Hall Ticket No | | | | | | | | | | | Question Paper Code: BCC206

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

M.Tech I Semester End Examinations (Supplementary) - January, 2019

Regulation: IARE–R16

ADVANCED MECHANICS OF SOLIDS

Time: 3 Hours **(CAD/CAM)** **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) Compare symmetrical bending and unsymmetrical bending using examples with a neat sketch. **[7M]**

   (b) A beam of equal – leg angle section, shown in Figure 1 below is subjected to its own weight. Determine the stress at point A near the built in section. It is given that the beam weighs 1.48 N/cm. The principal moments of inertia are 284 cm^4 and 74.1cm^2 **[7M]**

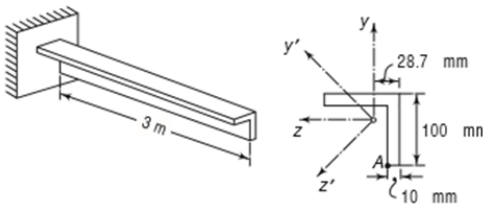

Figure 1

2. (a) A cantilever 120 mm wide and 200 mm deep is 2.5 m long. What is the uniformly distributed load which the beam can carry in order to produce a deflection of 5 mm at the free end? Take E = 200 GN/m^2. **[7M]**

   (b) Determine the shear stress distribution for a circular open section shown in Figure 2 under bending caused by a shear force. Locate the shear centre. **[7M]**

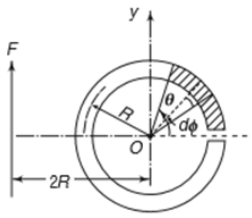

Figure 2

UNIT – II

3. (a) Explain the deflection of a curved beam with a neat sketch. **[7M]**

   (b) A ring with a rectangular section is subjected to diametric compression, as shown in Figure 3. Determine the bending moments and stress at point A of the inner radius across a section θ. r_1 and r_2 are the inner and external radii respectively. If the ring is subjected to diametric compression. Determine the change in the vertical diameter. **[7M]**

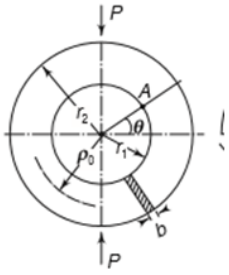

Figure 3

4. (a) For Figure 4 shown below an unsymmetrical beam section composed of four stringers A,B, C and D, each of equal area connected by a thin web. It is assumed that the web will not carry any bending stress. The beam section is subjected to the bending moments M_y and M_x, as indicated. Calculate the stresses in members A and D. The area of each stringer is 0.6 cm^2 **[7M]**

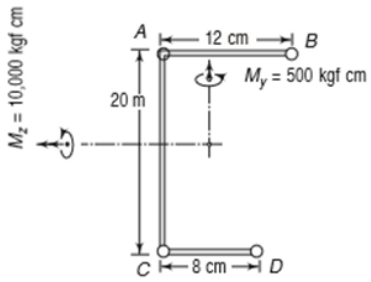

Figure 4

   (b) A bar of angle section is bent by a couple M acting in the plane of the larger side as shown in Figure 5. Find the centroidal principal axes Oy^1z^1 and the principal moments of inertia. If M = 1135 Nm, find the absolute maximum flexural stress in the section. **[7M]**

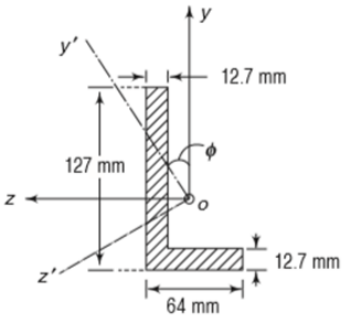

Figure 5

UNIT – III

5. (a) Describe torsion and derive a simple torsion equation of circular shaft fixed at one end and free at another end with a neat sketch. **[7M]**

   (b) For Figure 6 shown below a two cell tubular section as formed by a conventional air foil shape, and having one interior web. An external torque of 1000 Nm is acting in a clockwise direction. Determine the internal shear flow distribution. The cell area is as follows: **[7M]**
   A 1 = 680 cm^2 A2 = 2000 cm^2

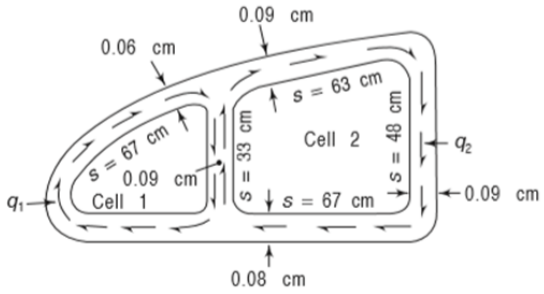

Figure 6

6. (a) A thin walled box section of dimensions 2a *a *t is to be compared with a solid section of diameter a for Figure 7. Find the thickness t so that the two sections have **[7M]**
   i. The same maximum stress for the same torque
   ii. The same stiffness

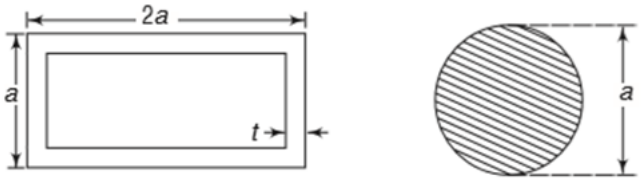

Figure 7

(b) A hollow aluminium section is designed, as shown in Figure 8 **[7M]**

i. for a maximum shear stress of 35000 kPa, neglecting stress concentrations. Find the twisting moment that can be taken up by the section and the angle of twist if the length of the member is 3 m. If the member is redesigned.

ii. find the allowable twisting moment and the angle of twist. Take G = 157.5 X 10^6kPa

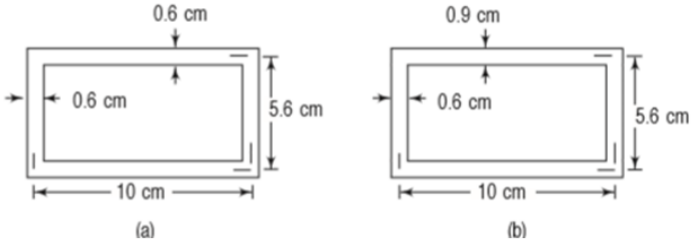

Figure 8

UNIT – IV

7. (a) Elaborate briefly the occurrences of stresses at the top, bottom and middle of layers of the simply supported plate when it is subjected to uniformly distributed load on the top side through out the area. **[4M]**

(b) A plate made of mild steel (E = 200 GPa, v = 0.29, and Yield stress= 315 MPa) has a thickness h = 10 mm and cover a circular opening having a diameter of 200 mm. The plate is fixed at the edges and is subjected to a uniform pressure p. **[10M]**

i. Determine the magnitude of the yield pressure P_y and deflection w_{max} at the centre of the plate when this pressure is applied.

ii. Determine a working pressure based on a factor of safety of SF = 2.00 relative to P_y

8. (a) A solid flat circular plate of 600mm diameter and 10mm thickness is acted upon by a concentrated load of 30KN at the centre of the plate. Determine the central deflection and maximum radial stresses at the edge .E = 207GPa , and v = 0.292 **[7M]**

(b) A square door has a side of 1m and thickness 10mm. The plate is simply supported and subjected to uniform pressure. Determine the yield pressure. E = 200 GPa, and v = 0.29 **[7M]**

UNIT – V

9. (a) Derive an expression for contact pressure of ball bearing **[7M]**

(b) A 20 mm long cast iron rod of 25 mm diameter is pressed on to a thick copper plate with a force of 20N. Determine the width of the contact area, the maximum pressure at the centre of the contact area. The properties of materials are **[7M]**

Cast iron E = 41.4 GPa, v = 0.211,

Copper E = 44.7 GPa, v = 0.326

10. (a) Explain Hertzian contact stress theory with a neat sketch **[7M]**

(b) Carbon steel balls, each 25 mm in diameter is pressed by a flat carbon plate force F = 18 N at the centre of the area of contact. For carbon steel E = 207GPa, and v = 0.292 **[7M]**

i. Determine the values of the principal stresses

ii. Determine the maximum shear stress. At what distance from the contact surface do they occur.