CBCS SCHEME

USN

18CV32

Third Semester B.E. Degree Examination, Jan./Feb. 2021
Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain longitudinal strain and lateral strain. **(04 Marks)**

b. State and illustrate Saint Venant's principle. **(06 Marks)**

c. A tension test was conducted on mild steel bar and the following data was obtained from the test:
Diameter of the bar = 18mm
Gauge length of the bar = 82mm
Load at proportional limit = 75KN
Extension at a load of 62KN = 0.113mm
Load at failure = 82KN
Final gauge length of the bar = 106mm
Diameter of the bar at failure = 14mm
Determine the Young's modulus, proportional limit, true breaking stress, %elongation and percentage reduction in cross sectional area. **(10 Marks)**

OR

2 a. What are the elastic constants and explain them briefly. **(06 Marks)**

b. Obtain expression for temperature stress in a bar of uniform cross section when expansion or contraction is prevented partially. **(04 Marks)**

c. A weight of 390KN is supported by a short column of 250mm square in section. The column is reinforced with 8 steel bars of cross sectional area 2500mm^2. Find the stresses in steel and concrete if E_s=15E_c.
If stress in concrete must not exceed 4.5MN/m^2, what area of steel is required in order that column may support a load of 480KN. **(10 Marks)**

Module-2

3 a. Derive Lame's equation for the radial and hoop stress for thick cylinder subjected to internal and external fluid pressure. **(08 Marks)**

b. A 2-dimensional element has the tensile stresses of 600MN/m^2 and compressive stress of 400MN/m^2 acting on two mutually perpendicular planes and two equal shear stresses of 200MN/m^2 on their planes. Determine
i) Resultant stress on a plane inclined at 30° wrt x-axis.
ii) The magnitude and direction of principal stresses.
iii) Magnitude and direction of maximum shear stress. **(12 Marks)**

OR

4 a. Obtain expression for volumetric strain in thin cylinder subjected to internal pressure in the form of $e_v = \frac{pd}{2tE}\left[\frac{5}{2} - \frac{2}{m}\right]$. **(08 Marks)**

b. A cast iron pipe has 200mm internal diameter and 50mm metal thickness and carries water under a pressure of 5N/mm^2. Calculate the maximum and minimum intensities of circumferential stresses and sketch the distribution of circumferential stress intensity and the intensity of radial pressure across the section. **(12 Marks)**

Module-3

5 a. Define shear force, bending moment and point of contraflexure. Explain how to calculate them? **(06 Marks)**

b. Develop shear force diagram and bending moment diagrams for the beam loaded shown in Fig. Q5(b) marking the values at salient points. Determine the position and magnitude of maximum bending moment.

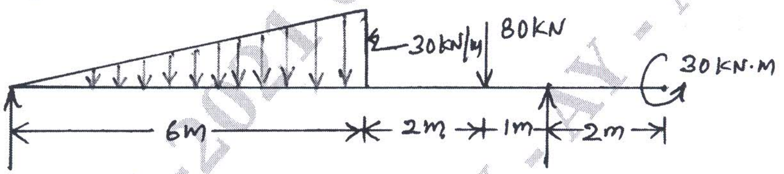

Fig. Q5(b) **(14 Marks)**

OR

6 a. Obtain the relationship between udl, shear force and bending moment. **(06 Marks)**

b. Construct SFD and BMD for the beam loaded shown in Fig. Q6(b). Also locate the point of contraflexure.

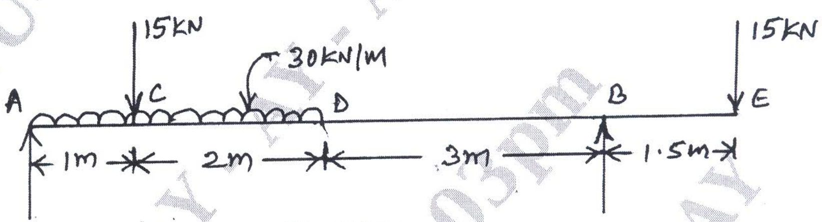

Fig.Q6(b) **(14 Marks)**

Module-4

7 a. Derive torsional equation with usual notations. **(06 Marks)**

b. A T-section of flange 120mm×12mm and overall depth 200mm with 12mm web thickness is loaded such that at a section it has a bending moment of 20KN.m and shear force of 120KN. Sketch the bending and shear stress distribution diagram marking the salient values. **(14 Marks)**

OR

8 a. Derive Bernoulli-Euler bending equation with usual notations. **(08 Marks)**

b. A solid circular shaft has to transmit power of 1000KW at 120rpm. Find the diameter of the shaft if the shear stress of the material is not to exceed 80N/mm^2. The maximum torque is 1.25 times the mean torque. What percentage saving in material could be obtained if the shaft is replaced by a hollow one whose internal diameter is 0.6 times the external diameter? The length of the shaft, material and maximum shear stress being same. **(12 Marks)**

Module-5

9 a. Define slope, deflection and elastic curve. Explain Macaulay's method of determining slope and deflection. **(10 Marks)**

b. Compare the crippling loads given by Euler's and Rankine's formula for a tubular steel column 2.5m long having outer and inner diameter as 40mm and 30mm respectively. The column is loaded through pin joints at the ends. Take permissible compressive stress as 320N/mm^2, Rankine constant as $\frac{1}{7500}$ and E=210GPa. For what length of the column of their cross section, does the Euler's formula cease to apply? **(10 Marks)**

OR

10 a. Differentiate between short and long column and what are the limitations of Euler's theory. **(06 Marks)**

b. Calculate slope at A and deflection at D for the overhanging beam shown in Fig. Q10(b). Take E = 200GPa and I = $50 \times 10^6 mm^4$. **(14 Marks)**

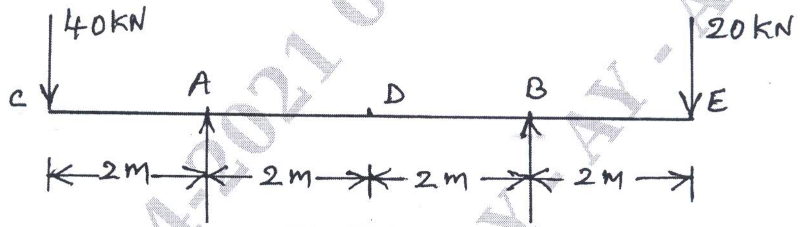

Fig. Q10(b).

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