Exam.Code:1014
Sub. Code: 7442

2123

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 Two prismatic bars of a by b rectangular cross section are glued together as shown in Figure 1. The allowable normal and shearing stresses for the glued joint are 700 kPa and 560 kPa, respectively. Assuming that the strength of the joint controls the design, what is the largest axial load P that may be applied? Use $\phi = 40°$, $a = 50$ mm, and $b = 75$ mm.

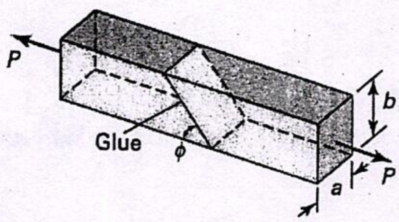

Figure 1

Q.2 The state of stress in a machine member is shown in Figure 2. The allowable compressive stress at the point is 14 MPa. Determine (a) the tensile stress σ_x and (b) the maximum principal and maximum shearing stresses in the member. Sketch the result on properly oriented elements.

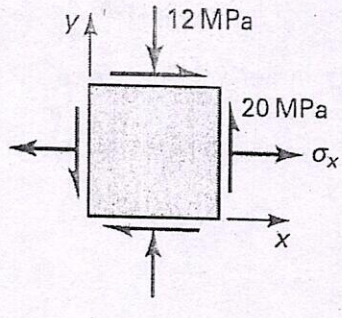

Figure 2

Q.3 Find the normal and shearing stresses on an oblique plane defined by $l = \sqrt{\frac{3}{13}}$, $m = \sqrt{\frac{1}{13}}$,

Contd.....P/2

and $n = \sqrt{\frac{9}{13}}$. The principal stresses are $\sigma_1 = 35\,\text{MPa}$, $\sigma_2 = -14\,\text{MPa}$, and $\sigma_3 = -28\,\text{MPa}$.

If this plane is on the boundary of a structural member, what should be the values of the surface forces p_x, p_y, and p_z on the plane?

Q.4 A 16 mm × 16 mm square $ABCD$ is sketched on a plate before loading. Subsequent to loading, the square becomes a rhombus illustrated in Figure 3. Determine (a) the modulus of elasticity, (b) Poisson's ratio, and (c) the shear modulus of elasticity.

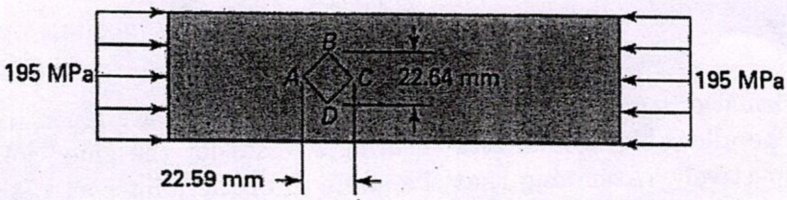

Figure 3

Part B

Q.5 The strain readings from a 60° rosette at point A shown in Figure 4 are $\varepsilon_a = 900\mu$, $\varepsilon_b = 340\mu$, and $\varepsilon_c = -80\mu$. Find the magnitude and directions of the pricipal strains.

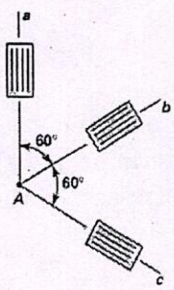

Figure 4

Q.6 Three bars of successively larger volume are to support the same load P (see Figure 5). Note that the first bar has a uniform cross-sectional area A over its entire length L. Neglecting stress concentrations, compare the strain energy stored in the three bars.

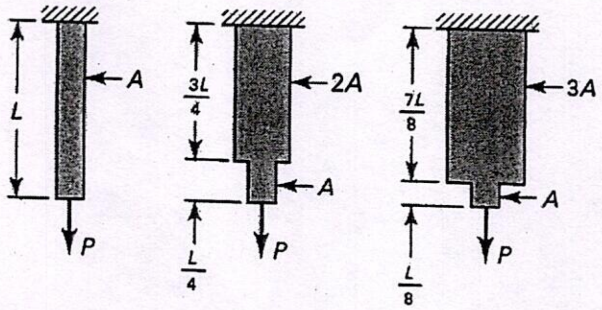

Figure 5

Q.7 A beam is supported and loaded as illustrated in Figure 6. Use Castigliano's *second* theorem to determine the reactions.

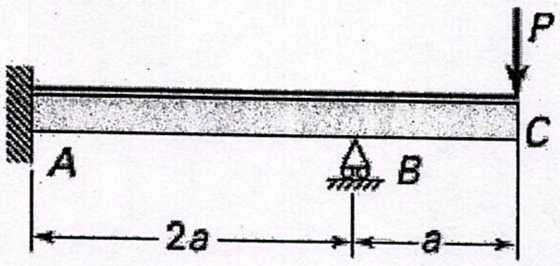

Figure 6

Q.8 Apply Castigliano's *first* theorem to compute the force P required to cause a vertical displacement $\Delta_v = 5\,\text{mm}$ in the hinge-connected structure depicted in Figure 7. Let $\alpha = 45°$, $L_0 = 3\,\text{m}$, and $E = 200\,\text{GPa}$. The area of each member is $6.25 \times 10^{-4}\,\text{m}^2$.

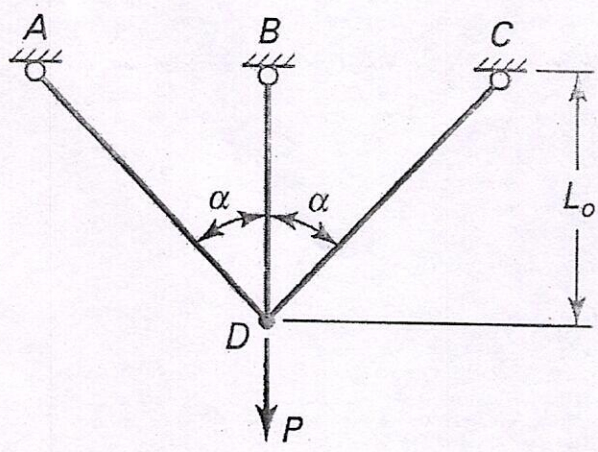

Figure 7

x-x-x