CBCS SCHEME

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18AE53

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Aircraft Structures – I

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. Assume the suitable missing data.

Module-1

1 a. Define : i) Static strength ii) Biaxial stress iii) Principal stress iv) Stress tensor v) Factor of safety **(10 Marks)**

b. A mild steel bracket shown in Fig Q1(b) is subjected to a pull of 10kN. The bracket has a rectangular cross section. Whose depth is twice the width? If the allowable stress for the material is 80N/mm^2. Determine the cross section of the bracket

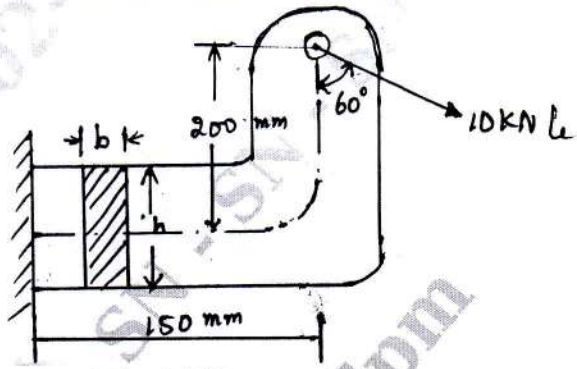

Fig Q1(b) **(10 Marks)**

OR

2 a. Explain maximum strain energy density theory and maximum principal strain theory with suitable equations. **(08 Marks)**

b. A cylinder boiler 2m diameter made of steel 20mm thick, is subjected to an internal pressure of 1.5MPa. find the factor of safety using
i) Maximum principal stress theory ii) Maximum shear stress theory
iii) Maximum principal strain theory iv) Total strain energy theory
v) Distortion energy theory
Take σ_{yield} = 350MPa and γ or 1/m = 0.25 **(12 Marks)**

Module-2

3 a. What is Impact stress? Derive the equation of maximum stress and impact factor for a bar subjected to an axial impact load. **(10 Marks)**

b. A 5Kg block is dropped from height of 200mm on a beam as shown in Fig Q3(b). The material has an allowable stress of 50MPa. Determine the dimensions of the rectangular cross section. Whose depth is 1.5 times the width? Take E = 70GPa.

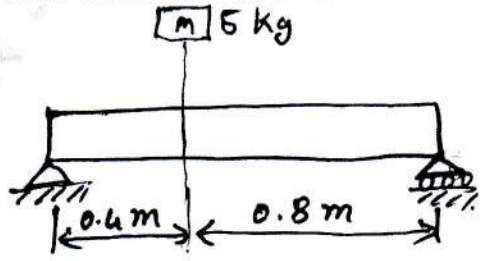

Fig 3(b) **(10 Marks)**

OR

4 a. Derive an equation for Soderberg criterion and Goodman criterion with its modifying factors. **(12 Marks)**

b. A cantilever beam of circular cross section is subjected to an alternating bending stress at a point on the outer fiber in the plane of the support that varies from 21MPa (compression) to 28MPa (Tension). At the same time there is an alternating stress due to axial loading that varies from 14MPa (compression) to 28MPa (Tension). Take ultimate strength = 412MPa yield strength = 309 MPa, actual stress concentration, factor as 1, size correction factor = 0.85 and surface correction factor = 0.9. determine,

i) Equivalent normal stress due to axial loading

ii) Equivalent normal stress due to bending

Assume load correction factor as 0.7 and endurance limit is 50% of ultimate strength. **(08 Marks)**

Module-3

5 a. Draw a neat sketch of V-n diagram and explain the basic flight loading condition. **(10 Marks)**

b. An aircraft having a weight of 250kN and a tricyle under carriage lands at a vertical velocity of 3.7m/s the various loads and reactions acting is shown in Fig Q5(b). If moment of inertia of the aircraft about its CG is $5.65 \times 10^8 Ns^2mm$. Determine the inertia forces on the aircraft the time taken for its vertical velocity to become zero and its angular velocity at this instant.

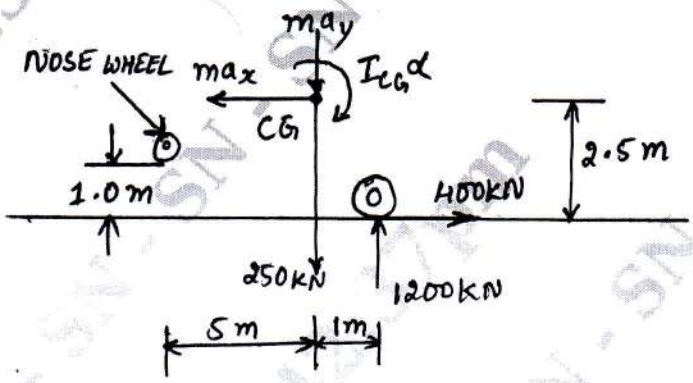

Fig Q5(b) **(10 Marks)**

OR

6 a. Explain the desirable properties of Aircraft materials. **(10 Marks)**

b. Discuss briefly the usage of Aluminium alloys and Titanium alloys in aircraft construction. **(10 Marks)**

Module-4

7 a. Derive equilibrium equation for a 3 dimensional system. **(07 Marks)**

b. The state of stress in a 2-diemnsionally stressed body is as shown in Fig Q7(b). Determine :

i) Normal and tangential stress on plane AC ii) Principal stress and principal plane

iii) Maximum shear stress and its location iv) Normal stress on Maximum shear plane.

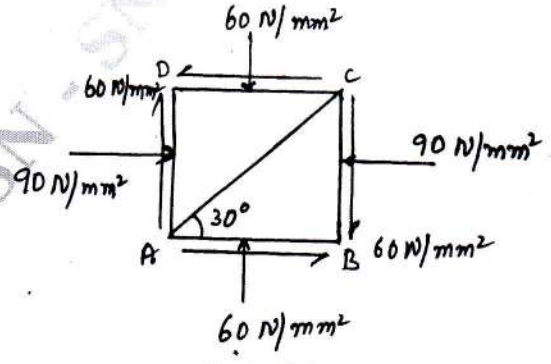

Fig Q7(b) **(13 Marks)**

OR

8 a. What are statically determinate and indeterminate structures? Explain with example. **(08 Marks)**

b. A truss is loaded as shown in Fig Q8(b). Determine the forces in all the members of the truss.

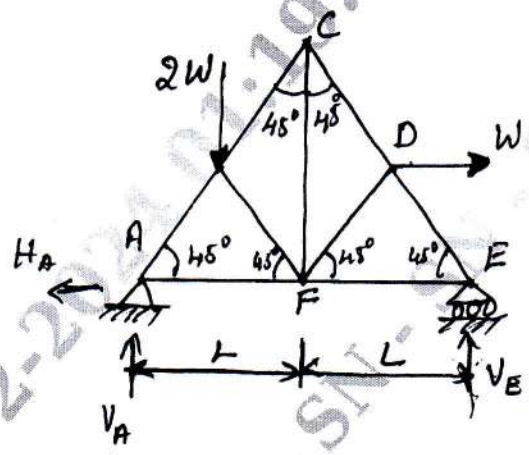

Fig Q8(b) **(12 Marks)**

Module-5

9 a. Determine the internal strain energy stored for the following conditions.

i) Cantilever beam caring udl of w/unit length through its entire length 'L'

ii) An elastic bar subjected to a torque 'T' **(10 Marks)**

b. Fig Q9(b) shows two bars AB and CB are pinned at AB and C, and subjected to horizontal applied force F at B. Using Castiglione's theorem, determine the horizontal and vertical displacement of pin B.

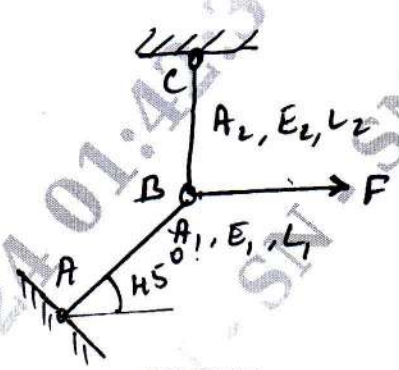

Fig Q9(b) **(10 Marks)**

OR

10 a. A hollow circular section 2.8m long column is fixed at one end and hinged at the another end. External diameter is 150mm and thickness of wall is 15mm Rankine constant = 1/1600 and σ_c = 550MPa. Compare the buckling loads obtained by using Euler's formula and Rankine formula. Also find the length of column for which both formula gives the same load. Take = E = 80GPa. **(12 Marks)**

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

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