

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

Aero Structures

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. What are codes and standards? Explain. (04 Marks)
- b. Explain Bi-axial and Tri-axial state of stresses. (06 Marks)
- c. A circular Rod of diameter 50 mm is subjected to loads as shown in Fig Q1(c), Determine the nature and magnitude of Stresses at the critical points.

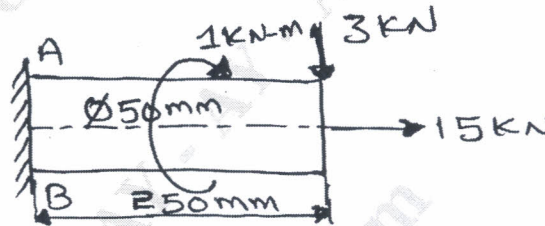


Fig Q1(c)

(10 Marks)

OR

- 2 a. Briefly explain the following failure theories
 - i) Maximum Shear stress theory
 - ii) Distortion Energy Theory. (06 Marks)
- b. Determine the diameter of a round rod to sustain a combined torsional load of 1500 N-m and a bending moment of 1000 N-m by the following theories of failure, material selected for the rod has a value of 300 MPa and 180 MPa for normal stress and shear stress at yield point respectively, take a value of 2.5 for the F.O.S
 - i) Maximum shear stress theory
 - ii) Octahedral shearing stress theory. (08 Marks)
- c. Explain various methods by which stress concentrations can be reduced with sketches. (06 Marks)

Module-2

- 3 a. What is impact stress? Derive a equation for impact stress due to axial impact. (06 Marks)
- b. What is Endurance limit? Briefly explain the factors affecting the Endurance limit. (08 Marks)
- c. A cantilever beam of span 800 mm has rectangular cross section of depth 200 mm. The free end of the beam is subjected to transverse load of 1 kN that drops on to it from a height of 40 mm selecting C40 steel, $\sigma_y = 328.6$ MPa, $E = 206$ GPA F.O.S = 3. Determine the width of rectangular cross section. (06 Marks)

OR

- 4 a. Formulate Miner's Rule for cumulative fatigue damage. (10 Marks)
- b. A hot rolled steel shaft is subjected to a torsional moment that varies from 330 N-m (clockwise) to 110 N-m (Counter clockwise) as the applied bending moment at the critical section varies from +440 N-m to -220 N-m. The shaft is of uniform cross section and no key way is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MPa and yield strength of 410 MPa. Take the endurance limits as half the ultimate strength factor of safety = 1.5, size factor of 0.85 and a surface finish factor of 0.62. (10 Marks)

Module-3

- 5 a. Define load factor, with neat sketch, discuss V-n diagram in detail. (10 Marks)
- b. An aircraft having a total weight of 45 kN loads 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 Q5(b), if the deceleration induced by the cable is $3g$ determine the tension 'T' in the cable the load on an under carriage strut and the shear and axial loads in the fuselage at section A-A ; The weight of the Aircraft aft of A A is 4.5 kN, calculate also the length of deck covered by the aircraft before it is brought to rest if the touchdown speed is 25 m/s.

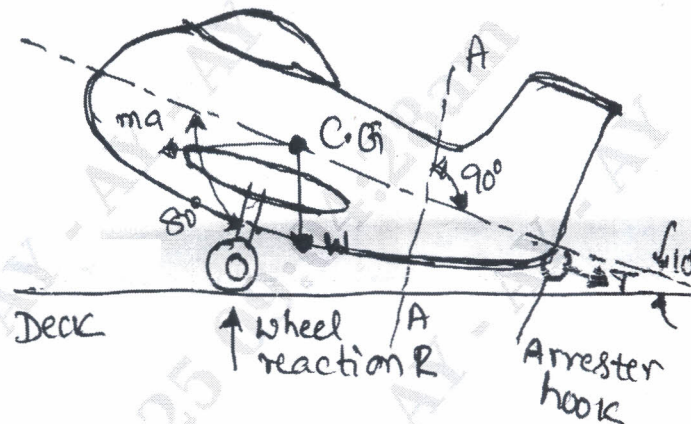


Fig Q5(b)

(10 Marks)

OR

- 6 a. Write a short note on the following :
 i) Aluminium alloys
 ii) Titanium alloys
 iii) Stainless steel alloys
 iv) Composite materials (12 Marks)
- b. What are the desirable properties materials for Aircraft applications? (08 Marks)

Module-4

- 7 a. Derive the Equilibrium equations for an Elastic body under forces. (10 Marks)
- b. The state of stress at a point is given by the following matrix
- $$\begin{bmatrix} 9 & 6 & 3 \\ 6 & 5 & 2 \\ 3 & 2 & 4 \end{bmatrix} \text{ MPa}$$
- Determine the principal stresses and their directions. (10 Marks)

OR

- 8 a. Explain statically determinate and indeterminate structures. Give examples. (06 Marks)
- b. Using the method of joints, determine the forces in all members of truss shown in Fig Q8(b).

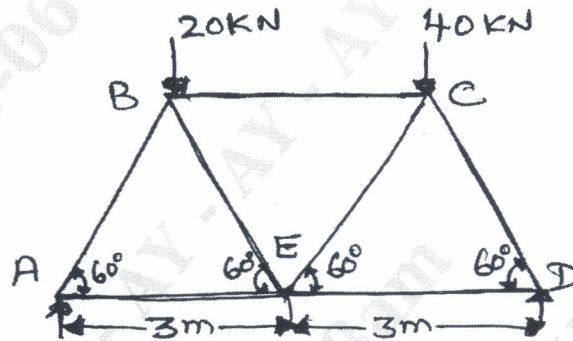


Fig Q8(b)

(14 Marks)

Module-5

- 9 a. State and prove Castiglione's theorem. Using Castiglione's theorem determine the deflection and slope at the free end of a cantilever beam subjected to point load at its free end. (12 Marks)
- b. Derive an expression for strain energy due to bending. (08 Marks)
- OR**
- 10 a. Write a short note on : (10 Marks)
- Southwell plot
 - Limitations of Euler's theory
- b. Find the diameter of the shaft required to transmit 60 kW at 150 rpm. If the maximum torque is 25% greater than the mean torque for a maximum permissible shear stress of 60 MN/m². Find also the angle of twist for a length of 4 m. Take G = 80 GPa. (10 Marks)
