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

IV B.Tech I Semester Examinations,December 2011
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. The load on a landing gear bolt consists of an axial pull of 8 kN together with a transverse shear force of 4 kN. Estimate the diameter of the bolt required according to
   (a) Maximum shear stress theory.
   (b) Shear energy theory and
   (c) Shear strain energy theory. Assume elastic limit in tension as 240 N/mm^2, Poisson's ratio=0.3 and a factor of safety of 3. [16]

2. What are the different types of landing gear? Explain the construction of a Tricycle landing gear, with neat sketches. [16]

3. Give a brief summary of landing gear loads and explain. [16]

4. List out and explain the properties of engineering materials for use in the manufacture of an aircraft in detail. [16]

5. (a) How do you calculate the effective width of skin per side of stringer for
      i. Bending
      ii. Hydrostatic pressure
      iii. Torsion.
   (b) Explain transverse shear general instability in combined torsion and bending. [12+4]

6. 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]

7. The Aluminum alloy 2024 - T_3 (E = 74 kN/mm^2) is used to fabricate a cylinder, radius (r) = 1200 mm. Wall thickness (t) is 1.2 mm and length of the cylinder, 1800 mm. Calculate the compressive load it can carry using design values based on 90% probability, 95% confidence level (for this case F_{ccr} / E = 0.000121) and 99% probability, 95% confidence level (for this case F_{ccr} / E = 0.000082). Discuss the above two levels and also calculate the geometrical parameter (z). The Poisson's Ratio μ and buckling coefficient (K_c) are 0.3 and 280 respectively. [16]

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

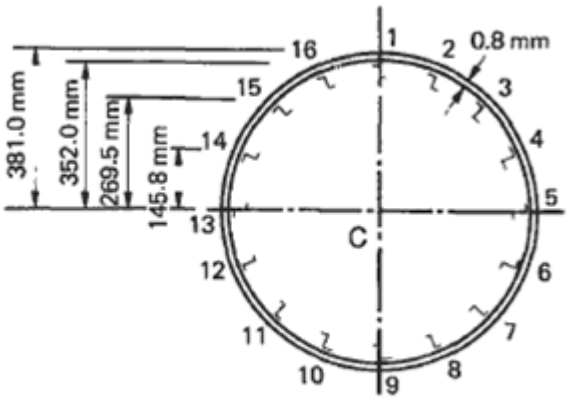
381.0 mm
352.0 mm
269.5 mm
145.8 mm
0.8 mm
C
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

Figure 1:

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

IV B.Tech I Semester Examinations,December 2011
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. The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to:
   (a) Maximum shear stress theory
   (b) Maximum strain energy theory and
   (c) Maximum distortion energy theory. [16]
2. Draw and explain the design of Shock Absorbers for a landing gear. [16]
3. Explain the roles of planning and structural mass in aircraft design process. [16]
4. The thin-walled single cell beam as shown in figure 2 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]

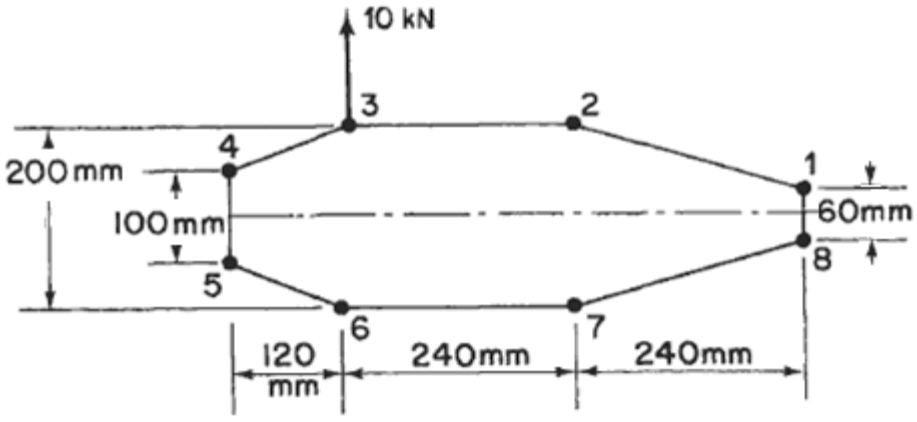

Figure 2:

5. What is reliability? What are the key elements of reliability? Explain. [16]
6. (a) Explain buckling of a monocoque circular cylinder under external hydrostatic pressure.

(b) A Monocoque cylinder has a radius (r) = 1500 mm, thickness (t) = 1.4 mm, length 2200 mm. Assume the value of $\mu = 0.3$. Torsional buckling coefficient (K_t) = 180. Find the geometrical parameter (z) and the Torsional moment this cylinder can sustain. [6+10]

7. Tricycle type of landing gear is shown in Figure 3. Find the forces G_v, F_v, H_d, F_d, H_v of brace Struts. Assume additional data if necessary. [16]

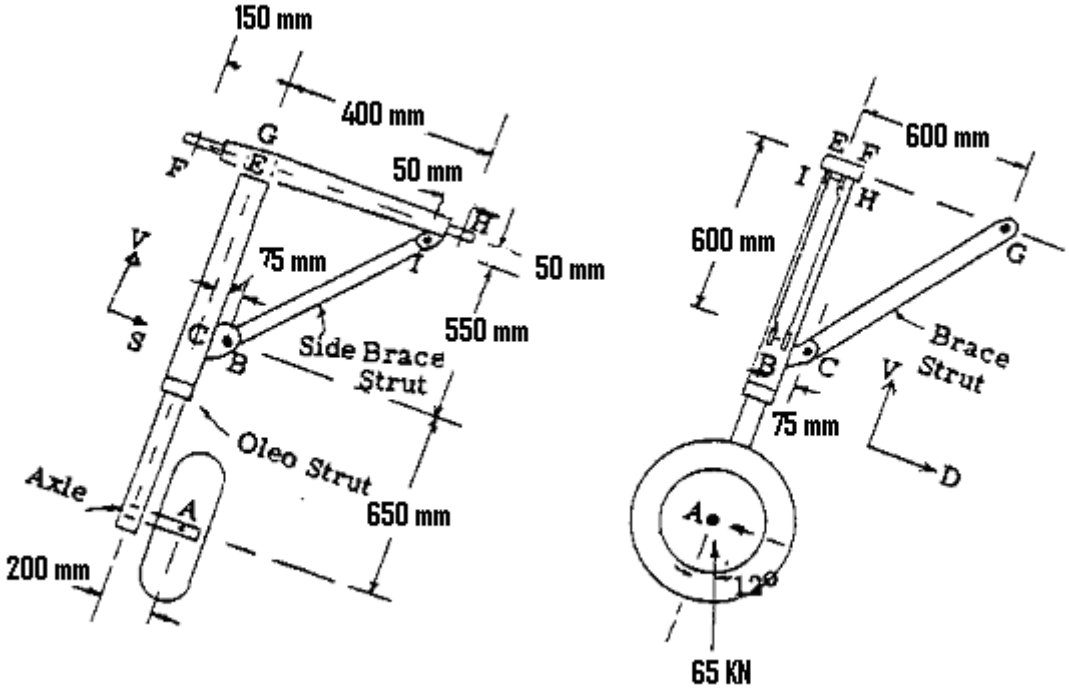

Figure 3:

8. A Circular Fuselage section is shown in figure 4 with longitudinal stringers represented by the small circles. The area of each stringer is 150 mm^2. The skin thickness is 1.2 mm. Material is aluminum alloy with E = 73 kN/mm^2. The fuselage frame spacing (a) = 400 mm. The fuselage section is subjected to the moment (M_y) = 67.8 kN-m causing compression on top half. Vetical load (V_z) = 23 kN (acting up) Torsional moment (T) = 23.93 kN-m (acting counter clock wise). Determine whether skin panel 'B' will buckle under the given combined loading on the fuselage section. [16]

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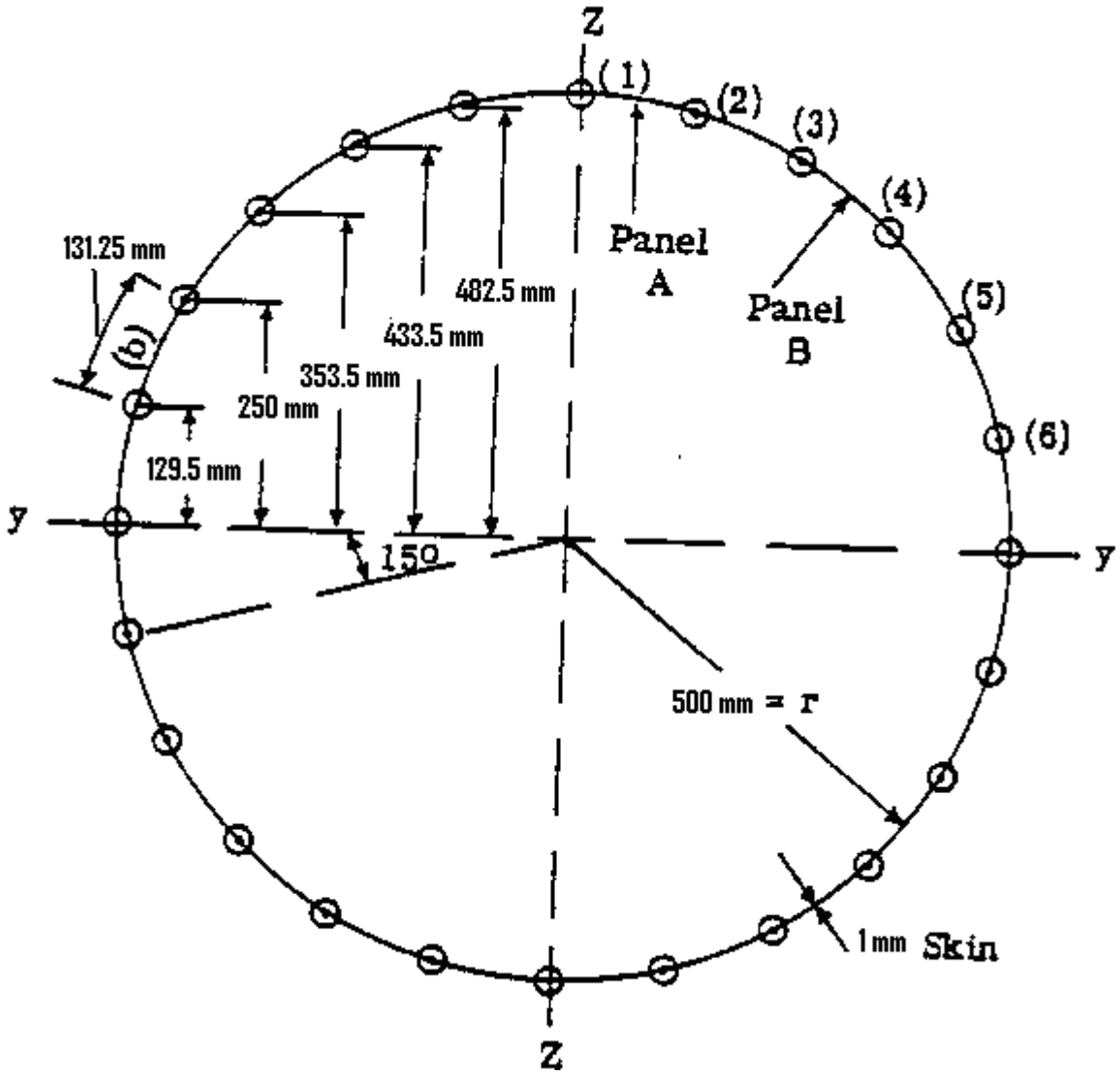
Z
(1)
(2)
(3)
(4)
(5)
(6)
Panel A
Panel B
131.25 mm
(b)
482.5 mm
433.5 mm
353.5 mm
250 mm
129.5 mm
y
y
15°
500 mm = r
1 mm Skin
Z

Figure 4:

Code No: 07A72103 **R07** **Set No. 1**

IV B.Tech I Semester Examinations,December 2011
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Aeronautical Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Explain the importance of Lubrication, Transitions, and Finishes in the Design of landing gear. [16]

2. Explain the importance of the following while designing the structure of an aircraft
   (a) Weight distribution.
   (b) Center of gravity envelope.
   (c) Weight break - up. [4+4+8]

3. (a) What are Safety, Risk and Risk acceptance? Explain in the context of structures.
   (b) Explain with block diagram the reliability analysis procedure at assembly level. [8+8]

4. The thin-walled single cell beam as shown in figure 5 has been idealized into a combination of direct stress carrying booms and walls carry only shear stress. The section supports a vertical shear load of 15 kN acting in a vertical plane through booms 2 and 7. Calculate the distribution of shear flow around the section. Each Boom area = 200 mm^2. [16]

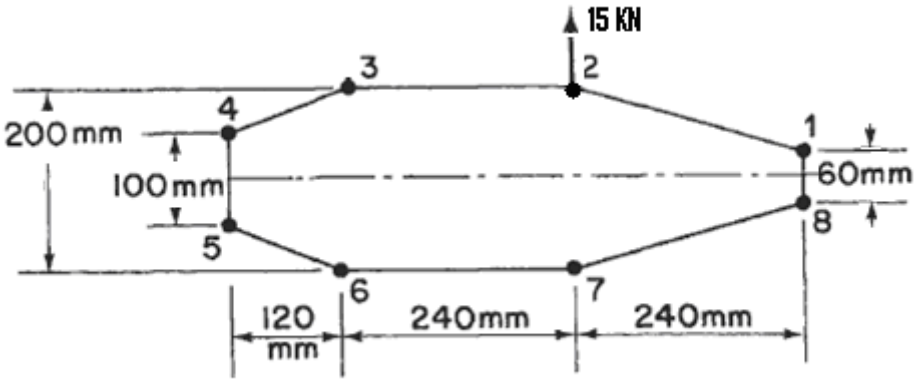

Figure 5:

5. 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]

6. (a) Explain the functions of different structural components in aircraft.

   (b) Explain the design procedures for these components. [8+8]

7. A Monocoque cylinder has the following dimensions: radius r = 2500 mm, thickness (t) =1.25 mm, length (L) = 2875 mm, E = 74 kN/mm^2. The cylinder is subjected to an axial compressive load of 225 kN and internal pressure of 0.03447 kN/mm^2. What is the margin of safety under this combined load system for 90% probability and 95% confidence level? (For this level F_{ccr} / E = 0.000121). Take μ = 0.3, η =1.0, K_c = 280. [16]

8. Explain the principles of producibility in design. [16]

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Code No: 07A72103 **R07** **Set No. 3**

IV B.Tech I Semester Examinations,December 2011
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. (a) Explain buckling of short cylinders, intermediate cylinders, long cylinders and very long cylinders.
   (b) Explain Torsional buckling stress of a Monocoque circular cylinder under pure torsion and also write the equation, explaining all the terms used. [12+4]

2. Explain the importance of the following while designing the structure of an aircraft
   (a) Major aircraft weights.
   (b) Weight distribution. [8+8]

3. What is reliability and why is it required? Explain the importance of reliability for designing aerospace components. [16]

4. Determine the axial loads in the members of the landing gear structure shown in figure 6. The members are pinned to supports at A, B and C. [16]

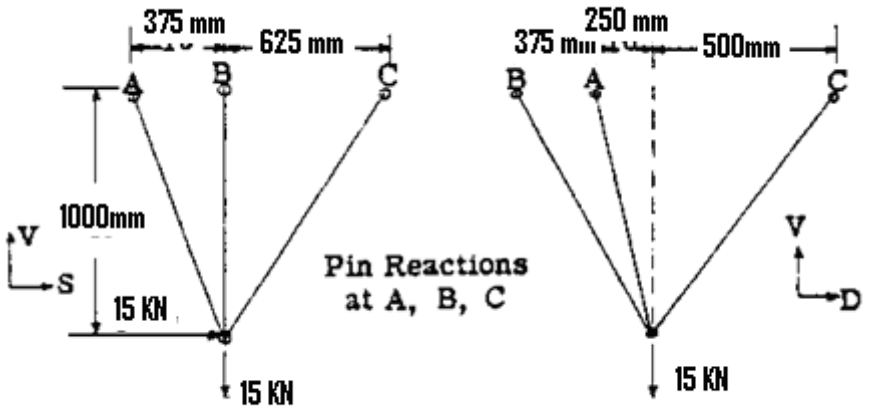

Figure 6:

5. Explain the engineer's responsibility in designing an aircraft. [16]

6. Derive an expression for the distortion energy per unit volume when a body is subjected to Principal stresses σ_1, σ_2 and σ_3. [16]

7. Explain structural test and wheel and brake test of landing gear. [16]

8. (a) Discuss load factor with neat sketches.

   (b) Assume that the transport aero plane as illustrated in figure 7 has just touched down in landing and a braking force of 157.5 kN on the rear wheels is being applied to bring the aeroplane to rest. The landing horizontal velocity is 37.5 m/s. Neglecting air forces on the aeroplane and assuming the propeller forces are zero, what are the ground reactions R_1 and R_2? What is the landing run distance with the constant braking force? Ignore aerodynamic forces and moments. [8+8]

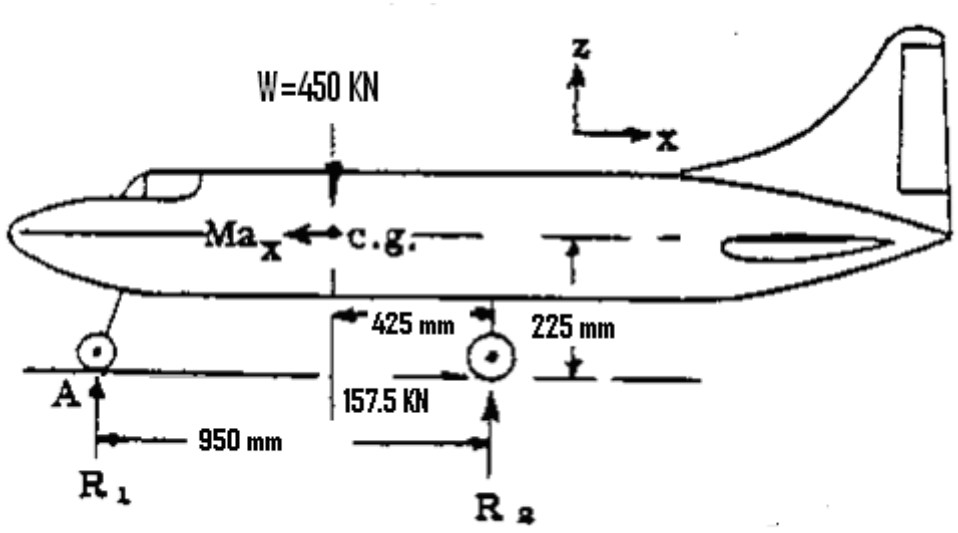

Figure 7:

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