Exam. Code: 0940
Sub. Code: 33856

2015
B.E. (Mechanical Engineering)
Fourth Semester
MEC-402: Mechanics of Solids

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part. Use usual notations and symbols for derivations. Assume suitably missing data if any. All questions carry equal marks.***

x-x-x

Q.1 Provide brief and clear answers to the following:

a. Give the expression for shear stress in a closed thin walled tube under torsion.
b. What is the value of moment of inertia when the product of inertia is zero.
c. Write the expression for the eccentricity of the neutral axis for a curved beam in pure bending.
d. Provide the expression for the complementary energy for a linear elastic cable.
e. Write the expression between critical stress and slenderness ratio.

Part A

Q.2 Strains for a state of plane stress are given by ε_x=-90μ, ε_y=-30μ, and γ_{xy}=120μ. If the elastic constants for the structure are E=209 GPa and ν=0.29, determine the complete strain and stress matrices.

Q.3 Determine the stress fields that arise from the following stress functions:

$$\Phi = Cy^2,$$

$$\Phi = Ax^2 + Bxy + Cy^2,$$

$$\Phi = Ax^3 + Bx^2y + Cxy^2 + Dy^3,$$

where A, B, C, and D are constants. Also suggest what states of stress the functions are suitable for. In addition check if the compatibility is satisfied.

Q.4 Determine the stress distribution in a thick walled cylinder with an inner diameter of 50mm and outer diameter of 150mm with $p_i = 35$MPa and $p_o = 0$.

Part B

Q.5 Consider a cantilever beam of length $L = 1$m with a concentrated load $P = 500$N applied at a distance $b = 0.2$m from the free end. Taking the stiffness of the beam $EI = 10 \times 10^4$N-m^2, determine the vertical deflection of the free end.

Q.6 Estimate the torque on a 10mm diameter steel shaft when yielding begins using (a) the Tresca and (b) the von Mises theory. The yield strength of steel is 140MPa.

Q.7 A three element rectangular rosette strain gage is mounted on a steel specimen. For a particular state of loading of the structure the strain gage readings are $\epsilon_A = 200\mu$, $\epsilon_B = 900\mu$, and $\epsilon_C = 1000\mu$. Determine the values and orientations of the principal stresses and the value of the maximum shear stress at the point. Let $E = 200$ GPa and $\nu = 0.285$.

x-x-x