CBCS SCHEME

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18AE53

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

Time: 3 hrs. Max. Marks:100

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

Module-1

1 a. Define static strength, biaxial stress, stress tensor, principal stress and factor of safety. **(10 Marks)**

b. A propeller mounted on a 100mm diameter solid shaft producer a torque of 4500Nm and a thrust of 90kN. Determine the maximum normal stress and maximum shear stress developed in the member. **(10 Marks)**

OR

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

b. A cylindrical boiler of 2m diameter made of sheet metal 20mm thick, is subjected to an internal pressure of 1.5MPa. Find the factor of safety using maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, maximum strain energy theory and maximum shear strain energy theory. Take σ_y = 350 MPa and μ = 0.25. **(12 Marks)**

Module-2

3 a. Define impact stress and derive the equation for the same. Also arrive at the equation for impact factor. **(10 Marks)**

b. Draw a SN diagram and explain endurance strength. Discuss the factors on which endurance strength depends. **(10 Marks)**

OR

4 a. Define stress concentration factor. Discuss how stress concentration effects can be reduced with neat sketches. **(10 Marks)**

b. A cantilever beam made of steel of circular section as shown in Fig.Q4(b). Determine the maximum load it can with stand for an indefinite life based on Goodman and Soderberg criteria. Use a factor of safety as 2. Theoretical stress concentration factor is 1.42 and notch sensitivity is 0.9. Assume the following ultimate stress = 550MPa, yield stress = 470MPa, Endurance limit = 275MPa, size factor = 0.85 and surface finish factor = 0.89.

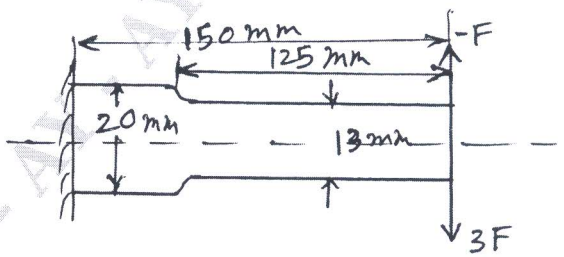

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Define limit load, proof load and load factor. Explain the loads acting on aircraft. **(10 Marks)**

b. Derive the equations for steady pull out and banked turn maneuver. **(10 Marks)**

OR

6 a. A semi aerobatic aircraft has reached its design diving speed of 185m/s in a dive inclined at 45° to the horizontal ground. If the maximum maneuver load factor for the aircraft is 5.5, determine the height at which the pullout from the dive must being for straight and level flight to be achieved at a height of 500m. Also draw the flight path with all the details. **(10 Marks)**

b. Discuss the desirable properties to be considered when selecting material for aircraft structure. **(10 Marks)**

Module-4

7 a. Derive the equations of equilibrium on a three dimensional body. **(10 Marks)**

b. A point in a strained member is subjected to biaxial stresses 85MPa (tensile along x axis) and 60MPa (compressive along y axis). The point is also subjected to a shear stress 45MPa such that shear force on vertical faces give rise to clockwise couple. Determine :

i) Stress acting on a plane whose normal is at an angle of 40° with reference to 85 MPa stress direction

ii) Magnitudes of principal stress and maximum and minimum shear stresses

iii) Orientations of the principal planes and maximum and minimum shear stress planes. **(10 Marks)**

OR

8 a. What are statically determinate and indeterminate structures? Give suitable examples with sketches. **(10 Marks)**

b. Calculate the reactions at the support for the beam shown in Fig.Q8(b) using Clayperon's three moment theorem.

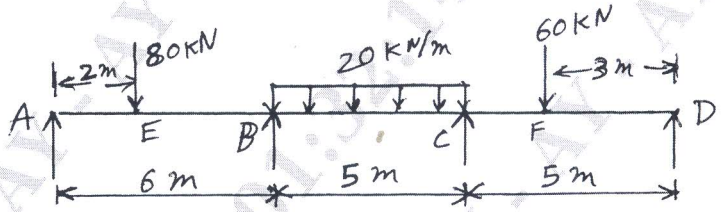

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. State and prove Maxwell's reciprocal theorem. **(10 Marks)**

b. A simply supported beam of span length 'ℓ' has an overhang of length 'a' on the left. The vertical load 'w' is applied at the end of the overhang. Calculate the deflection of the point of application of the load by Castiglione's first theorem. **(10 Marks)**

OR

10 a. What are the assumptions made in the Euler's column theory? Derive Euler's crippling load for the column with both ends hinged. **(10 Marks)**

b. A hollow column whose outside diameter is 200mm and thickness of 20mm is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine formula using a factor of safety of 2.5. Find the ratio of Euler's to Rankine's loads. Take E = $1 \times 10^5 N/mm^2$, Rankine constant = 1/1600 and permissive compressive stress = $550\ N/mm^2$. **(10 Marks)**

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