

Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014

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. What are the various types of loads that can act on an aircraft? Explain each of them. (10 Marks)
- b. With usual notations, derive the equations for the loads acting on a steady level flight. (10 Marks)
- 2 a. What are the desirable properties of aircraft materials? Explain. (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. Draw a neat diagram of stress-strain behavior of low carbon steel. Discuss all salient points. (08 Marks)
- b. Discuss the following with the help of neat sketches: i) Creep ii) Fatigue iii) Fracture (12 Marks)
- 4 a. Explain the different types of supports used in beams with the neat sketches. Also write the reactions at each support. (06 Marks)
- b. Using the method of joints, determine the member forces of the plane pin jointed truss of Fig. Q4 (b). (14 Marks)

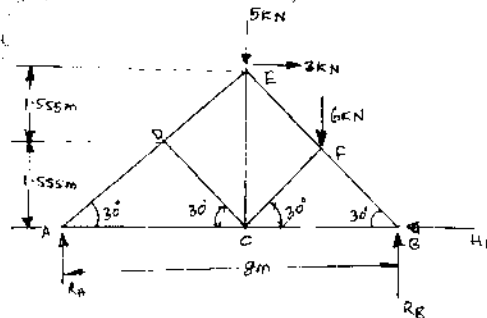


Fig. Q4 (b)

PART – B

- 5 a. What is the strain energy stored in a Cantilever of length L when carrying a concentrated load of P at the free end? Also obtain the expression for deflection at the free end. (06 Marks)
- b. State and prove Maxwell's reciprocal theorem. (08 Marks)
- c. Explain strain energy and complementary energy with a neat sketch. (06 Marks)
- 6 a. What are columns? How does it differ from beam? (04 Marks)
- b. Obtain an expression for the critical load for a long column subjected to bending when both ends are fixed. (08 Marks)
- c. A 2m long pin ended column of square cross section is to be made of wood. Assuming $E = 12 \text{ GPa}$ and allowable stress being limited to 12 MPa. Determine the size of the column to support the following loads safely: i) 96 kN ii) 200 kN. Use FOS of 3 and Euler's crippling load for buckling. (08 Marks)

- 7 a. What do you understand from Airy's stress function? Derive the relevant equation. (08 Marks)
- b. At a particular point in a structural member a 2D stress system exists where $\sigma_x = 60 \text{ N/mm}^2$, $\sigma_y = -40 \text{ N/mm}^2$ and $\tau_{xy} = 50 \text{ N/mm}^2$. If Young's modulus $E = 200 \text{ GPa}$ and Poisson's ratio $\nu = 0.3$. calculate the direct strain in the x and y directions and the shear strain at the point. Also calculate the principal strains at the point and their inclination to the plane on which σ_x acts. (12 Marks)
- 8 a. State and explain the following theories of failure:
- Maximum principal strain theory.
 - Maximum shear stress theory. (08 Marks)
- b. A material subjected to a simple tension test shows an elastic limit of 240 MPa. Calculate the factor of safety provided if the principal stresses set up in a complex 2D stress system are limited to 140 MPa tensile and 45 MPa compressive. The appropriate theories of failure on which your answer should be based are:
- The maximum shear stress theory.
 - The maximum shear strain energy theory. (12 Marks)