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Question Paper Code : 50082

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Fifth Semester

Aeronautical Engineering

AE 8502 — AIRCRAFT STRUCTURES – II

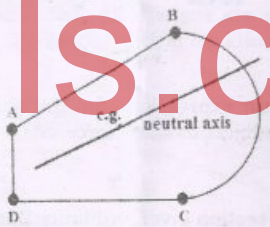
(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. When does unsymmetrical bending of a uniform beam occur?
2. In the cross-section given below, how can the point of maximum bending stress be identified without performing any calculations?



3. Write a short note on the significance of the shear centre position.
4. For a thin-walled beam, is there any type of loading which does not result in shear flow — explain your answer.
5. In the structural idealization of a typical wing section, how do we account for the direct stress carrying capacity of the wing skin?
6. Write a short note on inter-rivet buckling.
7. State the role of plate flexural rigidity in the buckling of thin plates subject to compression.
8. How does the plate buckling coefficient 'k' vary with plate aspect ratio for simply supported plates?
9. What types of maneuvers would result in torsion of an aircraft fuselage?
10. Explain the calculation of bending moment at a typical cross-section along the span of a cantilever type aircraft wing.

PART B — (5 × 13 = 65 marks)

11. (a) Derive and obtain an expression for the bending stress distribution in a thin-walled angle section subject to bending moments M_x and M_y. State the assumptions involved. How is the neutral axis orientation determined? List the different methods of bending stress distribution in unsymmetrical bending of beams. How is the neutral axis position determined? (13)

Or

(b) The webs of the section given in Figure 1 are ineffective in bending. Boom areas are given as A = 3 cm², B = C = 2.5 cm², and D = 2 cm². The given section is subject to bending moments M_x = 10 kNm and M_y = 4 kNm. Determine the bending stress in booms A, B and C in MPa. (13)

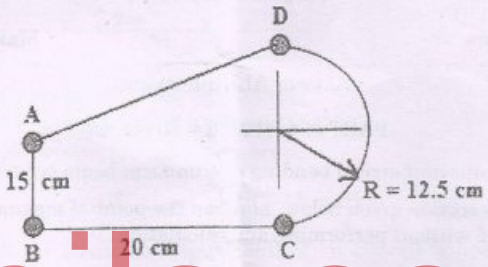


Figure 1

12. (a) Derive and obtain expressions for the shear flow distribution in thin-walled sections subject to shear force. State the assumptions involved. (13)

Or

(b) The thin-walled section given in Figure 2 is subject to a vertical shearing force of 900 N. Obtain the shear flow distribution and plot the same. Which point will experience maximum shear flow? (13)

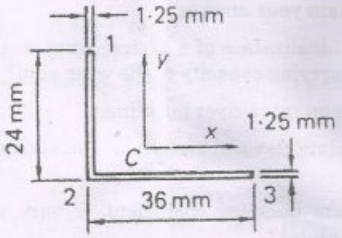


Figure 2

13. (a) The section given in Figure 1 is now subject to 940 N vertical shear. Obtain the shear flow in the webs. Explain how the shear center location of the given section can be determined. (13)

Or

(b) In Figure 3, boom areas 1 and 4 are 1.75 cm² while boom areas 2 and 3 are 1.50 cm². The webs of the section are assumed to be ineffective in bending. Determine all section properties of the given section. Obtain the shear flow pattern when the given section is subject to 900 N vertical shear.

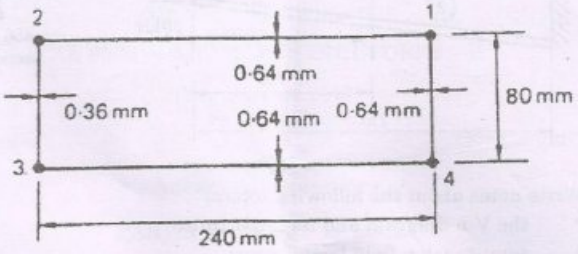


Figure 3

14. (a) An isotropic plate being subject to edge compression is show below in Figure 4. Assuming that all 4 edges are simply-supported, derive and obtain an expression for the critical buckling load. (13)

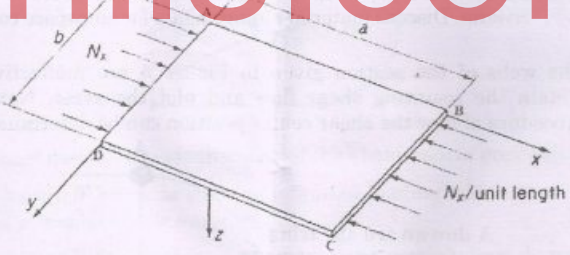


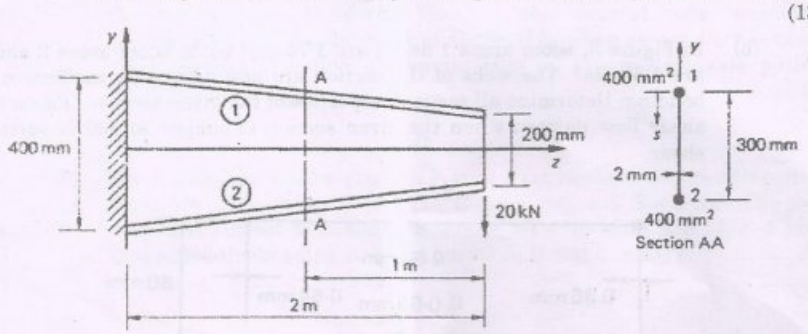
Figure 4

Or

(b) (i) Explain the procedure of determining the ultimate load carrying ability of a stiffened sheet in uni-axial compression. Use the concept of effective sheet width. (7)

(ii) For the thin plate is indicated in Figure 4, edge AB is clamped while edges BC and CD are simply-supported. How would you mathematically express the given boundary conditions? (6)

15. (a) A tapered beam is indicated below. Explain how shear flow distribution can be obtained in section A-A assuming that the web is ineffective in bending. How would shear flow analysis differ if the web is now assumed to be fully effective in resisting bending? How are flange loads obtained? (13)



Or

(b) Write notes about the following topics: (13)

- the V-n diagram and its importance
- semi-tension field beam theory

PART C — (1 × 15 = 15 marks)

16. (a) (i) List the structural components of an aircraft wing. Write about the design considerations and structural analysis of an aircraft wing spar. (9)

(ii) Differentiate between strength based and stiffness based design criteria. Discuss material requirements for aerospace components. (6)

Or

(b) The webs of the section given in Figure 5 are ineffective in bending. Obtain the resulting shear flow and plot the same. Next, explain the procedure of how the shear center position can be determined. (15)

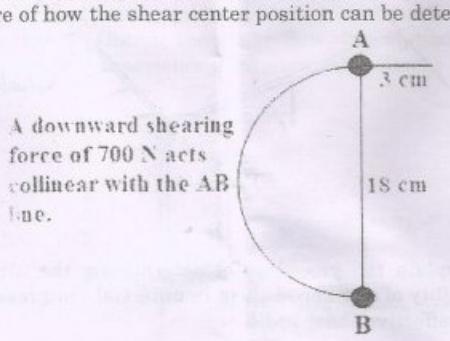


Figure 5