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Total number of printed pages – 3

B. Tech
PCME 4307(New)

Sixth Semester (Back) Examination – 2013
ADVANCED MECHANICS OF SOLIDS

BRANCH : MECH

QUESTION CODE : B 215

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any **five** from the rest.

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10
- (a) Define the deviatoric state of stress.
 - (b) What are stress invariants ?
 - (c) For ductile material which failure theory is considered and why ?
 - (d) State Castigliano's theorems.
 - (e) What do you mean by unsymmetrical bending ?
 - (f) Explain about shear centre.
 - (g) How a cylinder is defined thick or thin ?
 - (h) Give examples of repeated stress cycles.
 - (i) Define fracture toughness.
 - (j) List the use of composites ?
- 2 (a) The state of stress at a point is characterized by

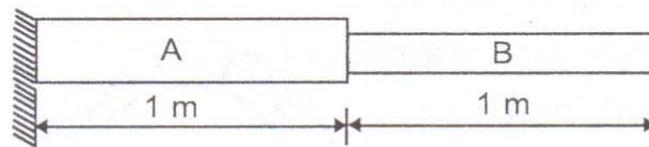
$$\tau_{ij} = \begin{bmatrix} 18 & 0 & 24 \\ 0 & -50 & 0 \\ 24 & 0 & 32 \end{bmatrix} \text{ MPa}$$

Determine the principal stresses and their directions.

5

P.T.O.

- b) The state of stress at a point is characterized by the components $\sigma_x = 100$ MPa, $\sigma_y = -50$ MPa, $\sigma_z = -50$ MPa, $\tau_{xy} = \tau_{yz} = \tau_{zx} = 100$ MPa. Determine the normal and shearing stresses on a plane which is equally inclined to all the three axes. 5
3. (a) The displacement field for a body is given by 5
- $$u = [(x^2 + y^2 + 4)i + (4x + 3y^2)j + (x^3 + 4z)k] 10^{-4}$$
- What is the displaced position of a point originally at (1,2,3)?
- (b) Briefly describe about different theories of failure. 5
4. (a) Using Castiglino's theorem, determine the deflection at the free end of the stepped cantilever beam as shown below. The cross-section of the stepped beam is 20 mm \times 30 mm (for section A) and 10 mm \times 15 mm (for section B). The Young's modulus of the beam material is 2.1×10^5 N/mm². 5



- (b) A cantilever beam of rectangular cross section 50 mm (width) \times 75 mm (depth) is subjected to an inclined load of 400 N at the free end. The inclination of the load is 30° to the vertical. The length of cantilever is 3 m. Find the direction of neutral axis and the maximum stress in the beam. Take $E = 2.0 \times 10^5$ MPa 5
5. (a) Write the assumptions made for bending of bars with large initial curvature. 2
- (b) A steel ring has a rectangular cross-section, 80 mm in the radial direction and 40 mm perpendicular to the radial direction. The mean radius of the ring is 160 mm. Calculate the maximum tensile and compressive stresses in the material of the ring if it is subjected to a pull of 18 kN. 8
6. (a) Give the general equations for circumferential and radial stress developed in thick cylinder. 2

- (b) A steel tube of 200 mm external diameter is to be shrunk on to another steel tube of 60 mm internal diameter. The diameter at the junction after shrinking is 120 mm. Before shrinking on, the difference of diameters at the junction is 0.08 mm. Calculate the radial pressure at the junction and the hoop stresses developed in the two tubes after shrinking on. Take Young's modulus of steel as 2.0×10^5 MPa. 8
7. (a) Explain fatigue failure under different loads. 5
(b) Describe about basic modes of fracture. How it is different from each other. 5
8. Write short notes on any **two** : 5×2
- (a) Types of composite materials
 - (b) Notch sensitivity
 - (c) Octahedral shear stress

