CBCS SCHEME

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15AE54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Aircraft Structure – I

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Sketch the stress-strain diagram for the following materials.
i) Mild steel
ii) Aluminum
iii) Cast iron
iv) Soft rubber. **(04 Marks)**

b. Derive 2D biaxial stress field for member. **(08 Marks)**

c. Define the following :
i) Factor of safety
ii) Maximum principal stress
iii) Codes and standards. **(04 Marks)**

OR

2 a. Explain the following failure theories :
i) Maximum principal stress theory
ii) Maximum shear stress theory
iii) Maximum shear strain energy theory. **(09 Marks)**

b. A body is under the action of two principal stresses of $40N/mm^2$ and $70N/mm^2$ (compressive), the third principal stress being zero. If the elastic limit in simple tension as well as compression is $200N/mm^2$. Find the factor of safety, based on the elastic limit according to 3 failure theories. Take $\mu = 0.3$. **(07 Marks)**

Module-2

3 a. Derive an expression for impact factor. **(08 Marks)**

b. List and explain the factors effecting endurance limit. **(08 Marks)**

OR

4 a. Derive Soderberg's equation when member is subjected to fatigue axial loading. **(08 Marks)**

b. Determine the maximum load for the simply supported beam, cyclically loaded as shown in Fig.Q4(b). The ultimate strength is 700MPa, the yield point tension is 520MPa and endurance limit in reversed bending is 320Mpa. Use factor of safely of 1.25. The load, size and surface correction factors are 1, 0.75 and 0.9 respectively.

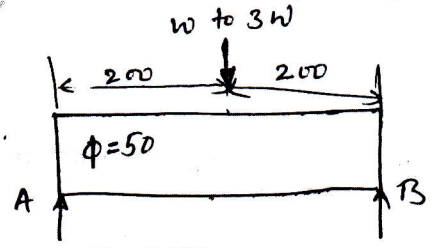

Fig.Q4(b) **(08 Marks)**

Module-3

5 a. List and explain the loads acting on the aircraft. (04 Marks)

b. Explain the functions of structural components of an aircraft considering wing structure. (06 Marks)

c. Derive for the load factor under steady pull out of an aircraft maneuvers. (06 Marks)

OR

6 a. Discuss the following as aircraft materials :
   i) Aluminum alloys
   ii) Stainless steel
   iii) Composite materials
   iv) Non-metals. (10 Marks)

b. Derive for crack propagation rate of structure showing :

$$\frac{da}{dN} = \frac{C(\Delta K)^n}{(1-R)K_C - \Delta K}.$$ (06 Marks)

Module-4

7 a. Derive a equilibrium equations for 3D elastic material and reduce to 2D plane stress condition. (10 Marks)

b. Explain the following with example :
   i) Plane stress
   ii) Plane strain
   iii) Principal stress. (06 Marks)

OR

8 a. Define the following with examples :
   i) Determinate structure
   ii) Indeterminate structure. (06 Marks)

b. Derive for three moments equations for beam. (10 Marks)

Module-5

9 a. Drive the strain energy stored in the beam loaded axially. (06 Marks)

b. Determine the strain energy stored in the beam as shown in Fig.Q9(b).

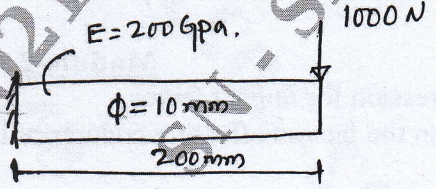

Fig.Q9(b) (06 Marks)

c. Define the following :
   i) Maxwell's Reciprocal's theorem
   ii) Castigliano's theorem. (04 Marks)

OR

10 a. Derive for Euler critical load of column under both the ends hinged condition. (08 Marks)

b. Show that critical load in Rankine's formula is $Pc_r = \frac{\sigma_c \cdot A}{1 + a(\frac{L}{r})^2}$. (04 Marks)

c. Calculate Euler's critical stresses for series of columns having slenderness ratio 50, 100, 150 under both hinged condition. Take $E = 2 \times 10^5$ n/mm^2. (04 Marks)

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