State and in Transition - Types, Work and Heat, Point and Path function.

Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry –Reference Points – Const. Volume gas Thermometer – Scales of Temperature.

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UNIT- II

Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system –Energy balance for closed systems-Specific heats-Internal energy, Enthalpy and Specific heats of Solids, liquids and Ideal gases, Some steady flow energy equation applied to Nozzle, Turbine, Compressor and heat exchanger devices, PMM-I..

UNIT-III

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence, Corollaries, PMM of Second kind, Carnot cycle and its specialties, Carnot's theorem, Thermodynamic scale of Temperature.
Clausius Inequality, Entropy, Principle of Entropy Increase, Availability and Irreversibility (Basic definitions) – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT-IV

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point and critical point, properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation, Property tables. Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

UNIT-V

Ideal Gas equation of state- Compressibility factor- Van der Waals equation of state- Beattie-Bridgeman equation of state- Benedict-Webb-Rubin equation of state- Viral equation of state- compressibility charts– variable specific heats .
Mixtures of perfect Gases – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes- Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heat and Entropy of Mixture of Perfect Gases and Vapour.
Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation , Carrier's Equation – Psychrometric chart.

TEXT BOOKS:

1. Engineering Thermodynamics, PK Nag 6th Edn , McGraw Hill.
2. Fundamentals of Thermodynamics – Sonntag, Borgnakke, Van Wylen, 6th Edn, Wiley

REFERENCES:

1. Thermodynamics by Prasanna Kumar, Pearson Publishers
2. Engineering Thermodynamics – Jones & Dugan PHI
3. Thermodynamics, an Engineering Approach, Yunus A Cenegel, Michael A Boles, 8th Edn in SI Units, McGraw Hill.

4. Thermodynamics – J.P.Holman , McGrawHill
5. An Introduction to Thermodynamics - Y.V.C.Rao – Universities press.
6. Thermodynamics – W.Z.Black & J.G.Hartley, 3rd Edn Pearson Publ.
7. Engineering Thermodynamics – D.P.Misra, Cengage Publ.
8. Engineering Thermodynamics – P.Chattopadhyay – Oxford Higher Edn Publ.

NPTEL/MOOC: https://nptel.ac.in/course.html

Course Code	DATA STRUCTURES	L	T	P	C
1005201203		3	0	0	3

COURSE OBJECTIVES:

1. Basics of data structures including their fundamentals building blocks: arrays and linked list.
2. To solve problems using linear data structures such as linear lists, stacks, queues.
3. To solve problems using searching and sorting techniques.
4. To be familiar with non-linear data structures such as trees.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Apply the C language Concepts: Pointers, Structures, Unions and recursion to solve the problems	PO1 PO2 PO3 PO11	2 2 3 1
CO2	Implement Standard Data Structures like Stack, Queue, List, Trees and Graphs	PO1 PO2 PO3 PO11	2 2 3 2
CO3	Choose appropriate data structure while building new application	PO1 PO2 PO3 PO5	2 2 3 3
CO4	Explain the need for data structuring techniques	PO1 PO2	3 3

UNIT- I

ARRAYS AND LINKED LISTS

The Abstract Data Type (ADT), Dynamic allocation of Arrays, Representation of multidimensional Arrays.

Single Linked List, Polynomials, Polynomial Representation- Adding Polynomials- Circular List Representation of Polynomials, Sparse Matrices, Sparse Matrix Representation, Doubly Linked Lists. **[8 Hours]**

UNIT-II

STACKS AND QUEUES

The Stack, Stacks using Dynamic Arrays, Recursion, Linked Stacks, The Queue, Linked Queues, Circular Queues using Dynamic Arrays, De-queue. Application of stacks and queues, Evaluation of Expressions, Expression- Postfix Notation- Infix to Postfix, Towers Of Hanoi Problem. **[8 Hours]**

UNIT-III

SEARCHING AND SORTING

Searching: Linear Search, Binary Search.

Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort. **[8 Hours]**

UNIT-IV

TREES:

Introduction, Terminology, Representation of Trees, Binary Trees, The Abstract Data Type, Properties of Binary Tress, Binary Tree Representations, Binary Tree Traversals: Inorder Traversal, Preorder Traversal, Postorder Traversal, Binary Search Trees: Definition, Searching a Binary Search Tree, Insertion into a Binary Search Tree, Deletion from a Binary Search Tree. **[10 Hours]**

UNIT-V

GRAPHS:

The Graph Abstract Data Type, Introduction, Definition, Graph Representation, Elementary Graph Operation- Depth First Search, Breadth First Search, Connected Components, Spanning Trees, Biconnected Components, Minimum Cost Spanning Trees- Kruskal's Algorithm, Prim s Algorithm, Shortest Paths and Transitive Closure, Single Source/All Destination, All-Pairs Shortest Path. **[10 Hours]**

Text Books:

- Fundamentals of Data Structures in C, Ellis Horowtiz, S.Sahni, Andrews Freed, University Press (India). Second Edition.
- Data Structures and Algorithm Analysis in C, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.

Reference Books:

1. Classic Data Structures, Debasis Samantha, PHI. (Second Edition)
2. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.
3. Data Structures using C, Reema Thareja, Oxford Home Publications, Second Edition

E-Books:

1. https://www.cs.bham.ac.uk/~jxb/DSA/dsa.pdf
2. https://vardhaman.org/wp-content/uploads/2018/12/Data%20Structures.pdf
3. https://www.ncertbooks.guru/data-structures/

IV Year – I Semester		L	T	P	C
1001202140	**Industrial Waste and Waste Water Management**	**3**	**1**	**0**	**3**

COURSE OBJECTIVES:

This course will give the student knowledge about Industrial waste water along with managing and treatment methods required for these waste water.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation	1 7	2 2
CO2	Impart knowledge on selection of treatment methods for industrial wastewater.	1 4 7	2 2 1
CO3	Describe the common methods of treatment in different industries	1 4 7	3 2 1
CO4	Explain operational problems of common effluent treatment plant	1 4 7	3 2 1

UNIT- I

INDUSTRIAL WATER QUALITY ANALYSIS [8 Hours]

Wastewater Quality characterization - Physical, Chemical and Biological; unit operations and processes used in water and waste water treatment.

UNIT- II

MISCELLANEOUS TREATMENT [10 Hours]

Introduction to Advanced water treatments - Adsorption - Ion Exchange - Reverse Osmosis - Electro dialysis - Micro, Ultra & Nano filtration - Chemical oxidation process.

UNIT- III

BASIC THEORIES AND INDUSTRIAL WASTEWATER MANAGEMENT [10 Hours]

Measurement of industrial wastewater flow - Industrial wastewater sampling and preservation of samples for analysis - Toxicity of industrial effluents due to Heavy metals - Volume and Strength reduction -Neutralization - Equalization, Stabilization and proportioning.

UNIT- IV

INDUSTRIAL WASTEWATER DISPOSAL MANAGEMENT [12 Hours]
Discharges into Streams, Lakes and oceans and associated problems - Land treatment - Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges.

UNIT- V

PROCESS AND TREATMENT OF SPECIFIC INDUSTRIES [12 Hours]
Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Paper and Pulp industries, Tanneries, Sugar Mills, Distillers, Dairy and food processing industries, Fertilizers, Textiles, Steel plants, Pharmaceutical Plants.

Text Books:

1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2. Industrial Wastewater Treatment by KVSG Murali Krishna.**E-Books:** (Specify links)
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi
4. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition

Reference Books:

1. Wastewater Engineering by Metcalf and Eddy Inc., Tata McGrawhill Co., New Delhi

2. H. S Peavy, D. R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw-Hill International Ed., 1985.

3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia & R.A. Christian, Prentice Hall of India.

4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3rd Edition.

II Year – I Semester		L	T	P	C
1005201200	Object Oriented Programming through C++	3	0	0	3

COURSE OBJECTIVES:

1. To understand how C++ improves C with object-oriented features
2. To learn the syntax and semantics of the C++ programming language.
3. To learn how containment and inheritance promote code reuse in C++.
4. To learn how inheritance and virtual functions implement dynamic binding with polymorphism.
5. To learn how to design and implement generic classes with C++ templates

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Articulate the principles of object-oriented programming and Outline the essential features and elements of the C++ programming language.	PO1	1
CO2	Apply the concepts of class, method, constructor, instance, data abstraction, function abstraction, inheritance, overriding, overloading, and polymorphism.	PO1 PO2	3 3
CO3	Apply virtual and pure virtual function in complex programming situations	PO1 PO2	2 3
CO4	To use template classes and the STL library in C++ and to incorporate exception handling in object oriented concepts	PO2	3

UNIT- I

INTRODUCTION TO C++

Difference between C and C++- Evolution of C++- The Object Oriented Technology- Disadvantage of Conventional Programming- Key Concepts of Object Oriented Programming- Advantage of OOP- Object Oriented Language. **[6 Hours]**

UNIT- II

CLASSES AND OBJECTS &CONSTRUCTORS AND DESTRUCTOR

Classes in C++ - Declaring Objects- Access Specifiers and their Scope- Defining Member Function Overloading Member Function- Nested class. Introduction to Constructors and Destructor- Characteristics of Constructor and Destructor-Types of Constructor - Anonymous Objects. **[8 Hours]**

UNIT- III

OPERATOR OVERLOADING AND TYPE CONVERSION & INHERITANCE

The Keyword Operator- Overloading Unary Operator- Operator Return Type- Rules for Overloading Operators, Overloading Assignment Operator (=). Inheritance, Types of Inheritance. Virtual Base class, object as class member, abstract classes. **[8 Hours]**

UNIT- IV

POINTERS & BINDING POLYMORPHISMS AND VIRTUAL FUNCTIONS

Pointer, Features of Pointers- Pointer Declaration- Pointer to Class- Pointer Object- this Pointer- Pointer to Derived Classes and Base Class, Binding Polymorphisms and Virtual Functions, Introduction- Binding in C++ - Virtual Functions- Rules for Virtual Function- Virtual Destructor. **[8 Hours]**

UNIT- V

GENERIC PROGRAMMING WITH TEMPLATES & EXCEPTION HANDLING

Generic Programming with Templates, Need for Templates- Definition of class Templates- Normal Function Templates- Overloading of Template Function-Bubble Sort Using Function Templates. Introduction to Standard Template Library: list-set-vector-map-deque. Introduction to Exception Handling: keywords try, throw and catch, multiple catch statements specifying exceptions. **[10 Hours]**

Text Books:

1. Programming in C++, Ashok N Kamathane, Pearson 2nd Edition.
2. The Complete Reference C++, Herbert Schildt, TMH.

Reference Books:

1. Object Oriented Programming C++, Joyce Farrell, Cengage.
2. C++ Programming: from problem analysis to program design, DS Malik, Cengage Learing.
3. Computer Programming with C++,kunal Pimparkhede, cambridge

II-Year – I Semester		L	T	P	C
1002202140	**Solar Photovoltaic Energy Systems**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

(i) To learn the fundamentals of solar photovoltaic (PV) energy systems

(ii) To study the types of electrical components and schemes used in such PV systems

(iii) To analyze the characteristics of solar radiation, PV cells, modules and arrays, stand-alone PV schemes with battery energy storage and grid-connected PV schemes

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Explain the fundamentals of solar photovoltaic (PV) energy systems	1,6,7	2,2,3
CO2	To analyze the characteristics of solar radiation, PV cells, modules and arrays	1,6,7	2,2,3
CO3	Explain the concept of stand- alone PV schemes with battery energy storage and grid-connected PV schemes	1,6,7,11	2,2,3,3
CO4	To analyze the system level issues related to PVenergy systems	1,6,7,11	2,2,3,3

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT- I

Modelling of PV Array [8 Hours]

Introduction to PV cell, Module, Array - effect of shading, use of bypass and blocking diodes; influence of temperature; types of solar cells and their performance; schemes for maximum power point tracking (Basic methods only) .Sizing of PV array for given load vaule.

UNIT- II

Design of grid connected PV System, Control of real and reactive power [8 Hours]

Block diagram of Grid connected PV system with single stage/double stage, Design DC-DC converter with MPPT, Design of Inverter, Role and design of filters (L, LC, and LCL), expression for real and reactive power control, block diagram of grid connected PV system with decoupled real and reactive power control (PI Controller)

UNIT- III

Design of Battery Energy Storage [8 Hours]

Different types of the battery, lead-acid battery, lithium ion battery, performance difference of these batteries, simple model of battery, battery sizing and turn-around efficiency.

UNIT- IV

Design of Isolated PV system, Control of Voltage and frequency [8 Hours]

Applications, Block diagram of Isolated PV system for AC and DC loads, energy demand analysis, Sizing of the overall system, control of voltage and frequency using Droop Controller, pros and cons of an Isolated and grid connected PV systems.

UNIT- V

PV System Level Issues [8 Hours]

Design related issues; grounding, dc arcing and other safety related issues; islanding; harmonics; electro-magnetic interference; energy yield and economics of a PV installation.

Text Book:

1. Gilbert M. Masters: Renewable and Efficient Electric Power Systems. John Wiley & Sons, 2004.

2.Weidong Xiao: Photovoltaic Power System, Modeling, Design, and Control. John Wiley & Sons, 2017.

Reference Books:

1. Roger A. Messenger & Jerry Ventre: Photovoltaic Systems Engineering. CRC Press, 2004, 2nd ed.

2. Solanki: Solar Photovoltaics: Fundamentals, Technologies and Applications. PHI Learning Pvt Ltd, 2009.

E-Books: https://www.bookzz.ren/bookzz/2865920/b53364, https://www.bookzz.ren/bookzz/2918940/02810a

NPTEL/MOOC: https://nptel.ac.in/courses/115/103/115103123/, https://nptel.ac.in/courses/115/107/115107116/

II Year – I Semester		L	T	P	C
1003202110	METALLURGY & MECHANICS OF SOLIDS LAB	0	0	3	1.5

COURSE OBJECTIVES:

To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also, to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Study the Microstructure of various ferrous and non-ferrous materials and its alloys	1 2 6 7 8 9 12	Study the Microstructure of various ferrous and non-ferrous materials and its alloys
CO2	Preparation and study harden ability in Heat treatment and other processes	1 2 6 7 8 9 12	Preparation and study harden ability in Heat treatment and other processes
CO3	Demonstrate the various mechanical properties of various materials using different mechanical testing Machines	1 2 6 7 8 9 12	Demonstrate the various mechanical properties of various materials using different mechanical testing Machines
CO4	Analyze the material characterization of different materials	1 2 6 7 8 9 12	Analyze the material characterization of different materials

LIST OF EXPERIMENTS

NOTE: Any 6 experiments from each section

S.No.	Name of the experiment	Skill
(A)METALLURGY LAB		
1	Preparation & demonstration of crystal structures like SC, BCC, FCC & HCP	Crystal modal preparation
2	Study of Metallurgical Micro Scope and specimen preparation for Microstructure observation	Specimen preparation
3	Study of the Micro Structures of Cast Irons.	Cast Iron microstructure
4	Preparation and study of the Microstructure of Mild steel, Medium carbon steels, High carbon steels	Steels microstructure
5	Preparation and study of the Microstructure of pure metals like Iron, Cu and Al	Pure metal microstructure
6	Study of the Micro Structures of Non-Ferrous alloys.	Non-Ferrous alloys microstructure
7	Study of the Micro structures of Heat-treated steels.	Heat treated microstructure
8	Harden ability of steels by Jominy End Quench Test	Harden ability determination
9	To find out the hardness of various treated and untreated steels.	Hardness of treated steels
(A) MECHNICS OF SOLIDS LAB:		
1	Direct tension test	Tensile properties determination
2	Compression Test on Cube	Compressive strength determination
3	Hardness test a) Brinells hardness test b) Rockwell hardness test	Hardness determination
4	Punch shear test	Shear strength determination
5	Test on springs	Modulus of rigidity determination
6	Impact test	Impact strength determination
7	Bending test on a) Simple supported b) Cantilever beam	Modulus of elasticity determination
8	Torsion test	Modulus of rigidity determination

II Year – I Semester		L	T	P	C
1003202111	PRODUCTION TECHNOLOGY LAB	0	0	3	1.5

COURSE OBJECTIVES:

To impart hands-on practical exposure on manufacturing processes and equipment

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COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Demonstrate the various shapes pattern making using wood work	1 2 6 7 8 9 12	2 2 3 1 2 3 1
CO2	Develop the required moulds for casting processes	1 2 6 7 8 9 12	2 2 3 1 2 3 1
CO3	Study the various welding processe and preparation of various welded joints	1 2 6 7 8 9 12	2 2 3 1 2 3 1
CO4	Demonstration and making of components using plastic moulding processes and mechanical press	1 2 6 7 8 9 12	2 2 3 1 2 3 1

LIST OF EXPERIMENTS

S.No.	Name of the experiment	Skill
1	Design and making of pattern i. Single piece pattern ii. Split pattern	Making patterns
2	Sand properties testing i. Sieve analysis (dry sand)	Sand testing

	ii. Clay content test iii. Moisture content test iv. Strength test (Compression test & Shear test) v.Permeability test	
3	Mould preparation i) Straight pipe ii) Bent pipe iii) Dumble iv) Gear blank	Making various types of sand moulds
4	Gas cutting and welding	Preparing weld joints
5	Manual metal arc welding i. Lap joint ii. Butt joint	Preparing various types of joints
6	Study of TIG/MIG Welding.	TIG, MIG welding operations
7	Study of Resistance Spot Welding	Preparing weld joints by spot welding
8	Study of Brazing and soldering	Preparations of brazing and soldering joints
9	Injection Molding	Preparing mould using injection moulding
10	Blow Molding	Preparing mould using blow moulding
11	Study of deep drawing and extrusion operations.	Drawing and extrusion operations
12	Simple models using sheet metal operations- Blanking and Piercing	Sheet metal operations

II Year – I Semester		L	T	P	C
1003202180	DRAFTING AND MODELLING LAB-I	0	0	4	2

COURSE OBJECTIVES:

1. To impart the fundamental knowledge on using design CAD software
2. To introduce various commands in AutoCAD to draw the geometric entities and to create2D and 3D wire frame models.
3. The student will be able to understand the paper-space environment thoroughly.
4. To make the students create geometrical model of simple solids and machine parts and display the same as an Isometric, Orthographic or Perspective projection.
5. To impart knowledge on how AutoCAD is used in Industries by solving some real time problems using these tools.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Demonstrate the various commands in CAD software and develop the different sketches	1 2 5 7 8 9 10 12	1 1 3 2 2 2 3 1
CO2	Develop the sketches using the projection of points,lines and planes	1 2 5 7 8 9 10 12	1 1 3 2 2 2 3 1
CO3	Generation of various sketches using the projection of various solids	1 2 5 7 8 9 10 12	1 1 3 2 2 2 3 1
CO4	Demonstration and making of isometric projection and its conversion	1 2 5 7 8 9 10 12	1 1 3 2 2 2 3 1

Topics

1. Introduction To Computer Aided Drafting: Generation of points, lines, curves, polygons, dimensioning. Types of modeling, object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modeling, and 3D wire frame modeling

2.View Points And View Ports: view point coordinates and view(s) displayed, examples to exercise different options like save, restore, delete, joint, single option.

3. Generation of orthographic projection of points, lines planes and solids

4. Computer Aided Solid Modeling: Conversion of orthographic Projection into Isometric projections and Vice-Versa, Modeling of simple solids.

List of Experiments:

1. Preparation of sketches using generation of points, lines, curves, polygons and dimensioning
2. Development of sketches using edit, Zoom, Cross hatching, pattern filling utility commands etc.
3. Preparation of sketches using different options like save, restore, delete, joint and single option
4. Preparation of sketches using 2D and 3D wire frame modeling
5. Generation of orthographic projection of points, lines
6. Generation of orthographic projection of planes
7. Generation of orthographic projection of regular solids like prism, pyramid, cylinder,cone and sphere etc
8. Computer Aided Solid Modeling: Conversion of orthographic Projection into Isometric projections ,Modeling of simple solids-1
9. Computer Aided Solid Modeling: Conversion of orthographic Projection into Isometric projections ,Modeling of simple solids-2
10. Computer Aided Solid Modeling: Conversion of orthographic Projection into Isometric projections ,Modeling of simple solids-3
11. Conversion of Isometric projection into orthographic projections-1
12. Conversion of Isometric projection into orthographic projections-2

TEXT BOOKS :

1. Engineering drawing by N.D Bhatt , Charotar publications.
2. Engineering Graphics, K.C. john, PHI Publications

REFERENCES:

1. Mastering Auto CAD 2013 and Auto CAD LT 2013 – George Omura, Sybex
2. Auto CAD 2013 fundamentals- Elisemoss, SDC Publ.
3. Engineering Drawing and Graphics using Auto Cad – T Jeyapoovan, vikas
4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age
5. Engineering Drawing – RK Dhawan, S Chand
6. Engineering Drawing – MB Shaw, BC Rana, Pearson

7. Engineering Drawing – KL Narayana, P Kannaiah, Scitech
8. Engineering Drawing – Agarwal and Agarwal, Mc Graw Hill
9. Engineering Graphics – PI Varghese, Mc Graw Hill
10. Text book of Engineering Drawing with auto-CAD , K.venkata reddy/B.S . publications.
11. Engineering Drawing with Auto CAD/ James D Bethune/Pearson Publications
12. Engineering Graphics with Auto CAD/Kulkarni D.M, Rastogi A.P, Sarkar A.K/PHI Publications

II Year – II Semester		L	T	P	C
1000202121	ENVIRONMENTAL SCIENCE	2	0	0	0

COURSE OBJECTIVES:

1. Classify, describe and explain the concepts of Ecosystems and environmental Studies.
2. Overall understanding of different types of natural resources and its conservation.
3. Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities.
4. An understanding of the environmental impacts of developmental activities and the importance of environmental management.
5. Awareness on the social issues, environmental legislations and global treats.

COURSE OUTCOMES:

CO's	At the end of the course, the student will have the ability to:	POs Mapped	Strength of mapping
CO1	Gain a higher level of personal involvement and interest in understanding and solving environmental problems.	1,6,7	2
CO2	Comprehend environmental problems from multiple perspectives with emphasis on human modern lifestyles and developmental activities.	1,6,7	2
CO3	Learn the management of environmental hazards and to mitigate disasters and have a clear understanding of environmental concerns and follow sustainable development practices.	1,6,7	2

**Strength of mapping (Intensity Scale) – 1(Lightly mapped), 2(Moderately mapped), 3(Heavily mapped)

UNIT I **(8 hrs)**

Multidisciplinary nature of Environmental Studies:
Definition Scope and its importance, Multidisciplinary nature of Environmental science.

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Energy flow in the ecosystem – Ecological pyramids - Ecological succession.

Social Issues and the Environment: Impacts of microbial toxins on human health. Urban problems related to energy- Water conservation, rain water harvesting and watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions. Climate change, Global warming, Acid rain, Ozone layer depletion.

UNIT II - (3 hrs)

BIODIVERSITY AND ITS CONSERVATION: Definition: genetic, species and ecosystem diversity –Value of biodiversity, Hot-spots of biodiversity, Threats to biodiversity, Endangered and endemic species of India – Conservation of biodiversity.

UNIT III: (8 hrs)

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources

UNIT IV – (9 hrs)

ENVIRONMENTAL POLLUTION: Definition, Cause, effects and control measures of:

a. Air Pollution.
b. Water pollution
c. Soil pollution
d. Noise pollution
e. Nuclear hazards

Role of an individual in prevention of pollution – Pollution case studies

Environmental Laws: Wildlife Protection Act 1972 –Water pollution prevention and control Act 1974 - Forest Conservation Act 1980n –Air pollution prevention and control Act 1981. Environmental Protection Act 1986 and 2006 - – Public awareness
SOLID WASTE MANAGEMENT: Causes**,** effects and control measures of urban and industrial wastes.

Sustainable Development: Goals of Sustainability, Conferences, Carbon credits and carbon footprints.

UNIT V – (4 hrs)

Environmental Management:
EIA and EA: Introduction, definition, scope, objectives and methodology.
Disaster management: Definition, floods, earthquake, cyclone and landslides.
Ecotourism: Definition, principles, advantages and disadvantages

Environmental Diary

Field Trip

Field work/Environmental Visit: Visit to a local area to document environmental assets – reserve forest/ eco-tourist spot : Visit to a local polluted site - Study of local environment - common plants, insects, birds - Study of simple ecosystems –pond, river, hill slopes etc - Visit to industries/water treatment plants/effluent treatment plants.

Text Books:

1. Text book of Environmental Studies for Undergraduate courses by ErachBharuncha for University Grants Commission, Universities Press.
2. Environmental Studies by Palaniswamy – Pearson Education.
3. Environmental Studies by Dr. S. Azeem Unnisa, Academic Publishing Company

Reference Books:

1.Textbook of Environmental Science by Deeksha Dave and E. Sai Baba Reddy, Cengage Publications.
2. Text of Environmental Sciences and Technology by M. Anji Reddy, BS Publications.
3. Comprehensive Environmental studies by J.P Sharma, Laxmi Publications.
4. Environmental sciences and Engineering – J Glynn Henry and Gary W Heinke – Prentice hall of India Private Limited.
5. A textbook of Environmental Studies by G.R Chatwal, Himalaya Publishing house.
6. Introduction to Environmental engineering and science by Gilbert M Masters and Wendell P Ela – Prentice hall of India private limited.