CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **18AE53**

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
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. Explain the following : i) Factor of safety   ii) Uniaxial stress   iii) True stress
iv) Stress tensor   v) Principal stress. **(10 Marks)**

b. A mild steel shaft of 50mm diameter is subjected to a bending moment of 2000N-m and a Torque 'T'. If the yield point of the steel in tension is 200MPa. Find the maximum value of this torque without causing yielding of the shaft according to,
i) Maximum principal stress theory
ii) Maximum shear stress theory
iii) Maximum distortion strain energy theory. **(10 Marks)**

OR

2 a. Why failure theory is important is aircraft structures? Explain the failure of brittle and ductile materials. **(10 Marks)**

b. Explain atleast four different theories of failure in detail. **(10 Marks)**

Module-2

3 a. Define fatigue. With neat sketch explain S-N diagram. **(10 Marks)**

b. What is endurance limit? Explain the important modifying factors effects the endurance limit. **(10 Marks)**

OR

4 a. Define fluctuating stress. Explain the Goodman and Soderberg relationship with relevant sketches and equations. **(10 Marks)**

b. A copper bar of 12mm diameter gets stretched by 1mm under a steady load of 4kN. What stress would be produced in the bar by a weight 500N, the weight falls through 80mm before striking the collar rigid fixed to the lower end of the bar? Take Young's modulus for the bar material as 100GPa. **(06 Marks)**

c. Define stress concentration and explain the same. **(04 Marks)**

Module-3

5 a. Draw the V-n diagram and explain in detail. **(08 Marks)**

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

c. An aircraft having a weight of 250kN and a triangle 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.Q5(c). If the moment of inertia of the aircraft about its CG is $5.65 \times 10^8 NS^2 mm$. Determine the inertia forces on the aircraft, the time taken for its vertical velocity to become zero and its angular velocity at this instant.
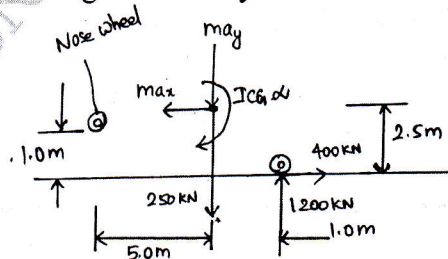

Fig.Q5(c) **(08 Marks)**

OR

6 a. What are the desirable properties of materials for aircraft applications? **(08 Marks)**
   b. Describe merits, demerits and applications of,
      i) Aluminium alloy
      ii) Stainless steel alloy
      iii) Titanium alloy
      iv) Composite material. **(12 Marks)**

Module-4

7 a. Derive the equilibrium equations for a 3 – D stress system. **(10 Marks)**
   b. Evaluate the principal stresses and principal planes for the state of stress shown in Fig.Q7(b) below.
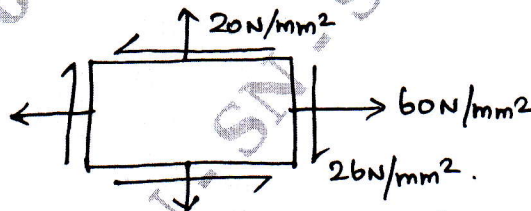

Fig.Q7(b) **(06 Marks)**

   c. Explain the strain – displacement relation. **(04 Marks)**

OR

8 a. Derive Clapeyron's three moment equation. **(10 Marks)**
   b. A king post truss of 8m span is loaded as shown in Fig.Q8(b). Find the forces in each member of the truss and tabulate the results.
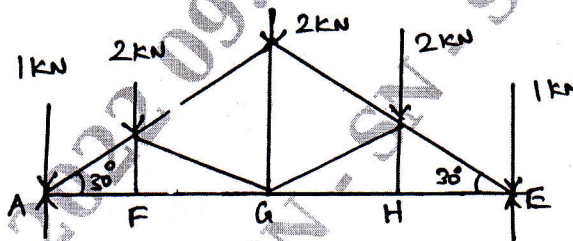

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. State and derive Maxwell's reciprocal theorem. **(10 Marks)**
   b. State and derive Castigliano's I and II theorem. **(10 Marks)**

OR

10 a. Write a short note on South-Well plot. **(06 Marks)**
   b. Derive Rankine's formula for columns. **(06 Marks)**
   c. A T-Section 150mm × 120mm × 20mm is used as a strut of 4m long with hinged at its both ends. Calculate the crippling load, if Young's modulus for the material be 200GPa.**(08 Marks)**

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