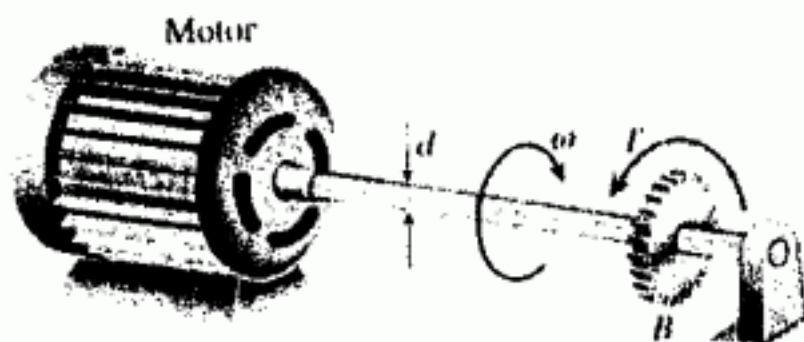
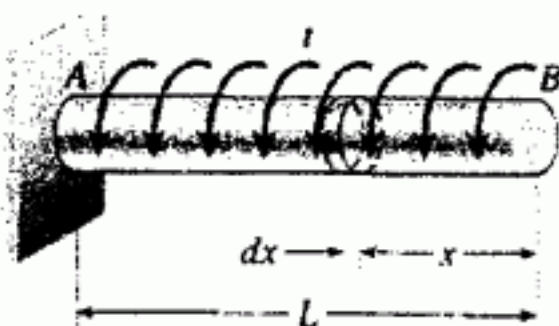


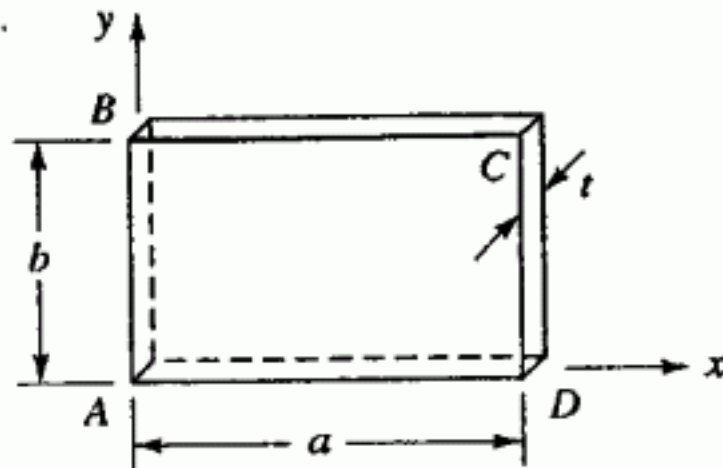
1. A motor driving a solid circular steel shaft transmits 30,000 Watts to a gear at B . The allowable shear stress in the steel is 42 MPa. What is the required diameter d of the shaft if it is operated at 5000 rpm. (15%)



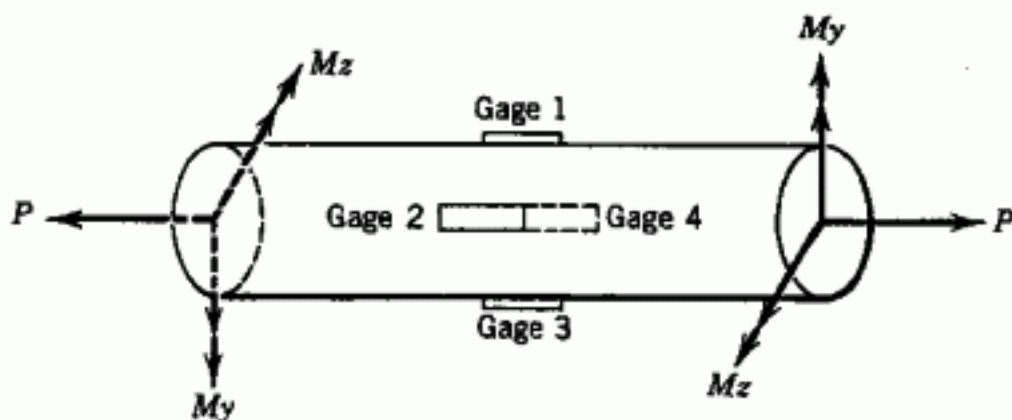
2. A prismatic bar AB , fixed at one end and free at the other, is loaded by a distributed torque of constant intensity t per unit distance along the axis of the bar. Derive a formula for the strain energy of the bar. (15%)



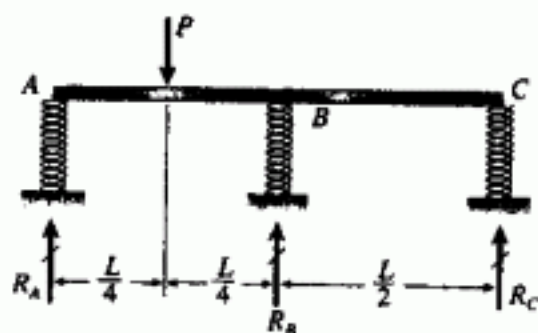
3. A bronze rectangular plate ($E = 100 \text{ GPa}$, $\nu = \frac{1}{3}$) is subjected to uniform stresses $\sigma_x = 150 \text{ MPa}$ and $\sigma_y = -90 \text{ MPa}$ along its edges. If it has a length $a = 100 \text{ mm}$, width $b = 50 \text{ mm}$, and thickness $t = 10 \text{ mm}$ prior to loading, calculate subsequent to loading : (a) the dimensions a , b , and t ; (b) the length of diagonal AC . (15%)



4. Four strain gages are mounted at 90° intervals around the circumference of a 100-mm-diameter steel ($E = 210 \text{ GPa}$, $\nu = \frac{1}{3}$) bar as shown. As a result of axial and flexural loadings the four gages indicate longitudinal strains of $\epsilon_1 = -200\mu$, $\epsilon_2 = 820\mu$, $\epsilon_3 = 600\mu$, and $\epsilon_4 = -420\mu$. Determine the axial load P and the two moments M_y and M_z . (20%)



5. A beam ABC rests on three identical spring supports A , B , and C . The flexural rigidity of the beam is $EI = 8 \times 10^6 \text{ N}\cdot\text{m}^2$, the stiffness k of each spring is $75 \times 10^6 \text{ N/m}$, the length L of the beam is 4 m , the load P is 32 kN . Determine the reactions R_A , R_B , and R_C , also draw the shear-force and bending moment diagrams for the beam. (20%)



6. A truss ABC supports a load W at joint B . The length L_1 of member AB is fixed, but the length of strut BC varies as the angle θ is changed. Strut BC has a solid circular cross section, assuming that collapse occurs by Euler buckling of the strut, determine the angle θ for minimum weight of the strut. (15%)

