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10AE56

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Aircraft Structures – I

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Sketch and explain all structural components of an aircraft in briefs. **(10 Marks)**

b. An airplane as shown in the Fig. Q1 (b) weighs 24000 N. It is flying horizontally at a velocity of 222 m/s. When the pilot pulls it upwards in 0 curved path with radius of curvature 2500 m. Find the using force (L), Tail force (T) and Load factor acting on the airplane (Assume T = D) **(10 Marks)**

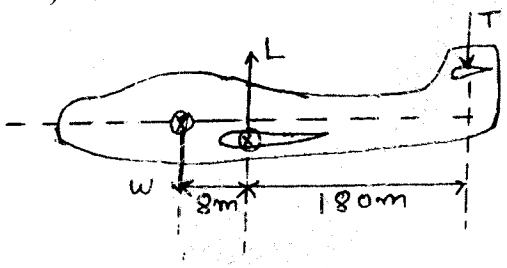

Fig. Q1 (b)

2 a. Explain and enlist the importance of Titanium α and β alloys in aircraft industry. **(10 Marks)**

b. Enlist various composite materials used in structural components of an aircraft and discuss the advantage of composite materials over metals. **(10 Marks)**

3 a. Explain all the stages of creep phenomenon in metallic components. **(08 Marks)**

b. Mention the various stages of fracture in ductile and brittle materials with brief explaination. **(08 Marks)**

c. What are the factors that influence the endurance limit? **(04 Marks)**

4 a. Analyse the structures below for determinancy and redundancy. **(10 Marks)**

(i) (ii)

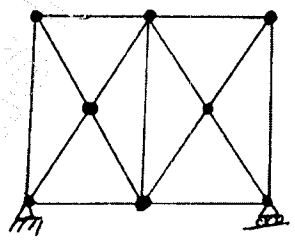

Fig. Q4 (a)

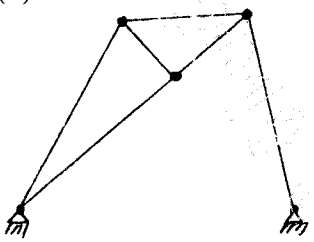

Fig. Q4 (b)

b. A truss of span 15 m carries a point load. 2 kN at joint D as shown in Fig. Q4 (b). Solve for all the forces and reactions in the truss structure. **(10 Marks)**

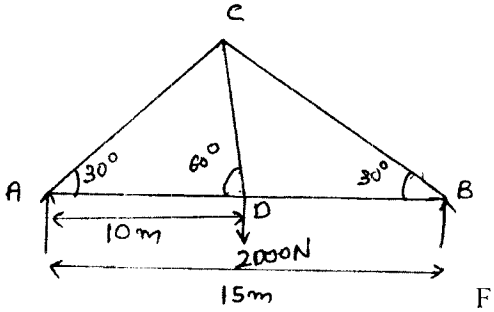

Fig. Q4 (b)

PART – B

5 a. Deduce an expression for strain energy of a beam bending condition. **(08 Marks)**

b. Define complementary strain energy. **(04 Marks)**

c. State and prove Castigaliano's I and II theorem. **(08 Marks)**

6 a. Derive an expression for eccentric loading on column. Using Rankine's method for buckling load determination. **(10 Marks)**

b. Consider a L section beam as shown in the Fig. Q6 (b). $200 \times 200 \times 20$ mm. Young's modulus E = 200 GPa. Find the crippling load for following conditions. Length of the column is 5000 mm.

(i) Hinged – hinged (ii) Fixed – Free (iii) Fixed – Fixed (iv) Fixed - hinged **(10 Marks)**

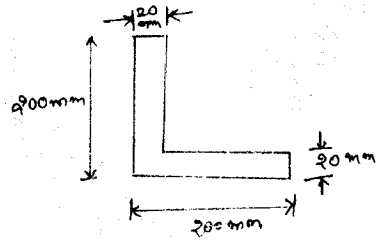

Fig. Q6 (b)

7 a. Define plane stress and plane strain. **(06 Marks)**

b. Derive an equilibrium equation for 3 D elastic body subjected to surface traction forces. **(06 Marks)**

c. Engineering strain components at the point in a body are given by,

$$(\text{strain})\varepsilon = \begin{bmatrix} 0.55 & -0.25 & 0 \\ -0.25 & -3 & 0.25 \\ 0 & 0.25 & -0.95 \end{bmatrix} \times 10^{-4}.$$

If $E = 25 \times 10^6$ N/m^2 and Poisson's ratio = 0.25. Determine stress components at this point. **(08 Marks)**

8 a. Deduce and explain (i) Maximum strain theory. (ii) Maximum strain energy theory. **(10 Marks)**

b. The principle stresses at a point in an elastic material are $\sigma_1 = 100$ N/mm^2 (tensile), $\sigma_2 = 80$ N/mm^2, $\sigma_3 = 50$ N/mm^2 (compression). If the stress at the elastic limit is 200 MPa. Poisson's ratio = 0.3. Determine FOS and deduce whether the failure in material will occur according to,

(i) Maximum principle stress theory.

(ii) Maximum principle strain theory. **(10 Marks)**

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