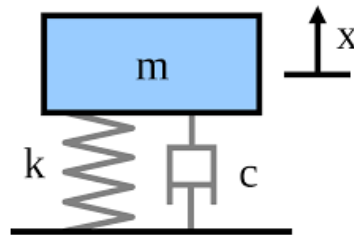# ENME 351: Single/Two Degree of Freedom Second Order Time Invariant Ordinary Homogenous/Non homogenous Differential Equations

SP2 – Modeling & Analysis

Part I

$$m\ddot{x} + c\dot{x} + kx = 0$$
$$\ddot{x} + 2\zeta w_n \dot{x} + w_n^2 x = 0$$
$$x(0) = x_0 \ \ and \ \ \dot{x}(0) = v_0$$

Consider the differential equation of motion given above:
1. Determine solutions for four cases given below:
   $$\zeta = 0; \quad 0 < \zeta < 1; \quad \zeta = 1; \quad \zeta > 1$$
2. Illustrate the cases using numerical values:
   All units in metric: m in kg; k in N/m; c in Ns/m x_o=0.1m; v_o = 10 m/s; m=2 kg; k=8 N/m
   Cases: c=0; c=1Ns/m; c=8 Ns/m; c=20 Ns/m
3. Implement MATLAB code and plot the time response.

Part II
Consider the system given below. Plot the displacement X_1 and X_2 of the two masses for the given parameters using SIMSCAPE and SIMULINK. Analyze the system by varying the variables. Assume F(t) is a unit step function.