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Question Paper Code : 40524

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2018
Fifth Semester
Aeronautical Engineering
AE 6502 – AIRCRAFT STRUCTURES – II
(Regulations 2013)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A (10×2=20 Marks)

1. Name 3 methods of normal stress determination when a beam undergoes unsymmetrical bending.
2. A beam with a rectangular (doubly symmetric) cross-section will always undergo symmetric bending – TRUE/FALSE ? Justify your answer.
3. Shear center depends on –
   i) Cross-section shape and dimensions alone
   ii) Cross-section dimensions and material properties
   iii) Cross-section dimensions and applied load magnitude.
4. Relate shear flow and shear stress and state the S.I. units for shear flow.
5. The shear center position for a thin-walled slit circular tube will :
   i) Coincide with the centroid position
   ii) Lie very close to the centroid of the section
   iii) Be located outside the slit tube.
6. Show that torque due to shear flow in a constant shear flow thin web is given by the expression $T = 2 A q$.
7. A multi-cell thin-walled closed tube is said to be statically indeterminate – explain why ?
8. Buckling refers to the phenomenon of _____

9. Write typical value ranges of the maximum positive and maximum negative load factors for the following aircraft :
   i) transport aircraft, and
   ii) highly maneuverable aircraft.

10. Flight envelopes are drawn for a range of _____ from sea level till the _____ of that aircraft.

PART – B (5×13=65 Marks)

11. a) i) Determine section properties of the angle-section given in Fig. 1. (6)

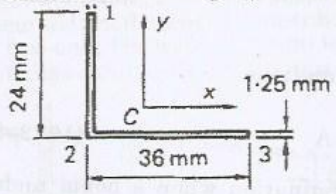

Figure 1

ii) Explain the method of determining the free-end deflection of a cantilever beam subject to a tip concentrated moment M_0 in a plane inclined at ϕ to the vertical plane. The beam is uniform with an unsymmetrical cross-section. (7)

(OR)

b) The cross-section of a 2 m long cantilever beam is indicated in Fig. 2. The given beam is subject to its own self-weight of 27.5 kg/m where 1 kg = 9.81 N.
   i) Determine the bending moment M_χ at the beam section adjacent to the fixed end and obtain an expression for the bending stress in the form $\sigma = Ay - Bx$. (4)
   ii) Evaluate the bending stress at point B using the expression $\sigma = Ay - Bx$, and (4)
   iii) Sketch the neutral axis on the cross-section and indicate its angle with the x-axis. The centroid of the section is the intersection point of the indicated horizontal and vertical axes. $I_{XY} = 1.186 \times 10^{-6}\ m^4$. (5)

$I_{xx} = 4 \times 10^{-6}\ m^4$, $I_{yy} = 1.08 \times 10^{-6}\ m^4$

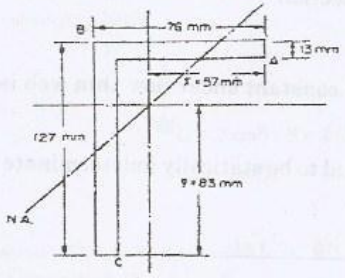

Figure 2

12. a) Obtain the shear flow in the thin-walled section shown in Fig. 3 where the radius of the semi-circular part is 5 cm while length of the horizontal part is 15 cm. Wall thickness = 2 mm throughout. The section is subject to a downward shear force of 18 kN passing through the shear center.

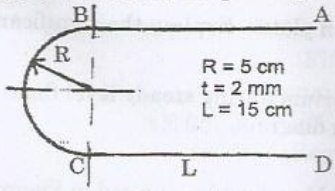

Figure 3

(OR)

b) Obtain the shear flow distribution in a thin-walled symmetric channel section of web height 8 cm, flange width 4 cm and wall thickness = 2 mm. The section is subject to a downward shearing force of 18 kN passing through the shear center. Find the shear center location.

13. a) Find the shear flow distribution when the cross-section given in Fig. 4 is subject to a vertical shear load of 30 kN applied through the shear center. A, B, C and D = 2 cm^2. Determine the shear center position of the given section. The webs are assumed to be ineffective in bending. Locate the shear center.

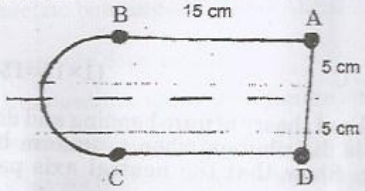

Figure 4

(OR)

b) Determine the shear flow distribution in the cross-section shown in Fig. 5 where the radius of the semi-circular part is 15 cm while wall thickness = 1.5 mm. The section is subject to a downward shearing force of 160 kN passing through the shear center. Make the initial cut exactly at the mid-point of the vertical wall AC and sketch the initial shear flow distribution first. Then determine q_0 and plot the final shear flow on a separate diagram.

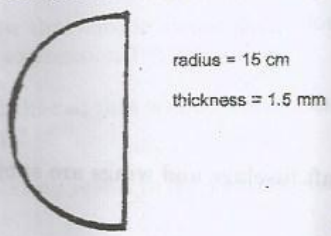

Figure 5

14. a) Write notes on the following topics :
    i) Effective width of a thin stiffened sheet subject to compression (7)
    ii) Strength of a thin-walled open section column. (6)

(OR)

b) Describe the phenomenon of buckling of thin plates. Explain the significance of the plate buckling coefficient 'k'.

15. a) i) How is an aircraft maintained in equilibrium during steady level flight ? (6)
    ii) Sketch and explain the features of a V-n diagram. (7)

(OR)

b) A thin-webbed tapered beam subject to a 20 kN tip load is indicated in Figure 6. Obtain and plot the shear flow distribution in the web at a section located at 1 m from the free-end. The web (t = 2 mm) is *fully effective* in resisting bending. Obtain the flange axial loads for the upper and lower flanges.

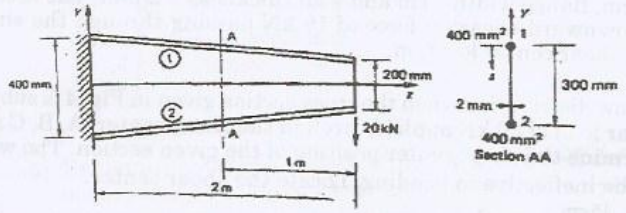

Figure 6

PART – C (1×15=15 Marks)

16. a) i) State the assumptions of the generalized theory of pure bending and derive an expression for the bending stress distribution when a uniform beam undergoes unsymmetrical bending. Show that the neutral axis passes through the centroid. (9)

    ii) The connecting web in cross-section of Figure 7 is ineffective in bending. Find the bending stresses in the stringers if the given section is subject to a bending moment of 3500 Nm in the vertical plane. (6)

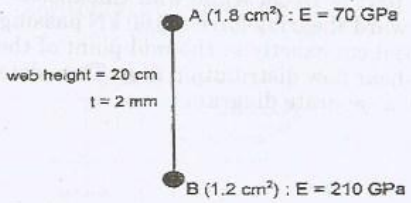

Figure 7

(OR)

b) What are the various loads that an aircraft fuselage and wings are subjected to ? Discuss them in brief.

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