Roll No. | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech. (AE) (Sem.–3rd)

MECHANICS OF MATERIALS

Subject Code : AE-201

Paper ID : [A0701]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students has to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.**

SECTION-A

1. Answer briefly :

(a) Define Poisson's ratio.

(b) What are principle stress plane?

(c) Define the point of contra-flexure.

(d) Explain section modulus of twisting.

(e) Explain the term flexural rigidity.

(f) Explain the different types of failures occurring in column and struts.

(g) Write the stiffness of springs connected in series and parallel mode.

(h) A thin cylinder is subjected to internal pressure only; determine the principal stresses induced in the cylinder in usual symbols.

(i) Write the relationship between moment, slope and deflection.

(j) Why hollow shafts are preferred over the solid shaft for power transmission?

SECTION–B

2. A bar of steel 250 mm long of rectangular cross-section 25 mm (depth) by 50 mm (width) is subjected to a uniform tensile stress of 200 MPa along its length. Find the change in its dimensions. E = 205 GPa and Poisson's ratio is 0.3.

3. A cantilever beam of 4 m span is loaded by a UDL of 20 kN/m over its whole span. It is also loaded by two point loads of 30 kN and 20 kN at a distance of 1 m and 2 m from the free end respectively. Draw the Bending Moment Diagram and Shear Force Diagram for the beam.

4. A steel specimen 150 mm^2 in cross-section elongates 0.05 mm over a 50 mm gauge length under an axial load of 30 kN. Calculate strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is 50 kN, calculate the elongation at elastic limit and its energy at this point also.

5. A two dimensional state of stress at a point is given by σ_x = 20 MPa, σ_y = 10 MPa and τ_{xy} = 25 MPa. Determine the direction and magnitude of the principal stresses in the material. Also locate the plane of maximum shear stress and their magnitude.

6. A closed coiled helical spring 100 mm mean diameter is made of 20 turns of 10 mm diameter steel rod. The spring carries an axial load of 100 N. Find the shear stress and the axial deflection of the spring. Assume G = 84 GPa.

SECTION–C

7. A solid shaft is to transmit 300 kW at 100 rpm. If the shear stress is not to exceed 80 MPa, find the diameter of the shaft. What percentage saving in the weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter? The length, material and maximum shear stress being the same.

8. Prove that the central deflection for a fixed beam at its both ends (of span l) and of uniform cross-section carrying a UDL w per unit length is $(wl^4)/384EI$.

9. Compare the crippling loads given by Rankine's and Euler's formulae for tubular struts 2250 mm long having outer and inner diameter of 37.5 mm and 32.5 mm respectively. Assume both ends hinged for the column, yield point stress as 315 MPa, α = 1/7500 and E = 200 GPa. If elastic limit for the material is taken as 200 MPa, below what length of the strut does the Euler formula ceases to apply?