CBCS SCHEME

USN | | | | | | | | | | 18AE53

Fifth Semester B.E. Degree Examination, June/July 2024
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 the following :
i) Hooke's law ii) Stress Tensor iii) Factor of safety
iv) Normal stress v) Principal plane and principal stress. **(10 Marks)**

b. A cylindrical shaft made of steel of yield strength 700MPa is subjected to static loads consisting of bending moment 10kN-m and a torsional moment 30kNm. Determine the diameter of the shaft using :
i) Maximum strain energy theory ii) Maximum shear stress theory.
Assume : FOS = 2, E = 210GPa and Poisson's Ratio = 0.25. **(10 Marks)**

OR

2 a. Draw the stress-strain curve for i) Ductile materials ii) Brittle material, and explain in detail. **(10 Marks)**

b. Explain the Theories of failures and its types in detail. **(10 Marks)**

Module-2

3 a. Define the following :
i) Impact Stress ii) Endurance Limit iii) Fatigue Strength
iv) Effect of Inertia v) Stress Concentration. **(10 Marks)**

b. Draw S-N diagram and explain its features. **(10 Marks)**

OR

4 a. Derive the Goodman and Soderberg Relationship for combination of stresses. **(10 Marks)**

b. Explain stresses due to combined loading. **(10 Marks)**

Module-3

5 a. Define load factor. Draw V-n diagram and explain in detail. **(10 Marks)**

b. An 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 reaction 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 Q5(b). If the moment of inertia of the aircraft about its CG is 5.65×10^8 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.

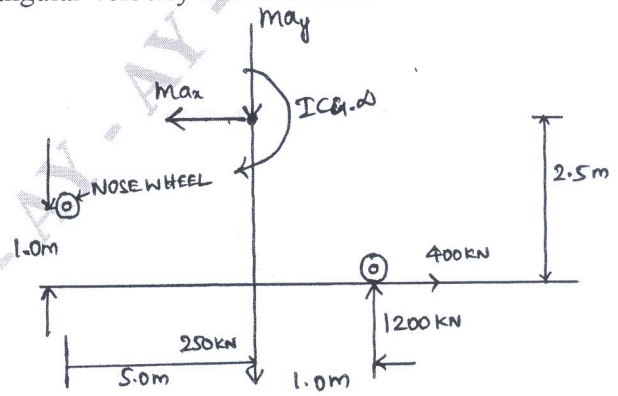

Fig Q5(b) **(10 Marks)**

OR

6 a. What are the desirable properties of a material to be considered for aircraft applications? **(10 Marks)**

b. List out the uses of i) Aluminium alloy ii) Titanium and its alloy iii) Composite materials. **(10 Marks)**

Module-4

7 a. Derive the equilibrium equations is 3-D for the state of stress system. **(10 Marks)**

b. A hollow shaft of 40mm outer diameter and 25mm inner diameter is subjected to a twisting moment of 120N-m, simultaneously, it is subjected to an axial thrust of 10kN and a bending moment of 80N-m. Calculate the maximum compressive and shear stresses. **(10 Marks)**

OR

8 a. Differentiate between Statistically Determinate and Indeterminate Structure. **(06 Marks)**

b. A truss of 8m span is loaded as shown in Fig Q8(b). Find the forces in each members of the truss and tabulate the results.

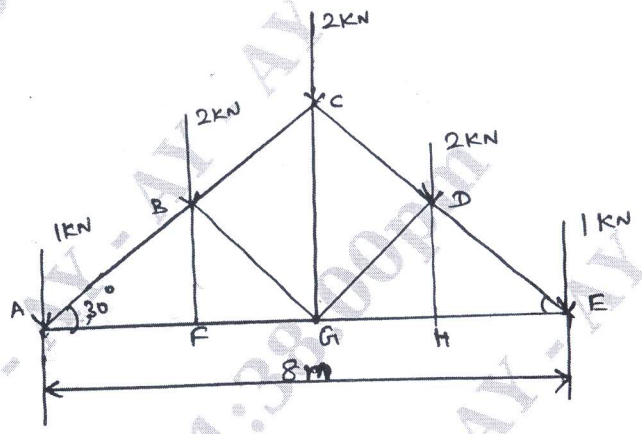

Fig Q8(b) **(14 Marks)**

Module-5

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

b. Explain Castigliono's Theorem in detail. **(10 Marks)**

OR

10 a. Derive Rankine's Formula from Euler's crippling load. **(06 Marks)**

b. What are the assumptions made in Euler's Column Theory? **(04 Marks)**

c. Compare the ratio of the strength of a solid steel column to that of a hollow of the same cross sectional area. The internal diameter if the hollow column is ¾ of the external diameter. Both the columns have the same length and are pinned at both ends. **(10 Marks)**

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