Hall Ticket No | | | | | | | | | | | Question Paper Code: AAE002

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

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

Regulation: IARE – R16

THEORY OF STRUCTURES

Time: 3 Hours **(AE)** **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) Derive an expression for the total elongation of a bar of uniform sectional area due to its own weight, when the bar is fixed at its upper end and hanging freely at the lower end. **[7M]**

   (b) Draw SFD and BMD for a simply supported beam of length 8 m carries point loads of 4 kN and 6 kN at a distance of 2 m and 4 m from the left end. **[7M]**

2. (a) Determine the diameter of a solid circular shaft which will transmit 337.5 kW at 300 rpm. The maximum shear stress should not exceed 35 MPa and twist should not be more than 10^0 in a shaft length of 2.5 m. Take the modulus of rigidity as 90 GPa. **[7M]**

   (b) A cantilever of length 5 m carries a uniformly distributed load of 2 kN/m length over the whole length and a point load of 4 kN at the free end. Draw the shear force and bending moment diagrams for the beam. **[7M]**

UNIT – II

3. (a) Explicate the terms Neutral axis, section modulus and moment of resistance. **[7M]**

   (b) An I-section has flanges of width 100 mm and the overall depth is 200 mm. The flanges and web are of uniform thickness 20 mm. Find the ratio of the maximum shear stress to the average shear stress. **[7M]**

4. (a) Show that the ration of maximum shear stress to mean shear stress in a rectangular cross-section is equal to 1.5 when it is subjected to a transverse shear force F. **[7M]**

   (b) A Castiron beam 20 mm x 20 mm in section and 1000 mm long is simply supported at the ends. It carries a point load W at the center. The maximum stress induced is 120 N/mm^2. What uniformly distributed load will break a cantilever of the same material 50 mm wide, 100 mm deep and 2 m long. **[7M]**

UNIT – III

5. (a) A beam with a span of 4.5 metres carries a point load of 30kN at 3 metres from the left support. If for the section I = 54.97x10$^{-6}m^4$ and E = 200GN/m^2, find : **[7M]**

   (i) The deflection under the load.

   (ii) The position and amount of maximum deflection.

   (b) A bar of length 4m when used as a simply supported beam and subjected to a u.d.l. of 30 kN/m over the whole span, deflects 15mm at the centre. Determine the crippling load when it is used as a column with following end conditions: **[7M]**

   (i) Both end pin-jointed

   (ii) One end fixed and other end hinged

   (ii) Both ends fixed.

6. (a) Define 'equivalent length of a column'? Enumerate the ratios of equivalent length and actual length of columns with various end conditions. **[7M]**

   (b) Determine slope at the left support, deflection under the load and maximum deflection of a simply supported beam of length 10 m, which is carrying a point load of 10 kN at a distance 6 m from the left end. Take E = 2 x 10^5 N/mm^2 and I = 1.1 x 10^8 mm^4. **[7M]**

UNIT – IV

7. (a) Analyze the axial forces in all the members of the plane truss as shown in Figure 1 **[7M]**

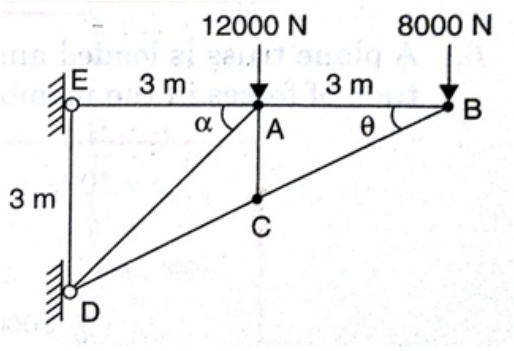

Figure 1

   (b) State and explain the Clapeyron's theorem of three moments. **[7M]**

8. (a) Five members OA, OB, OC, OD and OE meeting at O, are hinged at A and C and fixed at B, D and E. The lengths of OA, OB, OC, OD and OE are 3m, 4m, 2m, 3m and 5m and their moments of inertia are 400mm^4, 300mm^4, 200mm^4, 300mm^4 and 250mm^4 respectively. Determine the distribution factors for the members and the distributed moments, when a moment of 4000 kN-m is applied O.

   [7M]

   (b) Explain what you understand by perfect frame, deficient frame and redundant frame. **[7M]**

UNIT – V

9. (a) Define stress. Define stress at a point. How many stress components completely define state of stress at a point. **[7M]**

   (b) The tensile stresses at a point across two mutually perpendicular planes are 120 N/mm^2 and 60N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30^0 to the axis of the minor stress. **[7M]**

10. (a) Draw a typical three dimensional element and indicate state of stress in their positive sense on it. Also express the equations of equilibrium in case of a three dimensional stress system. **[7M]**

    (b) An elemental cube is subjected to tensile stresses of 30 N/mm^2 and 10 N/mm^2 acting on two mutually perpendicular planes and a shear stress of 10 N/mm^2 on these planes. Draw the Mohr's circle of stresses and hence or otherwise determine the magnitudes and directions of principal stresses and also the greatest shear stress. **[7M]**

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