B.E.(Aeronautical Engineering) Semester Fifth (C.B.S.)

Aircraft Structure - II

Paper – I

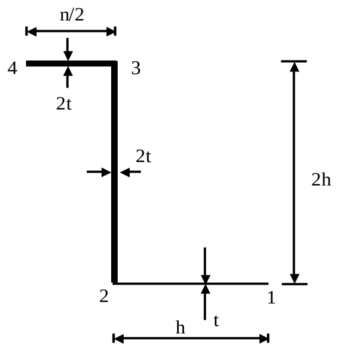
P. Pages : 4 **KNT/KW/16/7373**

Time : Three Hours Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Derive general expression for deformations of unsymmetrical beams subjected to external moments M_X and M_Y. **6**

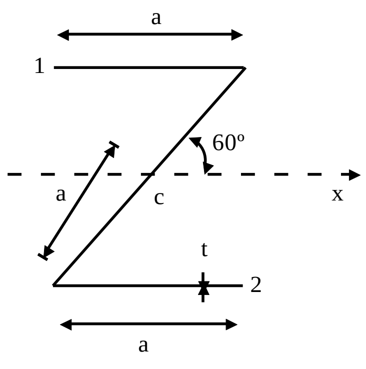
b) A thin walled beam has the cross - section shown in fig. below. If the beam is subjected to a bending moment M_X in the plane of the web 23, calculate and sketch the distribution of direct stress in the beam cross - section. **8**



OR

2. a) Derive the expression for direct stress distribution due to bending of unsymmetrical section beams. **5**

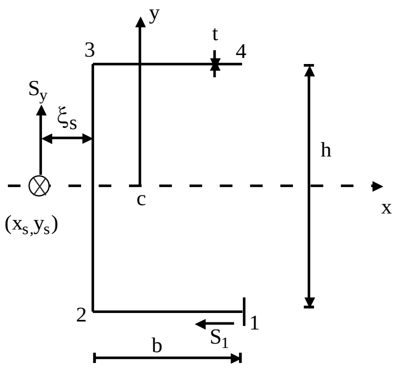
b) The thin walled beam section shown in fig. below is subjected to a bending moment M_X applied in a negative sense. Find the position of the neutral axis and the maximum direct stress in the section. **9**



3. a) Derive the following expression clearly stating the assumptions made. **5**

$$\frac{\partial q}{\partial s} + t\frac{\partial \sigma_z}{\partial z} = 0$$

b) Calculate the position of the shear centre of the thin - walled channel section shown in fig. below. The thickness t of the walls is constant. **8**



OR

4. a) Derive the following relation stating assumptions : **6**

$$q_s = -\left(\frac{S_x I_{xx} - S_y I_{xy}}{I_{xx} I_{yy} - I_{xy}^2}\right)\int_0^s t\,x.ds - \left(\frac{S_y I_{yy} - S_x I_{xy}}{I_{xx} I_{yy} - I_{xy}^2}\right)\int_0^s t\,y.ds$$

b) Explain membrane analogy. **7**

5. a) Show that for the closed section beams : **7**

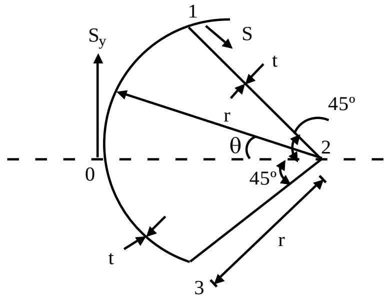
$$S_x\,\eta_0 - S_y\,\xi_0 = \oint P q_b\,ds + q A q_{s,0}$$

b) Prove that for the thin - walled closed section beams : **7**

$$q_{s,0} = -\frac{\oint \left(q_b/Gt\right) ds}{\oint ds/Gt}$$

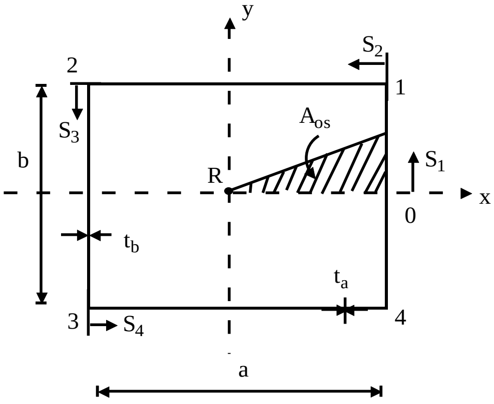
OR

6. A thin walled closed section beam of constant wall thickness t has the cross - section as shown in fig. Assuming that the direct stresses are distributed according to the basic theory of bending, calculate and sketch the shear flow distribution for a vertical shear force S_y applied tangentially to the curved part of the beam. **14**



7. a) Explain in 'Neuber Beam' with example. **3**

b) Determine the warping distribution in the doubly symmetrical rectangular, closed section beam, shown in fig. when subjected to an anticlockwise torque T. **10**

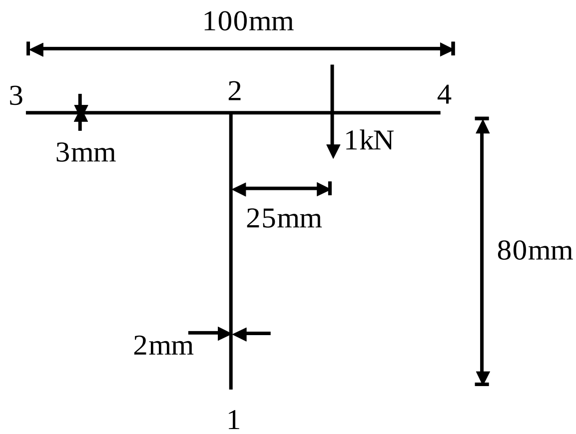


OR

8. a) Explain Bredt - Batho theory, hence prove that **6**

$$\frac{d\theta}{dz} = \frac{T}{4A^2} \oint \frac{ds}{Gt}$$

b) Determine the maximum shear stress in the beam section shown in fig. below stating clearly the point at which it occurs. Determine also the rate of twist of the beam section if the shear modulus G is $25\,KN/mm^2$. **7**



9. a) For plates subjected to distributed transverse load q, obtain : **8**

$$\frac{\partial^2 M_x}{\partial x^2} - 2\frac{\partial^2 M_{xy}}{\partial x \partial y} + \frac{\partial^2 M_y}{\partial y^2} = -q$$

b) Explain plate edge boundary conditions. **5**

OR

10. a) Explain the term "Antielastic" and "Synclastic surface". **3**

b) Derive following relation for pure bending of thin plate, where D is the flexural rigidity of the plate. **10**

$$M_x = D\left(\frac{1}{\rho_x} + \frac{\nu}{\rho_y}\right)$$

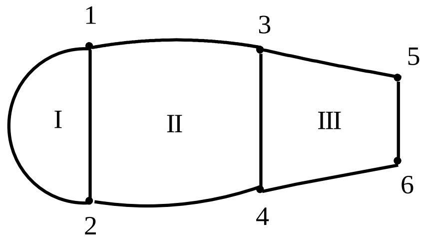
$$M_y = D\left(\frac{1}{\rho_y} + \frac{\nu}{\rho_x}\right)$$

11. Calculate the shear stress distribution in the walls of the three cell wing section shown in fig. below, when it is subjected to an anticlockwise torque of 11.3 kNm. **13**

Cell Area $\left(mm^2\right)$ is $A_I = 258000;\ A_{II} = 355000;$ and $A_{III} = 161000$.

Wall	length (mm)	thickness (mm)	G (GPa)
12^o	1650	1.22	24.2
12^i	508	2.03	27.6
13, 24	775	1.22	24.2
34	380	1.63	27.6
35, 46	508	0.92	20.7
56	254	0.92	20.7

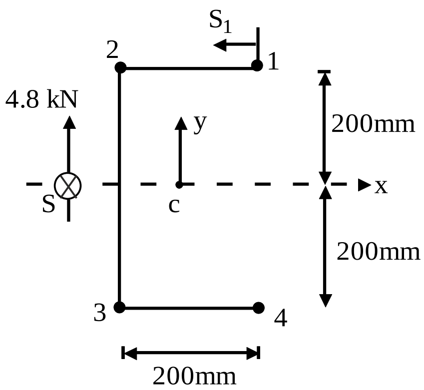
The superscripts o and i represents outer & inner walls connecting the same two booms.



OR

12. a) Explain structural Idealization of panel in detail. **4**

b) Calculate the shear flow distribution in the channel section shown in fig. 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 direct stresses. **9**



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