Hall Ticket No | | | | | | | | | | | Question Paper Code: ACE001

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech III Semester End Examinations (Regular) - November, 2018

Regulation: IARE – R16

STRENGTH OF MATERIALS - I

Time: 3 Hours **(CE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) i. What is the ratio of Young's modulus to bulk modulus value the Poisson's ratio of material is 0.3.

   ii. Derive the relation between shear modulus (G), modulus of elasticity (E) and the Poisson's ratio (μ) of a material? **[7M]**

   (b) Calculate the modulus of rigidity and bulk modulus of cylindrical bar of diameter 30mm and of length 1.5 m 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 $\times$ 10^5 N/mm^2 **[7M]**

2. (a) Derive the strain energy expression of tension or compression axial load for the following cases:

   i. Neglecting the weight of the bar **[7M]**

   ii. Including the weight of the bar

   (b) A steel bar of 40 mm $\times$ 40 mm square cross-section is subjected to an axial compressive load of 200 kN. If the length of the bar is 2 m and E = 200 GPa, what is the elongation of the bar? **[7M]**

UNIT – II

3. (a) A simply supported beam of length 'l' is subjected to a symmetrical uniformly varying load with zero intensity at the ends and intensity w (load per unit length) at the mid span. Derive the expression for maximum bending moment? **[7M]**

   (b) Draw the shear force and bending moment diagram for the beam shown in Figure. 1 **[7M]**

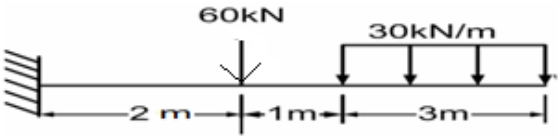

Figure 1

4. (a) Derive the relationship between Load, Shear force and Bending Moment. **[7M]**

(b) Draw the shear force and bending moment diagrams for the overhanging beam carrying uniformly distributed load of 2kN/m over the entire length and a point load of 2kN at the free end as shown in Figure. 2. Locate the point of contraflexure. **[7M]**

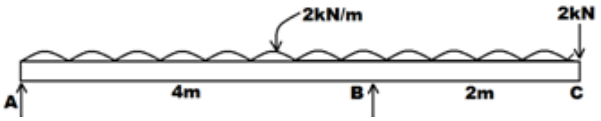

Figure 2

UNIT – III

5. (a) A wooden beam of rectangular cross-section 10 cm deep by 5 cm wide carries maximum shear force of 2000 kg. Find the Shear stress at neutral axis of the beam section? **[7M]**

(b) A 150 mm × 60 mm I-beam as shown in Figure. 3 is subjected to a shearing force of 15 kN. Determine the distribution of horizontal shear stress in the beam. Find what percentage of the total shear force is carried by the web. Web = 4 mm thick, flange = 6 mm thick. **[7M]**

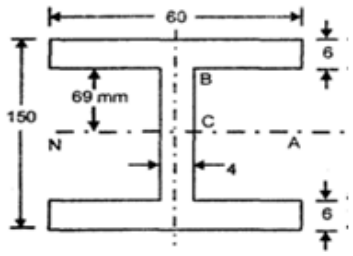

Figure 3

6. (a) Define section modulus. Derive the section modulus for the following shapes: (i) Rectangular, (ii) Circular and (iii) Hollow circular sections. **[7M]**

(b) A simply supported beam carries a uniformly distributed load of 40kN/m over the entire span. The section of the beam is rectangular having depth as 500mm. If the maximum stress in the material of the beam is 120N/mm^2 and the moment of inertia of the section is 7x10^8 mm^4, find the span of the beam. **[7M]**

UNIT – IV

7. (a) Derive the equation of shear stress produced in a circular shaft subjected to torsion. **[7M]**

   (b) A hollow shaft is to transmit 300kW power at 80rpm. If the shear stress is not to exceed $60\text{N}/mm^2$ and the internal diameter is 0.6 times the external diameter, find the external and internal diameters assuming that the maximum torque is 1.4 times the mean torque. **[7M]**

8. (a) A hollow shaft and a solid shaft construction of the same material have the same length and the same outside radius. The inside radius of the hollow shaft is 0.6 times of the outside radius. Both the shafts aresubjected to the same torque.

   i. What is the ratio of maximum shear stress in the hollow shaft to that of solid shaft?

   ii. What is the ratio of angle of twist in the hollow shaft to that of solid shaft? **[7M]**

   (b) Maximum shear stress developed on the surface of a solid circular shaft under pure torsion is 240 MPa. If the shaft diameter is doubled then what will be the maximum shear stress developed corresponding to the same torque? **[7M]**

UNIT – V

9. (a) List out the assumptions made in Euler's column theory and write down the relation between effective length and actual length for different end conditions. **[7M]**

   (b) Calculate the safe compressive load an a hollow cast iron column (one end rigidly fixed and the other end hinged) of 15cm external diameter, 10cm internal diameter and 10m in length. Use Euler's formula with a factor of safety of 5 and $\text{E} = 95\text{kN}/mm^2$. **[7M]**

10. (a) A hollow alloy tube 5m long with external and internal diameter 40mm and 25mm respectively was found to extend 6.4mm under a tensile load of 60kN. Find the buckling load for the tube when used as a column with both ends pinned. Also find the safe load for the tube by taking the factor of safety as 4. **[7M]**

    (b) A hollow cast iron column 200mm outside and 150mm inside diameter, 8m long has both ends fixed. It is subjected to an axial compressive load. Taking the factor of safety as 6, $\sigma_c = 560N/mm^2$ and $\alpha = \frac{1}{1600}$ for pinned ends, determine the safe Rankine's load. **[7M]**

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