CBCS SCHEME

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17CV/CT32

Third Semester B.E. Degree Examination, Aug./Sept. 2020
Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Missing data, if any can be assumed.***

Module-1

1 a. Define the four elastic constants. **(08 Marks)**

b. A steel rod of 30 mm in diameter is enclosed in an aluminium tube of 32 mm internal diameter and 60 mm external diameter. Both the bars are of length 750 mm and are rigidly connected to each other. The composite bar is subjected to an increase in temperature of 40°C. Compute the stresses in each material due to the temperature increase.
If the bar is also subjected to a compression of 200 kN, compute the resultant stresses. Also, find the final deformation of the compound bar.
Material properties are : $E_S = 200$ GPa, $\alpha_S = 12\times10^{-6}/^\circ C$
$E_A = 80$ GPa, $\alpha_A = 22\times10^{-6}/^\circ C$ **(12 Marks)**

OR

2 a. Sketch a typical stress strain curve for mild steel and briefly discuss the salient points on the curve. **(06 Marks)**

b. Derive an expression for elongation of a tapering rectangular plate of uniform thickness subjected to an axial load. **(08 Marks)**

c. A steel flat of thickness 25 mm tapers uniformly from 300 mm to 150 mm over a length of 750 mm. If the flat is subjected to an axial tension of 300 kN, compute the elongation of the flat. What is the % error if average area is used in calculating the extension? $E_S = 200$ KN/mm^2. Also, compute the maximum stress. **(06 Marks)**

Module-2

3 a. Show that the sum of the normal stresses on any two perpendicular planes in a general two dimensional system is $(\sigma_x + \sigma_y)$. **(06 Marks)**

b. A closed cylindrical steel vessel 8 m long and 3.2 m internal diameter is subjected to an internal pressure of 5 MPa with thickness of vessel being 50 mm. Assuming E = 200 GPa and $\mu = 0.3$, compute hoop and longitudinal stresses, maximum shear stress and changes in length, diameter and volume. **(08 Marks)**

c. Compute the maximum and minimum hoop stress and plot their variation across the pipe thickness having an internal diameter of 500 mm and thickness 80 mm if the pipe is subjected to an internal fluid pressure of 10 MPa. **(06 Marks)**

OR

4 a. Derive expressions for circumferential and longitudinal stresses in a thin cylinder subjected to internal pressure, p. **(06 Marks)**

b. Direct stresses of magnitude 120 MPa tensile and 80 MPa compressive are acting at a point along with a shear stress of 50 N/mm^2. Compute the normal and tangential stresses on a plane inclined at 40° anticlockwise with the plane on which 120 MPa tensile stress is acting. Also, compute the magnitudes of principal stresses and planes. Sketch the stresses and their planes. **(14 Marks)**

Module-3

5 a. A Cantilever beam is subjected to a UDL of 20 kN/m throughout its length. Sketch SFD and BMD indicating salient values. Cantilever length = 3 m. **(05 Marks)**

b. Sketch SFD and BMD for the beam shown in Fig. Q5 (b) indicating salient values (including point of contraflexure, maximum –ve and maximum +ve BMS and maximum SF). **(15 Marks)**

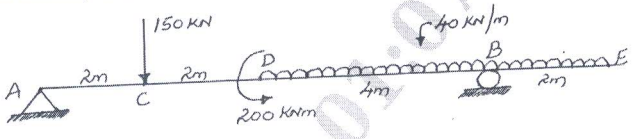

Fig. Q5 (b)

OR

6 a. A simply supported beam of span 8 m is carrying a concentrated load of 100 kN at a distance of 3 m from the left support. Sketch SFD and BMD indicating salient values. **(05 Marks)**

b. Sketch SFD and BMD for the beam shown in Fig. Q6 (b) indicating salient values (including point of contraflexure, maximum –ve and maximum +ve BMS and maximum SF). **(15 Marks)**

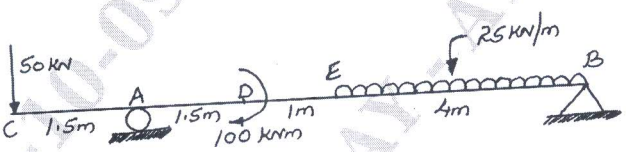

Fig. Q6 (b)

Module-4

7 a. Show that the strength of hollow shafts is greater than solid shaft having same material, length and weight. **(08 Marks)**

b. Explain maximum shear stress theory of failure. **(06 Marks)**

c. A steel shaft of diameter 150 mm transmits 250 kW at 200 rpm with $T_{max} = 1.35T_{mean}$. Compute the maximum shear stress and sketch the stress variation. **(06 Marks)**

OR

8 a. Explain maximum strain energy theory of failure. **(06 Marks)**

b. A hollow circular shaft rotates at 200 rpm transmitting a power of 600 KW. Compute the diameters of the shaft if the external diameter is 1.5 times the internal diameter permissible shear stress in the material is 80 MPa and the angle of twist is 1.1° over a length of 3 m. $T_{max} = 1.35\ T_{mean}$ and G = 80 GPa. Also, calculate the torque carried by a solid shaft of same length, cross sectional area and material as that of hollow shaft with the permissible shear stress and angle of twist being same. What is the percentage difference in torque carrying capacities? **(14 Marks)**

Module-5

9 a. Derive an expression for Euler's crippling load in a column with one end fixed and other end free. **(10 Marks)**

b. An unsymmetrical I section with top flange 300×20, bottom flange 150×15 and web thickness of 12 mm is used as a simply supported beam of span 6 m with a uniformly distributed load of 40 kN/m over its entire length. Overall depth of beam is 400 mm. Compute the maximum tensile and compressive stresses and sketch the bending stress distribution. Also, compute the shear stresses at salient points and sketch the shear stress distribution at support. **(10 Marks)**

OR

10 a. Derive an expression for shear stress in a beam with usual notations. **(10 Marks)**

b. A hollow rectangular column having external dimensions of 250×375 with thickness = 10 mm is used as a column of length 3.5 m with both ends of the column being fixed. Compute the buckling load using both the formulae. E = 200 GPa, Rankine's constant are $\alpha = \frac{1}{7500}$ and $\sigma_c = 320\ N/mm^2$. Comment on the formula giving larger load. **(10 Marks)**