INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech IV Semester End Examinations (Regular / Supplementary) - May, 2019

Regulation: IARE – R16

ANALYSIS OF AIRCRAFT STRUCTURES

Time: 3 Hours   **(AE)**   Max Marks: 70

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Explain about monocoque and semi monocoque structures with the help of neat sketches. **[7M]**

   (b) The simply supported beam shown in Figure 1 is subjected to a uniform transverse load. Find the deflection at mid-span using unit load method. **[7M]**
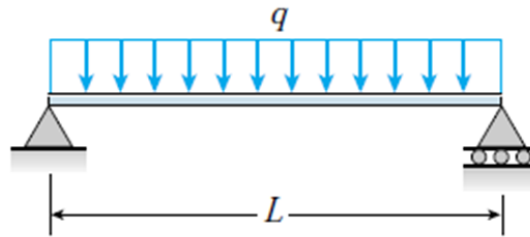

Figure 1

2. (a) Draw a neat sketch of a typical aircraft wing, fuselage and mark all the structural components.
   [7M]

   (b) Find the maximum deflection of a simply supported beam subjected to midpoint load using castigliano's theorem. **[7M]**

UNIT – II

3. (a) Deduce the governing differential equation for a thin plate which supports transverse and in-plane loads **[7M]**

   (b) A rectangular plate a x b, simply supported along each edge, possesses a small initial curvature in its unloaded state given by $w_0 = A_{11} sin\frac{\pi x}{a} sin\frac{\pi y}{b}$. Determine, using the energy method, its final deflected shape when it is subjected to a compressive load N_x per unit length along the edges x = 0, x =a. **[7M]**

4. (a) Explain the concept of complete tension field beam. **[7M]**

(b) A thin square plate of side a and thickness t is simply supported along each edge and has a slightinitial curvature giving an initial deflected shape

$$w_0 = \delta sin\frac{\pi x}{a} sin\frac{\pi y}{b}$$

If the plate is subjected to a uniform compressive stress in the x direction. find an expression for the elastic deflection w normal to the plate. Show also that the deflection at the mid-point of the plate can be presented in the form of a Southwell plot and illustrate your answer with a suitable sketch. **[7M]**

UNIT – III

5. (a) Derive and obtain an expression for the bending stress in an unsymmetrical section subjected to bending. **[7M]**

   (b) Find shear centre for the beam cross section shown in Figure 2 subjected to vertical shear load V through shear centre. **[7M]**
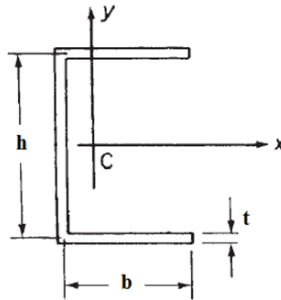

Figure 2

6. (a) Write short notes on the following **[7M]**
   i. Symmetrical bending
   ii. Unsymmetrical bending

   (b) An angle section shown in Figure 3 is subjected to $M_x = 20$kNm and $M_y = 15$kNm. Find the maximum bending stress. **[7M]**
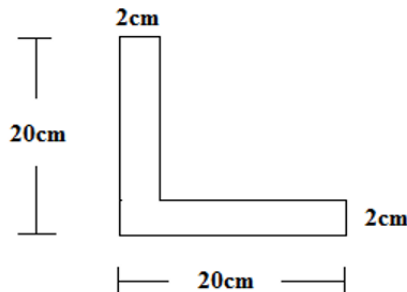

Figure 3

UNIT – IV

7. (a) Draw neat sketches of idealized simple wing section and illustrate the bending stress equation.
[7M]

(b) Calculate the shear flow distribution in the channel section shown in Figure 4. produced by a vertical shear 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 boom area is 300 mm^2, carry all the direct stresses.
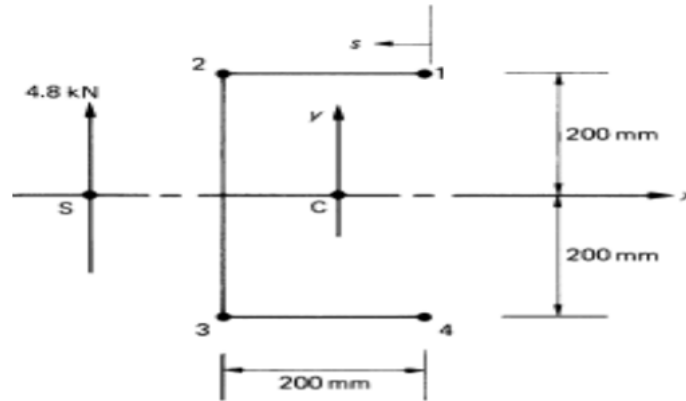[7M]

Figure 4

8. (a) How idealization effects on the analysis of open and closed section beams?
[7M]

(b) Figure 5 shows the cross-section of a single-cell, thin-walled beam with a horizontal axis of symmetry. The direct stresses are carried by the booms B_1 to B_4, while the walls are effective only in carrying shear stresses. Assuming that the basic theory of bending is applicable, calculate the position of the shear center S. The shear modulus G is the same for all walls: Cell area = 135000 mm^2; Boom areas: $B_1 = B_4 = 450$ mm^2; $B_2 = B_3 = 550$ mm^2.
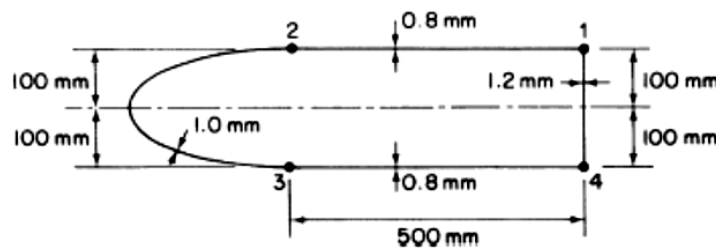[7M]

Figure 5

UNIT – V

9. (a) Explain how the torsion effect will be there on three boom shell with neat sketch.
[7M]

(b) Calculate the shear flows in the web panels and direct load in the flanges and stiffeners of the beam shown in Figure 6 if the web panels resist shear stresses only.
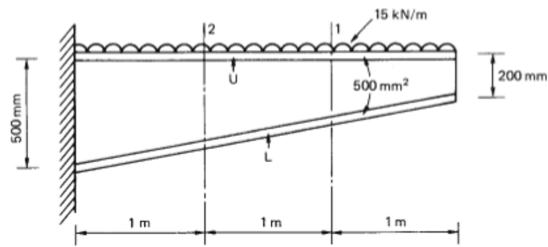[7M]

Figure 6

10. (a) Write a detailed note on the following with neat sketches   **[7M]**
    i) Fuselage frames
    ii) Wing ribs

    (b) The wing section shown in Figure 7 has been idealized such that the booms carry all the direct stresses. If the wing section is subjected to a bending moment of 300kNm applied in a vertical plane, calculate the direct stresses in the booms: Boom areas: $B_1 = B_6 = 2,580\ mm^2$; $B_2 = B_5 = 3,880\ mm^2$; $B_3 = B_4 = 3,230\ mm^2$.   **[7M]**
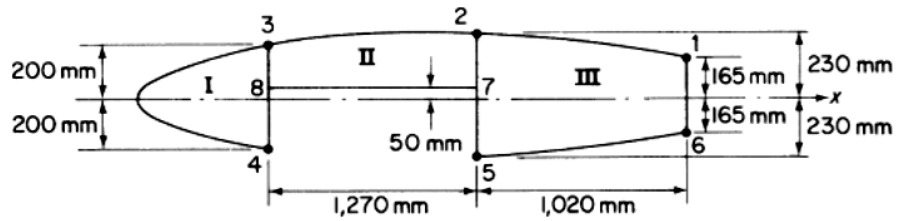

Figure 7

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