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10AE56

Fifth Semester B.E. Degree Examination, Dec.2015/Jan.2016

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. With usual notations, derive the equations for the loads acting on a steady level flight. **(08 Marks)**

b. Briefly explain the following airframe loads :
i) Aircraft inertia loads
ii) Symmetric manoeuvre loads
iii) Gust loads. **(12 Marks)**

2 a. Discuss the characteristics of any four materials used for aircraft construction. **(08 Marks)**

b. What are maraging steels? Discuss the main advantages of maraging steels over conventional low alloy steels? **(06 Marks)**

c. What are the advantages and limitations of using Titanium alloys in aircrafts? Discuss. **(06 Marks)**

3 a. Sketch the stress – strain diagram of mild steel subjected to tension. Discuss all the salient points on it. **(10 Marks)**

b. Discuss the following properties of materials :
i) Fatigue ii) Fracture **(10 Marks)**

4 a. Using the method of joints, determine the member forces of the plane pin – jointed truss of Fig. Q4 (a). **(14 Marks)**

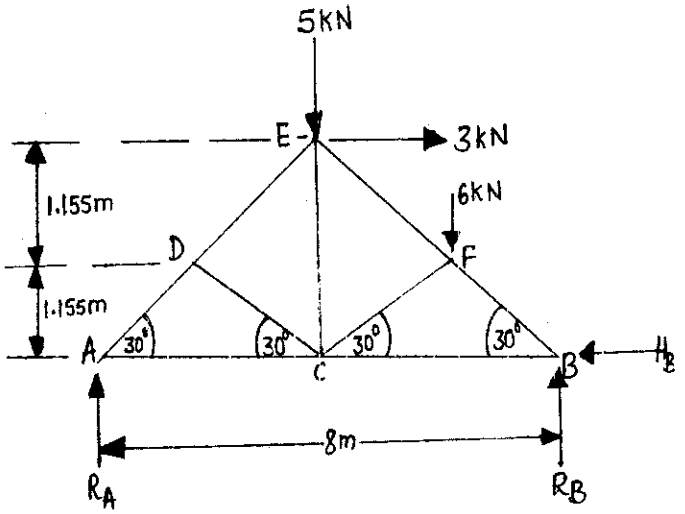

Fig Q4 (a)

b. Explain the different types of supports used in beams with the neat sketches. Also write the reactions at each supports. **(06 Marks)**

PART – B

5 a. State and prove Maxwell's reciprocal theorem. **(08 Marks)**

b. Explain unit load method of determining the deflection of beams. **(06 Marks)**

c. Explain the following:

i) Strain Energy

ii) Complementary energy

iii) Castigliano's theorem. **(06 Marks)**

6 a. Obtain an expression for the critical load for a long column subjected to bending when one end is fixed and other free. **(10 Marks)**

b. A 2 - m - long pin - ended column of square cross section is to be made of wood. Assuming E = 13 GPa, σ_{all} = 12MPa, and using a factor of safety of 2.5 in computing Euler's critical load for buckling, determine the size of the cross section if the column is to safely support (i) a 100 - kN load, (ii) a 200 - kN load. **(10 Marks)**

7 a. Obtain the expressions for determining the normal and tangential stress in a general 2D stress system. Also obtain the expressions for maximum and minimum principal stresses. **(12 Marks)**

b. A rectangular element in a linearly elastic isotropic material is subjected to tensile stresses of 83 and 65N/mm^2 on mutually perpendicular planes. Determine the strain in the direction of each stress and in the direction perpendicular to both stresses. Find also the principal strains, the maximum shear stress, the maximum shear strain and their directions at the point. Take E = 200000 N/mm^2 and ν = 0.3. **(08 Marks)**

8 Explain the following theories of failure :

a. Maximum principal stress theory

b. Maximum principal strain theory

c. Maximum shear stress theory

d. Distortion theory. **(20 Marks)**

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