CBCS SCHEME

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17AE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Aircraft Structures – I

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Missing data, if any, may be suitably assumed.

Module-1

1 a. Explain codes and standards in design of machine elements. **(06 Marks)**

b. A point in a structural member is subjected to plane stress as shown in Fig.Q1(b). Determine:
i) Normal and tangential stress
ii) Principle stresses and the direction
iii) Maximum shear stress and the directions.

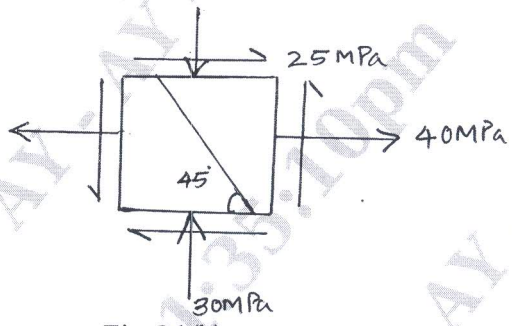

Fig.Q1(b) **(14 Marks)**

OR

2 a. State and explain following theories of failure :
i) Maximum normal stress theory
ii) Distortion energy theory. **(08 Marks)**

b. A mild – steel shaft of 60mm diameter is subjected to bending moment of 25×10^5N-mm and torque. If the yield point of steel in tension is 230MPa. Find the maximum value of torque without causing the yielding of the shaft, according to :
i) Maximum principle stress theory
ii) Distortion energy theory
Take F.O.S = 1.5. **(12 Marks)**

Module-2

3 a. Derive an expression for impact stress induced in a member subjected to axial load. **(10 Marks)**

b. A cantilever beam of span 800mm has a rectangular cross-section of depth 200mm. The free end of the beam is subjected to a transverse load of 1kN that drops on to it form a height of 40mm, selecting C- 40 steel (σ_y = 328.6MPa) and F.O.S = 3. Determine width of rectangular cross-section. **(10 Marks)**

OR

4 a. Derive Soderberg's relation for a member subjected to fatigue loading. **(10 Marks)**

b. A SAE – 1025 water quenched steel rod (σ_u = 620.8MPa, σ_y = 400.8MPa, σ_{en} = 345.2MPa) of circular cross-section shown in Fig.Q4(b) is subjected to load carrying form 'P' to '4P'. Determine the value of 'P' taking notch sensitivity factor, q = 0.4, F.O.S = 3. Assume surface correction factor = 0.8. Consider the section, where there is change of cross-section.

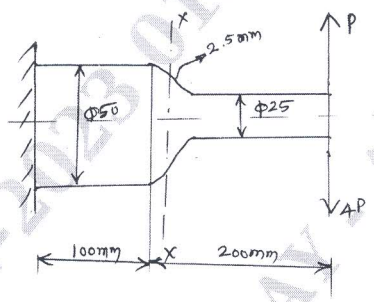

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Explain the types of loads acting on aircraft with neat sketches. **(10 Marks)**

b. Explain V-n diagram and what are the functions of structural components. **(10 Marks)**

OR

6 a. Explain the properties of aircraft materials and write down the classification. **(10 Marks)**

b. What is stress intensity factor and derive an equation for rate of crack growth. **(10 Marks)**

Module-4

7 a. Derive 3 – D equilibrium equation. **(10 Marks)**

b. Displacement field at a point on a body is given as follows :

$u = (x^2yz + z^2)$

$v = (xy^2z + y^2)$

$w = (xyz^2 + x^2)$

Determine strain components at (2, 1, 2) and express in matrix form. **(10 Marks)**

OR

8 a. Explain statically determinate and indeterminate structures. **(10 Marks)**

b. Explain the analysis of plane truss by the method of joints. **(10 Marks)**

Module-5

9 a. Derive the strain energy equation due to axial and bending loads. **(10 Marks)**

b. Explain Castiglino's and Maxwell's reciprocal theorem. **(10 Marks)**

OR

10 a. Define slenderness ratio and derive Euler's expression for buckling load for column with both ends hinged. **(10 Marks)**

b. A Hollow circular section 4m long column is fixed at both ends and carry an axial load of 500kN. The inner diameter of the column is 0.8 times the external diameter. Take $\alpha = \frac{1}{1600}$, σ_C = 550MPa and F.O.S = 2.5. Design the section of the hollow cast iron column. **(10 Marks)**

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