Hall Ticket No | | | | | | | | | | Question Paper Code:AAEC06

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR) - JULY 2022

Regulation:UG20

AEROSPACE STRUCTURES

Time: 3 Hours **(AERONAUTICAL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II

Answer ONE out of two questions in Modules III, IV and V

(NOTE: Provision is given to answer TWO questions from among one of the Modules III / IV / V

All Questions Carry Equal Marks

All parts of the question must be answered in one place only

MODULE – I

1. (a) State and explain the principle of the stationary value of the total potential energy.

[BL: Understand| CO: 1|Marks: 7]

(b) Determine the vertical deflection of the free end of the cantilever beam shown in Figure 1 by virtual work method. [BL: Apply| CO: 1|Marks: 7]

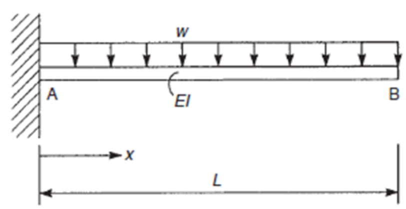

Figure 1

MODULE – II

2. (a) Described diagonal tension field beam and how it can be analysed by semi-empirical theory.

[BL: Understand| CO: 2|Marks: 7]

(b) The beam shown in Figure 2 is assumed to have a complete tension field web. If the cross-sectional areas of the flanges and stiffeners are, respectively, $350mm^2$ and $300mm^2$ and the elastic section modulus of each flange is $750mm^3$, determine the maximum stress in a flange and also whether or not the stiffeners will buckle. The thickness of the web is 2mm and the second moment of area of a stiffener about a axis in the plane of the web is $2000mm^4$; E =70000 N/mm^2.

[BL: Apply| CO: 2|Marks: 7]

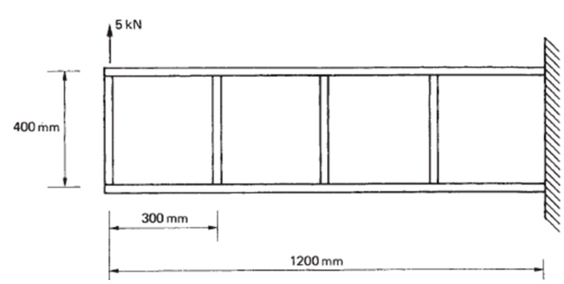

Figure 2

MODULE – III

3. (a) The closed section beam of the arbitrary section supports shear loads Sx and Sy. Derive the shear flow equation for an closed arbitrary section. [BL: Understand| CO: 3|Marks: 7]

   (b) Show that the position of the shear centre S with respect to the intersection of the web and lower flange of the thin-walled section shown in Figure 3, is given by $\xi_S = -45a/97$, $\eta_S = 46a/97$. [BL: Apply| CO: 3|Marks: 7]

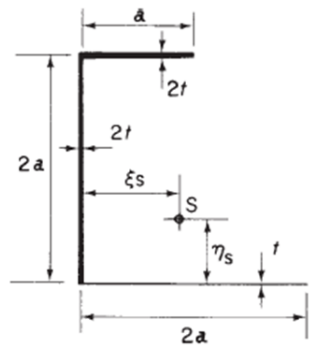

Figure 3

4. (a) Derive the equations to find out the primary and secondary warping of an open cross section subjected to torsion. [BL: Understand| CO: 4|Marks: 7]

   (b) A single cell, thin-walled beam with the double trapezoidal cross-section shown in Figure 4 is subjected to a constant torque T =90 500Nm and is constrained to twist about an axis through the point R. Assuming that the shear stresses are distributed according to the Bredt–Batho theory of torsion, calculate the distribution of warping around the cross-section. Illustrate your answer clearly by means of a sketch and insert the principal values of the warping displacements. The shear modulus G=27 500N/N/mm^2 and is constant throughout. [BL: Apply| CO: 4|Marks: 7]

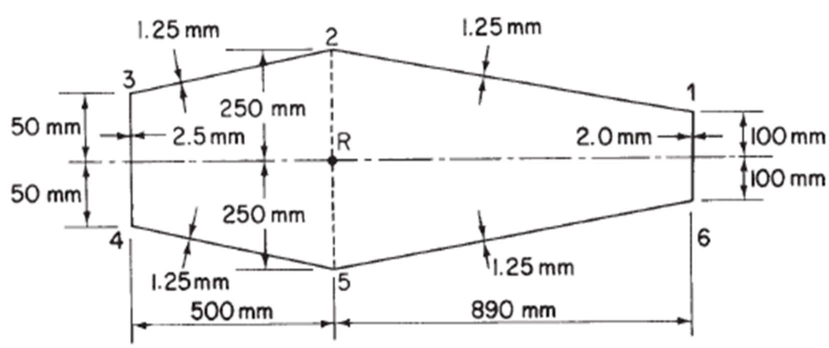

Figure 4

MODULE – IV

5. (a) What do you understand structural idealization? Explain the wing idealization process idealize the panel into a combination of direct stress carrying booms and shear stress only carrying skin. [BL: Understand| CO: 5|Marks: 7]

   (b) The fuselage shown in Figure 5 (a) below 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, in Figure 5 (b). Calculate the distribution of shear flow in the section. [BL: Apply| CO: 6|Marks: 7]

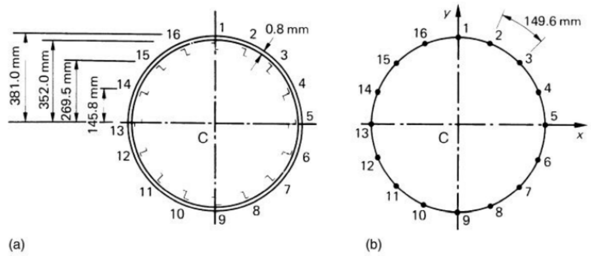

Figure 5

6. (a) Draw the neat sketches of idealized simple fuselage section and derive bending stress and shear flow distribution. [BL: Understand| CO: 5|Marks: 7]

   (b) The wing section shown in Figure 6 has been idealized such that the booms carry all the direct stresses. If the wing section is subjected to a bending moment of 300 kNm applied in a vertical plane, calculate the direct stresses in the booms. Boom areas: $B_1 = B_6 = 2580N/mm^2$ $B_2 = B_5 = 3880N/mm^2$ $B_3 = B_4 = 3230N/mm^2$. [BL: Apply| CO: 5|Marks: 7]

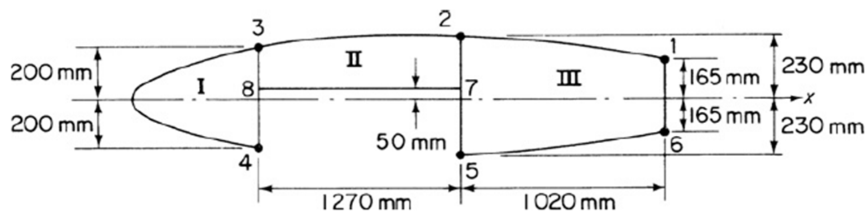

Figure 6

MODULE – V

7. (a) Why wings and fuselages are usually tapered along their lengths for greater? Explain the functions of an aircraft fuselage frames and wing ribs. [BL: Understand| CO: 6|Marks: 7]

   (b) A wing spar has the dimensions shown in the Figure 7 and carries a uniformly distributed load of 15 kN/m along its complete length. Each flange has a cross-sectional area of $500N/mm^2$ with the top flange being horizontal. If the flanges are assumed to resist all direct loads while the spar web is effective only in shear, determine the flange loads and the shear flows in the web at sections 1 and 2m from the free end. [BL: Apply| CO: 6|Marks: 7]

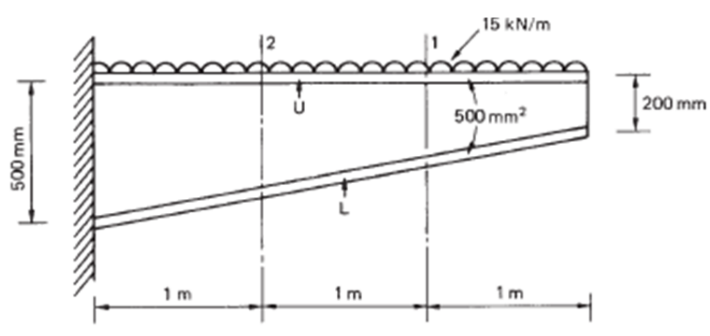

Figure 7

8. (a) State the theory that is used in torsion of closed section beams. Draw the structural elements in fuselage and explain their functions. [BL: Understand| CO: 6|Marks: 7]

(b) Determine the shear flow distribution in the web of the tapered beam shown in Figure 8(a) and (b) 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 bout its horizontal centroidal axis and the cross-sectional area of each flange is $400N/mm^2$. [BL: Apply| CO: 5|Marks: 7]

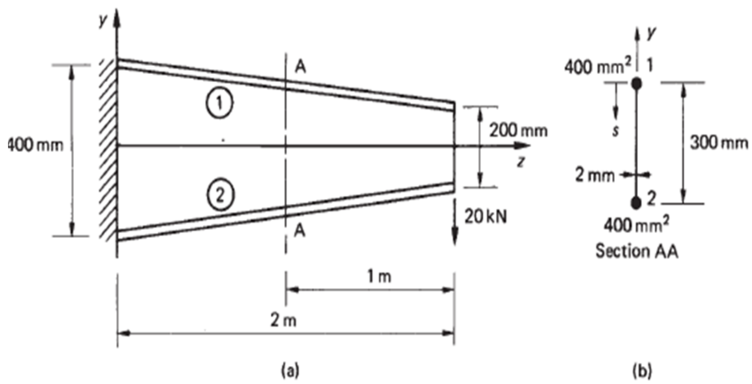

Figure 8

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