1. A simple beam $AB$ of I-shaped cross section is loaded as shown in Figure 1. Figure 1(a) is loads diagram. Figure 1(b) is the cross section view. (25%)
   (a) Draw the shear and moment diagrams then determine.
   (b) The maximum shear stress $\tau_{\text{max}}$.
   (c) The shear stress $\tau_{CP}$ in the joint between the flange and the web ($CD$ section) at point $E$ located at distance 4 meters from $A$.
   (d) The maximum bending stresses (both tension side $\sigma_{\text{max}}^{t}$ and compression side $\sigma_{\text{max}}^{c}$).

![Figure 1](image1)

2. Pin-connected members $ADB$ and $CD$ carry a load $W$ applied by a cable-pulley arrangement, as shown in Figure 2. (20%)
   Determine
   (a) The components of the reactions at $A$ and $C$.
   (b) The axial force, shear force, and moment acting on the cross-section at point $G$.
   Given: The pulley at $B$ has a radius of 150 mm. Load $W = 1.6$ kN.

![Figure 2](image2)
3. What is the major difference between beam and column? (5%)

4. A simple beam $AB$ loaded by a couple $M_0$ at the right-hand support is shown in figure 4.
   (25%)
   
   (a) Evaluate the strain energy of the beam from the bending moment in the beam.
   
   (b) Determine the angle of rotation $\theta_B$ by applying Castigliano’s theorem to the strain energy obtained in solution of (a).
   
   (c) Determine the angle of rotation $\theta_A$ by applying Castigliano’s theorem.

![Figure 4](image)

5. A cantilever beam of length $2L$ is loaded by a concentrated load $P$ acting at the free end. The beam is supported at $B$ by a linearly elastic spring with stiffness $k$. Please note that there exists a prescribed gap $\Delta$ between the support $B$ and the beam. (25%)

   (a) Let $k = 6EI/L^3$. Use the method of superposition to solve for all reactions.

   (b) What are the reactions when $k \to \infty$

![Figure 5](image)