CBCS SCHEME

USN | | | | | | | | | | |

15AE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 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. Define the following terms : static strength, stress tensor, principal stress and factor of safety. **(08 Marks)**

b. A circular rod of 60 mm diameter is subjected to loads as shown in Fig. Q1 (b). Determine the nature and magnitude of stresses at the critical points A and B. **(08 Marks)**

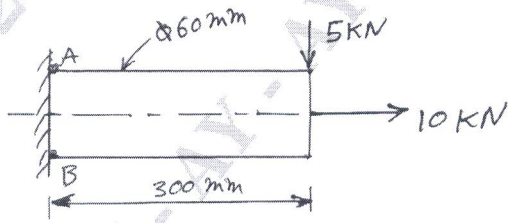

Fig. Q1 (b)

OR

2 a. Explain theories of failure suitable for ductile materials. **(08 Marks)**

b. A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10 kN-m and a torsional moment of 30 kNm. Determine the diameter of the shaft using, (i) Maximum shear stress theory (ii) Maximum strain energy theory. Take E = 210 GPa, $\mu = 0.25$ and n = 2. **(08 Marks)**

Module-2

3 a. Define the following terms : Stress concentration factor, Miners rule, Fluctuating stresses and Repeated stresses. **(08 Marks)**

b. Explain Impact stress and arrive at the equation for maximum stress and Impact factor for a bar subjected to an axial impact load. **(08 Marks)**

OR

4 a. Derive Goodman's criteria for fatigue. **(08 Marks)**

b. A steel rod of 1.5 m long has to resist longitudinally an impact of 2.5 kN falling under gravity at a velocity of 0.99 m/s. Maximum computed stress is limited to 150 MPa. Determine (i) Diameter of rod required (ii) Impact factor. Use $E = 206.8 \times 10^3 \text{ N/mm}^2$. **(08 Marks)**

Module-3

5 a. Draw a neat sketch of V-N diagram and explain the basic flight loading conditions. **(08 Marks)**

b. Derive the equations of motion for an aircraft in level flight and symmetric maneuver considering also the tail load. **(08 Marks)**

OR

6 a. Discuss the aluminium alloys and titanium alloys in aircraft. **(08 Marks)**

b. Discuss the factors to be considered, while selecting a material for an aircraft. **(08 Marks)**

Module-4

7 a. Derive the equations of equilibrium on a three dimensional body. **(08 Marks)**

b. A point in a body is subjected to tensile stresses 100 MPa and 70 MPa along two mutually perpendicular directions. The point is also subjected to shear stress of magnitude 50 MPa. Determine (i) Normal stress and shear stress acting on a plane which is at an angle of 120° with reference to 100 MPa stress plane. (ii) Magnitude of principal stress and max and min shear stresses (iii) Orientations. **(08 Marks)**

OR

8 a. Define plane stress, plane strain, determinate structure and indeterminate structure. **(08 Marks)**

b. Determine the reactions and forces in all the members for truss as shown in Fig. Q8 (b) using method of joints. **(08 Marks)**

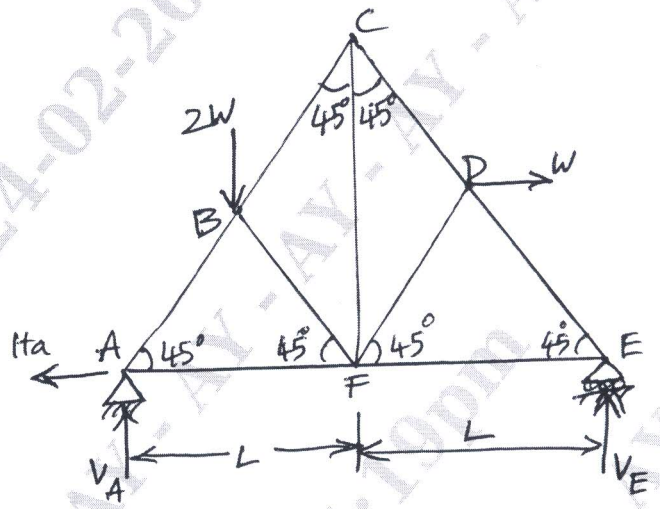

Fig. Q8 (b)

Module-5

9 a. State and prove Castigliano's theorem. **(08 Marks)**

b. State and prove Maxwell's reciprocal theorem. **(08 Marks)**

OR

10 a. Determine the buckling load for a strut of T section the flange width being 100 mm, overall depth 80 mm and uniform thickness of 10 mm throughout the section. The strut is 3 m long and is hinged at both ends. Take E = 200 GN/m^2 **(08 Marks)**

b. Derive the equation for central deflection for a column with initial curvature. **(08 Marks)**

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