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## Fifth Semester B.E. Degree Examination, July/August 2021 Aircraft Structures – I

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions.**

1.
  - a. Explain stress tensor and stress concentration factor. (05 Marks)
  - b. Body subjected to tensile stress of 100MPa and 70MPa along two mutually perpendicular directions. The point is also subjected to shear stress of 50MPa. Determine:
    - i) Normal and shear stress at plane inclined at  $120^\circ$  with reference to 100MPa stress plane.
    - ii) Principle and maximum, minimum shear stress
    - iii) Principle plane orientation
    - iv) Normal stress on planes of maximum and minimum shear stress. (15 Marks)
2.
  - a. Explain various methods by which stress concentration can be reduced with sketches. (05 Marks)
  - b. A point in a plate is subjected to a horizontal tensile stress of  $100\text{N/mm}^2$  and vertical stress of  $60\text{N/mm}^2$ . Find the magnitude of principle stresses. (15 Marks)
3.
  - a. What is impact stress? (05 Marks)
  - b. A steel rod is 1.5m long, is to resist impact load of 2.5kN falling under gravity at a velocity of 0.99m/sec maximum computed stress is limited to 150MPa. Determine: i) Diameter of rod ii) Impact factor given  $E = 206.8 \times 10^3 \text{N/mm}^2$ . (15 Marks)
4.
  - a. Explain Soderberg and Goodman lines with neat graph. (05 Marks)
  - b. A circular bar of 500mm length is supported freely at its two ends. It is acted upon by a central concentrated cyclic load having minimum value of 20kN and maximum value of 50kN. Determine diameter of bar taking FOS = 1.5, size effect of 0.85, surface finish factor of 0.9, stress concentrator factor of 1.  $\sigma_u = 650\text{MPa}$ ,  $\sigma_y = 500\text{MPa}$  and Endurance strength = 350MPa. (15 Marks)
5.
  - a. With neat sketch explain V-N diagrams (velocity load factor). (05 Marks)
  - b. An aircraft having weight of 250kN with tricycle landing gear lands with sink rate of 3.7m/sec such that vertical and horizontal reactions on wheel are 1200kN and 400kN. Where nose wheel is 1m from ground.  $I = 5.65 \times 10^8 \text{N/s}^2 \text{mm}$ . Determine inertia force on aircraft, time taken for its vertical velocity to become zero and its angular velocity at this instant. (15 Marks)
6.
  - a. What are the types of titanium used in aircraft and give their properties? (10 Marks)
  - b. Derive Griffith theory of crack growth on brittle material. (10 Marks)
7.
  - a. Define plane stress, plane strain and principle stress. (10 Marks)
  - b. Derive equations of equilibrium for the stress acting on a 3D element of an elastic material. (10 Marks)

- 8 a. What are statistically determinate and indeterminate structures give examples? (10 Marks)  
b. Prove Clapeyron's theorem of three moments. (10 Marks)
- 9 a. State and prove Castigliano's first theorem in beam subjected to load systems. (10 Marks)  
b. A cantilever of length 'L' carries UDL of W/unit length over whole span. Assuming uniform flexural rigidity, find strain energy stored and deflection at free end. (10 Marks)
- 10 a. Derive an equation for critical buckling load of a column with the end condition one fixed and other free. (10 Marks)  
b. A 2 meter long pin ended column of square cross section of wood, having  $E = 12\text{GPa}$ , and allowable shear stress  $12\text{MPa}$  is subjected to a load of  $96\text{kN}$ . Determine the size of the column. Use  $\text{FOS} = 3$ , and use Euler crippling load for buckling. (10 Marks)

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