Reg. No. :

Question Paper Code : X 10034

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Fifth Semester
Aeronautical Engineering
AE 8502 – AIRCRAFT STRUCTURES – II
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. A beam under unsymmetrical bending will deflect in a direction which is (always perpendicular to the neutral axis/usually inclined to the neutral axis/parallel to either one of the principal axis of inertia direction).

2. When does a beam with an unsymmetrical cross-section experience symmetrical bending ?

3. What is the locus of centroids of the different cross-sections of an elastic beam called ?

4. Sketch and mark the approximate shear center location of the thin-walled angle section.

5. What does shear center position depend on ?

6. Give the S. I. units of shear flow and state the relationship between shear flow and shear stress.

7. What is the delta P (ΔP) method is used for ?

8. In the elastic buckling of thin plates where the elastic plate buckling formula is applicable, on what parameters does the buckling constant K depend on ?

9. State the range of maximum positive allowable load factor ‘n’ for a passenger aircraft.

10. A typical aircraft wing under steady level flight conditions will normally undergo (symmetrical bending without twisting/unsymmetrical bending and twisting/ symmetrical bending and twisting).

PART – B **(5×13=65 Marks)**

11. a) The section indicated in Figure 1 is subject to bending moments $M_X = 5000$ N cm and $M_Y = -4000$ N cm. Determine the bending stress at corner points A, B and C and determine the neutral axis inclination angle.

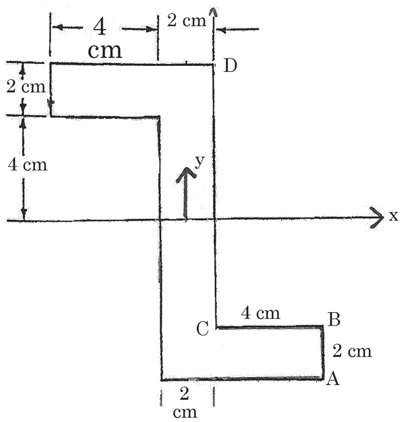

Figure 1

(OR)

b) The webs of the section indicated in Figure 2 are ineffective in bending A, B, C, D = 2 cm². Determine the bending stresses in the flanges A, B, C and D when the section is subject to bending moment $M_X = 1500$ Nm, BC = 10 cm.

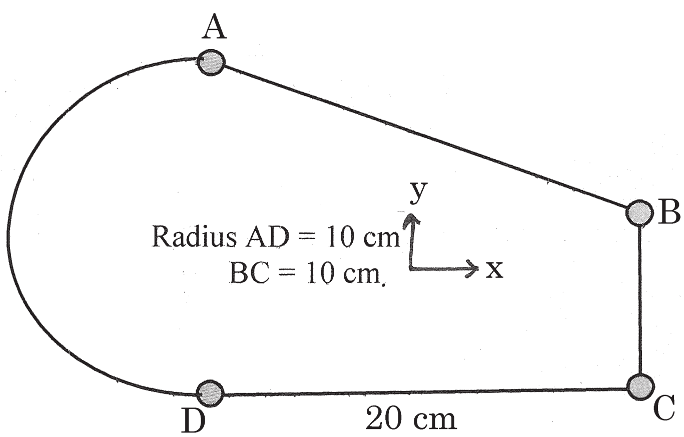

Figure 2

12. a) A thin-walled Z-section with wall thickness 1 mm is indicated in Figure 3. Obtain expressions for the shear flow distribution in A-B and B-C when the given section is subject to shear force V_y = 1 kN. Plot the resulting shear flow pattern.

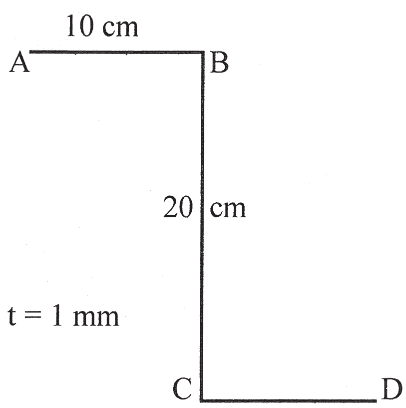

Figure 3

(OR)

b) The section indicated in Figure 4 is subject to V_y = 18 kN. Derive and obtain expressions for shear flow in the horizontal and curved portions. Obtain and mark the shear centre position.

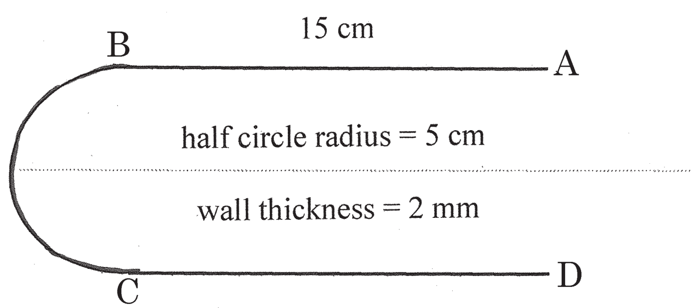

Figure 4

13. a) The section indicated in Figure 2 is subject to a vertical shear force 1.2 kN acting through the shear centre. Obtain and plot the resulting shear flow pattern. A, B, C, D = 2 cm^2. Find the horizontal distance between the shear center and point D.

(OR)

b) The webs of the section indicated in Figure 5 are ineffective in bending. The given section is subject to a vertical shear force 30 kN acting through the shear centre. Obtain the shear flow pattern and find the shear center location.

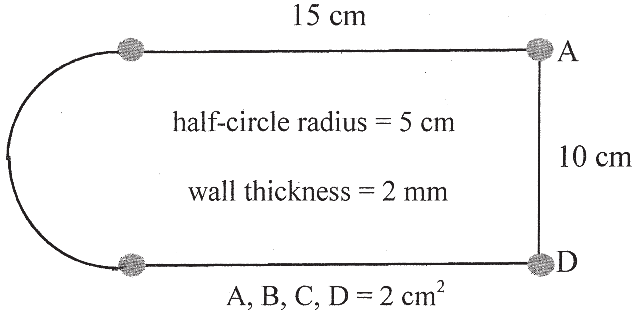

Figure 5

14. a) Explain the behaviour of thin sheets under compression. How will the stress distribution take place ? What is effective sheet width and how can this width be determined ?

(OR)

b) Explain the Needham and Gerard methods for the determination of crippling stress.

15. a) i) Categorize the different loads acting on an aircraft and give examples. **(7)**

ii) Explain Schrenk's method of estimating the lift distribution over an aircraft wing. **(6)**

(OR)

b) A thin-webbed tapered beam is indicated in Figure 6. Obtain and plot the shear flow distribution in the web at a section located 1 m from the free-end. The web (t = 2 mm) is fully effective in resisting bending.

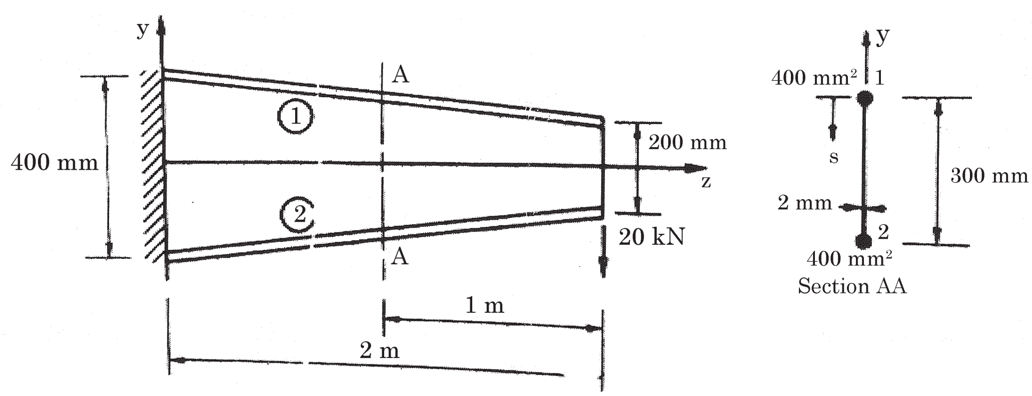

Figure 6

PART – C (1×15=15 Marks)

16. a) i) The section indicated in Figure 5 is now subject to a pure toque of 700 Nm. Determine the shear stress distribution and cell twist. Use E = 200 GPa. For a given torque, can the cell twist be decreased by using a stronger material – justify your answer. **(7)**

ii) Show that the shear flow in the walls of a closed thin-walled tube subject to pure torque will be constant along the perimeter. **(4)**

iii) Why is the determination of shear flow in the walls of a multi-cell tube subject to pure torque a statically indeterminate problem ? **(4)**

(OR)

b) i) Determine the section properties of the angle section given in Figure 7. What are principal axes of inertia and how are they determined ? **(7)**

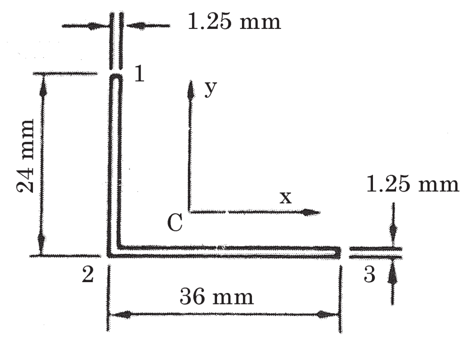

Figure 7

ii) Consider a uniform cantilever beam with an angle cross-section. The beam is subject to a tip shearing load P which is inclined at α° to the x-axis. Explain how tip deflection magnitude and direction can be determined by resolving the given load along principal directions. **(8)**

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