

**OBJECTIVES:**

- To learn fundamental concepts of Stress, Strain and deformation of solids with applications to bars, beams and thin cylinders.
- To know the mechanism of load transfer in beams, the induced stress resultants and deformations.
- To understand the effect of torsion on shafts and springs.
- To analyse a complex two dimensional state of stress and plane trusses

**UNIT I STRESS AND STRAIN 9**

Stress and strain at a point – Tension, Compression, Shear Stress – Hooke's Law – Relationship among elastic constants – Stress Strain Diagram for Mild Steel, TOR steel, Concrete – Ultimate Stress – Yield Stress – Factor of Safety – Thermal Stresses – Thin Cylinders and Shells – Strain Energy due to Axial Force – Resilience – Stresses due to impact and Suddenly Applied Load – Compound Bars.

**UNIT II SHEAR AND BENDING IN BEAMS 9**

Beams and Bending- Types of loads, supports – Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load, UDL, uniformly varying load. Theory of Simple Bending – Analysis of Beams for Stresses – Stress Distribution at a cross Section due to bending moment and shear force for Cantilever, simply supported and overhanging beams with different loading conditions - Flitched Beams.

**UNIT III DEFLECTION 9**

Double integration method - Macaulay's methods - Area moment method - conjugate beam method for computation of slopes and deflections of determinant beams.

**UNIT IV TORSION 9**

Torsion of Circular and Hollow Shafts – Elastic Theory of Torsion – Stresses and Deflection in Circular Solid and Hollow Shafts – combined bending moment and torsion of shafts - strain energy due to torsion - Modulus of Rupture – Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – Leaf Springs – Springs in series and parallel – Design of buffer springs.

## **UNIT V      COMPLEX STRESSES AND PLANE TRUSSES**

**9**

2 D State of Stress – 2 D Normal and Shear Stresses on any plane – Principal Stresses and Principal Planes – Mohr's circle - Plane trusses: Analysis of plane trusses - method of joints - method of sections.

**TOTAL (L:45+T:15): 60 PERIODS**

### **OUTCOMES:**

The students will have

- Thorough understanding of the fundamental concepts of stress and strain in mechanics of solids and structures.
- The ability to analyse determinate beams and trusses to determine shear forces, bending moments and axial forces.
- A sufficient knowledge in designing shafts to transmit required power and also springs for its maximum energy storage capacities.

### **TEXT BOOKS:**

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2007.
2. Bhavikatti. S., "Solid Mechanics", Vikas publishing house Pvt. Ltd, New Delhi, 2010.

### **REFERENCES :**

1. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.
2. Timoshenko.S.B. and Gere.J.M, "Mechanics of Materials", Van Nos Reinhold, New Delhi 1995.
3. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi,1995.
4. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 1997.
5. Ugural. A.C., "Mechanics of Materials", Wiley India Pvt. Ltd., New Delhi, 2013.

## **SUBJECT DESCRIPTION AND OBJECTIVES**

The subject of Mechanics of Solids cuts broadly across all branches of engineering profession. At the end of this course, the student will have knowledge about behaviour of members subjected to various types of forces. The subject can be mastered best by solving numerous problems.

This subject deals with

- Stress, Strain
- Deformation of Solids
- States of Stresses
- Behavior of Thin Cylinders & Shells
- Loading on Beams
- Bending Theory
- Deflection of Beams
- Shear Stresses
- Torsion
- Springs
- Analysis of Truss

**MICRO LESSON PLAN**

<b>WEEK</b>	<b>LECT.NO</b>	<b>TOPICS TO BE COVERED</b>	<b>TEXT / REFERENCE BOOK</b>
	<b>UNIT I      STRESS AND STRAIN</b>		
<b>I</b>	1	Stress and strain at a point (AV CLASS)	T 1
	2	Tension, Compression, Shear Stress, Hooke's Law	
	3	Relationship among elastic constants	
	4	Stress Strain Diagram for Mild Steel, TOR steel, Concrete	
	5	Ultimate Stress	
<b>II</b>	6	Yield Stress	
	7	Factor of Safety	
	8	Thermal Stresses	
	9	Thin Cylinders and Shells (AV CLASS)	
	10	Strain Energy due to Axial Force, Resilience	
<b>III</b>	11	Stresses due to impact and Suddenly Applied Load	
	12	Compound Bars	
	<b>UNIT II      SHEAR AND BENDING IN BEAMS</b>		
	13	Beams and Bending	T 1
	14	Types of loads, supports (AV CLASS)	
15	Shear Force and Bending Moment Diagrams for statically determinate beam with concentrated load		
16	Shear Force and Bending Moment Diagrams for statically determinate beam with UDL		
17	Shear Force and Bending Moment Diagrams for statically determinate beam with uniformly varying load		
<b>IV</b>	18	Theory of Simple Bending (AV CLASS)	T 1
	19	Analysis of Beams for Stresses	
	20	Stress distribution at a cross Section due to bending moment and shear force for Cantilever	

<b>V</b>	21	Stress distribution at a cross section due to bending moment and shear force for simply supported	T 1
	22	Stress distribution at a cross section due to bending moment and shear force for overhanging beams with different loading conditions	
	23	Problems	
	24	Flitched Beams	
<b>UNIT III DEFLECTION</b>			
<b>VI</b>	25	Double integration method for computation of slopes and deflections of determinant beams	T 1
	26	Problems	
	27	Problems	
	28	Problems	
<b>VII</b>	29	Macaulay's methods for computation of slopes and deflections of determinant beams	
	30	Problems	
	31	Problems	
<b>VIII</b>	32	Area moment method for computation of slopes and deflections of determinant beams.	
	33	Problems	
	34	Problems	
	35	Conjugate beam method for computation of slopes and deflections of determinant beams.	
	36	Problems	
<b>UNIT IV TORSION</b>			
<b>IX</b>	37	Torsion of Circular and Hollow Shafts	T 1
	38	Elastic Theory of Torsion (AV CLASS)	
	39	Stresses and Deflection in Circular Solid shafts	
	40	Stresses and Deflection in Circular hollow shafts	
	41	Combined bending moment	

<b>X</b>	42	Torsion of shafts	<b>T 1</b>
	43	Strain energy due to torsion	
	44	Modulus of Rupture	
	45	Power transmitted to shaft , Shaft in series and parallel	
	46	Closed and Open Coiled helical springs (AV CLASS)	
	47	Leaf Springs, Springs in series and parallel	
	48	Design of buffer springs	
<b>XI</b>	<b>UNIT V      COMPLEX STRESSES AND PLANE TRUSSES</b>		<b>T 1</b>
	49	2 D State of Stress (AV CLASS)	
	50	2 D Normal Stresses on any plane	
	51	2 D Shear Stresses on any plane	
	52	Principal Stresses & Principal Planes	
	53	Mohr's circle	
	54	Problems	
<b>XII</b>	55	Plane trusses	<b>T 1</b>
	56	Analysis of plane trusses (AV CLASS)	
	57	Method of joints	
	58	Problems	
	59	Method of sections	
	60	Problems	

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