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VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD

B.E. (Mech. Engg.: CBCS) III-Semester Supplementary Examinations, June-2019

Mechanics of Materials

Time: **3** hours Max. Marks: **60**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** from **Part-B***

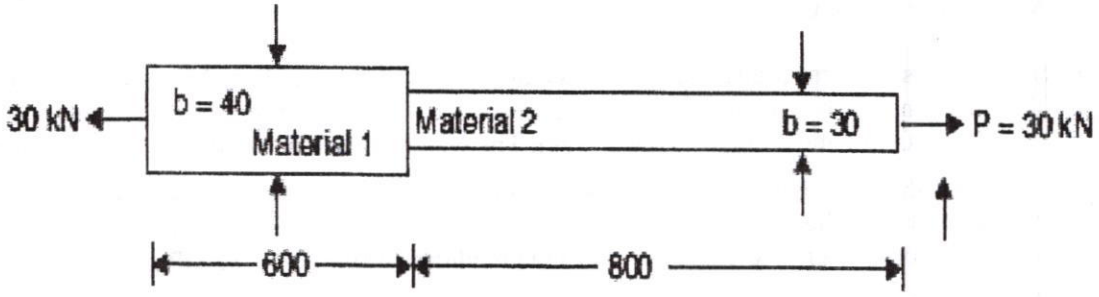
Part-A (10 × 2 = 20 Marks)

1. Draw stress-strain curve for mild steel and indicate salient points on it.
2. Compute the bulk modulus of a material whose Young's modulus is $E = 2\times10^5$ N/mm^2 and Poisson's ratio $\mu = 0.25$.
3. Define point of contra flexure and modulus of section.
4. A simply supported beam of span 5m is subjected to a point load of 50kN at a distance of 3 metres from the left end. Draw the Bending Moment Diagram.
5. Sketch the shear stress distribution across the depth of a rectangular section of a beam of dimensions 200mm x 400mm and subjected to a shear force 100kN at a section.
6. An element in a strained material is subjected to pure shear stress of 60N/mm^2. Determine the principal stresses and planes.
7. A cantilever carries a u.d.l. over the entire span 2m. If the slope at the free end is 1^0, find the deflection at the free end. Take $EI = 20\text{x}10^6$ Nmm^2.
8. Calculate the torsional rigidity of a circular shaft of 100 mm diameter. Assume modulus of rigidity as 80 GPa.
9. Differentiate between thin and thick cylinders.
10. Discuss the failure pattern in long and short columns.

Part-B (5 × 8 = 40 Marks)

Calculate the torsional rigidity

11. a) The stepped bar shown in Fig. is made up of two different materials. The material1 has Young's modulus as 2×10^5 N/mm^2, while that of material 2 is 1×10^5 N/mm^2. Find the extension of the bar under a pull of 30 kN if both the portions are 20 mm in thickness. [4]



b) A 400 mm long bar has rectangular cross-section 10 mm × 30 mm. This bar is subjected to [4]

i. 15 kN tensile force on 10 mm × 30 mm faces,
ii. 80 kN compressive force on 10 mm × 400 mm faces, and
iii. 180 kN tensile force on 30 mm × 400 mm faces.

Find the change in volume if $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$.

12. a) A cantilever beam of span 4m subjected to a point load of 50 kN at the free end in addition to an uniformly distributed load of 10kN/m intensity over the entire span. Analyse the beam and draw the shear force and bending moment diagrams. [4]

Contd…2

b) A simply supported beam of 5m span is subjected to two point loads of 80kN, 60kN at 2m and 3m from the left end. Analyse the beam and draw the shear force and bending moment diagrams. [4]

13. a) A beam of T-section has the flange 300 mm wide and 20 mm thick and web 20 mm wide and 200 mm deep. It carries a shear force of 200 kN at a cross section. Compute shear stresses at salient points and sketch shear stress distribution across the depth of the T-section. [4]

b) At a certain point in a strained material, the stresses on two planes at right angles to each other are 36 N/mm^2 and 20 N/mm^2, both tensile together with a shear stress of 6 N/mm^2. Compute the location of the principal planes and evaluate the principal stresses. [4]

14. a) A simply supported beam of span 12m carries two concentrated loads 100kN and 80kN at distances of 3m and 8m respectively from the left end. Compute the deflections under each load and maximum deflection. Take EI = $36x10^{13}Nmm^2$. [5]

b) A close coiled helical spring is made of 15mm steel rod, the coils having 12 complete turns and a mean diameter of 120mm. It carries an axial pull of 400N. Modulus of rigidity is 84GPa. Determine the shear stress induced in the material, deflection under the pull and stiffness of the spring. [3]

15. a) A cylindrical thin drum 800mm in diameter and 3m long has a shell thickness of 8mm. If the drum is subjected to an internal pressure of 2.5N/mm^2, determine longitudinal stress, circumferential stress and change in volume. Assume E as 200GPa and Poisson's ratio as 0.25. [4]

b) A short column of rectangular cross-section is 70mm×50mm carries a load of 50kN at a point 20 mm from the longer side and 15 mm from the shorter side. Compute the maximum compressive and tensile stresses in the section. [4]

16. a) A steel rail is 12 m long and is laid at a temperature of 18°C. The maximum temperature expected is 40°C. [4]

1) Estimate the minimum gap between two rails to be left so that the temperature stresses do not develop.
2) Calculate the temperature stresses developed in the rails, if:
   (i) No expansion joint is provided.
   (ii) If a 1.5 mm gap is provided for expansion.

Take $E = 2 \times 10^5 N/mm^2$ and $\alpha = 12 \times 10^{-6}/°C$.

b) Derive the formula of theory of simple bending: [4]

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

17. Answer any ***two*** of the following:

a) Sketch the shear stress distribution across an I-section when subjected to a shear force of 300kN. The top flange has a width of 300 mm and a thickness of 25 mm while the bottom flange has a width of 300 mm and a thickness of 25 mm. The web has a width of 20 mm and a depth of 250mm. [4]

b) A hollow shaft of diameter ratio 3/8 is to transmit 375kW at 100rpm, the maximum torque being 20% greater than the mean. Design the shaft if the shear stress is not to exceed 60MPa and the twist in a length of 4m is not to exceed 2^0. Assume modulus of rigidity as 85 GPa. [4]

c) A hollow cylindrical cast iron column is 4m long and both ends are fixed. Design the column to carry an axial load of 250kN. The internal diameter may be taken as 0.80 times the external diameter. Assume E as 95GPa. [4]

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