BVM ENGINEERING COLLEGE [AN AUTONOMOUS INSTITUTION]

2ES01: MECHANICS OF SOLIDS
CREDITS - 4 (LTP:3,0,1)

Course Objective:
This course is to introduce the basic principles of engineering mechanics and Mechanics of deformable bodies with emphasis on their analysis and application to practical engineering problems.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per week)			Credits	Assessment Scheme				Total Marks
				Theory		Practical		
L	T	P	C	ESE	CE	ESE	CE	
3	0	2	4	60	40	20	30	150

Course Contents:

Unit No.	Topic	Teaching Hours
1	**Introduction & Fundamentals of Statics:** 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. 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 statically determinate pin – jointed structures (Trusses). Coplanar non-concurrent forces: Moments & couples, Characteristics of moment and couple, Equivalent couples, Force couple system, Varignon's theorem, Resultant of non-concurrent forces by analytical method, Equilibrium conditions of coplanar non-concurrent force system.	09
2	**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 various types of loads and their combinations; Point of contra-flexure, point & magnitude of maximum bending moment, maximum shear force.	07
3	**Centroid and moment of inertia:** Centroid: Centroid of 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, and radius of gyration of areas. Examples related to moment of inertia of composite geometry	05

Unit No.	Topic	Teaching Hours
4	**Simple stresses & strains** Basics of stress and strain: 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.	07
5	**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. Shear stresses: Derivation of formula, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections.	06
6	**Columns and Struts:** Buckling of columns, different end conditions, effective length, least radius of gyration, Euler's and Rankine's formulae	03
7	**Direct and Bending stresses:** Members subjected to eccentric loads, middle third rule, kernel of section, chimney subjected to wind pressure, Retaining walls, dams subjected to hydraulic pressure	04
8	**Torsion:** Derivation of equation of torsion, Assumptions, application of theory of torsion equation to solid & hollow circular shaft, torsional rigidity.	04
9	Physical & Mechanical properties of materials: (laboratory hours) 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	(00 theory hours)
	Total	**45**

List of References:

1. S. B. Junnarkar and H. J. Shah, *"Applied Mechanics*", Charotar Publishing House Pvt. Ltd.
2. S. B. Junnarkar and H. J. Shah, "*Mechanics of Structure Vol. I*", Charotar Publishing House Pvt. Ltd.
3. P. J. Shah, *"Mechanics of Solids",* S. Chand, New Delhi.
4. N. K. Arora, *"Mechanics of Solids",* Books India Publications, Ahmedabad.
5. M. N. Patel, P. V. Patel, C. S. Sanghvi, J. S. Thakur, "*Mechanics of Solids*", Mahajan Publishing House, Ahmedabad.
6. Popov E.V., "*Engineering Mechanics of Solids*" Prentice Hall of India, New Delhi.
7. Hibbler R. C., "*Structural Analysis"* Pearson Education.

Course Outcomes:

After learning the course the students should be able to:

1. Apply fundamental principles of mechanics & principles of equilibrium to simple and practical problems of engineering.
2. Apply principles of statics to determine reactions & internal forces in statically determinate beams, trusses.

3. Determine centroid and moment of inertia of a different geometrical shape and able to understand its importance.
4. Know behaviour & properties of engineering materials.
5. Understand the different types of stresses and strains developed in the member subjected to axial, bending, shear, torsion & thermal loads.