CBCS SCHEME

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15AU34

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

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Explain with a neat sketch, stress-strain diagram of mild steel indicating its salient points. **(06 Marks)**

b. A steel bar ABCD of varying sections is subjected to the axial forces as shown in Fig. Q1 (b). (i) Find the value of P necessary for equilibrium. If $E = 210$ kN/mm^2 determine (i) Stress in various segments (ii) Total Elongation of bar (iii) Total strain in the bar. **(10 Marks)**

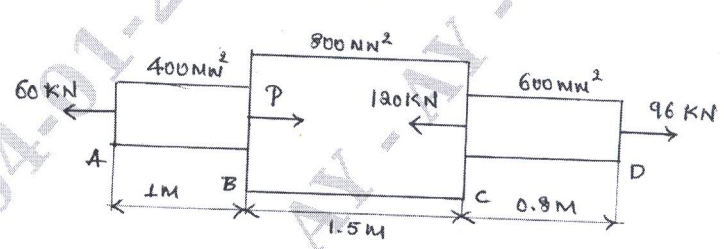

Fig. Q1 (b)

OR

2 a. Derive an expression for volumetric strain of a rectangular prismatic bar subjected to single direct load (P) or direct normal stress (σ). **(08 Marks)**

b. A bar of 20 mm diameter is subjected to a pull of 50 kN. The measured extension on guage length of 250 mm is 0.12 mm and change in diameter is 0.00375 mm. Determine (i) Young's modulus (ii) Poisson's ratio (iii) Bulk modulus (iv) Modulus of rigidity. **(08 Marks)**

Module-2

3 a. Define : (i) Principal stress (ii) Principal plane
(iii) Maximum shear stress (iv) Plane of maximum shear **(06 Marks)**

b. The state of stress in a two dimensionally stressed body is shown in Fig. Q3 (b). Determine graphically (by drawing Mohr's circle), the principal stresses, Principal planes, Maximum shear stress and its planes. **(10 Marks)**

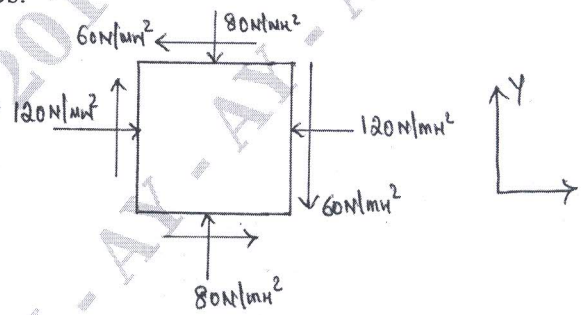

Fig. Q3 (b)

OR

4 a. Derive an expression for circumferential and longitudinal stress for thin cylinder. **(08 Marks)**

b. A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/MN^2. Find the maximum and minimum hoop stress across the section of the cylinder. Also sketch the radial pressure and hoop stress distribution across the section. **(08 Marks)**

Module-3

5 a. Define and explain the following types of load:
(i) Concentrated load.
(ii) Uniformly distributed load.
(iii) Uniformly varying load. **(06 Marks)**

b. A simply supported beam of length 6 m, carries point load of 3 KN and 6 KN at a distances of 2 m and 4 m from the left end. Draw the shear force and bending moment diagrams for the beam. **(10 Marks)**

OR

6 a. Write bending equation and explain each notation with units. Also list the assumptions made in theory of simple bending. **(08 Marks)**

b. An I section has the following dimensions. Flanges $200mm \times 10mm$; web $380mm \times 8mm$. The maximum shear stress developed in the beam is 20 N/mm^2. Find the shear force to which the beam is subjected. **(08 Marks)**

Module-4

7 a. Derive torsion equation with usual notations. State the assumptions in the theory of pure torsion. **(08 Marks)**

b. A hollow shaft having internal diameter 40% of its external diameter, transmits 562.5 kW power at 100 rpm. Determine the internal and external diameter of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 25 m should not exceed 1.3 degrees. The maximum torque being 25% greater than mean modulus of rigidity = $9 \times 10^4 N/mm^2$ **(08 Marks)**

OR

8 a. Derive the expression for Euler's critical load for a column when one end of the column is fixed and the other end is free. **(08 Marks)**

b. A hollow cast iron column whose outside diameter is 200 mm has a 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 4. Calculate the slendernesss ratio and the ratio of Euler's and Rankine's critical loads. Take f_c = 550 N/mm^2, $\alpha = \frac{1}{1600}$ in Rankine's formula and $E = 9.4 \times 10^4 N/mm^2$. **(08 Marks)**

Module-5

9 a. State Castigliano's theorem I and II. **(04 Marks)**

b. Define strain energy and modulus of resilence. **(04 Marks)**

c. The maximum stress produced by a pull in a bar of length 1100 mm is 100 N/mm^2. The area of cross sections and length are as shown in Fig. Q9 (c). Calculate the strain energy stored in the bar if $E = 2 \times 10^5 N/mm^2$. **(08 Marks)**

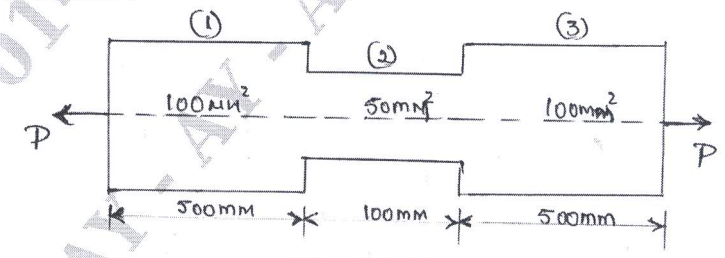

Fig. Q9 (c)

OR

10 a. Explain (i) Maximum principal stress theory. (ii) Maximum shear stress theory. **(08 Marks)**

b. Determine the strain energy and hence the deflection at the free end of a Cantilever beam of length L carrying a point load W at its free end. **(08 Marks)**

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