Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PCME 4307

Sixth Semester Examination – 2013

ADVANCE MECHANICS OF SOLIDS

BRANCH : MECHANICAL

QUESTION CODE : A 189

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 state of pure shear.

   (b) What are the importance of stress invariants ?

   (c) Name various yield criteria used in failure theory.

   (d) State Castigliano's theorems.

   (e) Give an example of cross-section of a beam for which unsymmetrical bending is impossible.

   (f) Define the importance of shear centre.

   (g) Give graphic representation of hoop stress and radial stress of a thick cylinder subjected to internal pressure.

   (h) Draw repeated and completely reversed stress cycles showing the salient features.

   (i) Define the notch sensitivity factor.

   (j) What are the advantages of composites ?

2. (a) The state of stress at a point is characterized by the components $\sigma_x = 10$, $\sigma_y = 2$, $\sigma_z = 6$, $\tau_{xy} = 4$, $\tau_{yz} = 6$, $\tau_{zx} = 8$ (in 1000 kPa units). Determine the principal stresses and their directions. 5

P.T.O.

(b) The state of stress at a point is characterized by the components $\sigma_x = 50$ MPa, $\sigma_y = -30$MPa $\sigma_z = 40$MPa, $\tau_{xy} = \tau_{yz} = \tau_{zx} = 0$. Determine

(i) the extremum values of the shear stress and its associated normal stress and

(ii) the octahedral shear stress and associated normal stress. 5

3. (a) The displacement field for a body is given by 5

$u = (x^2 + y)i + (3 + z)j + (x^2 + 2y)k$

Two points P and Q in the undeformed body have coordinates (0, 0, 1) and (2, 0, – 1) respectively. Determine the distance between P and Q after deformation.

(b) Explain about Maximum principal stress theory. How is it different from maximum shearing stress theory ? 5

4. (a) A cantilever beam of length L and constant flexural rigidity EI is loaded by a concentrated load W acting at the mid span. Determine by energy method the deflection and slope at the tip point of the beam considering only flexure. 5

b) A cantilever beam having a rectangular cross-section 30 mm (width) × 45 mm (depth) is subjected to an inclined load of 500 N at the free end. The inclination of the load is 30° to the vertical longitudinal plane and the line of action of the load passing through centroid of the section of the beam. The length of cantilever is 3 m. Find the position of neutral axis and the maximum stress in the beam. 5

5. (a) Write the assumptions made for bending of bars with large initial curvature. 2

(b) A steel crane hook has horizontal cross-section of trapezoidal section 4 cm wide at the inside, 1 cm wide at the outside, thickness 9 cm and centre of curvature 3 cm from the inside edge. It carries a vertical load of 20 kN whose line of action passes through the centre of curvature. Determine the maximum tensile and compressive stresses in the section. 8

6. (a) Deduce the general equations for circumferential and radial stress developed in thick cylinder. 5

(b) A thick cylinder of 160 mm and 240 mm internal external diameter respectively is subjected to an external pressure of 12 MPa. Determine the maximum value of internal pressure that can be applied if the maximum allowable stress is 36 MPa. Show the variation of the radial and circumferential stress developed in the material. 5

7. (a) What do you mean by the endurance limit of a material ? Describe about different types of loading causes fatigue with neat sketch. 5

(b) Describe about basic modes of fracture and explain the nature with neat sketch. How is it different from each other? 5

8. Write short notes on any **two** : 5×2

(a) Micromechanics of composite materials

(b) Fracture toughness

(c) Gerber and Soderberg criteria.