CBCS SCHEME

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15CV/CT32

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Strength of Materials

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define : i) Poisson's ratio ii) Volumetric strain iii) Temperature stresses **(06 Marks)**

b. A steel bar of 20 mm diameter is subjected to tensile load test. Determine stress, strain, Young's modulus, % elongation from the following data:
Gauge length – 200 mm, Extension at a load of 100 kN – 0.147 mm, Total elongation 50 mm. Also determine the % decrease in cross sectional area of the specimen if the diameter of the rod at failure is 16 mm. **(10 Marks)**

OR

2 a. Derive the relationship between Young's modulus and shear modulus with usual notation. **(06 Marks)**

b. A steel tube 45 mm external diameter and 3 mm thick encloses centrally a solid copper bar 30 mm diameter. The bar and the tube are rigidly connected together at their ends at a temperature of 30°C. Find the stresses developed in each material when heated to 180°C. Take $E_S = 200\,GPa$, $\alpha_S = 10.8\times10^{-6}/°C$; $E_C = 110\,GPa$, $\alpha_C = 17\times10^{-6}/°C$ **(10 Marks)**

Module-2

3 At a certain point in a stressed body, the principal stresses are σ_x = 80 MPa and σ_y = –40MPa. Determine σ and τ on the planes whose normal's are at +30° and +120° with x – axis. **(16 Marks)**

OR

4 a. Derive an expression of tangential stress and longitudinal stress of thin walled pressure vessels. **(08 Marks)**

b. A rectangular block of material is subjected to a tensile stress of 100N/mm^2 on one plane and a tensile stress of 50N/mm^2 on a plane at right angles together with shear stress of 60 N/mm^2 on same planes, find : i) direction of the principal plane ii) magnitude of the principal plane iii) magnitude of greatest shear stress. **(08 Marks)**

Module-3

5 a. Draw SFD and BMD for a simply supported beam carrying udl of intensity ω/m over the entire length. **(04 Marks)**

b. Draw SFD and BMD for a overhanging beam loaded as shown in Fig. Q5 (b). Indicate all salient features. **(12 Marks)**

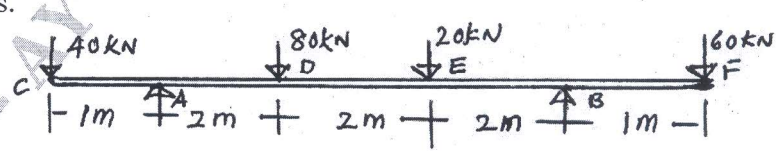

Fig. Q5 (b)

OR

6 a. Derive the relation between load, shear force and bending moment. **(04 Marks)**

b. From the given shear force diagram, shown in Fig. Q6 (b) develop the load diagram and draw BMD. Also determine points of contraflecture if any.

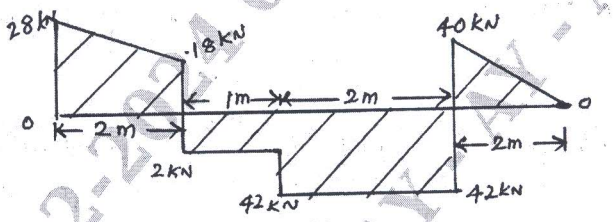

Fig. Q6 (b) **(12 Marks)**

Module-4

7 a. Derive the bending equation, $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$ with usual notation. **(06 Marks)**

b. A hallow tube of 6 m length with external diameter 60 mm and thickness 10 mm is subject to minimum crippling load. Find Euler's critical load for this column :

i) When both ends are fixed

ii) When one end fixed other end hinged. Assume E = 200 GPa. **(10 Marks)**

OR

8 a. Derive expression for crippling load for a long column when both ends are hinged. **(06 Marks)**

b. A circular pipe of external diameter 70 mm and thickness 8 mm is used as a simply supported beam over an effective span of 2.5 m. Find the max concentrated load that can be applied at the centre of the span if permissible stress in the tube is 150 N/mm^2. **(10 Marks)**

Module-5

9 a. Derive torsional equation for circular shaft. **(08 Marks)**

b. A steel shaft transmits 105kN at 160 rpm. If the shaft is 100mm in diameter. Find the torque on the shaft and the maximum sharing stress induced. **(08 Marks)**

OR

10 a. Define pure torsion, polar modulus and torsional rigidity. **(06 Marks)**

b. A solid shaft is subjected to a torque of 15 kN-m. Find the necessary diameter of the shaft if the allowable shearing stress is 60N/mm^2 and the allowable twist is 1 degree in a length of 20 diameters of the shaft. Take C = 8×10^4 N/mm^2. **(10 Marks)**

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