Chapter 3
1. Derive an equation for the speed and height as a function of time.

2. Find the equivalent inertia on shaft 2 \( I_{2e} \) and the angular acceleration \( \dot{\omega}_2 \) if
   \( I_1 = 0.3 \text{ kg m}^2 \), \( I_2 = 0.5 \text{ kg m}^2 \), shaft 1 rotates 3 times faster than shaft 2, \( T_1 = 0.5 \text{ N m} \), \( T_2 = -0.3 \text{ N m} \).

3. Answer the questions below for the rack and pinion shown. \( I \) is the inertia of the gear and take \( I_s \) as the inertia of the shaft.
   A) Write the equation for the total kinetic energy.
   B) Find the equivalent inertia.
Chapter 4

1. Find the transfer function $X(s)/Y(s)$ for the following system.

2. Find the transfer function $X(s)/Y(s)$ for the following system.

3. Find the natural frequency oscillation for the following:
4. Find the equation for the natural frequency of oscillation for the following: Neglect mass of the pulley.

5. Find the equations of motion for $x_1$ and $x_2$. Take $x_2 > x_1$

6. Neglect friction and find the transfer function of $X(s)/Y(s)$