SILVER OAK UNIVERSITY

College of Technology (01)

Diploma in Mechanical Engineering

Subject Name: Strength of Material

Subject Code: 1010122217

Semester:3rd

Prerequisite: Engineering Mechanics

Objective:

1. To apply the Principles of Mechanics to practical engineering problems.
2. To identify appropriate structural system for studying a given problem and isolate it from its environment.
3. Strength of material is very essential for an engineer in planning, designing and construction of various types of structures and machines, so that the design is safe and economical.

Teaching and Examination Scheme:

Teaching Scheme					Evaluation Scheme				Total Marks
					Theory		Practical		
L	T	P	Contact Hours	Credit	CIE (TH)	ESE (TH)	CIE (PR)	ESE (PR)	
3	0	2	5	4	40	60	30	20	150

Content:

Unit No.	Contents	Teaching Hours	Weightage %
1	**Basics of mechanics and force system** Introduction Definition of space, time, particle, rigid body, deformable body. Force, types of forces, Characteristics of a force, System of forces, Composition and resolution of forces. Fundamental Principles of mechanics: Principle of transmissibility, Principle of superposition, Law of gravitation, Law of parallelogram of forces, Newton's Laws of Motion.	6	25
2	**Fundamentals of Statics** **Coplanar concurrent and non-concurrent force system:** Resultant, Equilibrant, Free body diagrams. Coplanar concurrent forces: Resultant of coplanar concurrent force system by analytical and graphical method, Law of triangle of forces, Law of polygon of forces, Equilibrium conditions for coplanar concurrent forces, Lami's theorem. Application of these principles. **Coplanar non-concurrent forces:** Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Resultant of non-concurrent	8	

	forces by analytical method and graphical method, Equilibrium conditions of coplanar non-concurrent force system, Application of these principles. Concept of statically determinate and indeterminate problems. **Plane Truss:** assumptions used in the analysis of Truss. Perfect, imperfect and redundant truss, analysis of Truss by method of joints and method of sections.		
3	**Applications of fundamentals of statics** **Statically determinate beams:** Types of loads, Types of supports, Types of beams; Determination of support reactions, Relationship between loading, shear force & bending moment, bending moment and shear force diagrams for beams subjected to only three types of loads: i) concentrated loads ii) uniformly distributed loads iii) couples and their combinations; Point of contra flexure, point & magnitude of maximum bending moment, maximum shear force	10	15
4	**Stresses in Beams:** **Flexural stresses:** Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I, T, Angle, channel sections. **Slope & Deflection:** Formulae for Cantilever Beam subjected to Point Load at free end and with full UDL, Formulae for S.S Beam subjected to Point Load at MID SPAN and with full UDL Numerical problems on Slope and Deflection **Shear stresses:** Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.	10	20
5	**Torsion:** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity	5	
6	**Moment of inertia and mass moment of inertia Centroid:** Centroid of lines, plane areas and volumes, Examples related to centroid of composite geometry, Pappus – Guldinus first and second theorems. Moment of inertia of planar cross-sections: Derivation of equation of moment of inertia of standard lamina using first principle, Parallel & perpendicular axes theorems, polar moment of inertia, radius of gyration of areas, section modulus. Examples related to moment of inertia of composite geometry	7	10
7	**Physical & Mechanical properties of materials:** Elastic, homogeneous, isotropic materials; Stress –Strain relationships for ductile and brittle materials, limits of elasticity and proportionality, yield limit, ultimate strength, strain hardening, proof stress, factor of safety, working stress, load factor, Properties related to axial, bending, and torsional & shear loading, Toughness, hardness, Ductility, Brittleness.	4	10

8	**Basics of stress and strain:** **Stress and Strain:** 3-D state of stress (Concept only) Normal/axial stresses: Tensile & compressive Tangential Stresses: Shear and complementary shear Strains: Linear, shear, lateral, thermal and volumetric. Hooke's law, Elastic Constants: Modulus of elasticity, Poisson's ratio, Modulus of rigidity and bulk modulus and relations between them with derivation. **Application of normal stress & strains:** Homogeneous and composite bars having uniform & stepped sections subjected to axial loads and thermal loads, analysis of homogeneous prismatic bars under multidirectional stresses **Principle stresses:** Two-dimensional system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress, ellipse of stress and their applications	10	20

Course Outcome:

Sr. No.	CO statement	Unit No
CO-1	Apply fundamental principles of mechanics, equilibrium and statics to practical problems of engineering in real world.	1,2,3,8
CO-2	Ability to analyze the stresses and strain in any structures due to application of various types of load.	4,5
CO-3	Determine principal stresses and strains for two-dimensional system using analytical and graphical methods	8
CO-4	Calculate and locate the centroid and moment of inertia of a different geometrical shape and its use in engineering problem.	6
CO-5	Understand the different mechanical properties and behavior of material	7

Teaching & Learning Methodology:

The various methods or tools follows by the faculties to teach the above subject are:

1. Chock and Board
2. PPT
3. Flip Class Room
4. Video Animations

List of Experiments/Tutorials:

The students will have to solve at least five examples and related theory from each topic as an assignment/tutorial. Students will have to perform following experiments in laboratory and prepare the laboratory manual.

1. Estimate the resultant force and Prove the Law of Parallelogram, Polygon Law of Forces and Lami's Theorem
2. Authenticate reactions in beam through Graphical & analytical method

3. Equilibrium of coplanar concurrent forces.
4. Equilibrium of coplanar non-concurrent forces.
5. Equilibrium of coplanar parallel forces: Determination of reactions of simply supported beam
6. Determination of member force in a triangular truss

Major Equipment:

1. Apparatus for Law of Parallelogram, Lami's theorem and law of Polygon.
2. Force table
3. Beam set up
4. Truss set up
5. Beam apparatus to find reactions

Books Recommended:

1. Engineering Mechanics statics by R. C. Hibbeler, McMillan Publication
2. Engineering Mechanics by Vera Murali, OXFORD University Press (2010)
3. Engineering Mechanics by R S Khurmi S CHAND Publications
4. Engineering Mechanics by D S Kumar, S K Kataria and Sons Publication
5. Engineering Mechanics by Bear and Jonstan, newmedia Publication
6. Engineering Mechanics by S S Bhavikatti
7. Engineering Mechanics Statics and Dynamics Rajasekaran S and Sankarasubramanian, 3rd edition, Vikas Publishing House Pvt.Ltd. 2005.
8. Engineering Mechanics Statics and Dynamics by Irvin H Shames and Krishna Mohana Rao. G., 4th addition, Pearson Education 2006.
9. Engineering Mechanics Statics and Dynamics by Hibbeller, R.C. and Ashok Gupta, 11th addition, Pearson Education 2010.

List of Open Source Software/learning website:

1. Video Lectures on Applied Mechanics by Prof. S K. Gupta, Department of Applied Mechanics, IIT Delhi.
2. http://silveroakuni.ac.in/video-lecture
3. https://nptel.ac.in/
4. https://nptel.ac.in/courses/105/106/105106116/
5. https://nptel.ac.in/courses/112/106/112106286/