R18

Code No: 153BE

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech II Year I Semester Examinations, February - 2024

MECHANICS OF SOLIDS

(Common to ME, MCT, MIE)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a)	State the principle of St.Venant.	[2]
b)	Draw the stress strain curve and indicate the elastic limit, upper and lower yield points and ultimate stress on it.	[3]
c)	What is the importance of drawing shear force and bending moment diagrams?	[2]
d)	Classify the beams based on the constraints. Draw their schematic diagrams.	[3]
e)	List the assumptions made in the theory of pure bending.	[2]
f)	Sketch the shear stress distribution for I section beam. Also indicate the average and maximum shear stress locations.	[3]
g)	The principal Stresses and principal planes for a given loading are independent of coordinate system. Justify the statement.	[2]
h)	Explain the reasons for using different theories of failure.	[3]
i)	Show that volumetric strain for a shaft subjected to pure torsion is 0.	[2]
j)	Define torsional rigidity. What is its significance in the design of shafts?	[3]

PART – B

(50 Marks)

2. A steel rod of diameter 20 mm is encased in a copper tube of an external diameter 35 mm and an internal diameter 25 mm with the help of washers and nuts. The nut on the tie rod is tightened so as to produce a tensile stress of 40 MPa in steel rod. The combination is subjected to a tensile load of 20 kN. Determine the resultant stresses in the steel rod and in the copper tube. $E_s = 2E_c = 210$ GPa. [10]

OR

3.a) A copper bar of a diameter of 20 mm and a length of 600 mm is subjected to an axial tensile load. If the elastic limit stress is 200 MPa, determine the resilience at 100 MPa, the proof resilience and the modulus of resilience. Take E = 100 GPa.

b) Derive the relationship between the young's modulus and bulk modulus. [6+4]

4. A cantilever beam is loaded as shown in the figure 1. Plot the shear force and bending moment diagrams. Also find the reactions at the fixed support. What is the bending moment at a distance of 0.5 m from the fixed support? [10]

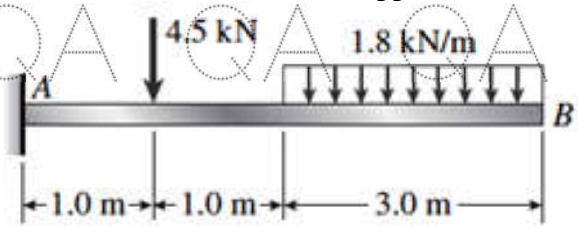

Figure 1

OR

5. A simply supported beam ABCD of length 8 m rests on supports B and C which are 5 m apart, the right-hand end, D, is overhanging by 2 m and the left-hand end, A, is overhanging by 1 m. The beam carries a uniformly distributed load of 5 kN/m over the entire length. It also carries two point loads of 4 kN and 6 kN at each end of the beam. Draw the shear force and bending moment diagrams for the beam and find the points of contra flexure. [10]

6.a) Prove that the neutral axis passes through the centroid of the cross section in pure bending.

b) A beam section is an isosceles triangle with base 40 mm and altitude 60 mm. Bending moment at a section is 0.4 kNm, which produces tension in the base. Draw stress distribution along the altitude of the section. Locate neutral axis also. [5+5]

OR

7. A round beam of circular section of diameter D is simply supported at the ends and carries a point load W at its centre. Determine the magnitude of the shear stress along the plane passing through the neutral axes at a particular section, which lies at a distance of L/4 from left-hand side support where L is span length. Draw the profile of the shear stress distribution indicating the average and maximum shear stress. [10]

8. The state of stress at a point in a stressed body is shown in figure 2. Draw a Mohr's stress circle and determine the principal stresses and principal angles with respect to plane BC. Compare the results with the analytical solution. [10]

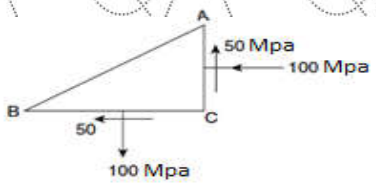

Figure 2

OR

9. The surface of a steel machine member is subjected to principal stresses of σ_1 = 100 MPa, σ_2 = 20 MPa and σ_3 = -80 MPa. What tensile strength is required to provide a factor of safety of 2.5 with respect to yielding according to the maximum shear stress theory and according to the Distortion energy theory? Comment on the result. [10]

10. A hollow shaft transmits 300 kW at 80 rpm. If the shear stress is not to exceed 60 MPa and internal diameter is 0.6 times the external diameter, find out diameters of the shaft. Assume maximum torque is 1.4 times the mean torque. What would be the diameter of the solid shaft for the same values of power, speed and the permitted shear stress? Also find the ratio of weights from solid to hollow shaft if both the shafts are made with the same material. [10]

OR

11.a) Derive the expression for the volumetric strain of a thin spherical shell subjected to internal pressure.

b) Find out the safer internal pressure for a spherical pressure vessel made of thin plate 0.25 cm thick, if the mean diameter of the sphere is 600 cm. The allowable stress in tension is 900 kg/cm^2. [5+5]

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