Reg. No. : E N G G T R E E . C O M

# Question Paper Code : 50030

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Fifth Semester



Aeronautical Engineering

AE 3501 — AIRCRAFT STRUCTURES – II

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why is bending moment called a stress resultant?

2. What type of loading would cause a beam with symmetric rectangular cross-section to bend unsymmetrically?

3. State the S.I. units for shear stress and for shear flow.

4. Sketch and indicate the shear centre position for the following sections.
   (a) thin-walled channel section
   (b) thin-walled angle section

5. Write down the expression for the strain energy in a thin-walled tube subject to pure torque.

6. Prove the relationship, $T = 2 \times A \times q$.

7. State the assumptions of a thin plate theory.

8. Define flexural rigidity of a thin plate.

9. Obtain aircraft load factor during a correctly banked level turn.

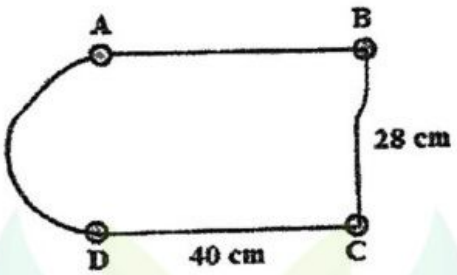
10. Why does an aircraft wing undergo torsion during steady level flight?

PART B — (5 × 13 = 65 marks)

11. (a) State the assumptions of the generalized theory of pure bending. A uniform beam of length L has a solid cross-section of unsymmetrical shape. The beam is subject to the bending moments in the horizontal and vertical planes. Derive and obtain the expression for the bending stress distribution in the cross-section. Explain how the neutral axis position can be determined. (13)

Or

(b) The webs of the section given below in figure 1 are ineffective in bending. The given section is subject to bending moments $M_x$ = 750 N cm in the vertical plane and $M_y$ = 650 N cm in the horizontal plane. Obtain the bending stress in the booms. Find the neutral axis orientation. (13)




A, D = 2.25 cm²

B, C = 2.0 cm²

Figure 1

12. (a) The web of the section given in figure 2 is effective in bending. The given section is subject to vertical shear equal to 500 N. Obtain and sketch the shear flow pattern. Determine the shear center location. (13)

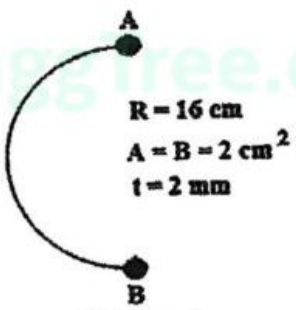



Figure 2

Or

(b) A thin-walled Z-section has flange width 'b' = 20 cm, web height 'h' = 40 cm and wall thickness t = 1.25 mm. Obtain expressions for the shear flow distribution when the applied shear load equals 1 kN in the vertical direction. Plot the shear flow variation and calculate maximum shear flow. (13)

13. (a) Explain the following. (4+5+4)

(i) shear flow analysis of a closed section subject to combined bending and torsion

(ii) shear flow and shear stress in multi-cell thin-walled tubes subject to pure torque

(iii) significance of the shear centre position.

Or

(b) The section indicated in figure 3 is subject to a vertical shearing load of 750 N passing through the shear centre of the section. The webs of the section are considered to be ineffective in bending. Cross-section area of booms A and B = 2 $cm^2$, while cross-section area of booms C and D = 2.1 $cm^2$. Obtain the shear flow distribution and plot the same. (13)

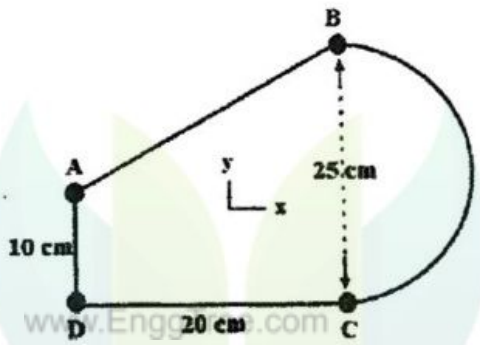



Figure 3

14. (a) Refer the figure given below 4(a) where the edges of the given plate are simply supported. Explain how the set of curves indicated in Figure 4(b) are obtained. Derive the relevant equations. (6+7)

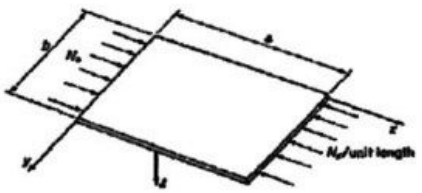


Figure 4 (a) and

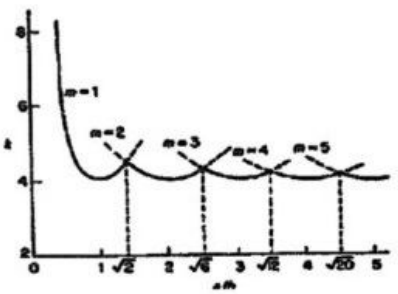



Figure 4 (b)

Or

(b) Differentiate between primary buckling, local buckling and crippling. For a thin- walled angle section column, explain how crippling load could be estimated. (13)

15. (a) Explain the construction and sketch of V-n diagram of a typical passenger aircraft. Indicate the regions of possible structural damage. Explain the effect of a sudden vertical gust on an aircraft. (13)

Or

(b) Write short notes about the following :

(i) materials used in aircraft construction and their properties

(ii) structural components of an aircraft wing and their functions. (7+6)

PART C — (1 × 15 = 15 marks)

16. (a) Explain structural idealization of an aircraft fuselage section. In the idealized fuselage section shown in fig. 5, the booms are equally spaced and each boom has a cross-section area equal to 100 mm². The given section is subject to a bending moment of 200 kNm applied in the vertical plane of symmetry and a vertical shearing load equal to 9 kN. Calculate the normal stress in the booms and explain how shear flow in the fuselage skin can be calculated. (15)

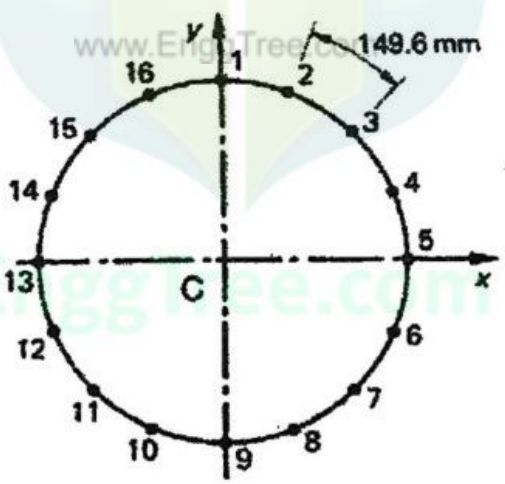



Figure.5

Or

(b) Explain the procedure for the shear flow analysis of thin-webbed tapered beams. How are flange loads calculated? Why are aircraft wing spars tapered? (6+5+4)