

INSTITUTE	FACULTY OF TECHNOLOGY
PROGRAM	BACHELOR OF TECHNOLOGY (CIVIL ENGINEERING)
SEMESTER	3
COURSE TITLE	MECHANICS OF SOLID
COURSE CODE	01CI1301
COURSE CREDITS	5

Objective:

- 1 To study about identification of different types of forces, systematic evaluation of effect of these forces, behavior of rigid bodies subjected to various types of forces, at the state of rest or motion of the particles, as Universe exist due to force only.
- 2 To understand the fundamental principles, concepts and techniques, both theoretical and experimental, with emphasis on the application of these to the solution of mechanics based suitable problems in all engineering.
- 3 To provide a firm foundation and formwork for more advanced study at every higher semester as the subject of Mechanics of Rigid bodies cuts broadly across all branches of engineering profession.
- 4 To determine stresses in thin cylinders and spherical vessels.

Course Outcomes: After completion of this course, student will be able to:

- 1 Apply the fundamental principles of mechanics to analyze the equilibrium of rigid and deformable bodies, including force systems, support reactions, and free body diagrams
- 2 Determine the Center of Gravity and the moment of inertia of simple and complex geometrical Shapes.
- 3 Describe the mechanical behavior of engineering materials subjected to various types of stresses and strain
- 4 Analyze torsional behavior of circular shafts and stresses in thin-walled pressure vessels subjected to internal pressure

Pre-requisite of course:..

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
4	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	<p>Introduction</p> <p>Terminologies: space, time, particle, rigid body, deformable body, Introduction: Definitions of Space, time, particle, rigid body, deformable-body, Force, Characteristics of a force, System of forces., Introduction: Application of force in engineering and resolution of forces, Principles of Transmissibility, superposition, Gravitational Law and Parallelogram Law of Forces. , Coplanar concurrent force system: Derivation of the resultant force and equilibrant force using analytical and graphical methods. Triangle law of forces and Polygon law of forces. , Equilibrium of rigid bodies: Conditions of equilibrium, Lami’s theorem, Concept of Free body diagram in engineering. Application of Lami’s theorem in various problems., Coplanar non-concurrent forces: Definition of moment, couple and its effect on rigid bodies. Properties of couple, equivalent force couple system with examples, Varignon’s theorem and its derivation., Resultant of Coplanar non-concurrent Force system: Calculation of resultant force in coplanar non-concurrent force system by analytical and graphical methods. , Support Reactions: Types of beams, loads and supports, Calculation of support reactions for determinate beams subjected different loads</p>	15
2	<p>Stresses & Strains</p> <p>Introduction: Definition and types of simple stresses (direct and indirect) and strains (linear and lateral) in an element and its importance in engineering, Hooke’s law, Evaluation of stresses and strains in members subjected to axial and shear loading for homogenous, composite, prismatic and tapered sections., Elastic Constants: Poisson’s ratio, Modulus of Elasticity, Rigidity, and Bulk modulus. Relationship between modulus of elasticity, rigidity, bulk modulus and Poisson’s ratio with problems. Volumetric strains, the effect of multi-directional stresses on homogeneous members. , Thermal Stresses: Evaluation of stresses in elements subjected to temperature effects in homogeneous and composite members , Bending Stress – Assumption, theory and derivation of equation for pure bending. Determination of bending stresses at various sections. Section modulus and bending stress distribution in beams of various cross-sections. , Shear stress – Derivation of equation for shear stress across the crosssection, Qualitative and Quantitative determination of shear stress distribution in beams having various cross-sections., Principle Stresses - Two-dimensional stress system. Evaluation of stresses in an inclined plane for members subjected to orthogonal stresses. Definition of principal plane, principal stresses, angle of obliquity, and resultant stress. Evaluation of Principal plane and principal stresses using analytical method. Analysis of Principal stresses and principal planes for two-dimensional stress system. Application of Mohr’s circle and ellipse of stress., Principle Stresses - Evaluation of Principal plane and principal stresses using analytical method. Analysis of Principal stresses and principal planes for two-dimensional stress system. Application of Mohr’s circle and ellipse of stress.</p>	22

Contents : Unit	Topics	Contact Hours
3	Centroid and Moment of Inertia Centroid: Definition, concept, and evaluation of centroid for standard one-dimensional, two-dimensional and three-dimensional shapes, centroid for composite lines, areas and volumes. , Pappus-Guldinas Theorem: Pappus Guldinus theorem and its application in calculating surface area and volume., Moment of Inertia: Definition and concept of Moment of Inertia. Perpendicular axis, Parallel axis theorem, Polar Moment of inertia, and radius of gyration. , Moment of Inertia: Moment of Inertia for planar sections using parallel axis theorem for standard lamina. Determination of moment of Inertia for composite lamina.	12
4	Torsion Definition of Torsion, Assumption, and derivation of equation for pure torsion in circular shafts, Torsional rigidity, and its application. Torque generated due to Power transmitted in the shaft. Stresses generated in members subjected to circulatory motion in circular and hollow circular shafts.	4
5	Thin Cylinder Circumferential and longitudinal stresses and strain in Thin cylinders and spherical vessels	3
Total Hours		56

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	Experiment-1 To determine the resultant of Co-Planar Con-Current forces	4
2	Experiment-2 To determine the resultant of Co-Planar Non-Concurrent forces	2
3	Experiment-3 Identify the Centroid and Center of Gravity of different bodies	2
4	Experiment-4 Determination of hardness of metals	2
5	Experiment-5 Determination of the impact of metals	2
6	Experiment-6 Determination of the compression test on metals and timber	2
7	Experiment-7 Determination of tensile strength of metals	2
8	Experiment-8 Determination of shear strength of metals	2
9	Tutorial-1 Determine Center of Gravity and Moment of Inertia	2
10	Tutorial-2 Calculate the support reactions of the statically determinate beams	2

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
11	Tutorial-3 Calculate stress in the beam, columns, and thin cylinders	2
12	Tutorial-4 Determine torsion, angle of twist, and stresses for mild steel pipes.	2
13	Tutorial-5 Determine principal stresses and strains for two two-dimensional systems using analytical and graphical methods	2
Total Hours		28

Textbook :

- 1 Elements of Mechanics of Solids, M. N. Patel, P. V. Patel, C. S. Sanghavi & J. S. Thakur, Mahajan Publication., 2008
- 2 Mechanics of solids, Santosh Shah & Siddharth Shah, Superior Publication, 2015
- 3 Mechanics of solids, N. K. Arora, Book India Publication, 2014

References:

- 1 Engineering Mechanics , Engineering Mechanics , G. S. Sawhney, PHI New Delhi, 2012
- 2 Strength of Materials, Strength of Materials, R. K. Rajput, S. Chand Publication, 2010
- 3 Strength of Materials, Strength of Materials, R. S. Khurmi, S. Chand Publication, 2005
- 4 Applied Mechanics, Applied Mechanics, S. B. Junarkar & H. J. Shah, Charotar Publication, 2011
- 5 Mechanics of Structures Vol-1, Mechanics of Structures Vol-1, H. J. Shah, S. B. Junarkar, Charotar Publication, 2008
- 6 Mechanics of Materials, Mechanics of Materials, Beer and Johnston, TMH, 2010
- 7 Mechanics of Materials, Mechanics of Materials, Hibbler R C, Pearson Education, 2006

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	10.00	35.00	25.00	10.00	10.00

Instructional Method:

- 1 At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- 2 Lectures will be taken in class room with the use of multi-media presentations, white board – mix of both.

Instructional Method:

- 3 Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation.
- 4 Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation
- 5 Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.
- 6 Surprise tests/Quizzes will be conducted which carries 5% component of the overall evaluation.
- 7 The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures. Minimum 8 experiments are planned based on the course content.