CBCS SCHEME

USN

21CV33

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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, may be suitably assumed.

Module-1

1 a. Explain elastic constants. **(08 Marks)**

b. A compound bar ABC 1.5m long is made up of two parts of aluminium and steel and the cross section area of alluminium bar is twice that of steel bar. The bar is subjected to an axial load of 300kN. If the elongations of aluminium and steel parts are equal, then determine the lengths of two parts of the compound bar. Take modulus of elasticity of steel as $E_s = 200$ GPa and aluminium is $\frac{1}{3}^{rd}$ of E_s.

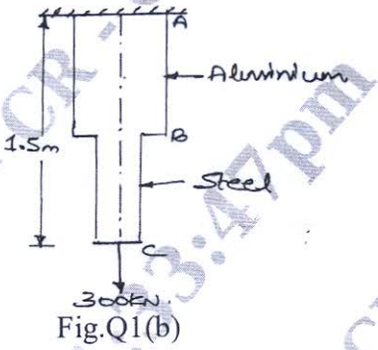

Fig.Q1(b) **(12 Marks)**

OR

2 a. Explain the relationship between Young's modulus and bulk modulus. **(04 Marks)**

b. Prove that the sum of the normal stresses on any two perpendicular planes in a general two dimensional stress system is $(\sigma_x + \sigma_y)$. **(08 Marks)**

c. A steel bar is 16m long at a temperature 24°C find the free expansion of the bar. If the temperature is raised to 62°C. Take E = 200GPa, $\alpha = 12 \times 10^{-6}$/°C. Find thermal stresses produced when : i) free expansion of bar is completely prevented ii) Bar is permitted to expand by 3.3mm only. **(08 Marks)**

Module-2

3 a. Define terms, point of inflexion and point of contraflexure. **(04 Marks)**

b. For a cantilever beam with UDL of 'ω' kN/m throughout the span 'ℓ'm, plot the shearforce and bending moment diagram and indicate the maximum values on the diagram. **(06 Marks)**

c. Draw SFD and BMD for a beam shown in Fig.Q3(c). Locate the point of contraflexure and maximum bending moment.

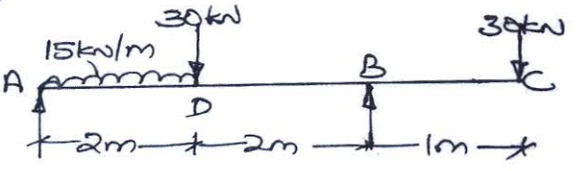

Fig.Q3(c) **(10 Marks)**

OR

4 a. Establish a relationship between SF, BM and intensity of loading. **(04 Marks)**

b. Draw SFD and BMD for a cantilever beam shown in Fig.Q4(b).

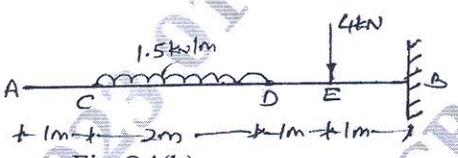

Fig.Q4(b) **(06 Marks)**

c. A beam AB is loaded as shown in Fig.Q4(c). Plot SFD and BMD.

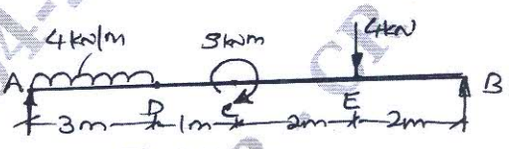

Fig.Q4(c) **(10 Marks)**

Module-3

5 a. List the assumptions made in simple theory of bending. **(04 Marks)**

b. Establish a relationship between moment and radius of curvature. **(06 Marks)**

c. A 1m long cantilever beam with T – section is subjected to a point load of 10kN at its free end the size of the flange is 140 × 10mm and overall depth of section is 150mm. Thickness of web is 10mm. Determine the maximum tensile stress and maximum compressive stress induced in the section and draw bending stress distribution. **(10 Marks)**

OR

6 a. Derive an expression to determine shear stress for a triangular section. **(08 Marks)**

b. The unsymmetrical I – section shown in Fig.Q6(b) is subjected to a shear force of 40kN. Draw the shear stress variation diagram across the depth.

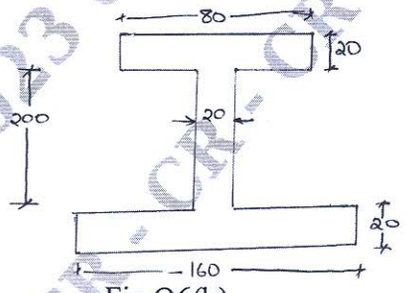

Fig.Q6(b) **(12 Marks)**

Module-4

7 a. Explain the concept of pure torsion and list the assumption in developing the theory of pure torsion. **(05 Marks)**

b. The diameter of water pipeline is 750mm. It has to withstand a water head of 60m. Find the thickness of seamless pipe if principal stress is 20N/mm^2. Take unit weight of water as 9810N/m^3. **(05 Marks)**

c. A thick cylindrical pipe with outside diameter and internal diameter 200mm is subjected to an internal fluid pressure of 14N/mm^2. Determine the maximum hoop stress developed in the cross section. Sketch the variation of hoop stress across the thickness of pipe. What is the percentage error, if the maximum hoop stress is found from the equation of these pipes? **(10 Marks)**

OR

8 a. Derive a torsional equation with a neat sketch. **(08 Marks)**

b. A hollow propeller shaft of a fishing boat is to transport 3750KW@ 240rpm if the internal diameter is 0.8 times the external diameter and if the maximum shear stress developed is to be limited to 160N/mm^2. Determine the size of the shaft. **(12 Marks)**

Module-5

9 a. List the various assumptions to derive the expression for buckling load for long column. **(04 Marks)**

b. Derive an expression to determine buckling load for column when one end is fixed other end is hinged. **(06 Marks)**

c. A hollow cast iron column whose outside diameter is 200mm and thickness is 20mm is 4.5m long and is fixed at both ends. Calculate safe load by Rankine's formula using factor of safety 2.5. Find ratio of Euler's to Rankine's rule. Take modulus of elasticity as 1×10^5N/mm^2 ; Rankine's constant $\frac{1}{1600}$ for both ends fixed case and $f_c = 550$N/mm^2. **(10 Marks)**

OR

10 a. Derive a deferential equation for deflection using standard notation using neat sketch. **(08 Marks)**

b. An overhanging beam ABC supported at A and B is loaded as shown in Fig.Q10(b). Determine the deflection at free end C and the maximum deflection between A and B. Take $\varepsilon = 200$ kN/mm^2, $I = 45 \times 10^6$mm^4.

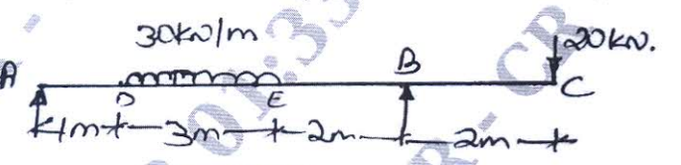

Fig.Q10(b) **(12 Marks)**

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