CBCS SCHEME

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15CV/CT32

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Derive an expression for the elongation of a rectangular tapering bar subjected to an axial pull P. **(08 Marks)**

b. A stepped bar is subjected to external loading as shown in Fig. Q1 (b). Determine the magnitude of axial force P such that net deformation in the bar does not exceed 02 mm. E for steel is 200 GPa and that for copper is 100 GPa. Larger diameter and smaller diameters are 40 mm and 15 mm respectively. **(08 Marks)**

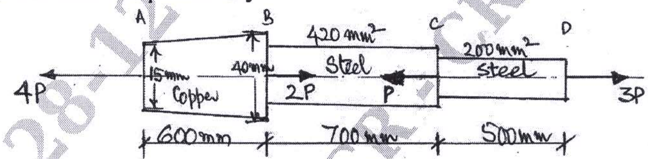

Fig. Q1 (b)

OR

2 a. Derive the relationship between modulus of elasticity (E), modulus of rigidity (C) and bulk modulus (K). **(08 Marks)**

b. Two parallel walls 6 m apart are stayed together by a steel rod 25 mm diameter at a temperature of 80°C. Calculate the pull exerted by the steel rod when it is cooled to 20°C if, (i) the walls do not yield (ii) the walls yield together at two ends by 1.5 mm totally. Given: $E = 2\times10^5\ N/mm^2$ coefficient of thermal expansion $= \alpha = 11\times10^{-6}/^\circ C$. **(08 Marks)**

Module-2

3 a. Derive expression for principal stresses and their planes for a two dimensional stress system. **(08 Marks)**

b. The state of stress in a two dimensionally stressed body is as shown in Fig. Q3 (b). Determine the principal planes, principal stresses, maximum shear stress and their planes. Schematically represent these planes on x-y coordinates: **(08 Marks)**

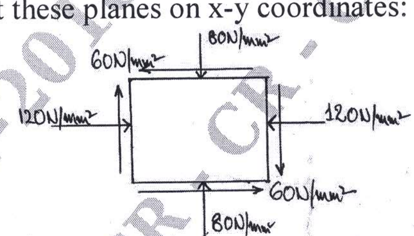

Fig. Q3 (b)

OR

4 a. Show that in the case of a thin cylindrical shell subjected to internal fluid pressure, the volumetric strain is equal to the sum of twice the hoop strain and longitudinal strain and also obtain expression for $e_V = \frac{P.d}{2tE}\left[\frac{5}{2} - \frac{2}{m}\right]$ with usual notations. **(08 Marks)**

b. A thick cylinder of 250 mm internal diameter and 350 mm outer diameter contains a fluid at a pressure of 12 N/mm². Determine the hoop stresses and radial stresses and draw a neat sketch showing the stress distribution across wall thickness. **(08 Marks)**

Module-3

5 a. Explain the different types of supports in beams with neat sketches. **(06 Marks)**

b. A overhanging beam with roller and hinged supports is as shown in Fig. Q5 (b). Draw bending moment and shear force diagrams for given loadings. **(10 Marks)**

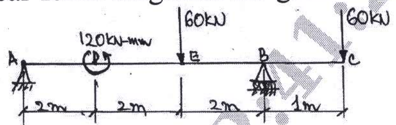

Fig. Q5 (b)

OR

6 a. Derive the relationship between intensity of loading, shear force and bending moment. **(08 Marks)**

b. Draw shear force and bending moment diagrams for a beam loaded as shown in Fig. Q6 (b). Indicate the point of inflexion and locate the points of contraflexure and also maximum bending moment. **(08 Marks)**

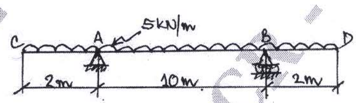

Fig. Q6 (b)

Module-4

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

b. A beam is of square cross section of sides 100 mm. If the permissible stress is 70 N/mm^2, find the moment of resistance of the beam section. Find whether there is any improvement in moment of resistance if the section is placed with one of the diagonals vertical. **(10 Marks)**

OR

8 a. Write a note on: (i) Effective length of columns (ii) Limitations of Euler's theory on columns. **(08 Marks)**

b. A hollow column of cast iron whose outside diameter is 200 mm has thickness of 20 mm. It is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Calculate slenderness ratio and compare Euler's and Rankine's critical loads.

Take critical stress = $\sigma_C = 550$ N/mm^2

Rankine's constant = $\alpha = \frac{1}{1600}$

Elastic modulus = $E = 8 \times 10^4$ N/mm^2 **(08 Marks)**

Module-5

9 a. Derive the expression for torsion in circular shafts and state the assumptions. **(08 Marks)**

b. A solid shaft rotating at 500 rpm transmits 30 kW. Maximum torque is 20% more than mean torque. Allowable shear stress is 65 MPa, modulus of rigidity is 81 GPa and angle of twist in the shaft should not exceed 1° in 1 mt length. Determine the suitable diameter. **(08 Marks)**

OR

10 a. Determine the ratio of power transmitted by a hollow shaft and a solid shaft when both have same weight length, material and speed. The diameter of solid shaft is 150 mm and external diameter of hollow shaft is 250 mm. **(08 Marks)**

b. (i) What is the significance and importance of theories of failure?

(ii) Explain the maximum principal stress theory (Rankine's) **(08 Marks)**

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