Registration No. :

Total number of printed pages – 4

Sixth Semester Regular Examination – 2014

ADVANCED MECHANICS OF SOLIDS

BRANCH : MECH

QUESTION CODE : F 257

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 stress invariant.

    (b) What are the different compatibility conditions ?

    (c) Name the various theories of failure.

    (d) State the theorem of virtual work.

    (e) How asymmetrical bending is different from symmetrical bending ?

    (f) State the importance of shear centre.

    (g) What is shrink fit ?

    (h) Define notch sensitivity.

    (i) Define fracture toughness.

    (j) Enumerate the advantages of composite materials.

2. (a) For the following stress matrix, determine the principal stresses and the directional cosines associated with the normal to the surfaces of each principal stress.   5

$$\tau_{ij} = \begin{vmatrix} 3 & 1 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 0 \end{vmatrix} \text{ Mpa}$$

P.T.O.

(b) The state of stress at a point is characterized by the components

$$\tau_{ij} = \begin{vmatrix} 20 & 0 & 0 \\ 0 & -15 & 0 \\ 0 & 0 & 25 \end{vmatrix} \text{ MPa}$$

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

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

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

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.   5

(b) Briefly describe about maximum normal stress and maximum shear stress theories of failure.   5

4. (a) A Simply supported beam of length 2L and constant flexural rigidity EI is loaded by a concentrated load 2W acting at the mid span. Determine by energy method the deflection of points at L/2 and L from left end of the beam considering only flexure.   5

(b) The rectangular beam of Fig. below (in zy plane) is subject to loads that create a bending moment of 3000 Kg-m acting in a plane oriented at 30° to the y-axis. Determine the peak tensile and compressive stresses in the beam.   5
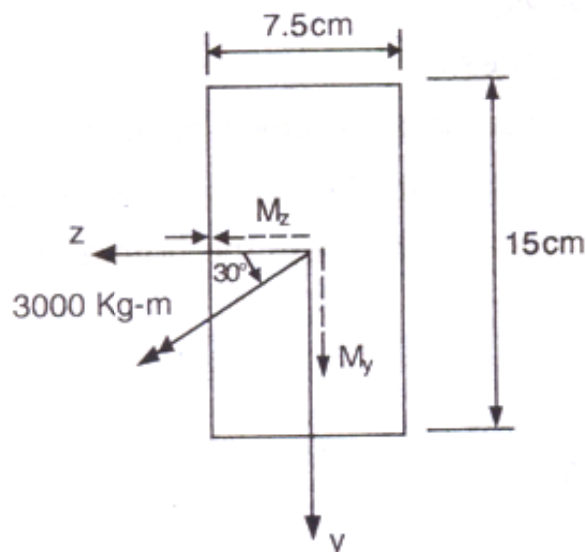
5. (a) For the crane hook made of steel shown below what should be the shape of the cross section at AB. Give the approximate proportion. 4

30kN

3cm

7cm
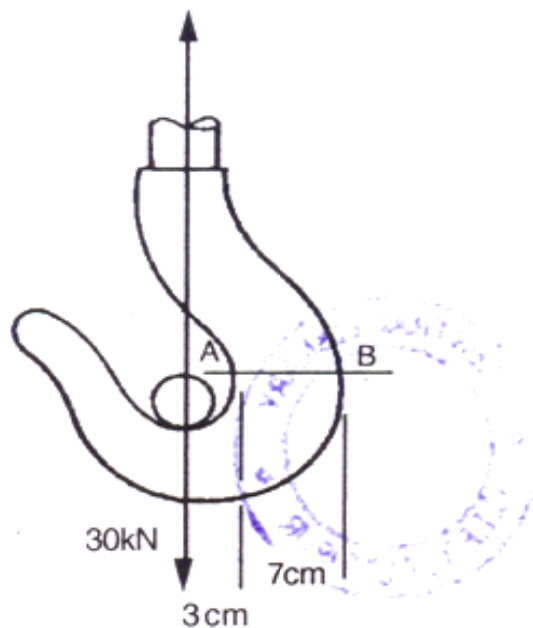
(b) Determine the shear center of the thin-walled section indicated in Figure below. The thickness t is constant throughout the beam. 6

20 mm

15 mm

25 mm

25 mm

15 mm

e

t

V
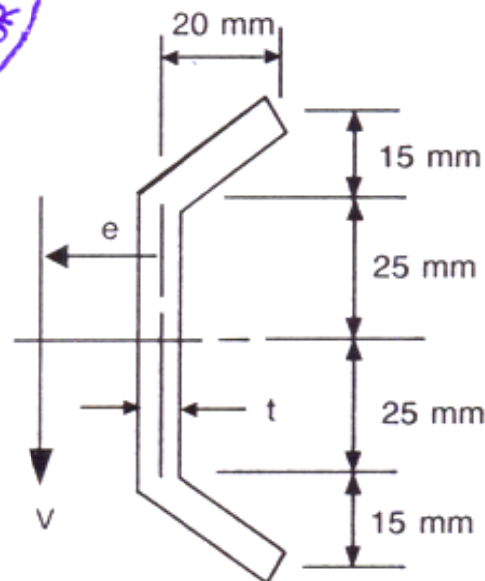
6. (a) Derive equations for circumferential and radial stress developed in thick walled cylinder under plane stress condition subjected to external and internal pressure. Assume proper symbols of the variables used. 5

(b) A thick-walled tube is subjected to an external pressure P_0. Its internal diameter 0.2 m and external diameter is 0.3m, the poisions ratio $v = 0.3$ and

$E = 2 \times 10^5$ MPa. If the maximum shear stress is limited to 200 MPa, determine the external pressure P_0 and also the change in external radius.

5

7. (a) What do you mean by the endurance limit of a material ? Describe about the different factors that affects the endurance limit. 5

   (b) Describe the properties of transversely isotropic and orthotropic materials ?

   5

8. Write short notes on any **two** of the following 5 × 2

   (a) Brief description of different types of laminates with figure.

   (b) Condition for deferent modes of fracture.

   (c) Castigliano's theorems