Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech**

PCME4307

6th Semester Regular / Back Examination 2015-16
ADVANCED MECHANICS OF SOLIDS
BRANCH: MECHANICAL
Time: 3 Hours
Max Marks: 70
Q.CODE: W319

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: **(2 x 10)**

a) The circumferential stress at the outer surface of a thick cylinder subjected to an internal fluid pressure of 600kg/cm^2 is 400kg/cm^2. What is the magnitude of circumferential stress at inner surface of the cylinder?

b) A close ring of mean diameter 100mm is subjected to two equal and opposite force of 5kN along a diameter. What is the magnitude of moment at a cross-section of ring located perpendicular to the line of action of force?

c) Write the formula to locate the neutral axis in the context of un-symmetrical bending.

d) Write differential equation of equilibrium in 3-dimension.

e) Explain Auto Frettage in context of Thick cylinder.

f) What are the factors that influence the fatigue strength of a component?

g) A plane is designated by its normal $n\left(1/\sqrt{3},\ 1/\sqrt{2},\ 1/\sqrt{6}\right)$. Determine the inclination of plane with y – axis.

h) Define principal axes in context of moment of inertia.

i) The normal strain at a point in x, y, z direction is 0.02, 0.06 & 0.03 respectively. The shear strain at the same point on x, y, z plane is -0.04, -0.02 & 0 respectively. Determine the cubical dilatation at the point.

j) State Maxwell's reciprocal relation.

Q2 **a)** The state of stress at a point is characterized by the components $\sigma_x = 12.31,\ \sigma_y = 8.96,\ \sigma_z = 4.34,\ \tau_{xy} = 4.2,\ \tau_{yz} = 5.27\ and\ \tau_{xz} = 0.84$. Determine the values of principal stresses and the direction of maximum principal stress. **(5)**

b) Determine the normal and shear stresses on octahedral plane for the state of stress given in question 2(a) **(5)**

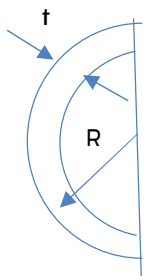
Q3 The displacement field for a body is given by $\left[\left(x^2 + y\right)i + \left(y + z\right)j + \left(x^2 + 2z^2\right)k\right]10^{-3}$. Determine displacement gradient matrix at a point P(2, 2, 3). If PQ and PR are two line segments having direction cosines as $PQ\left(1/\sqrt{3},\ 1/\sqrt{3},\ 1/\sqrt{3}\right), PR\left(1/\sqrt{2},\ 1/\sqrt{2},\ 0\right)$, determine the change in angle between PQ and PR. **(10)**

Q4 **a)** An electrical contact material is produced by infiltrating copper into a porous tungsten carbide compact(WC).The density of WC is 15.77Mg/m^3 and that of the final composite is 12.3Mg/m^3. Assuming that all of the pores are filled with copper, and given density of copper as 8.94Mg/m^3, Calculate the volume fraction of copper in composite, the volume fraction of WC in composite and the original density of WC. **(5)**

b) An off-shore drilling platform has a steel sheet 30mm thick 10m wide and 20m long. The sheet is subjected to a tensile stress in the direction of its length. The fracture toughness of the material is 28.5MPa$\sqrt{m}$. The sheet has a 60mm long central transverse crack. Calculate the tensile stress for fracture failure. If the yield strength of the material is 240 MPa. How does the failure stress compare with it? The plate may be assumed as infinite plate having the crack centrally. **(5)**

Q5 **a)** 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 100mm long and 10mm thickness. Determine the maximum value of stress if the beam weighs 1.5N/cm and the principal moment of inertia is 284cm^4 and 74.1cm^4. **(5)**

b) Locate the shear centre for the section shown below. **(5)**



Q6 **a)** A cantilever beam of length 2m has square cross-section of 30mm side for 0.75m from free end and circular cross-section of 50mm diameter for remaining portion. It is subjected to a load of 20kN at free end. Determine the deflection of the beam at a point 1m from the free end. Take Young's modulus as 210GPa. **(5)**

b) Determine the end moments for a beam of length L, fixed at both the ends and subjected to a concentrated load P, at mid-span of the beam. **(5)**

Q7 **a)** A thick steel cylinder with internal diameter of 10cm and external diameter of 20cm is fixed on the outer circumference. Determine the stress at inside and outside surfaces if it is subjected to an internal fluid pressure of 10N/mm^2. **(5)**

b) A cantilever beam of rectangular cross-section is subjected to a concentrated load of 10kN at free end. The length, breadth and depth of beam are 1m, 10cm and 15cm respectively. The line of action of load makes 30^{0}with vertical. Determine the maximum stress in the beam. **(5)**

Q8 **a)** The 40cm side of a rectangular area (40x20cm)makes 30^0 with horizontal. Determine the moment of inertia of the area about a horizontal axis at a distance 30mm from its centroid. **(5)**

b) A rod of circular cross-section is subjected to an alternating tensile force, varying from 20kN to 70kN. Determine the diameter of the rod according to Goodman and Soderberg method. The ultimate and yield strength of rod material are 1000 MPa and 550MPa respectively. **(5)**