Question Paper

Exam Date & Time: 03-Mar-2021 (02:00 PM - 05:00 PM)

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

THIRD SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAR 2021

Aircraft Structures (AAE 2155)

Marks: 50 **Duration: 180 mins**

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed.

Type: DES

Q1. Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take E_s=2*10^5 N/mm^2 and E_c=1*10^5 N/mm^2. (4)

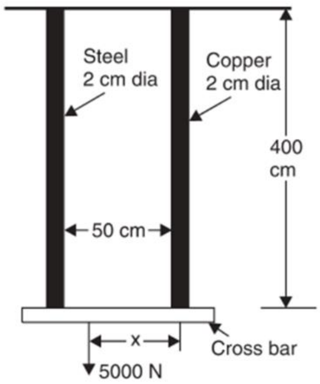


Fig.1

Q2. Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30 mm and of length 1.5 m if the longitudinal strain in a bar during 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 (3)

Q3. Define: Shear modulus, slenderness ratio, longitudinal strain and indeterminate loads. (2)

Q4. A 10 m long simply supported beam, as shown in Fig.2 carries 2 point loads of 10 kN and 6 kN at 2 m and 9 m respectively from the left end. It also has a UDL of 4 kN/m run for the length between 4 m and 7 m from the left end. Calculate and draw the shear force and bending moment diagram at each point. (4)

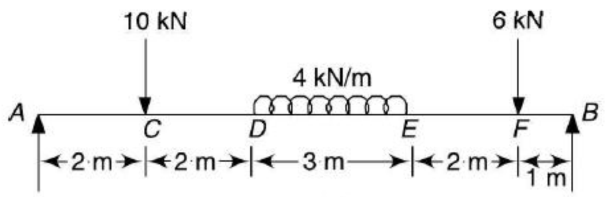
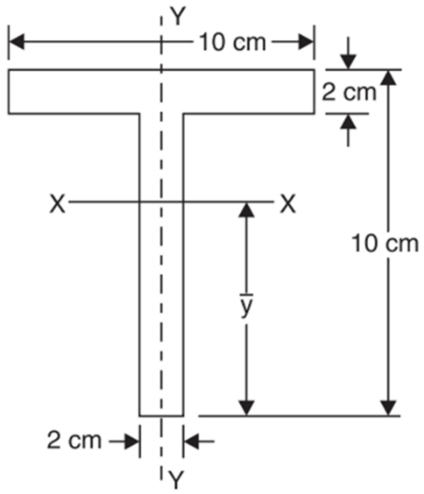


Fig.2

Q5. Derive the equations for slope and deflection of a simply supported beam with eccentric point load. (5)

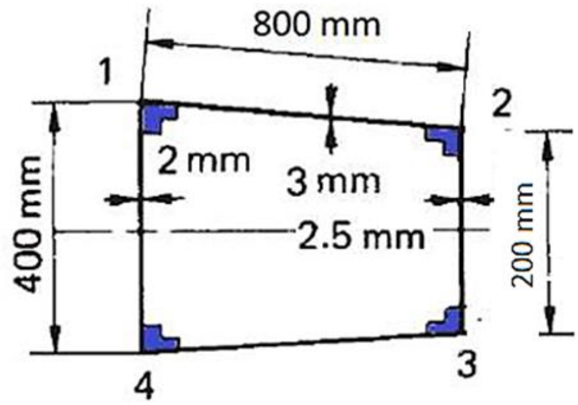
Q6. Mention all the six assumptions in theory of simple bending. (3)

Q7. Determine the crippling load for a T section of dimensions 10 cm*10 cm* 2 cm and of length 5 m when it is used as a strut with both of its ends hinged. Take $E=2*10^5$ N/mm^2. (4)



Q8. List major Loads acting on the Structural Components of an aircraft (2)

Q9. Part of a wing section is in the form of the two-cell box shown in Figure in which the vertical spars are connected to the wing skin through angle sections all having a cross-sectional area of $200mm^2$. Idealize the section into an arrangement of direct stress carrying booms and shear stress only carrying panels suitable for resisting bending moments in a vertical plane. (4)

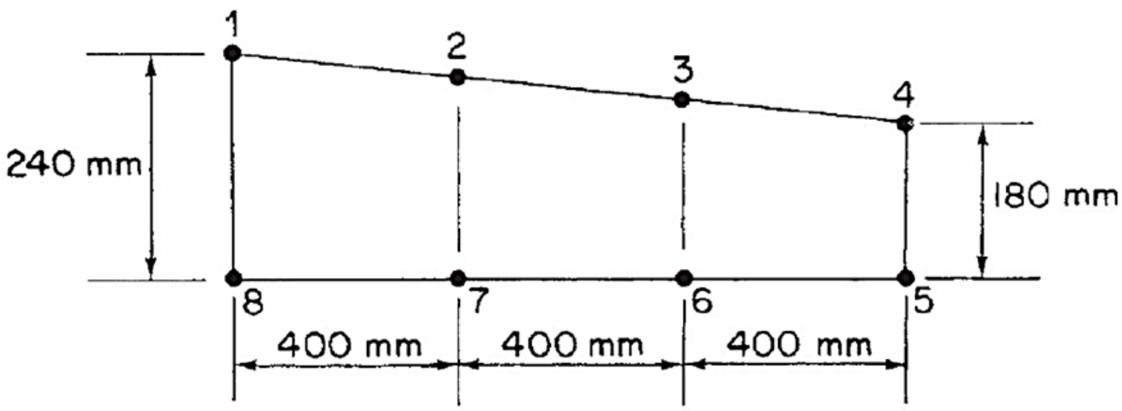


$$B_1 = \frac{t_D b}{6}\left(2 + \frac{\sigma_2}{\sigma_1}\right)$$

$$B_2 = \frac{t_D b}{6}\left(2 + \frac{\sigma_1}{\sigma_2}\right)$$

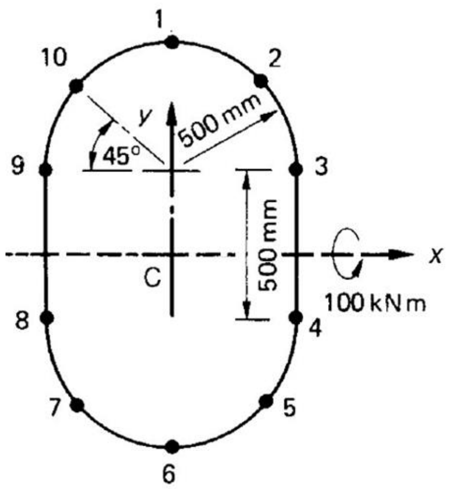
Q10. The central cell of a wing has the idealized section shown in Figure. If the air loads on the wing produce bending moments of −120 kNm and −30 kNm, respectively at the section shown, calculate Position of GC, Moment of Inertia and the direct stresses in the booms. Neglect axial constraint effects and assume that the lift and drag vectors are in vertical and horizontal planes.

B1 = B4 = B5 = B8 = 1000mm^2 and B2 = B3 = B6 = B7 = 600mm^2 (5)

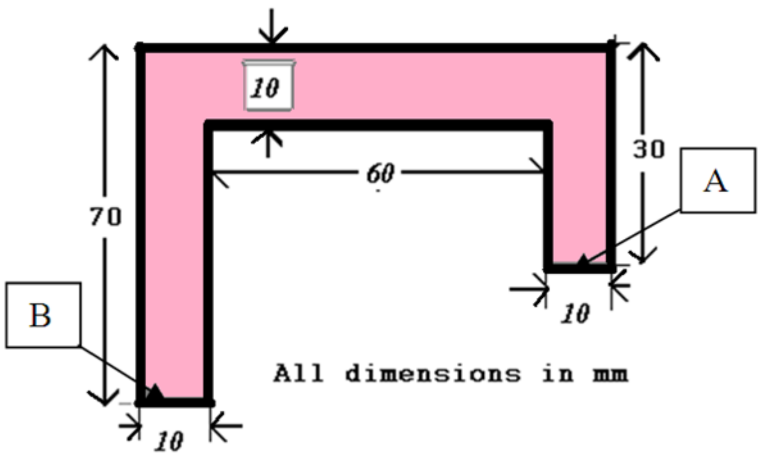


$$\sigma_z = \left(\frac{M_y I_{xx} - M_x I_{xy}}{I_{xx} I_{yy} - I_{xy}^2}\right) x + \left(\frac{M_x I_{yy} - M_y I_{xy}}{I_{xx} I_{yy} - I_{xy}^2}\right) y$$

Q11. The doubly symmetrical fuselage section shown in Figure has been idealized into an arrangement of direct stress carrying booms and shear stress carrying skin panels; the boom areas are all 150mm^2. Calculate the direct stresses in the booms for a bending moment of 100 kN m. (5)



Q12. A beam having the cross-section shown in figure is subjected to a bending moment of 6 kNm in a vertical plane. Calculate the direct stress due to bending at points A & B and the position of Neutral Axis (5)



$$\sigma_z = \left(\frac{M_y I_{xx} - M_x I_{xy}}{I_{xx} I_{yy} - I_{xy}^2}\right) x + \left(\frac{M_x I_{yy} - M_y I_{xy}}{I_{xx} I_{yy} - I_{xy}^2}\right) y$$

Q13. Derive equation for SHEAR FLOW an unsymmetrical, open section beam (4)