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15CV/CT32

Third Semester B.E. Degree Examination, July/August 2022
Strength of Materials

Time: 3 hrs.

Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Assume missing data suitably.

Module-1

- 1 a. Draw a neat sketch of Stress – Strain curve for mild steel specimen subjected to axial tensile test and mark the salient points on it. (04 Marks)
- b. Derive the relationship between Modulus of Rigidity and Modulus of Elasticity. (06 Marks)
- c. A 2.5m long steel bar having uniform diameter of 40mm for a length of 2m and in the next 0.5m its diameter gradually reduces to 20mm. Determine the elongation of the bar when subjected to an axial tensile load of 160kN. Take $E = 200$ GPa. (06 Marks)

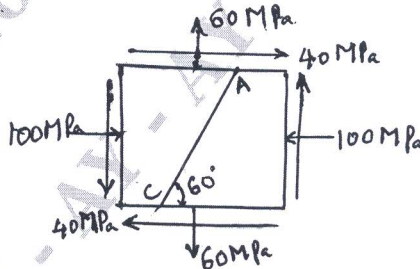
OR

- 2 a. Define the following : i) Bulk Modulus ii) Poisson's ratio iii) Modulus of Elasticity iv) Volumetric strain. (04 Marks)
- b. Derive an expression for the deformation of the tapering circular cross sectional bar subjected to an axial Force 'P'. Use Standard notations. (06 Marks)
- c. A steel rod is 20m long at 20°C. Find the Free expansion the temperature is raised to 70°C. Also find the temperature stress produced when i) The expansion is fully restrained ii) The rod is permitted to expand by 5mm. Take $E = 200$ GPa and $\alpha = 12 \times 10^{-6}/^\circ\text{C}$. (06 Marks)

Module-2

- 3 a. Define Principal Stresses and Principal Planes. (04 Marks)
- b. Derive an expression for circumferential stress developed in a thin cylindrical shell subjected to Internal pressure 'P'. (04 Marks)
- c. In an elastic material the stresses acting on an elementary block are as shown in Fig. Q3(c). Compute i) Principal stresses and Principal planes. ii) Normal and Tangential stress on plane AC. (08 Marks)

Fig. Q3(c)



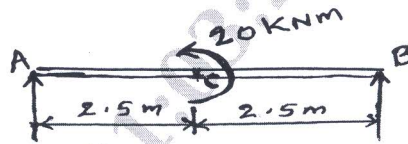
OR

- 4 a. Differentiate between Thin and Thick cylinders. (04 Marks)
- b. Show that Principal planes and Maximum shearing planes are inclined at 45° with each other. (04 Marks)
- c. A thick walled cylindrical pressure vessel has inner radius of 150mm and outer radius of 185mm. Draw a sketch, showing the radial pressure and hoop stress distribution in the section of the cylinder wall, when an internal pressure of 10MN/m² is applied. (08 Marks)

Module-3

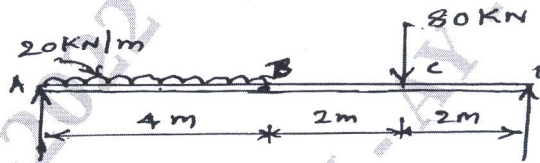
- 5 a. Define i) Bending Moment ii) Shear Force. (04 Marks)
 b. Draw the SFD and BMD for the beam shown in Fig. Q5(b). (04 Marks)

Fig. Q5(b)



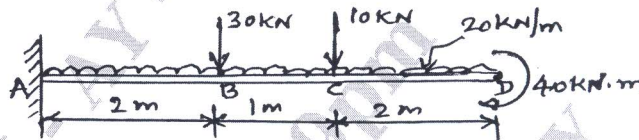
- c. Draw SFD and BMD for the loaded beam shown in Fig. Q5(c). (08 Marks)

Fig. Q5(c)

**OR**

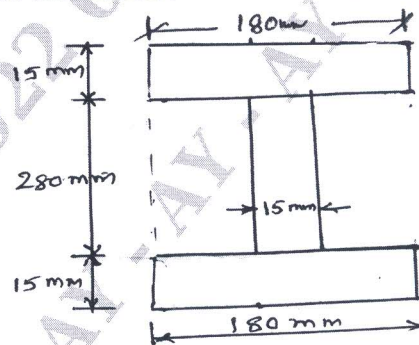
- 6 a. Explain the terms : i) Sagging Bending moment ii) Hogging Bending moment. (04 Marks)
 b. Derive the relation between Intensity of load, Shear force and Bending moment. (04 Marks)
 c. A Cantilever is subjected to the loads as shown in Fig. Q6(c). Draw SFD and BMD. (08 Marks)

Fig. Q6(c)

**Module-4**

- 7 a. State the assumptions made in Pure Bending theory. (04 Marks)
 b. A beam with I Section as shown in Fig. Q7(b) is subjected to a bending moment of 120 kNm and a Shear force of 60 kN. Determine the bending stress and Shear stress distribution across the depth of the section. (12 Marks)

Fig. Q7(b)

**OR**

- 8 a. Explain the terms : i) Section Modulus ii) Moment of Resistance. (04 Marks)
 b. Differentiate between Long Columns and Short Columns. (04 Marks)
 c. A 2.5m long column with hollow circular section is hinged at both ends. External diameter is 140mm and thickness of wall is 20mm. Taking $E = 80 \text{ GPa}$, $\alpha = \frac{1}{1600}$ and $\sigma_c = 550 \text{ MPa}$. Compare the Buckling loads obtained using Euler's formula and Rankine's formula. (08 Marks)

Module-5

- 9 a. Explain the terms : i) Polar Modulus ii) Torsional Rigidity. (04 Marks)
b. List the Common theories of Failure and explain the Maximum Principal Stress theory (Rankine's theory). (06 Marks)
c. A 60mm diameter Solid shaft is subjected to a torque 3KN – m. Determine Maximum shear stress induced and Angle of twist in 1 mtr , Length of the shaft. Take $G = 80 \text{ KN/mm}^2$. (06 Marks)

OR

- 10 a. State and explain the Maximum Strain Energy theory (Haigh's theory). (04 Marks)
b. List the assumptions made in the theory of Pure Torsion. (04 Marks)
c. A Solid circular shaft has to transmit power of 1000KW at 120 rpm. Find the diameter of the shaft if the Shear stress must not exceed 80 N/mm^2 . Maximum torque is 1.25 times the mean. What percentage of material by weight is saved if the solid shaft is replaced by a hallow one, whose internal diameter is 0.6 times the external diameter. The length and maximum shear stress being same. (08 Marks)
