CBCS SCHEME

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18MT33

Third Semester B.E. Degree Examination, June/July 2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive an expression for extension of a uniformly tapering rectangular bar. **(08 Marks)**

b. Calculate the stress in each material if the composite rod is subjected to axial force as shown in Fig.Q1(b).

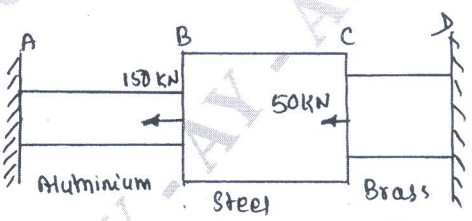

Fig.Q1(b)

Area	: 900mm^2	: 2000 mm^2	: 1200 mm^2
Length	: 0.5 m	: 0.25 m	: 0.35 m
E	: 70 GPa	: 200 GPa	: 83 GPa

(12 Marks)

OR

2 a. Derive an expression for relation between Young's modulus and Bulk modulus. **(10 Marks)**

b. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30mm and length 1.5m if the longitudinal strain in a bar during a tensile stress is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. Take E = 1×10^5 N/mm^2. **(10 Marks)**

Module-2

3 a. Derive an expression for maximum normal stress and maximum shear stress in a biaxial stress system. **(10 Marks)**

b. At a point in a strained material, the principal tensile stresses across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2. Determine Normal stress shear stress and the resultant stress in a plane inclined at 20° with the major principal plane. Also determine the obliquity. What will be the intensity of stress, when acting alone will produce the same maximum strain if $\mu = 0.25$. **(10 Marks)**

OR

4 An element in a stressed material has tensile stress of 500 N/mm^2 and a compressive stress of 350 N/mm^2 acting on a two mutually perpendicular planes and equal shear stress of 100 N/mm^2 on these planes. Find the principal stresses and position of principal planes. Also find maximum shearing stress and verify the answer by Mohr's circle method. **(20 Marks)**

Module-3

5 A simply supported beam at the end, carries a UDL of 10 kN/m between the supports 10m apart and counter clockwise moments of 60 kN-m and 40 kN-m at left end and right end respectively applied to beam. Draw SFD and BMD for the beam. Maximum bending moment occurs at a distance 'x' form left end. **(20 Marks)**

OR

6 Analyze the beam shown in the Fig.Q6 and draw SFD and BMD.

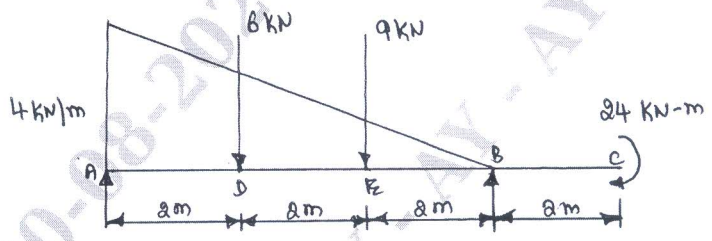

Fig.Q6 **(20 Marks)**

Module-4

7 a. Show that in a rectangular cross section beam, $\tau_{max} = 1.5\ \tau_{avg}$. **(08 Marks)**

b. A cast iron beam is of "T" section with a flange width = 100mm, flange thickness = 20mm, web height = 80 mm and web thickness = 20mm. Beam is simply supported on a span of 8m. The beam carries a UDL of 1.5 kN/m on entire span. Determine maximum tensile and compressive stresses. **(12 Marks)**

OR

8 a. Derive an expression for deflection of a cantilever beam with UDL for entire span. **(10 Marks)**

b. A beam of length 5m and of uniform rectangular section is supported at its end and carries uniformly distributed load over the entire length. Calculate the depth of the section if the maximum permissible bending stress is 8 N/mm^2 and central deflection is not to exceed 10mm. **(10 Marks)**

Module-5

9 a. Derive an expression for pure torsion of a circular shaft and state the assumptions made. **(10 Marks)**

b. A solid cylindrical shaft is to transmit 300 kW power at 100 rpm.

i) If shear stress is not to exceed 80 N/mm^2, find its diameter.

ii) What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals to 0.6 of the external diameter, the length material and maximum shear stress being the same. **(10 Marks)**

OR

10 a. Derive an expression for crippling load of a column when both ends are hinged. **(10 Marks)**

b. Calculate the safe compressive load on a hollow cast iron column (One end rigidly fixed and other hinged) of 15cm external diameter, 10cm internal diameter and 10m in length. Use Euler's formula with a factor of safety of 5 and E = 95 kN/mm^2. **(10 Marks)**

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