Exam. Code: 0940
Sub. Code: 6712

2054
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. What alloy is commonly used in making resistance strain gages? Give its most useful property.
b. What is stress concentation?
c. A piece of chalk is twisted. At what angle to the axis of the shaft does the chalk fracture? Why?
d. Write the equilibrium equations for a stress cube.
e. What is Castigliano's first theorem? Explain.

Part A

Q.2 Strains for a state of plane stress are given by $\varepsilon_x = -90\mu$, $\varepsilon_y = -30\mu$, and $\gamma_{xy} = 120\mu$. If the elastic constants for the structure are E=209 GPa and ν=0.29, determine the complete strain and stress matrices.

Q.3 A point in a state of plane stress is isolated by three surfaces as shown in Figure 1. Using the transformation equations determine the values of σ and τ.

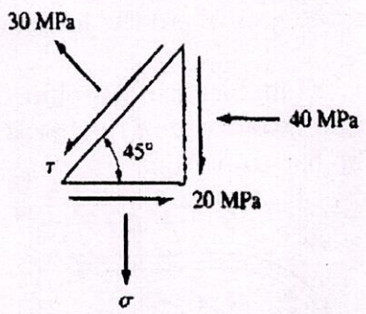

Figure 1

Q.4 Using the stress function

$$\Phi = Axy + Bx^2 + Cx^2y + Dy^3 + Exy^3 + Fx^2y^3 + Gy^5,$$

obtain the stress field for the simply supported beam shown in Figure 2. Compare the results with the elementary mechanics of materials formulation.

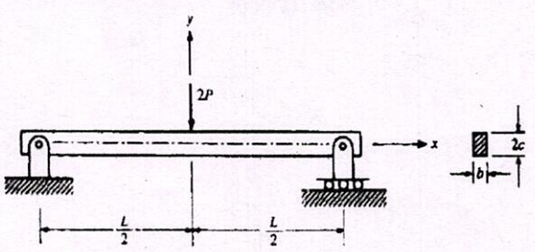

Figure 2

P.T.O.

Part B

Q.5 Referring to the composite bar shown in Figure 3 let the force P be applied through the geometric centroid as shown. In terms of P, E_s, E_a, a, and t determine (a) the net bending moment transmitted by the cross section and (b) the maximum normal stresses in the aluminum and steel. Assume E_a=70 GPa, and E_s=210 GPa.

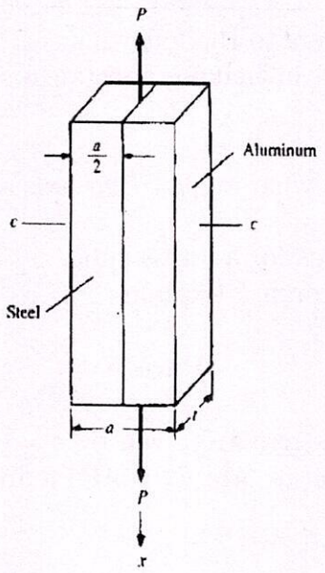

Figure 3

Q.6 For the wire form shown in Figure 4 the sectional rigidity is EI. Using Castigliano's method determine the change in the gap where the loads are applied. Consider the effect of bending only.

Q.7 A long slender bar of rigidity EI and length L is pinned at each end to a very rigid foundation. If the coeffiecient of thermal expansion of the bar is α, determine the increase in temperature ΔT which will cause the bar to buckle.

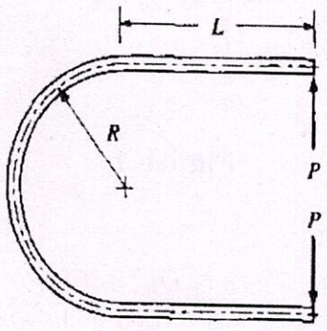

Figure 4

x-x-x