Code No: 07A72103 **R07** **Set No. 2**

IV B.Tech I Semester Examinations,November 2010
STRUCTURAL ANALYSIS AND DETAILED DESIGN
Aeronautical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Define and explain the following theories of failure:
   (a) Maximum shear stress.
   (b) Maximum strain energy theory.
   (c) Maximum shear strain energy theory. [5+5+6]
2. Define Reliability. Explain Weibull distribution used in reliability analysis. [16]
3. What are the different types of landing gear? Explain the construction of a Tricycle landing gear, with neat sketches. [16]
4. A Fuselage has a circular cross-section as shown in figure 1. The cross-sectional area of each stringer is 100 mm^2 and the fuselage is subjected to bending moment of 200 kNm applied in the vertical plane of symmetry, at this section. Calculate the direct stress distribution. [16]

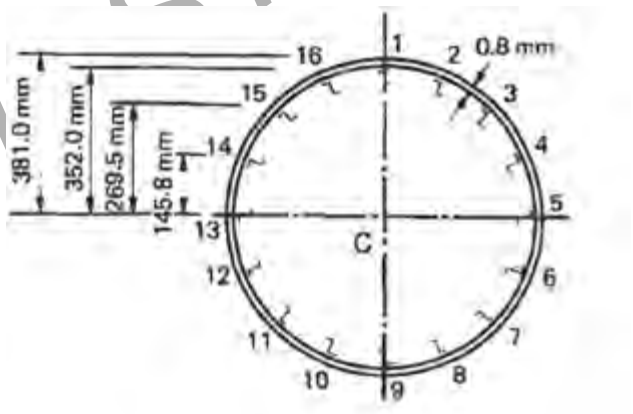

Figure 1:

5. List out and explain the properties of engineering materials for use in the manufacture of an aircraft in detail. [16]
6. Explain the following with equations
   (a) Torsional buckling stress under transverse shear of a Monocoque circular cylinder.
   (b) Buckling of a circular cylinder under pure torsion with internal pressure. Explain all the terms used. [8+8]

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7. Explain Kinematic Guidelines and Gear Lock Design Guidelines while designing the landing gear. [16]

8. The fuselage as shown in Figure 2 is subjected to a bending moment of 100 kNm applied in the vertical plane of symmetry. If the section has been completely idealized into a combination of direct stress carrying booms and panels carrying only shear stress determine the direct stress in each boom. [16]

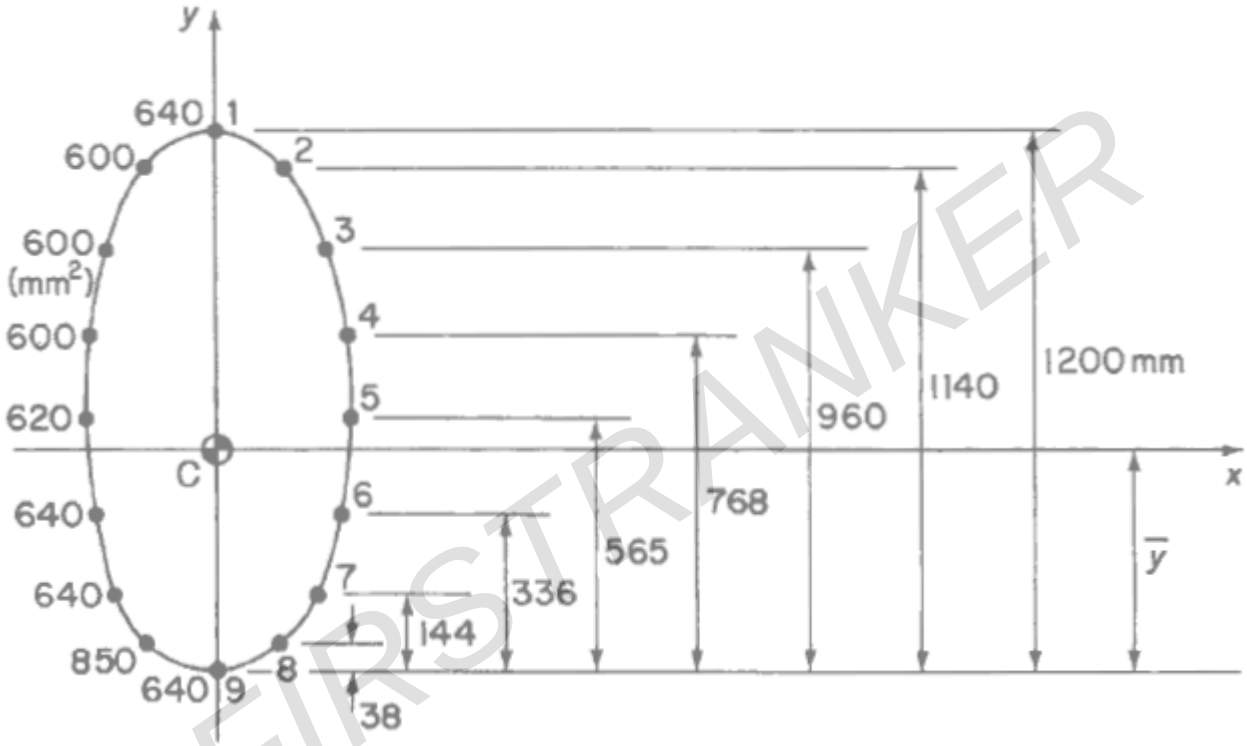

Figure 2:

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Code No: 07A72103 **R07** **Set No. 4**

IV B.Tech I Semester Examinations,November 2010
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Aeronautical Engineering

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1. Explain the following with equations:
   (a) Buckling of monocoque circular cylinder under external hydrostatic pressure and internal radial pressure.
   (b) Buckling of monocoque circular cylinder under axial load and internal pressure. [8+8]
2. Discuss the sizing scenario in airframe structural design. [16]
3. What is buckling of spherical plates under uniform external pressure? Explain with the help of equations. [16]
4. A thin cylindrical shell, 2.5 m in diameter is composed of plates 12.5 mm thick. The yield stress of for the material is 300 N/mm^2. Calculate the internal pressure which would cause yielding according to the following theories of failure.
   (a) Maximum shear stress,
   (b) Maximum strain energy,
   (c) Maximum shear strain energy. Poisson's ratio=0.25. [16]
5. The thin-walled single cell beam as shown in figure 1 has been idealized into a combination of direct stress carrying booms and walls carrying only shear stress. The section supports a vertical shear load of 10 kN acting in the vertical plane through booms 3 and 6. Calculate the distribution of shear flow around the section. Boom areas: B1 = B8 = 200 mm^2 , B2 = B7 = 250 mm^2, B3=B6=400 mm^2, B4 = B5=100 mm^2. [16]
6. Explain current Landing Gear Design of
   (a) Boeing B747
   (b) Lockheed C-5
   (c) C-141
   (d) Fighter Airplane. [4×4]
7. Find the forces (CD, C_V, C_D, B_V, A_V, B_D, A_D) in each member of main landing gear shown in Figure 2. Assume additional data if necessary. [16]

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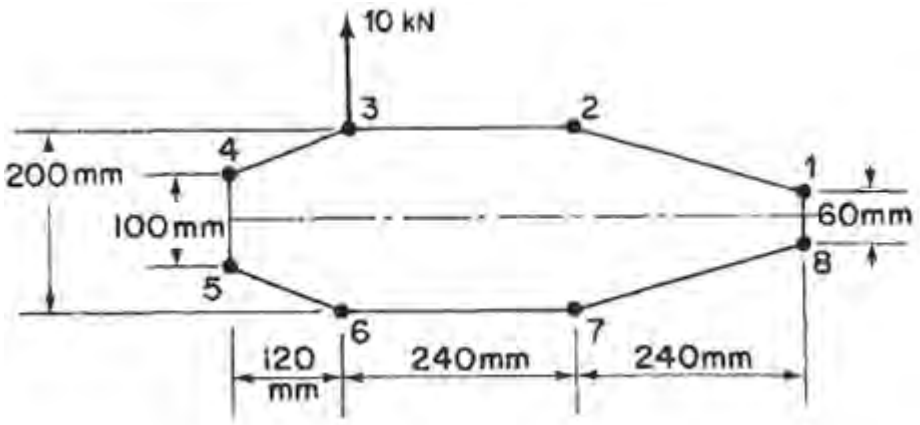

Figure 1:

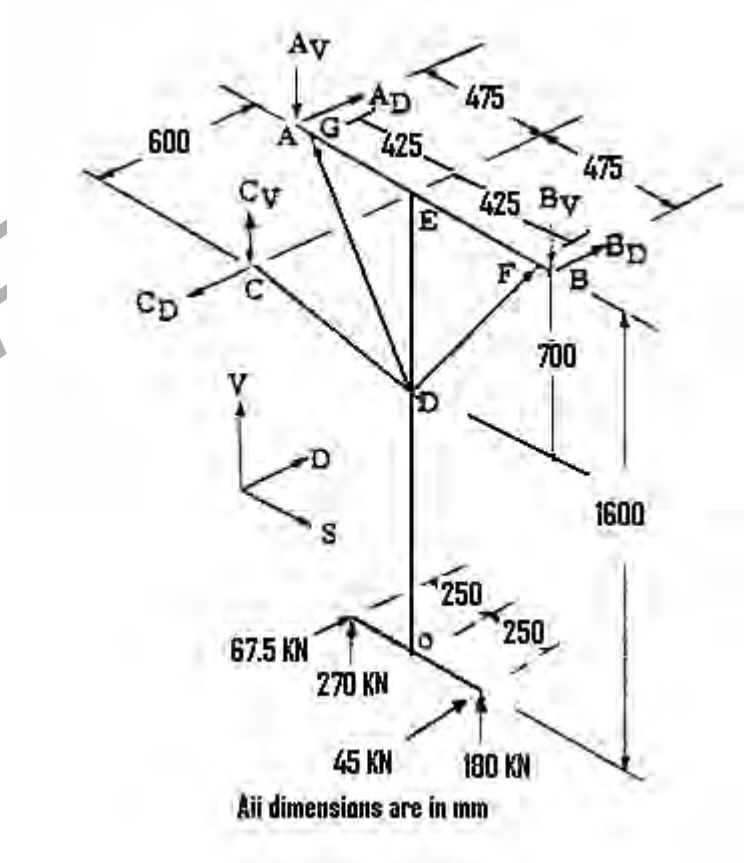

Figure 2:

8. What are the design strategies for improving system reliability? Explain in general and in the context of structures. [16]

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1. What are effective sheet thickness and effective area of stringer type of fuselage section? Explain with the help of neat sketches. [16]
2. Draw and explain typical transport and fighter aircraft wings. [16]
3. Explain:
   (a) Skin instability
   (b) Panel instability
   (c) General instability. [5+6+5]
4. Explain the terms Ground Handling and take-off in order to understand the varied design considerations of landing gear. [16]
5. A shaft is subjected to a maximum torque of 10 kNm and a maximum bending moment of 7.5 kNm at a particular section. If the allowable equivalent stress in simple tension is 160 MN/m^2, find the diameter of the shaft according to:
   (a) Maximum shear stress theory,
   (b) Strain energy theory and
   (c) Shear strain energy theory. Poisson's ratio is 0.24. [16]
6. Determine the axial loads in the members of the landing gear structure shown in figure 5. The members are pinned to supports at A, B and C. [16]
7. (a) Find out the maximum stresses developed in a plate with holes and notches subjected to tensile loads.
   (b) Explain different design methods to reduce stress concentration effect with the help of neat sketches. [8+8]
8. How is an airplane built? Explain with the help of a block diagram. [16]

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SET- 1 Question Number 6

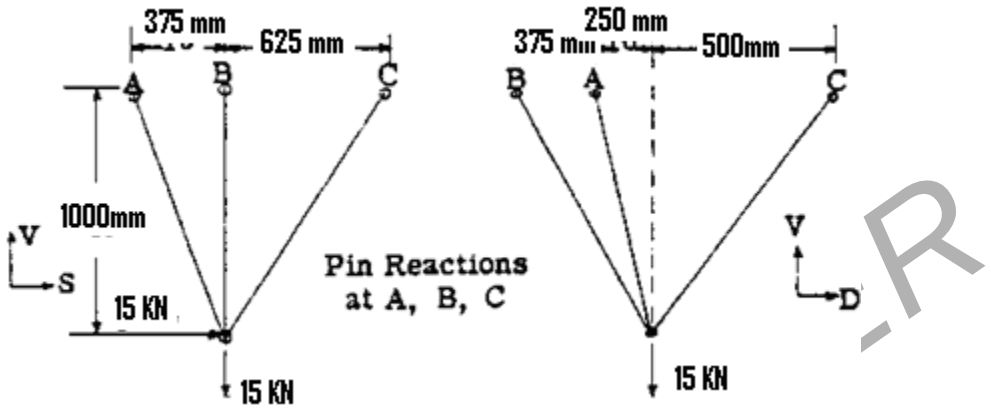

Figure 5

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1. (a) What are reliability and failure rate in the context of structures? Explain.
   (b) How do you classify the failures in structures? Explain. [6+10]
2. (a) Explain the altitudes of the airplane that are specified by government aviation agencies for design of landing gear with neat sketches.
   (b) Explain the construction of Oleo strut with neat sketches. [8+8]
3. What do you understand by the term "Theories of failure"? Name and explain the important theories of failure. [16]
4. Explain the design of wing and fuselage intersection with the help of neat sketches. [16]
5. Explain the important roles of the following aspects of a high speed aircraft:
   (a) Structural stiffness
   (b) Aerodynamic characterstics
   (c) Load analysis of high speed aircraft. [5+5+6]
6. A 762 mm radius circular cross-section fuselage has 0.8 mm skin thickness and 16 number of stringers are equally placed around the circumference as shown in figure 6

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The stringers numbers 1 and 9 are placed on y-axis, number 5 and 13 are placed on x-axis. The cross-sectional area of each stringer is 100 mm^2 and the vertical distance from mid line of the section wall to stringer number (1) is 381.0mm, to (2) and (16), 352.0 mm, to (3) and (15), 269.5 mm, to (4) and (14), 145.8 mm. The fuselage is subjected to a bending moment of 250 kNm applied in the horizontal plane of symmetry at this section. Calculate the direct stress distribution. [16]

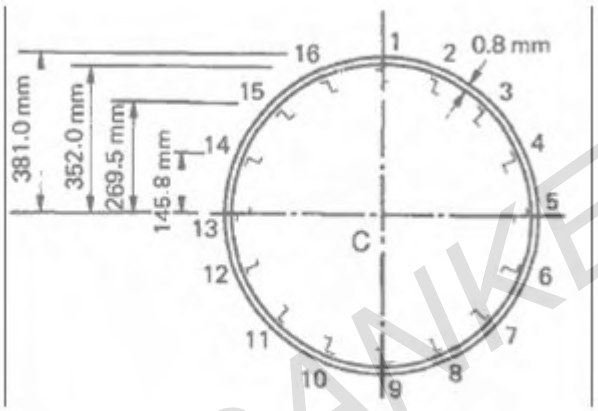

Figure 6

7. A Monocoque cylinder has the following dimensions: radius (r) = 850 mm thickness (t) = 1.25 mm, length (L) =1500 mm. What is the torsional moment this cylinder can sustain? Use design values based on 90% probability, 95% confidence level (for this case F_{st} / e = 0.000082) and 99% probability, 95% confidence level (for this case F_{st} / E = 0.000060). Discuss the above two levels. Take μ = 0.3, E = 74 kN / mm^2. [16]

Geometrical parameter (z)	Torsional Buckling Coefficient (K_t)
2000	160
3000	235

8. Explain the following:
   (a) Control surface
   (b) Emergency crash loads
   (c) Ditching and Breakway design
   (d) Ground gust loads. [16]

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