Question 2:

Determine the equation of motion of the system from Newton’s Second Law. Assume mass \( m = 5 \text{ kg} \) and spring constant \( k = 500 \text{ N/m} \). Find the initial displacement, \( x_0 \), such that the mass oscillates over a total range of 4 m. Assume the initial perturbation velocity, \( v_0 \), is 10 m/s.

\[
2C = 4m = 2 \sqrt{\frac{v_0^2}{\omega_n^2} + x_0^2} = 2 \sqrt{\frac{100^2}{100} + 1.73^2}
\]

\[
2 = 1 + x_0^2
\]

\[
x_0 = 1.73 \text{ m}
\]