CBCS SCHEME

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15AE54

Fifth Semester B.E. Degree Examination, July/August 2022
Aircraft Structures – I

Time: 3 hrs.

Max. Marks: 80

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

Module-1

1 a. Define the following : i) Normal stress ii) True stress iii) Stress tensor
      iv) Factor of safety v) Principal stress **(08 Marks)**
   b. Explain atleast four different theories of failures in detail. **(08 Marks)**

OR

2 a. A mild steel shaft of 50mm diameter in subjected to bending moment of 2000N-m and a torque 'T'. If the yield point of the steel in tension is 200MPa. Find he 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. **(08 Marks)**
   b. With the help of stress–strain curve explain the failure of ductile materials and brittle materials. **(08 Marks)**

Module-2

3 a. Define Fatigue. With neat sketch, explain S-N diagram. **(08 Marks)**
   b. What is Endurance limit? Explain the modifying factors which effects the endurance limit. **(08 Marks)**

OR

4 a. A copper bar of 12 mm diameter gets stretched by 1mm under a steady load of 4 kN. What stress would be produced n the bar by a weight 500N, the weight falls through 80mm before striking the collar rigid fixed to the lower and of the bar. Take Young's modulus for the bar material as 100 GPa. **(06 Marks)**
   b. Define fluctuating stress and stress concentration factor. **(04 Marks)**
   c. Explain the Goodman and Soderberg relationship with relevant equation and sketches. **(06 Marks)**

Module-3

5 a. Define load factor. With neat sketch, discuss V-n diagram in detail. **(06 Marks)**
   b. The aircraft shown in Fig.Q5(b) weights 135kN and has landed such that at the instant of impact, the ground reaction on each main undercarriage wheel is 200kN and its vertical velocity is 3.5m/s. If each undercarriage wheel weights 2.25kN and is attached to oleo strut, as shown in Fig.Q5(b), calculate the axial load and bending moment in the strut; the strut may be assumed to be vertical. Determine also the shortening of the strut when the vertical velocity of the aircraft is zero.
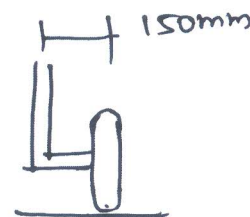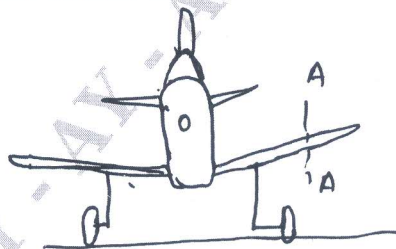

Fig.Q5(b) **(10 Marks)**

OR

6 a. What are the desirable properties of materials required for aircraft applications? **(08 Marks)**
   b. List merits, demerits and applications of
      i)   Aluminum alloy
      ii) Stainless steel
      iii) Titanium and its alloys
      iv) Composite materials. **(08 Marks)**

Module-4

7 a. Derive the equilibrium equations for a 3 – D stress system. **(08 Marks)**
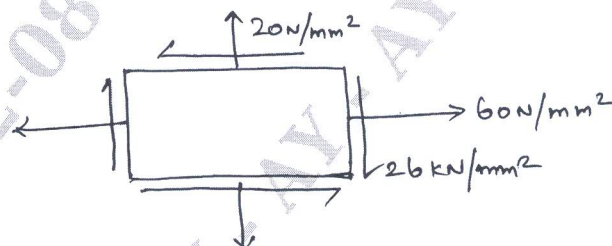   b. Evaluate the principal stresses and principal planes for the state of stress shown in Fig.Q7(b).

Fig.Q7(b) **(04 Marks)**
   c. Describe the strain–displacement relation. **(04 Marks)**

OR

8 a. Derive Clapeyron's three moment equation. **(08 Marks)**
   b. Fig.Q8(b) shows a cantilever truss having a span of 4.5 meters. It is hinged at two joints a wall and is loaded as shown in Fig.Q8(b). Find the forces in all the members.
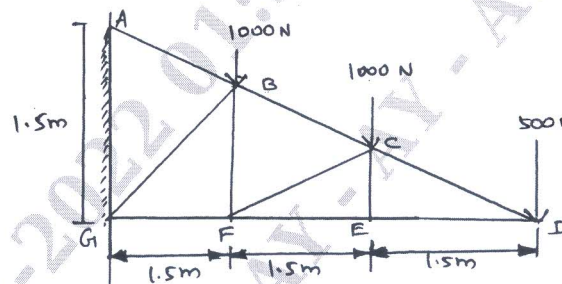

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Sate and derive Castiglino's I and II theorem. **(08 Marks)**
   b. State and prove Maxwell's reciprocal theorem. **(08 Marks)**

OR

10 a. What are the assumptions made in Euler's column theory? **(04 Marks)**
   b. Write a short note on south well plot. **(04 Marks)**
   c. A T – section 150mm × 120mm × 20 mm 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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