CBCS SCHEME

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17AE54

Fifth Semester B.E. Degree Examination, July/August 2021
Aircraft Structures – I

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions.***

1 a. Define: i) Stress ii) Shear stress iii) Tri-axial stress iv) Stress tensor v) Principal stress. **(10 Marks)**

b. Define stress concentration. Explain the steps to determine the stress concentration factor. **(10 Marks)**

2 a. Why failure theory is important? Explain.
i) Maximum normal stress theory.
ii) Strain Energy Theory. **(10 Marks)**

b. The load on a bolt consists of an axial pull of 10kN together with a transverse shear force of 5kN. Find the diameter of bolt required according to
i) Maximum principal stress theory
ii) Maximum shear stress theory
iii) Maximum strain energy theory. **(10 Marks)**

3 a. What is safe-life? Draw the S-N diagram and explain in detail. **(10 Marks)**

b. Define fatigue and endurance limit. Explain the modifying factors of endurance limit in detail. **(10 Marks)**

4 a. Explain the Goodman and Soderberg relationship with neat graphs and write the equation for combined loading. **(10 Marks)**

b. Define Impact stress. Derive the equations for Impact stress due to axial, bending and torsion loads. **(10 Marks)**

5 a. What are the different types of loads act in an aircraft? Explain the flight envelope in detail. **(10 Marks)**

b. A aircraft having a weight of 250kN and a tricycle under carriage lands at a vertical velocity of 3.7m/s such that the vertical and horizontal reactions on the main wheels are 1200kN and 400kN, respectively; at this instant, the nose wheel is 1.0m from the ground, as shown in Fig.Q.5(b) below. If the moment of inertia of the aircraft about its CG is $5.65 \times 10^8 NS^2mm$, determine the inertia force on the aircraft, the time taken for its velocity to become zero and its angular velocity at this instant. **(10 Marks)**

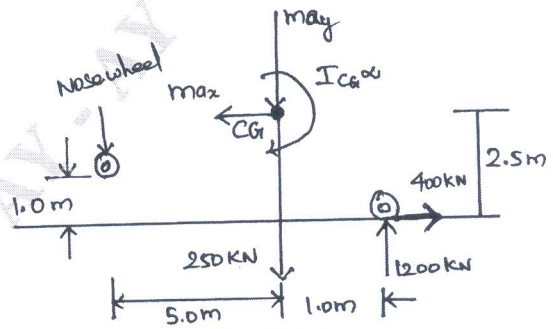

Fig.Q.5(b)

6 a. What list out the desirable properties of materials for aircraft application? **(10 Marks)**

b. Define stress intensity factor. Derive the crack growth rate and draw the graph. **(10 Marks)**

7 a. Derive the equilibrium equation in 3-dimensions. **(08 Marks)**

b. Define principle plane and principle stress. **(04 Marks)**

c. A plane element in a boiler is subjected to tensile stresses of 400MPa on one plane and 150MPa on the other at right angles to the former. Each of the above stresses is accompanied by a shear stress of 100MPa such that when associated with the minor tensile stress tends to rotate the element in anticlockwise direction, find:

i) Principal stresses and their directions

ii) Maximum shearing stresses and the directions of the plane on which they act. **(08 Marks)**

8 a. Derive Clapeyron's three moment equation. **(10 Marks)**

b. Fig.Q.8(b) shows a cantilever truss having a span of 4.5 meters. It is hinged at two joints to a wall and is loaded as shown. Find the forces in all the members of the stress truss. **(10 Marks)**

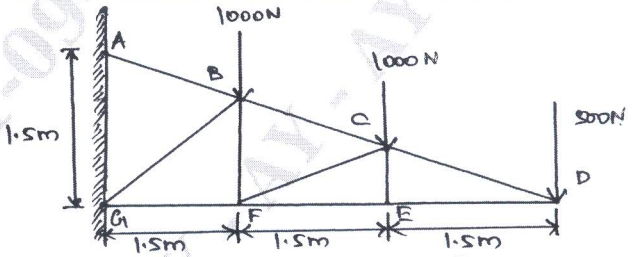

Fig.Q.8(b)

9 a. State and derive Maxwell's Reciprocal theorem. **(10 Marks)**

b. State and derive Castigliano's theorem. **(10 Marks)**

10 a. What are the assumptions made in Euler's column theory and derive the equation for crippling load for one end fixed and the other end free condition. **(12 Marks)**

b. Find the Euler's crippling load for a hollow cylindrical steel column of 38mm external diameter and 2.5mm thick. Take length of the column as 2.3m and hinged at its both ends. Take E = 205GPa. Also determine crippling load by Rankine's formula using constants as 335MPa and $\frac{1}{7500}$. **(08 Marks)**

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