Code No: 183BK **R22**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech II Year I Semester Examinations, February - 2024
MECHANICS OF SOLIDS
(Common to ME, AE, MIE)

Time: 3 Hours **Max. Marks: 60**

Note: This question paper contains two parts A and B.
i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.
- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of **ten questions** (numbered from 2 to 11) **carrying 10 marks each**. From each unit, there are two questions and the student should answer one of them. Hence, the student should answer five questions from Part-B.

PART- A

(10 Marks)

1.a) Define Poisson's ratio. [1]
b) How is shear strain different from direct strain? [1]
c) Sketch and name the different loading types that generally act on a beam. [1]
d) What is statically indeterminate beam? Give couple of examples. [1]
e) How normal stresses are developed in a beam in case of pure bending? [1]
f) Sketch the variation of shear stress across the depth of rectangular T-section showing the positions of maximum shear stress. [1]
g) Interpret the complementary shear stresses with a diagram. [1]
h) What are the theories of failure for brittle materials? [1]
i) What is equivalent twisting moment in a shaft? [1]
j) What is limiting value of the slenderness ratio beyond which Euler's formula is applicable? [1]

PART - B

(50 Marks)

2.a) Draw and explain the stress–strain diagram of a mild steel specimen subjected to tension test and identify the salient points on the curve.
b) A nylon thread is subjected to a 10 N tension force. Knowing that the Young's modulus E = 4 GPa and that the length of the thread increases by 1.1%, determine the diameter of the thread, and the stress in the thread. [7+3]

OR

3.a) What is volumetric strain? Show that it is the algebraic sum of three mutually perpendicular strains.
b) The rails of a railroad track are welded together at their ends when the temperature is 20 ^{o}C. What compressive stress is produced in the rails when the temperature is increased to 45 ^{o}C? The coefficient of thermal expansion is $11E^{-6}$ /^{o}C and the modulus of elasticity, E is 210 GPa. [5+5]

4. The cantilever beam AB shown in the figure 1 is subjected to a triangular load acting over one-half of its length and a concentrated load acting at the free end. Draw the shear-force and bending-moment diagrams for this beam. [10]

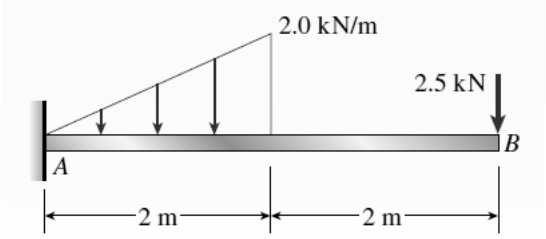

Figure 1

OR

5. Draw the shear force and bending moment diagrams for the overhanging beam shown in figure 2. Also indicate the salient points on the diagrams. [10]

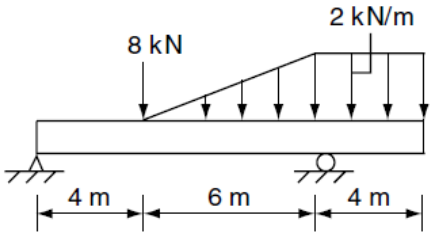

Figure 2

6. A beam of rectangular cross section 50 mm wide and 150 mm deep is used as a cantilever 6 m long and subjected to a uniformly distributed load of 2 N/m over the centre length. At the mid span of the beam, determine the bending stress at the top, bottom and 50 mm from the top fiber. Also calculate the maximum bending stress and its location. [10]

OR

7. Derive the shear stress distribution in a beam of solid circular section. Also obtain the relation between the maximum and average shear stress. [10]

8. The direct tensile stress acting at a point in two mutually perpendicular planes are 500 MPa and 200 MPa. The complementary stress acting on these planes is 250 MPa. Find the principal stresses and planes using Mohr's circle and analytically. [10]

OR

9.a) State and explain the maximum principal theory and maximum shear stress theory.

b) A shaft is designed based on maximum distortion energy theory as the criteria of failure and factor of safety of 2. The material used is 30C8 steel with yield strength of 310 MPa. The shaft is subjected to an axial load of 40 kN. Determine the maximum torque that can be applied to the shaft before yielding. Diameter of shaft is 20 mm. [4+6]

10. A solid circular copper shaft is required to transmit 30 HP at 200 rpm. Determine the diameter of the shaft if the maximum shear stress is not to exceed 60 MPa in shaft. The solid shaft is now replaced by a hollow copper shaft with the internal diameter 0.7 times the external diameter. Determine the external diameter of the shaft, if it is required to transmit same horsepower, at same rpm and maximum stress produced in shaft also remains the same. Find the percentage saving of material of shaft by using hollow shaft in place of solid shaft. [10]

OR

11.a) List the assumptions made in Euler's theory of buckling.

b) An allowable axial load for a 3-m-long column with hinged ends is 30 kN. Another column of the same material, same cross-section and same length, but with one end fixed and the other end hinged, suffers buckling. What is buckling load for the column? [3+7]

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