CBCS SCHEME

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21AE53

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Aero Structures

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Explain the following :
i) Stress ii) Factor of safety iii) Stress Tensor **(08 Marks)**

b. Explain atleast three different types of failure. **(12 Marks)**

OR

2 a. A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting if bending moment 10 KN-m and a torsional moment of 30 KN-m. Determine the diameter of the shaft using different theories of failure, assuming a factor of safety of 2. Take E = 210 GPa and Poisson's ratio = 0.25. **(14 Marks)**

b. Define stress concentration factor and explain how to determine the same. **(06 Marks)**

Module-2

3 a. Explain stress life (SN) curve for ferrous material. **(10 Marks)**

b. Determine the maximum load for the simply supported beam cyclically loaded as shown below Fig.Q3(b). The ultimate strength is 700 MPa the yield point in tension is 520 MPa and the endurance limit in reversed bending is 320 MPa. Use a factor of safety of 1.25. The load, size and surface correction factor are 1, 0.75 and 0.9 respectively.

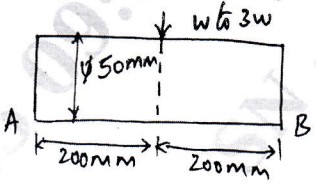

Fig.Q3(b) **(10 Marks)**

OR

4 a. Formulate Miner's rule of cumulative fatigue damage. **(06 Marks)**

b. A steel cantilever member as shown below Fig.Q4(b) is subjected to a transverse load at its end varies from 45 N top of 135 N down. An axial load varies from 110 N compression to 450 N tension. Determine the required diameter at the change of section of infinite life using a factor of safety of 2. The strength properties of material are σ_u = 550 MPa, σ_r = 470 MPa endurance limit from reversed bending test σ_c = 275 MPa. Notch sensitivity index q = 1. Assume K = 1.635, e_{Sz} = 0.85 , e_l = 0.7 , e_{Sr} = 0.83 for axial and for bending K = 1.44 and e_{Sr} = 0.83 .

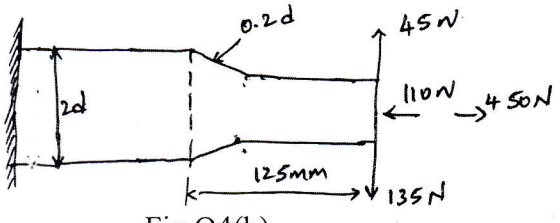

Fig.Q4(b) **(14 Marks)**

Module-3

5 a. Explain load factor and different types of loads that acts on the aircraft. **(04 Marks)**

b. Explain V-n diagram. **(06 Marks)**

c. An aircraft having a weight of 250 KN and a tricycle under carriage lands at a vertical velocity of 3.7 m/s, such that the vertical and horizontal reactions on the main wheels are 1200 KN and 400 KN respectively at this instant the nose wheel is 1.0m from the ground as shown the Fig.Q5(c). If the moment of inertia of the aircraft about its CG is 5.65×10^8 Ns^2-mm , determine the inertia forces on the aircraft, the time taken for its vertical velocity to become zero and its angular velocity at this instant.

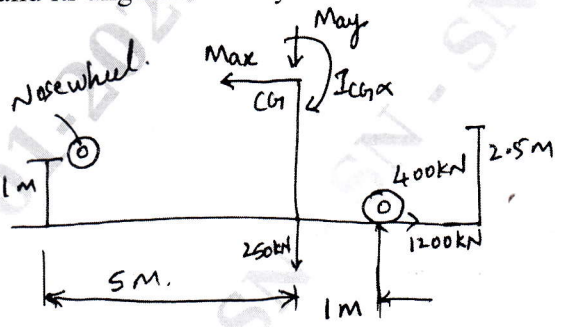

Fig.Q5(c) **(10 Marks)**

OR

6 a. What are the desirable properties of materials for aircraft application? **(08 Marks)**

b. Describe the uses of aluminium alloy, Titanium alloy stainless steel and composite materials with merits and demerits. **(12 Marks)**

Module-4

7 a. Derive the equilibrium equation for the state of stress in three dimensions. **(10 Marks)**

b. Define Principal plane and Principal stresses. **(04 Marks)**

c. For the state of stress shown in Fig.Q7(c), find the principal plane and principal stresses.

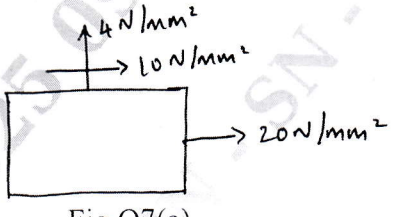

Fig.Q7(c) **(06 Marks)**

OR

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

b. A truss of span 10 m is loaded as shown in the Fig.Q8(b). Find the forces in all the members.

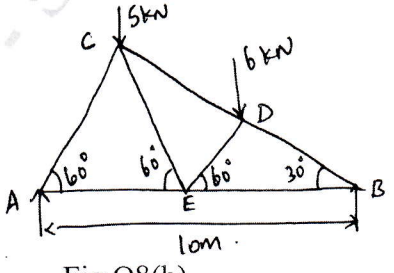

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. State and explain the method of least work. **(08 Marks)**

b. State and explain the Maxwell's Reciprocal theorem. **(08 Marks)**

c. Define strain energy and write the equation for axial load and bending loads. **(04 Marks)**

OR

10 a. What are the assumptions made in Euler's column theory? Derive the Euler's crippling load for the column with one end fixed and one end free condition. **(10 Marks)**

b. A T-section 150 mm × 120 mm × 20 mm is used as a strut of 4 m long hinged at both the ends. Calculate the crippling load, if Young's modulus for the material of the section is 200 KN/mm^2. **(06 Marks)**

c. Define Slenderness ratio and give the limitations of Euler's formula. **(04 Marks)**

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