

VTU B.E/B.TECH QUESTION PAPER SET

CBCS SEMESTER VI

AIRCRAFT STRUCTURES- II

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15AE64

Sixth Semester B.E. Degree Examination, June/July 2018 Aircraft Structures – II

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. Define unsymmetrical Bending and explain its sign conventions. (06 Marks)
- b. Derive the equation for direct stress distribution due to bending and position of the neutral axis. (10 Marks)

OR

- 2 a. The beam section shown in Fig Q2(a) is subjected to a bending moment of 10kN.m in both the axes. Determine the distribution of direct stress

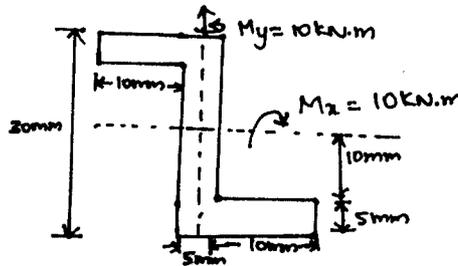


Fig Q2(a)

- b. Derive the Bredth – Batho Theory (Rule) (04 Marks)

Module-2

- 3 a. Explain the structural Idealization principle and explain the Idealization procedure of a panel. (08 Marks)
- b. Describe the effect of idealization on the analysis of open and closed section beams. (04 Marks)
- c. Justify the effects of booms in the idealized structure whether the shear stress distribution will get affected or not, because of its presence. (booms). (04 Marks)

OR

- 4 a. Calculate the shear flow distribution in the channel section, shown in Fig Q4(a) produced by a vertical load of 4.8kN acting through its shear center. Assume that the walls of the section are effective in resisting only shear stresses, while the booms, each of area 300mm^2 , carry all the direct stress. (08 Marks)

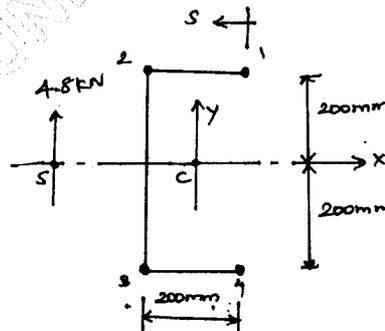


Fig Q4(a)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.

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b. Derive the equation for shear flow of open section beams.

(08 Marks)

Module-3

- 5 a. Determine the Crippling stress using Needham and Gerard method. (08 Marks)
 b. Explain Bolted joint (or) riveted joints and welded joints and explain the concept of effective width. (08 Marks)

OR

- 6 a. Explain eccentrically loaded convections. (08 Marks)
 b. Determine the Buckling of Isotropic flat plates in compression. (08 Marks)

Module-4

- 7 Determine the shear flow distribution in the web of the tapered beam shown in Fig Q7(a) at a section midway along its length. The web of the beam has a thickness of 2mm and is fully effective in resisting direct stress. The beam tapers symmetrically about its horizontal centroidal axis and the cross sectional area of each flange is 400mm^2 . The internal bending moment and shear load at the section A-A produced by external load are $M_x = 20\text{kNm}$ and $S_y = -20\text{kN}$. (16 Marks)

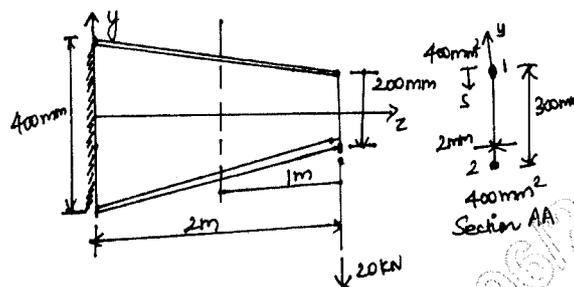


Fig Q7

OR

- 8 a. Explain the three boom shell structure in wings. (08 Marks)
 b. Calculate the shear stress distribution in the walls of the three cell using section as shown in Fig Q8(b) when it is subjected to counterclockwise torque of 11.3 kN.m. The data are in the table 8(b) (08 Marks)

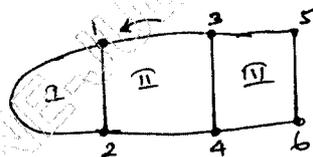


Fig Q8(b)

Table Q8(b)				
Wall	Length (mm)	Thickness (mm)	G(N/mm ²)	Cell area (mm ²)
12°	1,650	1.22	24,200	A _I = 258,000
12°	508	2.03	27,600	A _{II} = 355,000
13,24	775	1.22	24,200	A _{III} = 161,000
34	380	1.63	27,600	
35,46	508	0.92	20,700	
56	254	0.92	20,700	

Note: The superscript symbols O and i are used to distinguish between outer and inner walls connecting the same tow boom.

Module-5

- 9 The fuselage shown in Fig Q9-(a) subjected to a vertical shear load of 100kN applied at a distance of 150mm from the vertical axis of symmetry as shown for the idealized section in Fig Q9-(b). Calculate the distribution of shear flow in the section. (16 Marks)

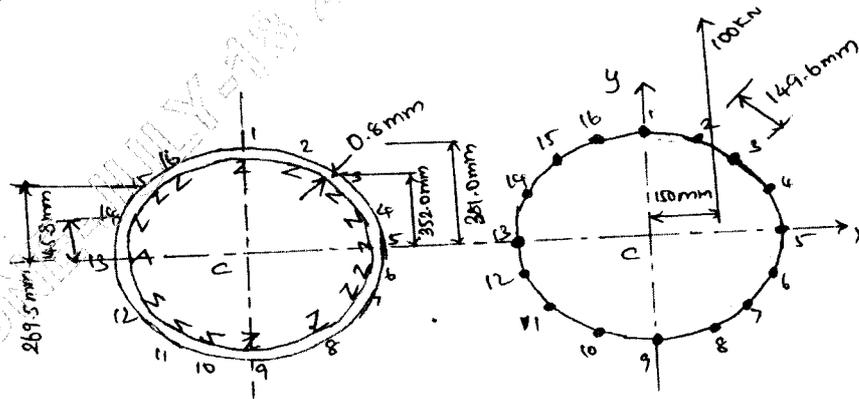


Fig Q9 (a)

Fig Q9 (b)

OR

- 10 a. Explain the principles of stiffeners construction with an example. (08 Marks)
 b. Write a short note on Fuselage Frames and explain the shear flow distribution in the frames. (08 Marks)

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Sixth Semester B.E. Degree Examination, June/July 2019 Aircraft Structures – II

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. What are the assumptions of symmetric bending? Explain the unsymmetric bending with associated equations. (10 Marks)
- b. Determine the deflection curve and mid-span deflection of the simply supported beam shown in Fig.Q1(b); the beam has a doubly symmetrical cross section. (06 Marks)

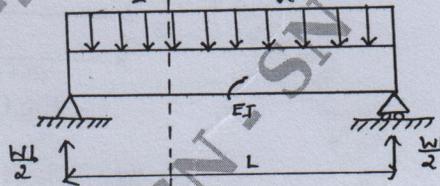


Fig.Q1(b)

OR

- 2 a. Calculate the position of the shear center of the thin-walled channel section shown in Fig.Q2(a). The thickness t of the wall is constant. (10 Marks)

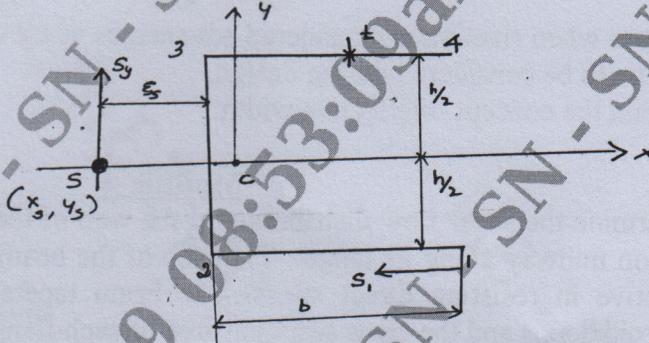


Fig.Q2(a)

- b. Derive the displacement associated with the Bredt-Batho shear flow. (06 Marks)

Module-2

- 3 a. Determine the shear flow distribution in the beam shown in Fig.Q3(a). When it is subjected to a shear load in its vertical plane of symmetry. The thickness of the walls of the section is 2 mm throughout. (10 Marks)

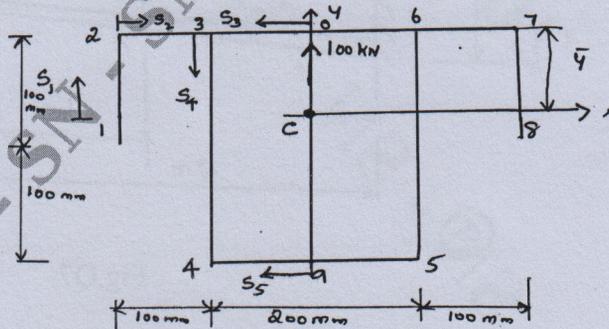


Fig.Q3(a)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

b. Explain about Idealization of a panel.

(06 Marks)

OR

4 Calculate the shear flow distribution in the channel section shown in Fig.Q4. Produced by a vertical shear load of 4.8 kN acting through its shear centre. Assume that the walls of the section are effective in resisting only shear stresses, while the booms, each of area 300mm^2 , carry all the direct stresses. (16 Marks)

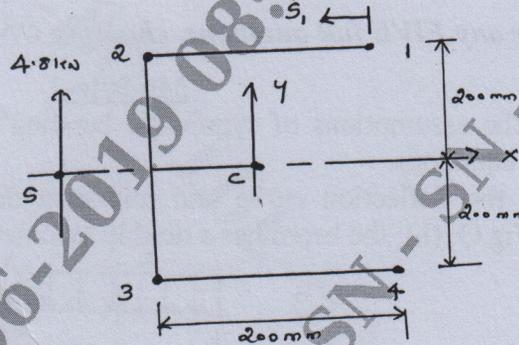


Fig.Q4

Module-3

5 a. Derive an expression for buckling stress for isotropic flat plates in compression. (08 Marks)
 b. Explain buckling and crippling stress. Bring out the essential differences between them. (08 Marks)

OR

6 a. Discuss when riveting is considered advantages in a/c design and explain design parameters that are to be considered during design. (08 Marks)
 b. Explain the concept of effective width. (08 Marks)

Module-4

7 Determine the shear flow distribution in the web of the tapered beam shown in Fig.Q7, at a section midway along its length. The web of the beam has a thickness of 2mm and is fully effective in resisting direct stress. The beam tapers symmetrically about its horizontal centroidal axis and the cross sectional area of each flange is 400mm^2 . (16 Marks)

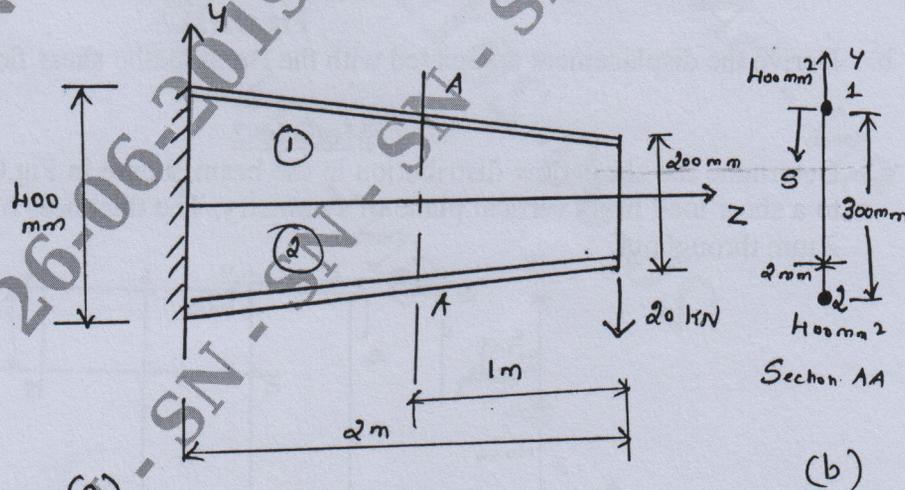


Fig.Q7

OR

- 8 The cantilever beam shown in Fig.Q8 is uniformly tapered along its length in both x and y directions and carries a load of 100 kN at its free end. Calculate the forces in the booms and shear flow distribution in the walls at a section 2 m from the built in end if the booms resist all the direct stresses while the walls are effective only in shear. Each corner both has a cross sectional area of 900 mm² while both central booms have cross sectional areas of 1,200 mm². (16 Marks)

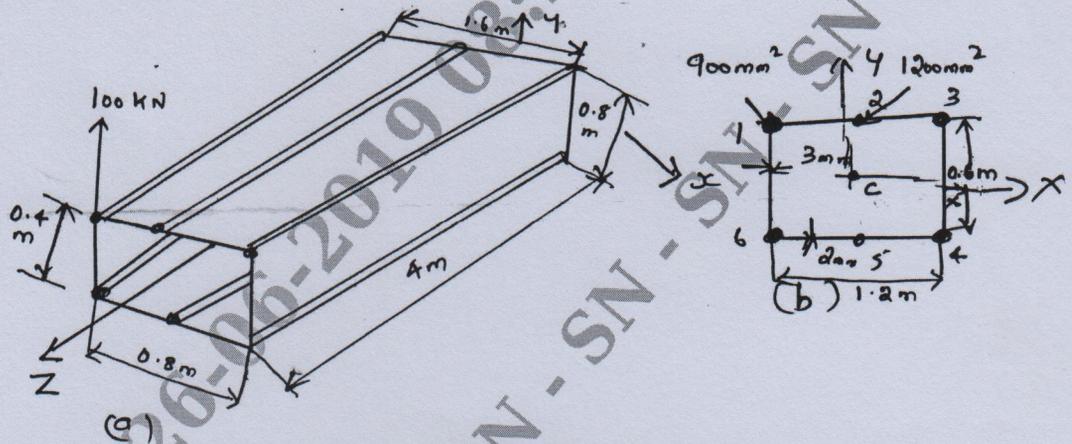


Fig.Q8

Module-5

- 9 The fuselage of the section, the bending moment due to SCIF weight was 9.8 kNm and due to symmetrical pull out tail load 45.1 kNm down. The tail load may be assumed to be acting at 2 m away from the section. If the stringers are 16 in number and placed as shown in Fig.Q9, with areas of stringers placed symmetrical about yy axis. Calculate the stress in stringers. (16 Marks)

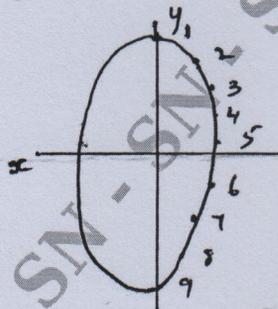


Fig.Q9

Stringers	Area (mm ²)	x	y
1	640	0	660
2	600	100	600
3	600	200	420
4	600	300	228
5	620	500	25
6	640	450	-204
7	640	300	-396
8	850	150	-502
9	640	0	-540

OR

- 10 a. Explain and derive Cut-Outs in fuselage structure. (08 Marks)
 b. Derive and explain about stress analysis in fuselage frames caused due to torsion. (08 Marks)

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Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Aircraft Structures – II

Time: 3 hrs.

Max. Marks: 80

Note: Answer FIVE full questions, choosing one full question from each module.

Module-1

- 1 a. Derive the equation for direct stress distribution due to unsymmetrical bending and position of the neutral axis. (10 Marks)
- b. Derive the relationship between load intensity, shear force and bending moment. (06 Marks)

OR

- 2 a. Derive the Breadth-Batho theory. (06 Marks)
- b. Find the maximum normal stress due to bending for the section shown in Fig.Q2 (b)
 $M_x = 1500 \text{ N.m}$, $M_y = 0$ (10 Marks)

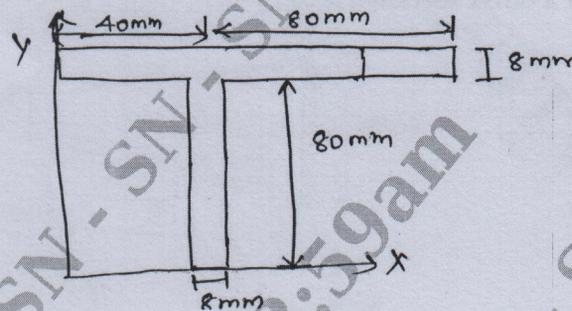


Fig. Q2 (b)

Module-2

- 3 a. Explain the principle of structural idealization. (08 Marks)
- b. Derive the equation for shear flow in open section beams. (08 Marks)

OR

- 4 a. Describe the effect of idealization on the analysis of open and closed section beams. (04 Marks)
- b. Justify the effects of booms in the idealized structure whether the shear distribution will get affected or not, because of its presence (booms). (04 Marks)
- c. Derive the equation for shear flow in closed section beams. (08 Marks)

Module-3

- 5 a. Explain Buckling of isotropic plate in compression. (08 Marks)
- b. Explain Needham and Gerard method for determining crippling stress. (08 Marks)

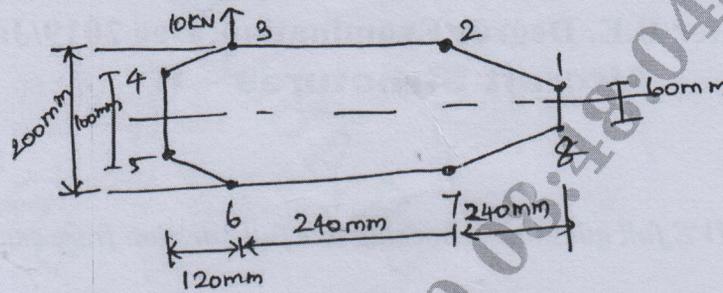
OR

- 6 a. Explain the concept of effective width. (06 Marks)
- b. Explain bolted or riveted joints. (04 Marks)
- c. Explain accuracy of fitting analysis. (06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
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Module-4

7. a. Explain three-boom shell in detail. (06 Marks)
 b. The thin walled single cell beam shown in Fig. Q7 (b) has been idealized into a combination of direct stress-carrying booms and shear stress only carrying walls.



Boom areas
 $B_1 = B_8 = 200 \text{ mm}^2$
 $B_2 = B_7 = 250 \text{ mm}^2$
 $B_3 = B_6 = 400 \text{ mm}^2$
 $B_4 = B_5 = 100 \text{ mm}^2$

Fig. Q7 (b)

If the section supports a vertical shear load of 10 kN acting in a vertical plane through booms 3 and 6, calculate the distribution of shear flow around the section. (10 Marks)

OR

8. Determine the shear flow distribution in the web of the tapered beam shown in Fig. Q8 at a section midway along its length. The web of the beam has a thickness of 2 mm and is fully effective in resisting direct stress. The beam tapers symmetrically about its horizontal central axis and a cross sectional area of each flange is 400 mm^2 . (16 Marks)

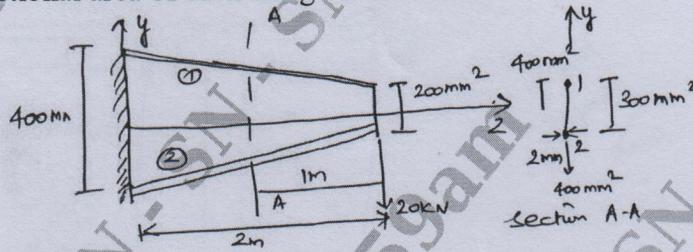


Fig. Q8

Module-5

9. a. Explain the principles of stiffeners construction with example. (08 Marks)
 b. Why cut-outs in fuselages is required? Explain the construction of fuselage frames. (08 Marks)

OR

10. The fuselage of a light passenger carrying aircraft has the circular cross section shown in Fig. Q10. The cross sectional area of each stringer is 100 mm^2 and the vertical distance given in Fig. Q10 are to the mid-line of the section wall at the corresponding stringer position. If the fuselage is subjected to a bending moment of 200 kNm applied in the vertical plane of symmetry, at this section, calculate the direct stress distribution. (16 Marks)

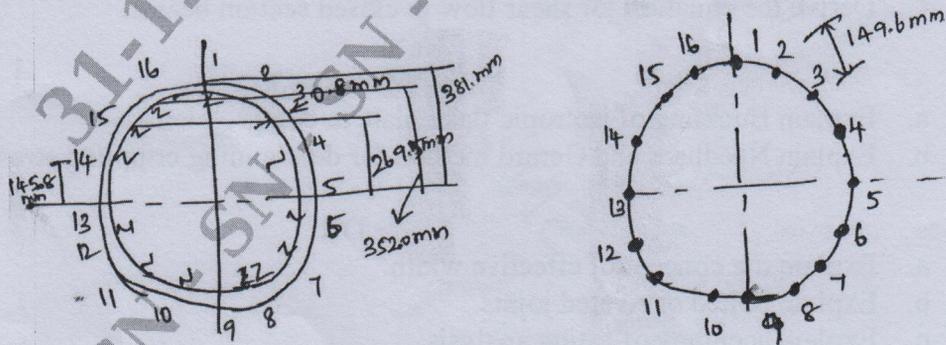


Fig. Q10

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Sixth Semester B.E. Degree Examination, Aug./Sept.2020

Aircraft Structures – II

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Derive an equation for direct stress due to bending in an unsymmetrical section. (08 Marks)
- b. A thin walled cantilever beam of unsymmetrical cross-section supports shear loads at its free end as shown in Fig.Q1(b). calculate the value of direct stress at the extremity of the lower flange (Point A) at a section half way along the beam if the position of the shear loads is such that no twisting of the beam occurs.

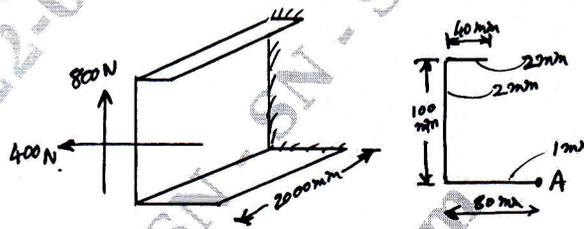


Fig.Q1(b)

(08 Marks)

OR

- 2 a. Define : Shear flow, shear center, elastic air and Bredt-Batho theory. (08 Marks)
- b. Calculate the position of the shear center of the thin walled section shown in Fig.Q2(b).

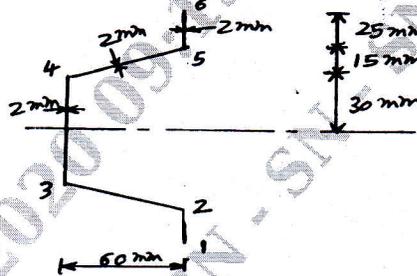


Fig.Q2(b)

(08 Marks)

Module-2

- 3 a. Find the angle of twist per unit length in the wing whose cross-section is shown in Fig.Q3(a) when it is subjected to a torque of 10 kNm. Find also the maximum shear stress in the section. $G = 25 \text{ GPa}$. Wall 12(outer) = 900 mm. Nose cell area = 20,000 mm².

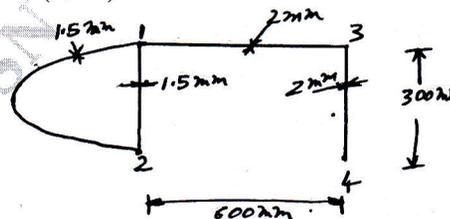


Fig.Q3(a)

(08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

- b. If the wing box as shown in Fig.Q3(b) is subjected to a torque of 100 kNm, calculate the rate of twist of the section and the maximum shear stress $G = 25 \text{ GPa}$.

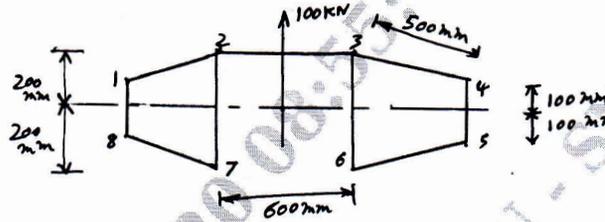


Fig.Q3(b)

(08 Marks)

OR

- 4 a. Obtain the equation for shear flow in open section idealized beam. (08 Marks)
 b. Fig.Q4(b) shows Two-cell box type wing section with vertical spars connected to the wing skin through angle sections having cross sectional area of 300 mm^2 . Idealize the section into direct stress carrying booms and shear stress only carrying panels suitable for resisting bending moments in virtual plane.

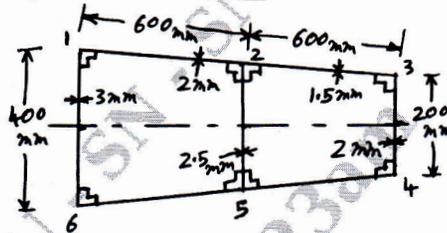


Fig.Q4(b)

(08 Marks)

Module-3

- 5 a. Derive an equation for critical stress for uniform rectangular plate. (08 Marks)
 b. The sheet stringer panel shown in Fig.Q5(b) is loaded in compression. The sheet is assumed to be simply supported at the loaded ends and free at the sides. Each stringer has an area of 65 mm^2 . Assume $E = 7.1 \times 10^4 \text{ MPa}$, $K = 3.62$ and 0.385 for the sheet between stringers and edge of the sheet respectively. Find the total compressive load (i) when the sheet first buckles (ii) when the stringer stress is 69 MPa .

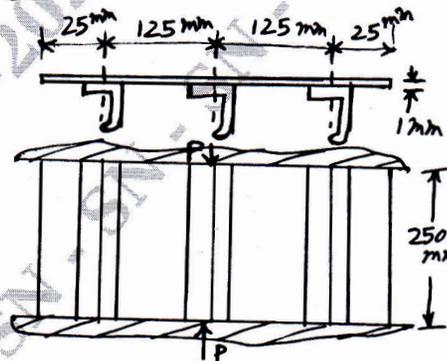


Fig.Q5(b)

(08 Marks)

OR

- 6 a. Explain the design parameters involved in Rivet joints. (12 Marks)
 b. Write a note on effective skin width. (04 Marks)

Module-4

- 7 a. Determine the shear flow distribution in the web of the tapered beam shown in Fig.Q7(a) at a section midway along its length. The web of the beam has a thickness of 2mm and is fully effective in resisting direct stress. Each flange area is 400 mm^2 .

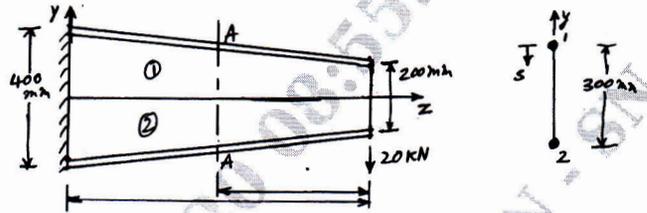


Fig.Q7(a)

(12 Marks)

- b. Write a note on wing strength requirements.

(04 Marks)

OR

- 8 The structural portion of a wing consists of a three-bay rectangular section box which may be assumed to be firmly fixed at all points around its periphery. The wing is having a cut-out on the under surface of the central bay and is subjected to a torque of 10 kNm at its tip as shown in Fig.Q8. Calculate the shear flows in the skin panels, spar webs, loads in the corner flanges and the forces in the ribs on each side of cut-out.

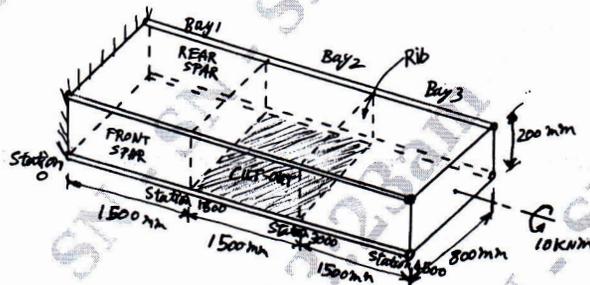


Fig.Q8

(16 Marks)

Module-5

- 9 The fuselage as shown in Fig.Q9 is subjected to a vertical shear load of 100 kN applied at a distance of 150mm from the vertical axis of symmetry as shown for the idealized section. Calculate the distribution of shear flow in the section.

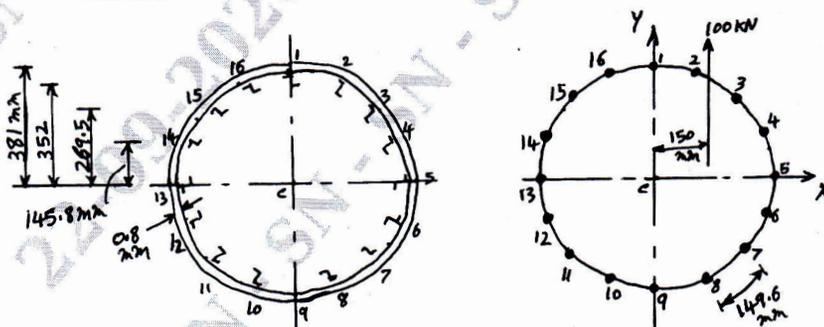


Fig.Q9

(16 Marks)

OR

- 10 a. Explain with a neat sketch, how shear flow is calculated in fuselage panel with cutouts for windows. (08 Marks)
 b. Explain with a neat sketch, how shear flow distribution around the periphery of the frame is determined. (08 Marks)
