Mid-term Exam 2

1. A beam has a roller support at A and a sliding support at B. The sliding support permits vertical movement but no rotation. Use the load differential equation $EIv(x)'' = -q(x)$ to obtain: (i) the deflection $v(x)$ of the beam, (ii) the deflection $\delta_B$ at end B. (20%)

![Beam with roller and sliding support](image1)

2. A propped cantilever beam is loaded by a counterclockwise moment $M_O$ acting at support B. (i) Use the shear force differential equation $EIv(x)''' = V(x)$ to obtain the deflection $v(x)$ of the beam. (ii) Calculate the reaction forces and moments at supports A and B. (20%)

![Beam with propped and moment](image2)

3. Use the moment-area method to determine the angles of rotation $\theta_A$ and $\theta_B$ at the ends and the maximum deflection $\delta_{\text{max}}$ at midspan. (20%)

![Beam with concentrated loads](image3)

4. (i) Determine the strain energy $U$ stored in the beam due to the two concentrated loads $P$. (ii) Use the strain energy method to find the deflection $\delta$ under the load $P$. (20%)

![Beam with concentrated loads](image4)
5. Two identical simply supported beams AB and CD are supported so that they are cross each other at their midpoints. Before the uniform load is applied, the beams just touch each other at the crossing point. Determine the reaction forces at the supports A, B, C and D. (20%) Gere 10.4-16

6. A cantilever beam AB of length L and height h is subjected to a temperature change varying linearly between the top and bottom of the beam. Let the temperature at the top be $T_1$ and at the bottom be $T_2$ ($T_1 > T_2$). Before the temperature changes, a small gap $\Delta$ exists between end B and the top of a spring (stiffness k). If the deflection of end B is greater than $\Delta$, compute the force in the spring. (20%)

Useful formulas

$$ v = -\frac{Px^2}{6EI} (3a-x), \quad 0 \leq x \leq a $$

$$ v = -\frac{Pbx}{6LEI} (L^2 - b^2 - x^2), \quad 0 \leq x \leq a $$

$$ v = -\frac{qx}{24EI} (L^3 - 2Lx^2 + x^3) $$