Lesson Plan

Strength of Materials (2020-21)

Syllabus

Course Code	Course Name	Credits
MEC302	**Strength of Materials**	**03**

Module	Detailed Contents	Hrs
1.	**Introduction-Concept of Stress** Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, Stress Strain Diagram, elastic constants and their relations- volumetric, linear and shear strains. Composite sections, Thermal stress and strain. Principal stresses and Principal planes- Mohr's circle. Moment of inertia about an axis and polar moment of inertia	**08**
2.	**Shear Force and Bending Moment in Beams:** Introduction to types of beams, supports and loadings. Definition of bending moment and shear force, Sign conventions, relationship between load intensity, bending moment and shear force. Shear force and bending moment diagrams for statically determinate beams subjected to points load, uniformly distributed loads, uniformly varying loads, couple and their combinations.	**06**
3.	**Stresses in Beams:** Theory of bending of beams, bending stress distribution, shear stress distribution for point and distributed loads in simply supported and over-hanging beams, cantilevers.	**08**
4.	**Deflection of Beams:** Deflection of a beam: Double integration method, Maxwell's reciprocal theorems for computation of slopes and deflection in beams for point and distributed loads. **Torsion:** Stresses in solid and hollow circular shafts.	**06**
5.	**Thin Cylindrical and Spherical Shells:** Stresses and deformation in Thin Cylindrical and Spherical Shells subjected to internal pressure **Strain Energy:** Strain energy stored in the member due to gradual, sudden and impact loads, Strain energy due to bending and torsion.	**06**
6.	**Columns:** Buckling load, Types of end conditions for column, Euler's column theory and its limitations and Rankine formula.	**05**

Recommended Books

References:

1. Strength of Materials by Ryder, Macmillan
2. Mechanics of Materials by James M. Gere and Barry J. Goodno, Cengage Learning, 6thEd, 2009
3. Mechanics of Materials by Gere and Timoshenko, CBS 2nd Edition
4. Elements of Strength of Materials by Timoshenko and Youngs, Affiliated East -West Press
5. Mechanics of Materials byBeer, Jhonston, DEwolf and Mazurek, TMHPvt Ltd., New Delhi
6. Mechanics of Structures by S.B.Junnarkar, Charotar Publication
7. Mechanics of Materials by S.S.Ratan, Tata McGraw Hill Pvt. Ltd
8. Introduction to Solid Mechanics by Shames, PHI
9. Strength of Materials by S. Ramamrutham, Dhanpat Rai Pvt. Ltd
10. Strength of Materials by W.Nash, Schaum's Outline Series, McGraw Hill Publication, Special Indian Edition
11. Strength of Materials by R. Subramanian, Oxford University Press, Third Edition 2016

Links for online NPTEL/SWAYAM courses:

1. http://www.nptelvideos.in/2012/11/strength-of-materials-prof.html
2. https://swayam.gov.in/nd1_noc20_ce34

Course Objectives and Course Outcomes

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres subjected to various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of Loading.
3. To study distribution of various stresses in the mechanical elements under different types of loads.

Outcomes: Learner will be able to…

1. Demonstrate fundamental knowledge about various types of loading and stresses induced.
2. Draw the SFD and BMD for different types of loads and support conditions.
3. Analyse the bending and shear stresses induced in beam.
4. Analyse the deflection in beams and stresses in shaft.
5. Analyse the stresses and deflection in beams and Estimate the strain energy in mechanical elements.
6. Analyse buckling phenomenon in columns.

Lesson Plan

	Topics Planned	Module	Hours
Week1 (10/07/20)	Introduction-Concept of Stress Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses, Stress Strain Diagram, elastic constants and their relations, volumetric, linear and shear strains. **Factor of safety;** deformation of uniform/tapering rectangular and circular and circular cross−section bars; deformation of members made of	**1**	**1**

	composite materials; shear stress and shear strain **Poisson's ratio**; volumetric strain; bulk modulus; relationship between Young's modulus, bulk modulus and modulus of elasticity		
Week 2 (13/07/20 – 17/07/20)	Composite sections, Thermal stress and strain. Principal stresses and Principal planes- Mohr's circle. Moment of inertia about an axis and polar moment of inertia	**1**	**4**
Week 3 (20/07/20 – 24/07/20)	**2.1 Shear Force and Bending Moment:** Axial force, shear force and bending moment diagrams for statically determinate beams excluding beams with internal hinges for different types of loading.	**2**	**4**
Week 4 (27/07/20 – 31/07/20)	**2.1 Shear Force and Bending Moment:** Axial force, shear force and bending moment diagrams for statically determinate beams excluding beams with internal hinges for different types of loading.	**2**	**4**
Week 5 (03/08/20 – 07/08/20)	**Introduction to Moment of Inertia**. Introduction to centre of gravity and parallel axis theorem and perpendicular Axis, Polar Moment of Inertia.	**2**	**4**
Week 6 (10/08/20 – 14/08/20)	**5.1 Theory of Torsion:** Torsion of circular shafts−solid and hollow, stresses in shafts transmitting power	**5**	**4**
Week 7 (17/08/20 – 21/08/20)	5.1 Shafts in series and parallel. 5.2 Concept of equivalent torsion and bending moments.		
Week 8 (31/08/20 – 09/09/20)	Determination using Mohr's circle maximum shear stress,	**5**	**4**
Week 9 (07/09/20 – 11/09/20)	Determination using Mohr's circle maximum shear stress, Principal stresses in beams principal stresses in shafts subjected to torsion, bending and axial thrust	**5**	**4**
Week 10 (14/09/20 – 18/09/20)	Thin Cylindrical and Spherical Shells: Stresses and deformation in Thin Cylindrical and Spherical Shells subjected to internal pressure **6.2 Strain**	**6**	**4**

	energy: Strain energy due to axial loads gradually applied transverse loads and under impact load. Formulae.		
Week 11	**3.1 Theory of Bending:** Flexure formula for straight beams; principal axes of inertia; moments of inertia about principal axes; transfer theorem. .	**3**	**4**
Week 12 (28/09/20 – 02/10/20)	3.1 Theory of Bending: Flexure formula for straight beams; principal axes of inertia; moments of inertia about principal axes; transfer theorem **3.1** Numerical on application of flexure formula, section modulus and moment of resistance of a section.	**3**	**2**
Week 13 (05/10/20 – 09/10/20)	**3.1 Theory of Bending:** Flexure formula for straight beams; principal axes of inertia; moments of inertia about principal axes; transfer theorem. **3.1** Numerical on application of flexure formula, section modulus and moment of resistance of a section.	**4**	**4**
Week 14 (12/10/20 – 16/10/20)	**3.2** Shear Stress in Beams: Distribution of shear stress across plane sections used commonly for structural purposes; shear connectors.	**4**	**4**
Week 15 (19/10/20 – 23/10/20)	4.1 Bending Moment Combined with Axial Loads: Application to members subjected to eccentrics loads, core of section.		
Week 16 (26/10/20-30/10/20)	Numerical on Bending Moment Combined with Axial Loads: Application to members subjected to eccentrics loads, core of section.		
Week 17 (02/11/20-06/11/20)	**4.2 Deflection of Beams:** Deflection of cantilevers sample supported and overhanging beams using double integration and Macaulay's method for different types of loadings		
Week 18 (09/11/20 10/11/20)	Numerical on Deflection of cantilevers sample supported and overhanging beams using double integration and Macaulay's method for different types of loadings		

Week 19 (19/11/20)	Numerical on Deflection of cantilevers sample supported and overhanging beams using double integration and Macaulay's method for different types of loadings		
Week 19 (26/11/20)	**Unit Test 2 SE**		