CBCS SCHEME

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15AE54

Fifth Semester B.E. Degree Examination, June/July 2023
Aircraft Structures – I

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. What are codes and standards? Explain. **(04 Marks)**

b. A steel saw blade 1mm thick is bent into an arc of a circle of 500mm radius. Determine the flexural stress induced and the bending moment required to bend the blade which is 15mm wide. Take E = 210GPa. **(12 Marks)**

OR

2 a. What is factor of safety? Write the formulae for tension stress, pure shear stress. **(04 Marks)**

b. A point in a plate is subjected to a horizontal tensile stress of 100N/mm2. And a vertical stress of 60N/mm^2. Find the magnitude of principle stresses. **(12 Marks)**

Module-2

3 a. A mass of 50 kg drops through 25 mm at the centre of a 250 mm long simply supported beam. The beam has a square cross section and yield strength of 400 MN/m^2. Take Young's modulus as 207000 MN/m^2 and factor of safety 2. Determine the dimension of the cross section of beam. **(08 Marks)**

b. Discuss how stress concentration can be reduced in structural components subjected to different loading cases. **(08 Marks)**

OR

4 a. A circular bar of 500 mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having a minimum value of 20 kN and a maximum value of 50 kN. Determine the diameter of bar by taking a factor of safety is 1.5, size effect of 0.85, surface finish factor of 0.9, stress concentration factor of 1. Given ultimate strength = 650 MPa, yield strength = 500 MPa and endurance strength = 350 MPa. **(08 Marks)**

b. Show how the modified Goodman diagram is constructed, for:
(i) Axial and bending stresses (ii) Torsional shear stresses **(08 Marks)**

Module-3

5 a. With a neat sketch, explain velocity diagram. **(08 Marks)**

b. An aircraft having a total weight of 45kN lands on the deck of a aircraft carrier and is brought to rest by means of a cable engaged by an arrester hook as shown in Fig. Q5(b). If the deceleration induced by the cable is 3g. Determine the tension T is the cable, the load on the undercarriage strut. And shear and axial loads in the fuselage at the section A-A. The weight of the aircraft aft of A-A is 4.5 kN. Calculate also the length of deck covered by the aircraft before it is brought to rest if the touchdown speed 25m/s. **(08 Marks)**

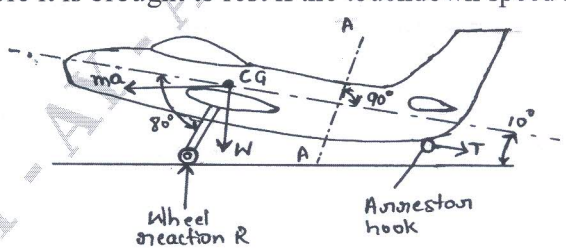

Fig Q5(b)

OR

6 a. Briefly, explain Griffith's theory and derive an expression for stress required for creation of new crack surface. **(08 Marks)**

b. List the desirable properties of materials used in aircraft structures. **(04 Marks)**

c. Write a short note on Titanium Alloys. **(04 Marks)**

Module-4

7 a. Derive the expression for maximum shear stress on a rectangular element acted on by two tensile force perpendicular to each other, of unit depth. **(06 Marks)**

b. A rectangular element in a linearly elastic isotropic material is subjected to tensile stress of 83 and 65 N/mm^2 on mutually perpendicular planes. Determine the strain in the direction of each stress and in the direction perpendicular to both stresses. Find also the principal strains, the maximum shear stress, the maximum shear strain and the directions at that point. Take $E = 2 \times 10^5$ N/mm^2 and $\gamma = 0.3$. **(10 Marks)**

OR

8 a. Derive Claperon's 3 moment equation. **(08 Marks)**

b. In the truss, determine the force in the member AB. (Ref. Fig.Q8(b)]. **(08 Marks)**

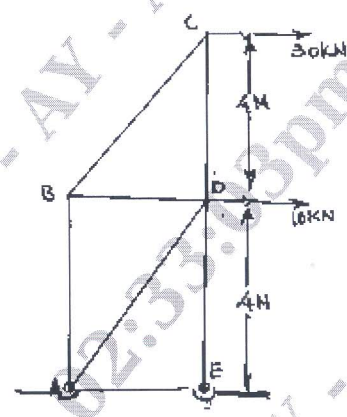

Fig.Q8(b)

Module-5

9 a. What is strain energy? Derive the equation for strain energy due to bending and torsion. **(09 Marks)**

b. State and explain Castiglino's theorem. Using Castiglino's theorem find the deflection of a cantilever subjected to point load P at its free end. **(07 Marks)**

OR

10 a. State the assumptions and explain the limitations of Euler's theory. **(04 Marks)**

b. Formulate Rankine-Gordon Equation. **(04 Marks)**

c. A 2.5m long hollow circular column with inner diameter to outer diameter ratio 0.8 is to carry a load of 136kN. One end of the column is fixed and the other end is hinged. Determine the diameters of the column. Take σ_c = 320MPa, $a = \frac{1}{7500}$ for material of column, FOS = 2.5. **(08Marks)**

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