CBCS SCHEME

USN | | | | | | | | | | **17CV/CT32**

Third Semester B.E. Degree Examination, June/July 2019
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.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

Module-1

1 a. With a neat sketch, define salient features of stress – strain curve for a tensile specimen. **(06 Marks)**

b. Define the following terms :
i) True stress ii) Proof stress iii) Poisson's ratio. **(06 Marks)**

c. A compound bar consists of a circular rod of steel of diameter 20mm rigidly fitted into a copper tube of inner diameter 20mm and thickness 5mm both of same length. If both are subjected to a load of 100kN, find the stress developed in the two materials. E_S = 200 GPa and E_C = 120GPa. **(08 Marks)**

OR

2 a. Derive an expression for elongation of a tapering plate of thickness t, subjected to a tensile force. **(08 Marks)**

b. Explain temperature stresses induced in a body and derive an expression to find the same. **(04 Marks)**

c. A composite bar made of aluminium and steel is held between two supports. Find the stresses in the bars when temperature falls by 20°C, given that the length of steel and aluminium bars are 600mm and 300mm and cross sectional areas are 200mm^2 and 300mm^2 respectively.
$\alpha_s = 11.7 \times 10^{-6}/°C$ and $\alpha_a = 23.4 \times 10^{-6}/°C$, E_s = 210GPa and E_a = 70 GPa. **(08 Marks)**

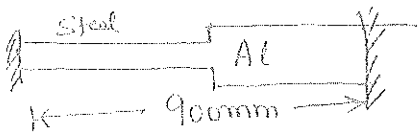

Fig.Q2(c)

Module-2

3 a. For a state of stresses with σ_X = 85 MPa (Tensile), σ_Y = 60 MPa (compressive) with a shear stress of 45 MPa, determine the principal stresses and locate principal planes. Also obtain maximum tangential stress and locate corresponding planes (Fig.Q3(a)). **(10 Marks)**

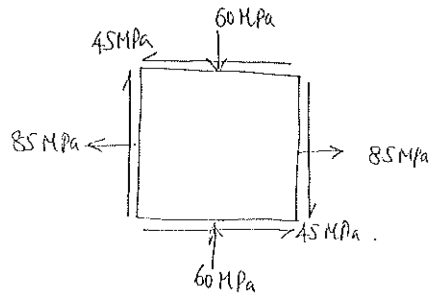

Fig.Q3(a)

b. Derive an equation for change in volume for a thin cylinders. **(10 Marks)**

OR

4 a. Derive an expression for normal and tangential stresses on an inclined plane whose normal makes an angle θ with the inclination of σ_X. **(10 Marks)**

b. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure of 80MPa. Find the maximum and minimum hoop stress across section. Sketch the radial and hoop stress distribution across the section. **(10 Marks)**

Module-3

5 a. Define shear force and bending moment along with sign convention and units. **(06 Marks)**

b. For the beam shown in Fig.Q5(b), draw the shear force and bending moment diagram and locate the point of contraflexure. **(14 Marks)**

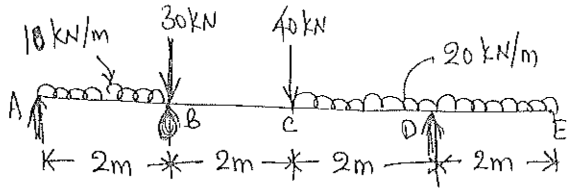

Fig.Q5(b)

OR

6 a. Derive the relation between load intensity, shear force and bending moment. **(06 Marks)**

b. Draw shear force and bending moment diagram for the beam shown in Fig.6(b). Locate the points of contraflexure. **(14 Marks)**

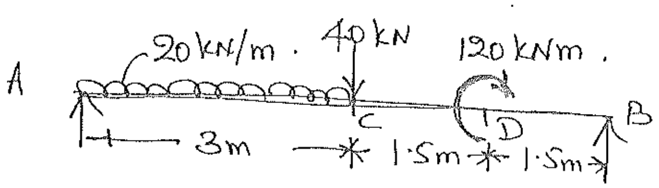

Fig.6(b)

Module-4

7 a. Derive the torsional equation for a circular shaft.

$$\frac{T}{J}=\frac{\tau_s}{R}=\frac{C\theta}{\ell}.$$

(10 Marks)

b. A component is subjected to the following stresses σ_X = 60MPa, σ_Y = 45MPa, τ_{XY} = 30 MPa. The yield stress of the material is 300MPa and Poisson's ratio 0.3. Find the factor of safety using maximum principal stress theory, maximum shear stress theory and maximum principal strain theory. **(10 Marks)**

OR

8 a. Explain momentum principal stress, maximum shear stress and principal strain theories of failure. Derive the necessary equations to assess the failure. **(10 Marks)**

b. A solid shaft transmits 250 kW at 100rpm. If the shear stress is not to exceed 75 MPa, what should be the diameter of the shaft? If this shaft is to be replaced by a hollow one, whose diameter ratio is 0.6, determine the size and percentage saving in weight the maximum shear stress being the same. **(10 Marks)**

Module-5

9 a. Derive the equation of pure bending $\frac{M}{I}=\frac{f}{y}=\frac{E}{R}$ with usual notations. State the assumptions. **(10 Marks)**

b. Find the Euler's crippling load for a hallow cylindrical steel column of 40mm diameter and 4mm thick. Take the length of the column as 2.3m and column is hinged at both ends. Also determine the crippling load by Rankine's formula using constants as 335MPa and 1/75,000. Take $E = 205 \times 10^3 N/mm^2$. **(10 Marks)**

OR

10 a. State the assumptions and derive an expression for Euler's crippling load for a column with both ends hinged. **(10 Marks)**

b. A simply supported beam 100mm×200mm carries a central concentrated load W. The permissible stress in bending and shear are 15MPa and 1.2MPa respectively. Determine the safe load W, if the span of the beam is 3m. **(10 Marks)**

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