CBCS SCHEME

USN | | | | | | | | | | 17CV32

Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Strength of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Show that volumetric strain is equal to algebraic sum of the strains in three mutually perpendicular directions in case of cuboid. **(05 Marks)**

b. Calculate the diameter of steel rod needed to carry a load of 8 kN, if the extension is not to exceed 0.04 percent. Assume $E = 210\ GN/m^2$. **(05 Marks)**

c. A reinforced concrete column $300\,mm \times 300\,mm$ in size has 4 reinforcement bars of steel 20 mm in diameter. Calculate the safe load, the column can carry if the permissible stress in concrete is 5.2 MN/m^2, $\dfrac{E_{steel}}{E_{concrete}} = 18$. **(10 Marks)**

OR

2 a. Derive an expression for change in length in case of a uniformly varying circular cross section whose diameter varies from d_1 to d_2 over a length 'L' subjected to an axial force F. **(06 Marks)**

b. A rod is 2 m long at a temperature of 10°C. Find the expansion of the rod when the temperature is raised to 80°C. If this expansion is prevented, find the stress induced in the material of the rod. Take $E = 1.0 \times 10^5$ MPa and $\alpha = 12 \times 10^{-6} /^{\circ}C$. **(05 Marks)**

c. A bar of cross section $10mm \times 10mm$ is subjected to an axial pull of 8000 N. The lateral dimension of the bar is found to be changed to $9.9985mm \times 9.9985mm$. If the modulus of rigidity is 0.8×10^5 N/mm^2, determine the Poisson's ratio and modulus of elasticity. **(09 Marks)**

Module-2

3 a. Derive expressions for hoop stress and longitudinal stress in case of thin cylinder. **(08 Marks)**

b. At a point in a strained material the stresses acting are as shown in Fig. Q3 (b). Determine the (i) Principal stresses and their planes (ii) Maximum shear stress and their planes (iii) Normal and shear stresses on the inclined plane AB. **(12 Marks)**

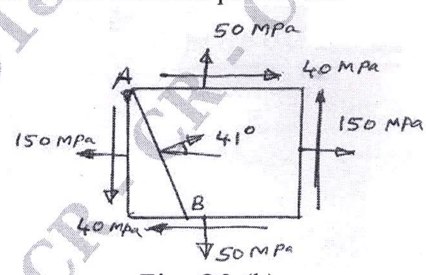

Fig. Q3 (b)

OR

4 a. At a point in a strained material the normal stresses are σ_x and σ_y which are tensile in nature and shear stress acting is τ_{xy}, derive expressions for normal stress and shear stress on an inclined plane making an angle 'θ' with the vertical plane. **(10 Marks)**

b. The inside diameter of thick cylinder is 200 mm. If the internal pressure is 8 N/mm^2 and maximum permissible stress in cylinder wall is 20 N/mm^2, what is the minimum thickness required. If the internal pressure is to be increased to 12 N/mm^2 without exceeding maximum stress, what is the external pressure to be applied? **(10 Marks)**

Module-3

5 a. A cantilever of length 'l' is subjected to a load intensity of w/m at fixed end, uniformly varying to zero at free end. Considering a section 'X' at a distance 'x' from free end, write shear force and bending moment equations and using them draw shear force diagram and bending moment diagram. **(10 Marks)**

b. Draw shear force diagram and bending moment diagram for the Cantilever beam shown in Fig. Q5 (b). **(10 Marks)**

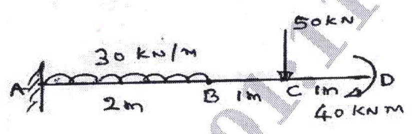

Fig. Q5 (b)

OR

6 a. What is Pare bending? Explain with examples. **(05 Marks)**

b. Draw shear force diagram and bending moment diagram for the beam shown in Fig. Q6 (b). **(15 Marks)**

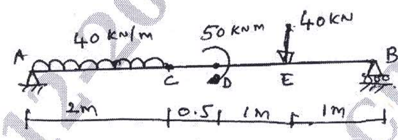

Fig. Q6 (b)

Module-4

7 a. Explain maximum strain energy theory (Beltrami and Haigh). **(05 Marks)**

b. Derive the expression for power transmitted by the shaft. **(05 Marks)**

c. A solid shaft has to transmit 120 kW of power at 160 rpm. If the shear stress is not to exceed 60 MPa and the twist in a length of 3 m must not exceed 1°, find the suitable diameter of the shaft. G = 80 GPa. **(10 Marks)**

OR

8 a. Derive with usual notations the torsion equation,

$$\frac{T}{J} = \frac{\tau_{max}}{R} = \frac{G_\theta}{L}$$ **(10 Marks)**

b. The cross section of a bolt is required to resist an axial tension of 15 kN and a transverse shear of 15 kN. Estimate the diameter of the bolt by (i) Maximum principal stress theory and (ii) Maximum shear stress theory. The elastic limit of the material is 300 N/mm^2. Poisson's ratio = 0.25 and factor of safety = 3. **(10 Marks)**

Module-5

9 a. Derive Euler's crippling load when both ends of column are hinged. **(06 Marks)**

b. A horizontal beam of the section shown in Fig. Q9 (b) is 4 m long and is simply supported at the ends. Find the maximum uniformly distributed load it can carry if the compressive and tensile stresses are not to exceed 60 MPa and 30 MPa respectively. **(14 Marks)**

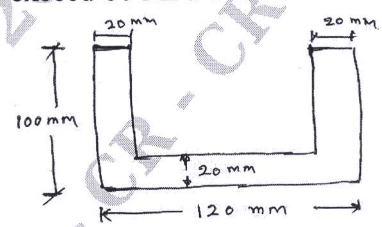

Fig. Q9 (b)

OR

10 a. Define : (i) Neutral axis (ii) Section modulus (iii) Flexural rigidity (iv) Moment of resistance **(08 Marks)**

b. Compare the crippling loads as found from Euler's and Rankine's formula for a mild steel tube of length 3 m, of internal diameter 5 cm and thickness of metal 0.25 cm. Both ends are pin jointed. $E = 2.1\times10^2$ KN/mm^2. Take $\alpha = \frac{1}{7500}$, $\sigma_C = 300$ N/mm^2. **(12 Marks)**

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