Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

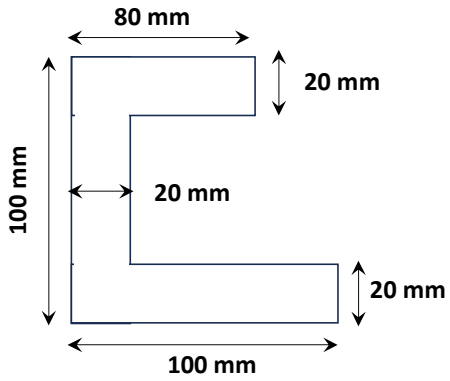
Course: Design of Aerospace Structure — **Semester: Vth**

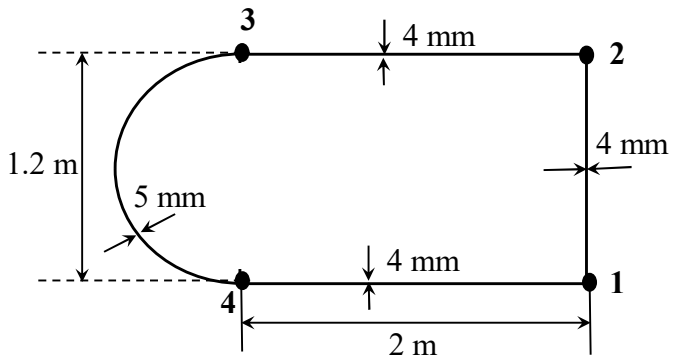
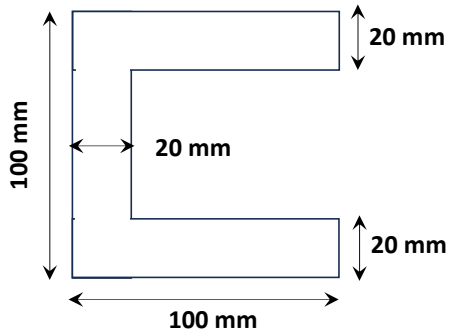
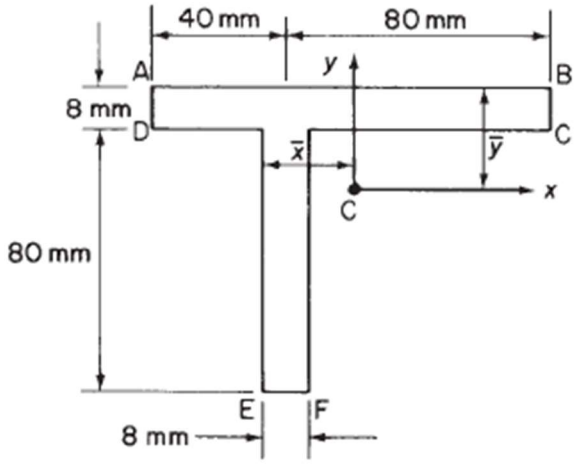
Program: B Tech Aerospace — **Time : 03 hrs.**

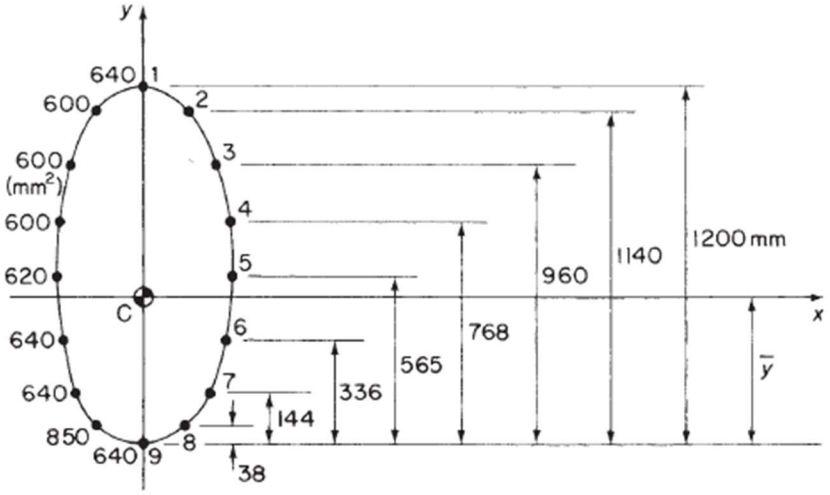
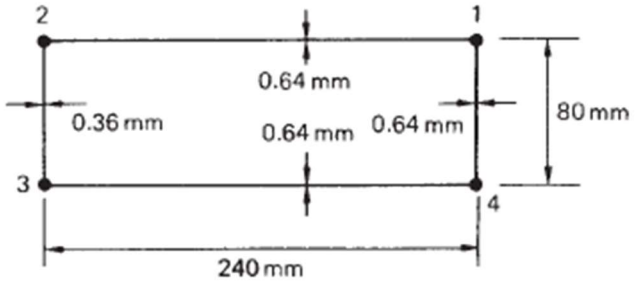
Course Code: ASEG 3037P — **Max. Marks: 100**

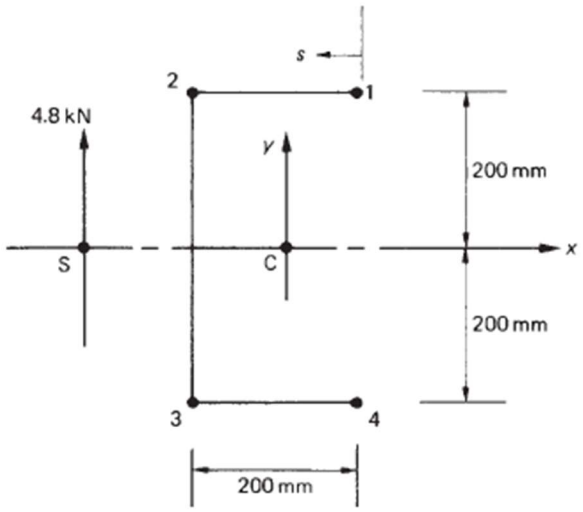
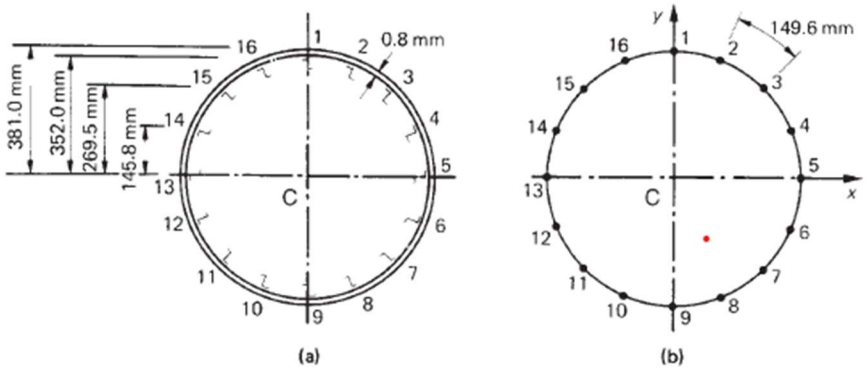
Instructions: Assume suitable right-handed coordinate system.
Assume any suitable value for missing data

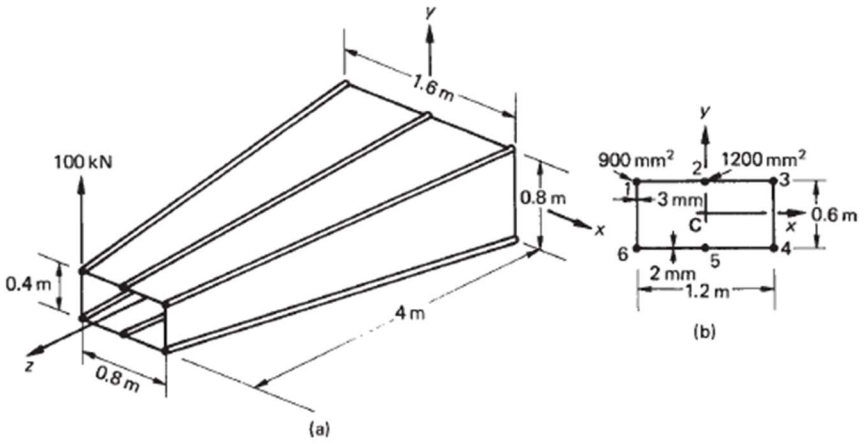
SECTION A
(5Qx4M=20Marks)

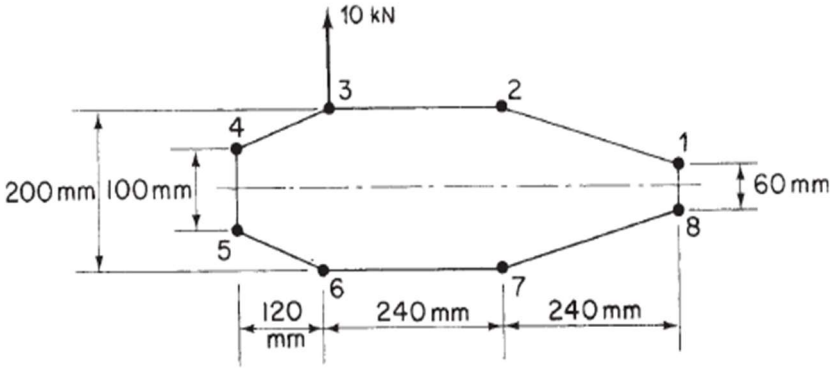
S. No.		Marks	CO
Q 1	Explain the structure idealization in aircraft structure and boom analogy.	**4**	**CO1**
Q 2	Calculate I_{xx} and I_{yy} about the centroidal x and y axis. 	**4**	**CO1**
Q 3	Derive the Bredt-Batho formula for torsion of closed section beam.	**4**	**CO3**
Q 4	Determine the twist rate of shown closed thin cross-section in figure which is subjected to twisting moment of 8 kN-m. Take $G = 65$ GPa and boom area $B_1 = B_2 = B_3 = B_4 = 100\ \text{mm}^2$. Assume there is constant shear flow over the complete skin panel.	**4**	**CO2**

			
Q 5	Determine the total force in upper flange for the section shown in figure, if the transverse force of 10 kN is acting only in vertical upward direction. 	**4**	**CO1**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	A beam having the cross-section shown in figure is subjected to a bending moment of 1500 N-m in a vertical plane. Determine the location of centroid C i.e. $\bar{x}$ and $\bar{y}$. Also, calculate the direct bending stress at point A and at point F due to bending. 	**10**	**CO2**

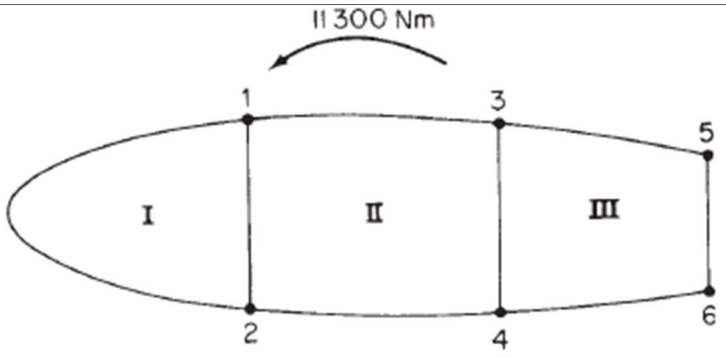
Q 7	The fuselage section shown in figure is subjected to a bending moment of 100 kN-m applied in the vertical plane of symmetry. If the section has been completely idealized into a combination of direct stress carrying booms and shear stress only carrying panels, determine the direct stress in each boom.  	**10**	**CO3**
Q 8	Determine the position of the shear centre of the rectangular four boom beam section shown in figure. The booms carry only direct stress, and the skin is only effective in carrying shear stress. The area of each boom is 100 mm^2.  **Or** Calculate the shear flow distribution in the channel section shown in figure produced by a vertical shear load of 4.8 kN acting through its shear centre. Assume that the walls of the section are only effective in resisting shear stresses while the booms, each of area 300 mm^2, carry all the direct stresses.	**10**	**CO1**

			
Q 9	The fuselage of a light passenger carrying aircraft has the circular cross-section shown in figure (a). The cross-sectional area of each stringer is 100 mm^2 and the vertical distances given in figure (b) 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 kN-m applied in the vertical plane of symmetry, at this section, calculate the direct stress distribution. 	**10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10	The cantilever beam shown in figure 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 total forces in the booms and the 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 boom has a cross-sectional area of 900 mm^2 while both central booms have cross-sectional areas of 1200 mm^2.	**20**	**CO4**



Q 11	The thin-walled single cell beam shown in figure has been idealized into a combination of direct stress carrying booms and shear stress only carrying walls. 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. Boom areas: $B1 = B8 = 200\ mm^2$, $B2 = B7 = 250\ mm^2$, $B3 = B6 = 400\ mm^2$, $B4 = B5 = 100\ mm^2$.  **Or** Calculate the shear stress distribution in the walls of the three-cell wing section shown in figure, when it is subjected to an anticlockwise torque of 11300 N-m. Assume the Bredt-Batho theory of torsion.	**20**	**CO3**

Wall	**Length (mm)**	**Thickness (mm)**	**G (N/mm^2)**	**Cell Area (mm^2)**
12 (outer)	1650	1.22	24200	$A_I = 258000$
12 (inner)	508	2.03	27600	
13, 24	775	1.22	24200	$A_{II} = 355000$
34	380	1.63	27600	
35, 46	508	0.92	20700	$A_{III} = 161000$
56	254	0.92	20700	

	 11 300 Nm 1 3 5 I II III 2 4 6		