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**Fifth Semester B.E. Degree Examination, June/July 2015**

**Aircraft Structures - I**

Time: 3 hrs.

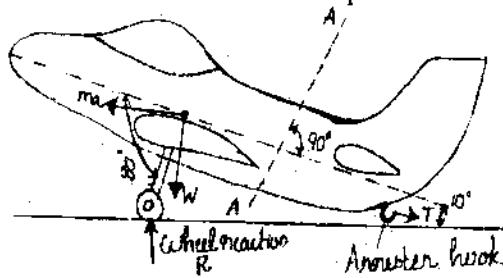
Max. Marks: 100

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

**PART - A**

- 1 a. What are the various types of loads acting on an aircraft? (04 Marks)
- b. With a neat sketch, explain the V-n diagram. (08 Marks)
- c. An aircraft having a total weight of 45kN lands on the deck of an aircraft carrier and is brought to rest by means of a cable engaged by an arrester hook, as shown in Fig. Q1(c). If the deceleration induced by the cable is 3g, determine the tension, T in the cable, the load on an undercarriage strut, and the shear and axial loads in the fuselage at the section AA; the weight of the aircraft aft of AA is 4.5 kN. Calculate also the length of deck covered by aircraft before it is brought to rest if the touch down speed is 25m/s.

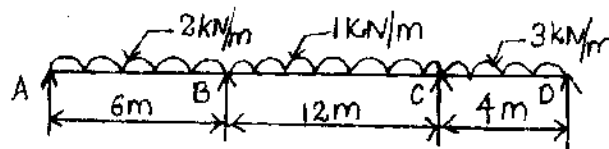
Fig. Q.1(c)



(08 Marks)

- 2 a. Write a short note on the usage of Titanium and stainless steel in aircraft. (08 Marks)
- b. List the various desirable properties of the materials used in aircraft structures and explain each one of them in brief. (08 Marks)
- c. What is composite materials? State its use in aircraft. (04 Marks)
- 3 a. Explain in detail about the failure of materials due to creep and fatigue. (10 Marks)
- b. Draw the stress – strain curve and explain the stress – strain behaviour of ductile and brittle materials. (10 Marks)
- 4 a. A continuous beam ABCD of uniform cross section is loaded as shown in Fig. Q4(a). Find the bending moment and reactions at the supports using Clapeyron's three moment equation?

Fig. Q.4(a)

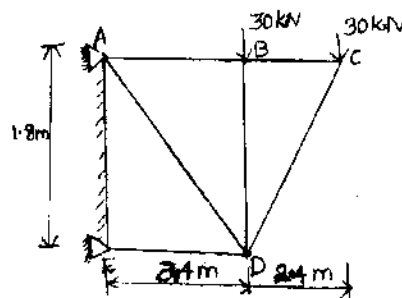


(10 Marks)

- b. Find the forces in the members of truss shown in Fig. Q4(b) using method of joints. Given AB = 1.8m, ED = 2.4m.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and for examinations written on 12.8 - 50, will be treated as malpractice.

Fig. Q.4(b)

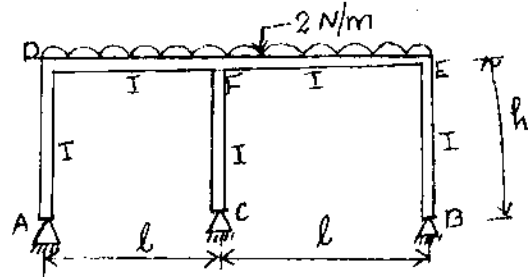


(10 Marks)

**PART – B**

- 5 a. State and derive the Maxwell's reciprocal theorem. (10 Marks)  
 b. Calculate the support reactions at the support 'A' and 'B' using Castigliano's theorem. Consider the energy due to bending alone. Neglect the shear effect and the normal forces acting on the member AD, CF and BE in Fig.Q5(b).

Fig. Q.5(b)



(10 Marks)

- 6 a. What are the limitations of Euler's theory. (04 Marks)  
 b. Determine the shortest length for a pin-jointed steel column of cross section 75mm × 48mm using Euler's formula. Take critical stress value as 220 Mpa and  $E = 205 \text{ Gpa}$ . (06 Marks)  
 c. A 4-m long fixed end hollow cast-iron column supports an axial load of 1MN. The external diameter of the column is 200mm. determine the thickness of column by using Rankine formulae taking a constant of  $\frac{1}{6400}$  and working stress as  $78 \text{ MN/mm}^2$ . (10 Marks)
- 7 a. Derive the equilibrium equations for the stresses acting on a three dimensional element of an elastic material. (12 Marks)  
 b. A cylindrical pressure vessel has an internal diameter of 2m and is fabricated from plates of 20mm thick. If the pressure inside the vessel is  $1.5 \text{ N/mm}^2$  and in addition, the vessel is subjected to an axial tensile load of 2500kN, calculate the direct and shear stresses on a plane inclined at an angle of  $60^\circ$  to the axis of the vessel. Calculate also the maximum shear stress. (08 Marks)
- 8 a. Explain maximum strain energy theory and their limitations in detail. (08 Marks)  
 b. A bolt is subjected to an axial pull of 12kN together with a transverse shear force of 6kN. Determine the diameter of the bolt using  
 i) Maximum principal stress theory.  
 ii) Maximum strain theory.  
 iii) Maximum shear stress theory. (12 Marks)

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