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

Question Paper Code : 20034

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

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. List the cross sections of the beam that never experiences unsymmetrical bending.

2. Sketch the normal stress distribution across the cross section of a rectangular cantilever beam subjected to a tip load vertically downward.

3. Give two examples of single symmetric section.

4. Locate the shear center for a beam of T-cross section with help of a neat sketch.

5. State the compatibility condition for a single cell beam subjected to lateral load passes through the shear center.

6. State whether the shear center will lie outside or inside of cross section of a thin walled closed section beam.

7. Write the lowest value of buckling coefficient for a plate with all the four edges simply supported.

8. Give the expression for the flexural rigidity of the plate.

9. To carry a given load, a monocoque structures heavier than semi monocoque construction. (True / False).

10. State whether a single cell structure subjected to torque is a determinate or indeterminate structure.

PART B — (5 × 13 = 65 marks)

11. (a) A cantilever I-section 2.4 m long is subjected to a load at its free end as shown in figure 11 (a). Determine the resulting bending stress at corners A and B on the fixed section of the cantilever beam using equation,

$$\sigma_z = \frac{M_y I_{xy} + M_x I_{yy}}{I_{xx} I_{yy} - I_{xy}^2} Y - \frac{M_x I_{xy} + M_y I_{xx}}{I_{xx} I_{yy} - I_{xy}^2} X$$

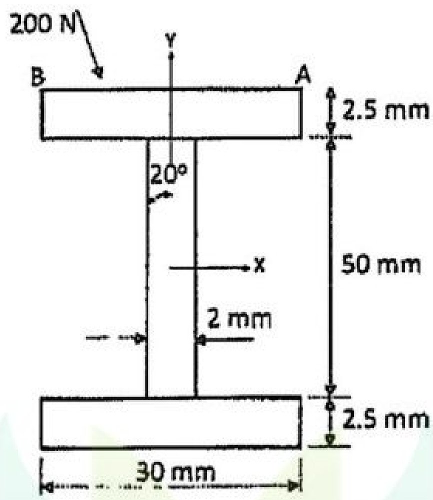

figure 11 (a)

Or

(b) A wood cantilever beam of rectangular cross section supports an inclined load P, at its free end as shown in figure 11 (b). Calculate the maximum tensile stress P at its (σ_{max}) and the maximum deflection (δ) due to the load P. Data for the beam are as follows: Breath (b) = 75mm, Depth (d) = 150 mm, Length (L) = 1.5 m, load (P) = 800 N, angle (θ) = 30° and Young's modulus (E) = 12 GPa.

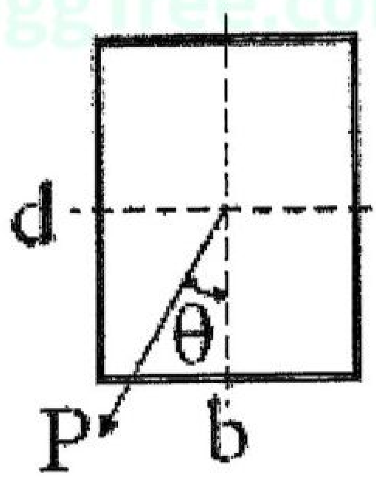

Figure 11 (b)

12. (a) Determine the shear flow distribution and locate the shear center for the section shown in figure 12 (a) using the formula

$$q = \frac{V_X I_{XY} - V_Y I_{YY}}{I_{XX} I_{YY} - I_{XY}^2} \sum A_i Y_i + \frac{V_Y I_{XY} - V_X I_{XX}}{I_{XX} I_{YY} - I_{XY}^2} \sum A_i X_i$$

Each of the stringers has an area of 4 cm² and the section is subjected to a vertical force of 50 kN.

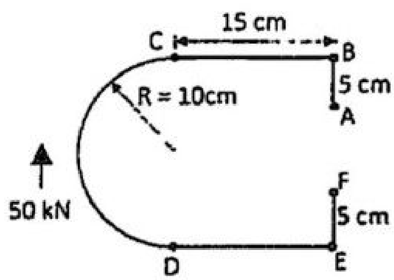

Figure 12 (a)

Or

(b) Find the shear flow and shear center for the C section shown in figure.

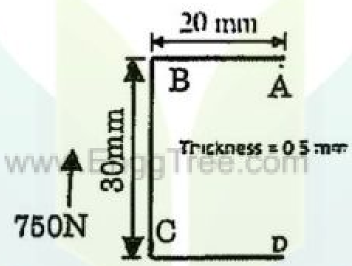

figure 12 (b)

13. (a) The figure 13 (a) shows a single cell beam with four flanges (booms). Determine the shear center of the beam using the equation.

$$q = \frac{V_X I_{XY} - V_Y I_{YY}}{I_{XX} I_{YY} - I_{XY}^2} \sum A_i Y_i + \frac{V_Y I_{XY} - V_X I_{XX}}{I_{XX} I_{YY} - I_{XY}^2} \sum A_i X_i$$

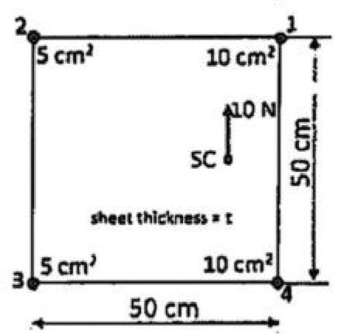

figure 13 (a)

Or

(b) Determine the shear flow in the walls of the multi-cell tube structure shown in figure 13 (b), for an applied torque of 1.4 kNm. Also calculate the twist per unit length. Take G = 75 GPa and thickness (t) = 2 mm for all walls.

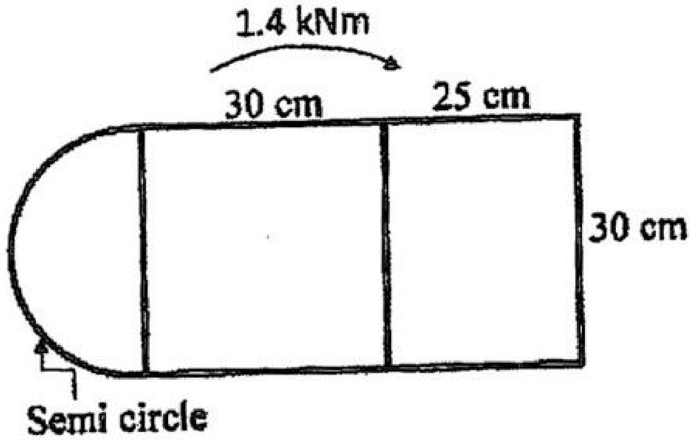

figure 13 (b)

14. (a) Determine the crippling stress for the formed section made of Al alloy 2024 – T 3 shown in figure 14 (a) using angle method,

$F_{CY} = 2.75 \times 10^{8}$ N/m². $E_C = 70 \times 10^{9}$ N/m².

$$\frac{F_{CS}}{(F_{CY}E)^{\frac{1}{2}}} = \frac{C_e}{\left(\frac{b'}{t}\right)^{0.75}}$$

$C_e = 0.316$ (two edge free),

$C_e = 0.342$ (one edge free), $Ce = 0.366$ (no edge free)

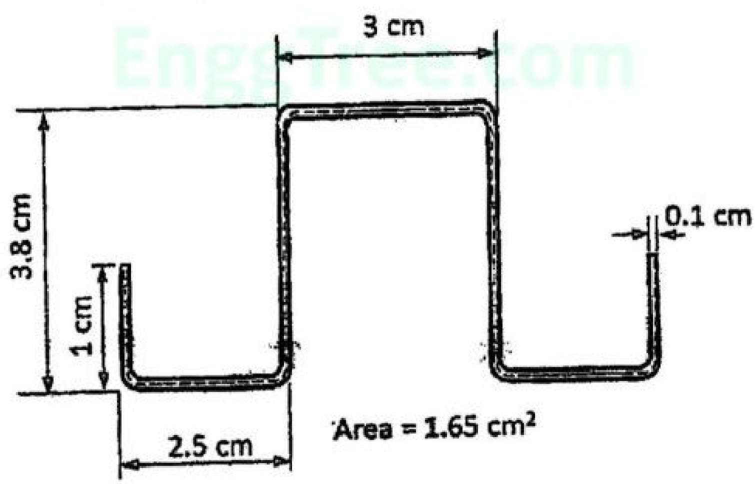

figure 14 (a)

Or

(b) Find the shear flow for the Z section shown in Figure 14 (b) subjected to a vertical force V. Thickness of the section is 't'.

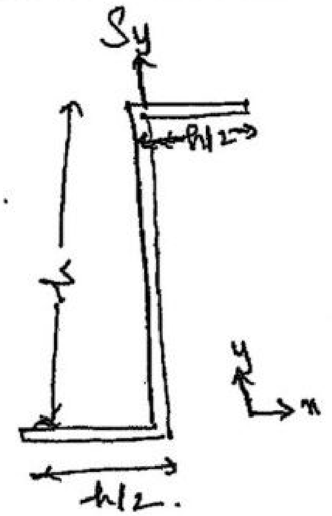

Fig 14 (b)

15. (a) The sheet stringer panel shown in Fig. is loaded in compression by means of rigid members. The sheet is assumed to be simply supported at the loaded ends and at the rivet lines and to be free at the sides. Each stringer has an area of 0.65 cm^2. Assume E = 70 GPa for the sheet and stringers. Determine the total compressive load P for the following cases.

(i) When the sheet first buckles

(ii) When the stringers stress is 70 MN/m^2

(iii) When the stringers stress is 210 MN/m^2.

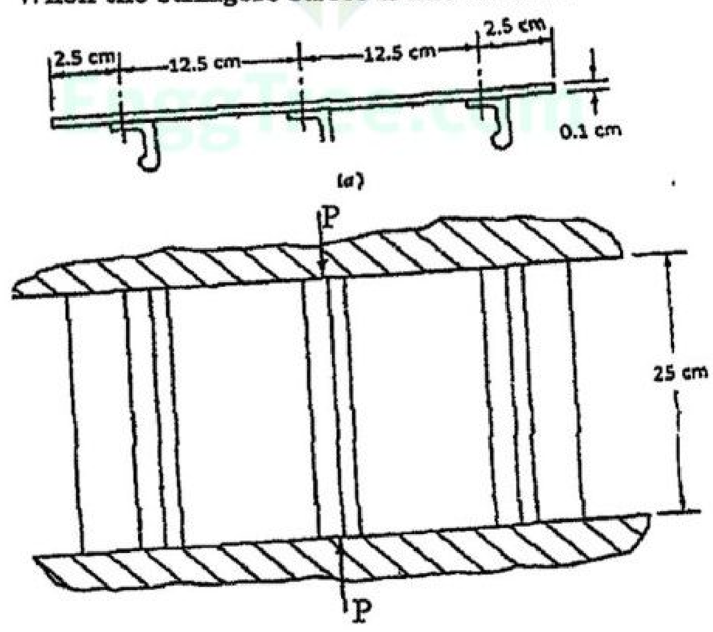

figure 15 (a)

Or

(b) Determine the crippling stress for the formed section made of Al-alloy 2024-T3 shown in figure 15 (b) using Gerard method,

FCY = 2.75×10^8 N/m². Ec = 70×10^9 N/m².

$\frac{F_{cs}}{F_{CY}} = 0.56\left[\left(\frac{gt^2}{A}\right)\left(\frac{E}{F_{CY}}\right)^{\frac{1}{2}}\right]^{0.85}$ and also compare with the $(F_{CS})_{max} = 0.8F_{CY}$

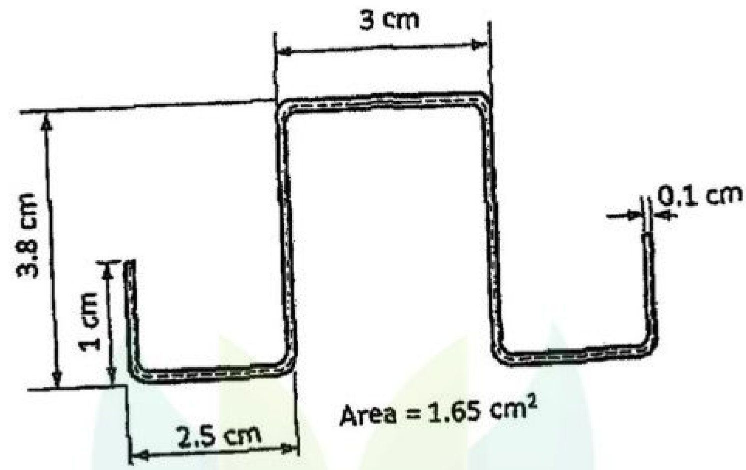

figure 15 (b)

PART C — (1 × 15 = 15 marks)

16. (a) A fuselage bulkhead of 1 m diameter has 12 stringers equally placed around the section given in figure 16 (a). Each stringer area is 6.25 cm². The bulk head is subjected to a symmetrical load of 10 kN. Find the shear flow around the bulk head.

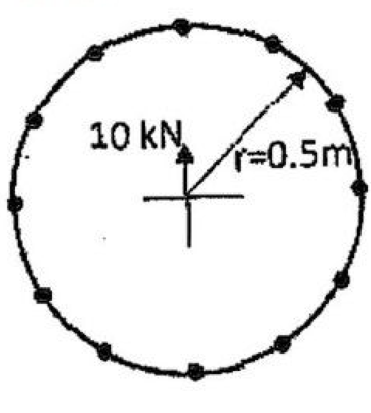

figure 16 (a)

Or

(b) Find the shear flow and twist per unit length of the two cell tube made of aluminium as shown figure 16 (b) and is subjected to a torque 90000 Ncm.

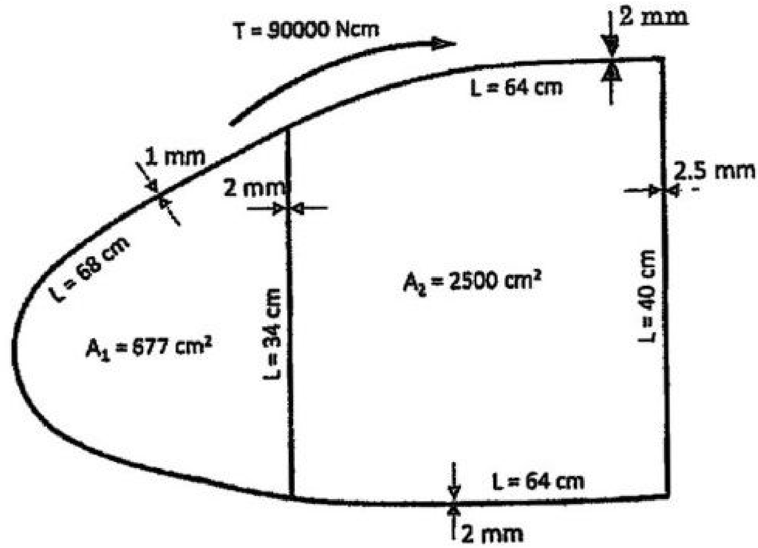

figure 16 (b)
