FISAT
FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY
AUTONOMOUS
Focus on Excellence

Semester 2
Mechanics of Solids

Course Code	Teaching hours per week				Credits	Exam hours	Course type	CIE Marks	ESE Marks
	L	T	P	R					
26NNVPC201	2	1	0	0	3	2.5	PCC	40	60

1. **Preamble:** Mechanics of Solids is one of the foundation courses in the study of structural systems that introduces the fundamental principles governing the behavior of deformable bodies under various types of loading. The course provides the analytical foundation required to determine internal forces, bending moments, and deflections in beams and other structural members to analyze basic structural elements. Emphasis is given to developing the ability to apply these principles to practical civil engineering problems, forming a crucial basis for advanced structural analysis and design courses.

2. **Prerequisites:** NA

Module Number	Syllabus Description	Contact Hours
1	**Concept of stress and strain** – Types of stress and strain, Stress – strain relation - Hooke's law, Stress-strain diagram of mild steel, Factor of safety, Working stress Elastic constants - Poisson's ratio - Modulus of Elasticity, Modulus of Rigidity, Bulk modulus- relationship between elastic constants Axially loaded bars with uniform and uniformly varying cross section–stress, strain and deformation. **Temperature effects** - Temperature stress in composite bars	9
2	**Shear force and bending moment diagrams** Different types of beams, Types of loading on beams, Concept of bending moment and shear force - Relationship between intensity of load, shear force and bending moment, Shear force and bending moment diagrams of cantilever beams, simply supported beams and overhanging beams for different types of loads. Point of contraflexure.	9
3	**Bending stress** - Theory of simple bending, Assumptions and limitations. Section Modulus - Calculation of bending stress in beams, Moment of resistance. Beams of uniform strength. **Shear stress** - Shear stress in beams of different cross sections - shear centre	9

	Deflection of beams - Derivation of differential equations for deflection of beams - Double Integration Method, Macaulay's method, Moment Area Method	
4	**Stresses on inclined planes** - Stresses on inclined planes for uniaxial and biaxial stress fields, Principal stresses and principal planes, Maximum shear stress in 2D problems. Mohr's circle of stress for 2D problems **Stresses in Thin and Thick Cylinders** : Stresses in thin cylinders, Thick cylinders - Lamie's equation - Stresses in thick cylinders due to internal and external pressure **Theory of columns** - Short column – Direct and bending stress. Kern of a section. Slender column – Euler's buckling load, Slenderness ratio, Limitation of Euler's formula. Rankine's formula.	9
	Total hours	36

3. **Course Assessment Methods**

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination- 1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

Part A	Part B	Total
8x3 =24marks • 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks	**4x9 = 36 marks** • Each question carries 9 marks. • Two questions will be given from each module,out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions.	**60**

4. Course Outcomes

At the end of the course students should be able to:

Course Outcomes		Blooms Taxonomy Level
CO1	Explain the fundamental concepts of stress, strain, and elastic constants, and determine the relationships among them for various loading conditions.	K2
CO2	Apply the concepts of shear force and bending moment to construct shear force and bending moment diagrams for beams subjected to different types of loads and support conditions	K3
CO3	Apply bending, shear, and deflection theories to evaluate stresses, strains, and deflections in beams under different loading conditions.	K3
CO4	Apply the principles of stress analysis to determine stresses on inclined planes, stresses in thin and thick cylinders under different loading conditions and determine strength and stability of short and slender columns	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyze, K5- Evaluate, K6- Create

5. Mapping of Course Outcomes with Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-

6. Text Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Mechanics of Structures - Vol 1	H. J. Shah and S. B. Junnarkar	Charotar Publishing House	32nd Edition 2016
2	A Text book of Strength of Materials	R. K. Bansal	Laxmi Publications	7th Edition, 2022
3	Mechanics of Materials	B. C. Punmia, Ashok K. Jain, Arun Kumar Jain	Laxmi Publications	Revised Edition 2017

7. Reference Books

Sl No	Title of Book	Name of Author/s	Publisher	Edition and Year
1	Engineering Mechanics of Solids	Egor P. Popov	Prentice Hall International Series	2nd Edition 2015
2	Mechanics of Materials	James M Gere, S.P. Timoshenko	CBS Publishers and Distributors	2nd Edition 2004
3	Mechanics of Materials	R.C. Hibbeler	Pearson Publications	10th Edition 2018
4	Strength of Materials	S.Ramamrutham and R. Narayanan	Dhanpat Rai Publishing Co	18th Edition 2014
5	Strength of Materials	S S Rattan	McGraw Hill Education India	3rd Edition 2016

8. Video Links or any other Reference Materials

Sl No	Details Like Weblink, Publication Details	Module
1	*https://onlinecourses.nptel.ac.in/noc22_ce46/preview*, IIT Kanpur	1,3
2	*Lecture Notes | Solid Mechanics | Civil and Environmental Engineering | MIT OpenCourseWare*	2,3
3	*nptel.ac.in/courses/112106319*	4
4	*https://www.youtube.com/@solidmechanics-prof.jaygho7500*	4

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Model Question Paper

Register No…… Name: ……..

FEDERAL INSTITUTE OF SCIENCE AND TECHNOLOGY (FISAT)
(Autonomous)
SECOND SEMESTER BTECH DEGREE EXAMINATION, MONTH &YEAR

Course Code : 26NNVPC201
Course Name : Mechanics of Solids

Total Marks : 60 Duration : 2.5 hours

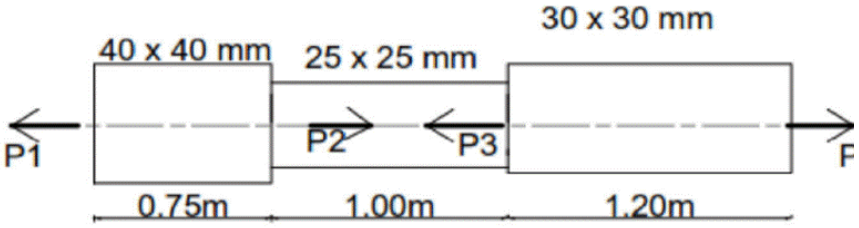
PART - A

	(Answer all questions. Each question carries 2 marks)	*CO*	*Marks*
1	Draw the stress – strain diagram of mild steel and mark the salient points	CO1	3
2	Explain the analysis of composite bar subjected to temperature stresses	CO1	3
3	Derive the relationship between bending moment and shear force in a beam	CO2	3
4	What do you mean by point of contraflexure? State its significance	CO2	3
5	List three assumptions in theory of pure bending	CO3	3
6	Show that the maximum shear stress in a rectangular cross section is 1.5 times the average shear stress	CO3	3
7	Define the terms : Principal stresses and principal strains	CO4	3
8	Define the slenderness ratio of a column. State its significance	CO4	3

PART - B

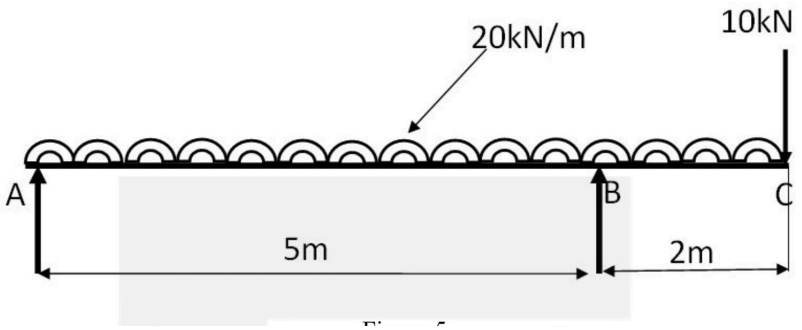
(Answer one full question from each module. Each question carries 9 marks)

9	A member ABCD is subjected to point loads P_1, P_2, P_3, P_4 as shown in figure. Calculate the force P3 necessary for equilibrium if P_1 = 120 kN , P_2 = 220 kN and P_4 = 160 kN. Determine also the net change in length of member. E = 200 GPa	CO1	9



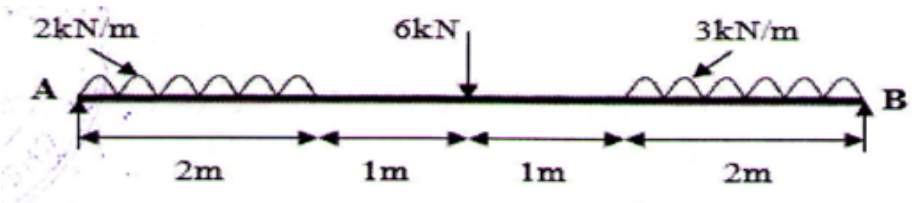
OR

10	A steel bar is placed between two copper bars each having the same area and length as the steel bar at 15°C. At this stage they are rigidly connected together at both the ends. When the temperature is raised to 315°C, the length of the bars increases by 1.50 mm. Determine the original length and the final stresses in the bars. Take Es= 2.1 x10^5 N/mm^2, Ec = 1 x 10^5 N/mm^2, αs = 0.000012 per °C, αc = 0.0000175 per °C	CO1	9
11	Analyse the overhanging beam shown in figure. Draw shear force diagram and bending moment diagram and mark the values at all salient points including the point of contraflexure	CO2	9



OR

12	Draw the shear force and bending moment diagram of the simply supported beam AB shown below. Mark the salient values. Also find maximum bending moment.	CO2	9



13	A beam of I section 200 mm wide and 300 mm deep with flange and web thickness 20 mm is used as a simply supported beam over a span of 7 m. The beam carries a distributed load of 5 kN/m over the whole span and a concentrated load of 20 kN at mid span. Determine the maximum bending stress set up and sketch the stress distribution.	CO3	9
	OR		
14	Determine and draw the shear stress variation along the depth of an I section beam having a uniform thickness of 10 mm, for the web and flanges. The total height of the section is 200 mm and the overall width of each flange is 100 mm. The shear force is 250 kN.	CO3	9
15	At a point in an elastic material under strain, there are normal stresses of 60 MN/m^2 (tensile) and 35 MN/m^2(compressive) respectively at right angles to each other with a shearing stress of 25 MN/m^2. Find the principal stresses and position of principal planes. Find also the maximum shear stress and its plane.	CO4	9
	OR		
16	A solid shaft of 200 mm diameter has the same cross sectional area as that of a hollow shaft of the same material with an inside diameter of 150 mm. Find the ratio of the power transmitted by the two shafts at the same speed.	CO4	9

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