Exam.Code:1014
Sub. Code: 35206

2125
M.E. (Mechanical Engineering)
First Semester
MME-103: Advanced Mechanics of Materials

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

***NOTE:** Attempt five questions in all, selecting atleast two questions from each part. Assume suitably the missing data, if any. Use usual notations and symbols for derivations. All questions carry equal marks.*

x-x-x

Part A

Q.1 A welded plate carries the uniform bi-axial tension illustrated in Figure 1. Determine the maximum stress for two cases: (a) The weld has an allowable *shear* stress of 30 MPa. (b) The weld has an allowable *normal* stress of 80 Mpa.

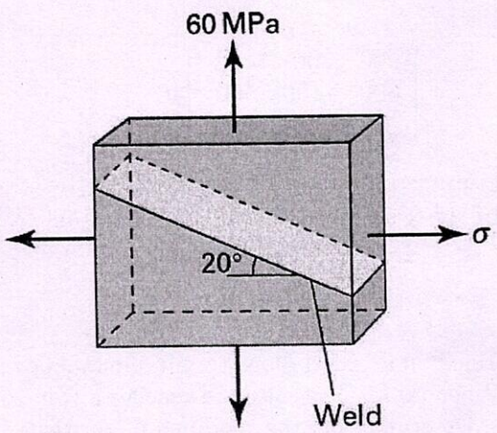

Figure 1

Q.2 The stress at a point in a machine component relative to a x, y, z coordinate system is given by:

$$\begin{bmatrix} 100 & 40 & 0 \\ 40 & 60 & 80 \\ 0 & 80 & 20 \end{bmatrix} \text{MPa.}$$

Referring to the parallelpiped shown in Figure 2, calculate the normal stress σ and the shear stress τ at point Q for the surface parallel to the following planes: (a) CEBG (b) ABEF (c) AEG

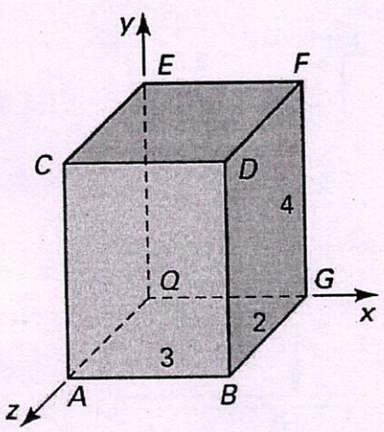

Figure 2

Q.3 Rectangle ABCD is inscribed on the surface of a member prior to loading, see Figure 3. Following the application of the load, the displacement field is expressed by

$$u = c(2x + y^2), \qquad v = c(x^2 - 3y^2),$$

Contd.....P/2

where $c = 10^{-4}$. Subsequent to the loading, determine (a) the length of the sides AB and AD; (b) the change in the angle between the sides AB and AD; and (c) the coordinates of point A.

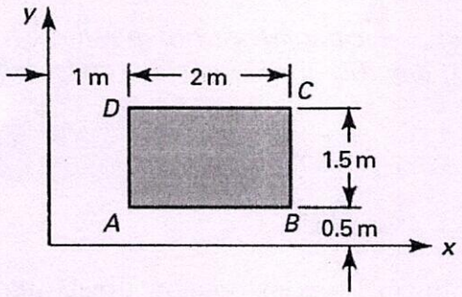

Figure 3

Q.4 At a point in a stressed body, the strains, related to the coordinate set xyz, are given by:

$$\begin{bmatrix} 200 & 300 & 200 \\ 300 & -100 & 500 \\ 200 & 500 & -400 \end{bmatrix} \mu$$

Determine (a) the strain invariants; (b) the normal strain in the x' direction, which is directed at an angle $\theta = 30°$ from the x axis; (c) the principal strains ϵ_1, ϵ_2, and ϵ_3; and (d) the maximum shear strain.

Part B

Q.5 A tensile test is performed on a 12mm diameter aluminum alloy specimen ($\nu = 0.33$) using a 50mm gage length. When an axial tensile load reaches a value of 16kN, the gage length has increased by 0.10mm. Determine (a) the modulus of elasticity (b) the decrease Δd in diameter and (c) the dilatation of the bar.

Q.6 A 45° rosette is used to measure strains at a critical point on the surface of a loaded beam. The readings are ϵ_a=-100μ, ϵ_b=50μ, and ϵ_c=100μ for θ_a=0°, θ_b=45°, and θ_c=90°. Calculate the principal strains and stresses and their directions. Use E=200GPa and ν=0.3.

Q.7 Three bars of successively larger volume are to support the same load P, see Figure 4. Note that the first bar has uniform cross-sectional area A over its lenght L. Neglecting stress concentrations, compare the strain energy stored in the three bars.

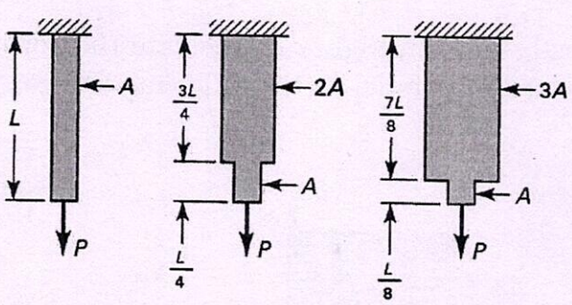

Figure 4

Q.8 The built-in beam shown in Figure 5 is supported at one end by a spring of constant stiffness k. Determine the redundant reaction.

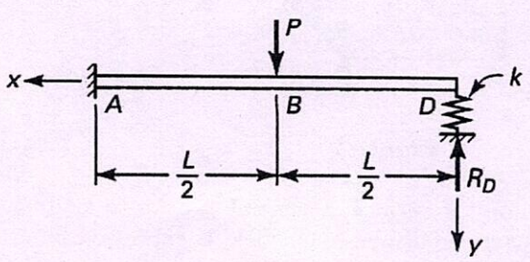

Figure 5