Exam.Code:0940
Sub. Code: 7096

2062

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. Assume suitable missing data if any. Use usual notations and symbols for derivations. 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 some of its properties.
b. What is the Rayleigh-Ritz method?
c. A circular shaft made of cast iron. What angle does the fracture surface make with respect to the axis of the shaft at the time of failure? Explain briefly.
d. What is a Wheatstone bridge? How is it used with strain gages?
e. What is the virtual force method? Explain briefly.

Part A

Q.2 Determine the stress fields that arise from the following stress functions:

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

where A, B, C, and D are constants. Also suggest what states of stress the functions are suitable for.

Q.3 Determine the location of the neutral axis and the eccentricity e for the curved bar of rectangular cross section shown in the Figure 1. With $M = 250\text{N}\cdot\text{m}$ determine the tangential stress at the inner and outer radius.

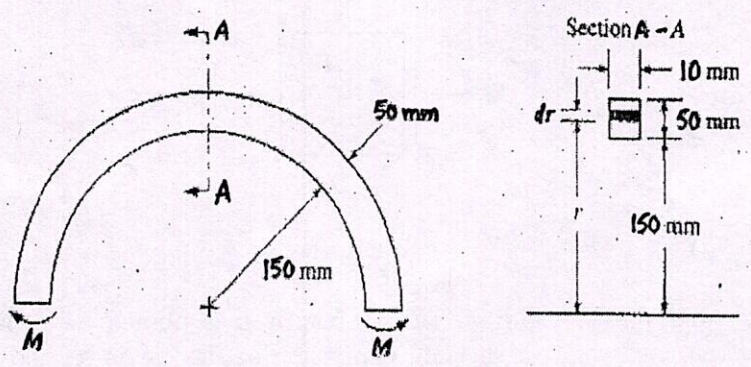

Figure 1

P.T.O.

Q.4 Using Castigliano's theorem, determine the reactions at A and B of the beam shown in Figure 2.

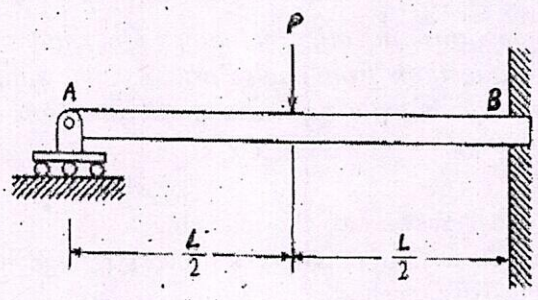

Figure 2

Part B

Q.5 Figure 3 shows a round shaft of diamter 1.5 in loaded by a bending moment $M_z = 5000$ lbf $\cdot$ in, a torque $T = 8000$ lbf $\cdot$ in, and an axial tensile force $N = 6000$ lbf, If the material is ductile with a yield strength $S_Y = 40,000$ lbf/in^2, determine the factor of safety corresponding to failure by yielding using the Tresca theory and the von Mises theory.

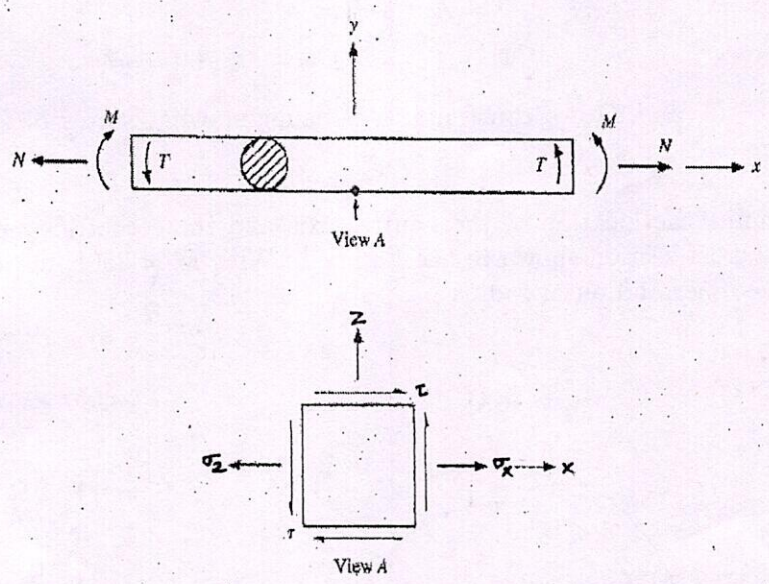

Figure 3

Q.6 A long slender bar of rigidity EI and length L is pinned at each end to a very rigid foundation. If the coefficient of thermal expansion of the bar is α, determine the increase in temperature ΔT which will cause the bar to buckle.

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 $E = 200\text{GPa}$ and $\nu = 0.285$.

x-x-x