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Total Number of Pages: 03

Course: B.Tech  
Sub\_Code: RCI5D002

5<sup>th</sup> Semester Regular/Back Examination: 2024-25

SUBJECT: Advance Mechanics of Material

BRANCH(S): Civil

Time: 3 Hours

Max Marks: 100

Q.Code: R016

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

**Part-I**

**Q1 Answer the following questions:**

**(2 x 10)**

- What is unsymmetrical bending? Mention two reasons for it.
- What is stress optic law?
- What do you mean by strain rosette?
- State maximum principal stress theory.
- Explain fatigue in materials.
- What is meant by the state of stress at a point?
- Explain the plane stress and strain with ONE example each.
- Explain what do you mean by theory of failure.
- Differentiate between thick and thin cylinders.
- What is notch sensitivity?

**Part-II**

**Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve) (6 x 8)**

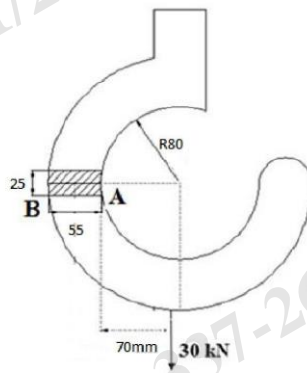
- A cantilever beam of length 3m is subjected to its own weight. The cross-section of the beam is angle-section with equal leg of 100 mm long and 10 mm thickness. Determine the maximum value of stress if the beam weighs 1.5 N/cm and the principal moment of inertia is  $284 \text{ cm}^4$  and  $74.1 \text{ cm}^4$ .
- Explain maximum principal strain theory and Tresca's theory.
- Derive the equation for radial & hoop stress developed in a thick cylinder subjected to both internal and external pressure for a plain stress case.
- Plot the variation of radial and hoop stress developed inside the cylinder subjected to only internal pressure.
- A thick-walled tube with an internal radius of 12 cm is subjected to an internal pressure of 200 MPa. ( $E = 2.1 \times 10^5 \text{ MPa}$  and  $\nu = 0.3$ ). Determine the optimum value of the external radius if the maximum shear stress developed is limited to 350 MPa.

- f) A shaft is subjected to a maximum torque of 14 kNm and a maximum bending moment of 10 kNm at a particular section. Determine the diameter of the shaft according to maximum shear stress theory if the elastic limit in simple tension is 180 MPa.
- g) A compound cylinder is formed by shrinking a cylinder of 240 mm internal diameter and 320 mm external diameter on a cylinder of 160 mm internal diameter and 240 mm external diameter. The shrinking pressure is 12 MPa. Determine the minimum temperature to which the outer cylinder must be heated to slip it over the inner cylinder.  $E = 205 \text{ GPa}$ ,  $\alpha = 6 \times 10^{-6}/^\circ\text{C}$ .
- h) A cantilever beam of rectangular cross-section is subjected to a concentrated load of 10 kN at free end. The length, breadth, and depth of beam are 1 m, 10 cm, and 15 cm respectively. The line of action of load makes  $30^\circ$  with vertical. Determine the maximum stress in the beam.
- i) A steel ring has a rectangular cross-section, 75 mm in the radial direction and 45 mm perpendicular to the radial direction. If the mean radius of the ring is 150 mm and maximum tensile stress is limited to  $180 \text{ MN/m}^2$ . Calculate the tensile load the ring can carry.
- j) Show five theories of failure graphically.
- k) Discuss on two-dimensional photo-elastic methods of stress analysis.
- l) Write short note (any one)  
 (i) Isoclinic and Isochromatic fringe patterns (ii) Resistance Strain gauge

### Part-III

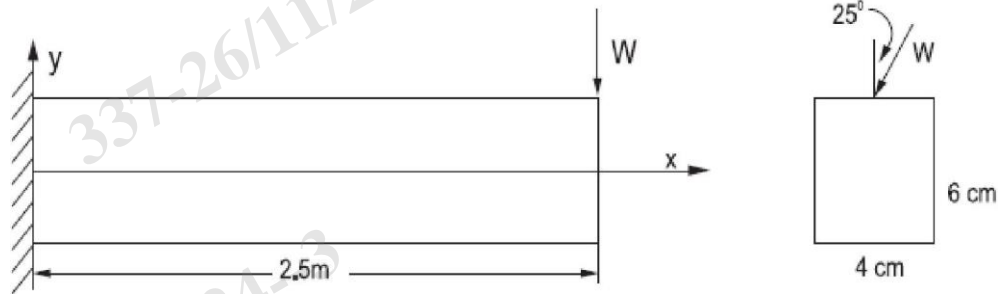
#### Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3 a) A crane hook of rectangular cross section 25 mm wide and 55 mm deep has an inner radius of curvature 80 mm. The load line is at 70 mm from the inside of the section. Determine the maximum fiber stress induced, if it carries a load of 30 kN. (13)



- b) Explain what do you mean by compound cylinder? (3)
- Q4 a) A thick cylinder with internal diameter 150 mm and external diameter 300 mm is fixed on the outer circumference. Determine the stresses at outside and inside surface if it is subjected to an internal fluid pressure of  $120 \text{ KN/mm}^2$ . Assume Poisson's ratio to be 0.3. (8)
- b) Define shear centre. Locate the shear centre of an unequal I section. (8)

- Q5** A cantilever of rectangular cross section of breadth 4 cm and depth 6 cm is subjected to an inclined load  $W$  at free end as shown in figure. The length of cantilever is 2.5 m and the angle of inclination of the load with vertical is  $25^\circ$ . What is the maximum value of  $W$  if the maximum stress due to bending is not to exceed  $200 \text{ N/mm}^2$  **(16)**



- Q6** a) Derive the equilibrium equations corresponding to three dimensional states of stress problems. Also derive the strain compatibility equations. **(12)**
- b) Explain light and dark field in a polariscope **(4)**