Questions

Tower – MATLAB and Simulink

Que 1.	Tower – Simulink	Block – Math Modeling

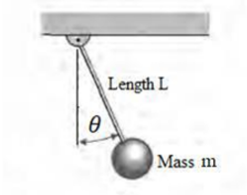
The dynamics of the suspension of a vehicle are defined by this equation:

$$\ddot{y}(t) = -\frac{C_D}{M}\dot{y}(t) - \frac{C_s}{M}y(t)$$

Create a Simulink model of the system and simulate it with a stop time of 15 seconds.
Use these parameters and initial conditions:
M = 1 Kg, C_D = 1 $\frac{N-s}{m}$, $y_0 = 0\,m$, C_s = 2 $\frac{N}{m}$, $\dot{y}_0 = 0\,m$

Que 2.	Tower – Simulink	Block – Math Modeling

Consider the pendulum oscillator shown in Figure. The torque on the mass is T = $mgLsin\theta$ where g is the gravitational constant. The equilibrium condition for the mass is θ_0 = 0°. This approximation is reasonably accurate for — pi/4 <θ < pi/4.
Create a Simulink model for the Pendulum Oscillator considering the above conditions.



Equation –

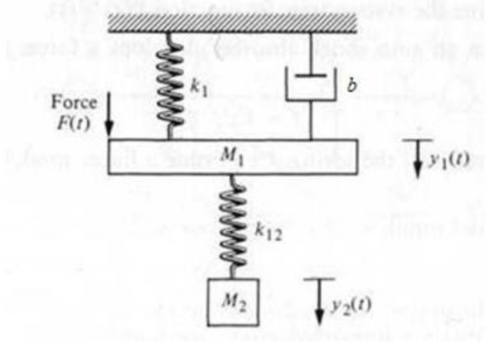
$$I0\ddot{\theta} + mgL\theta = T_{in}$$

Where,
$m=1Kg$, I_0 = 0.088 $Kg.m^2$, L =0.43m, g = 9.81 m/s^2

Que 3.	Tower – Simulink	Block – Math Modeling

Dynamic Vibration Absorbers are based on the concept of attaching a secondary mass to a primary vibrating system such that the secondary mass dissipates the energy and thus reduce the amplitude of vibration of the primary mass system.

In the given figure, the primary system is assumed to be a damped single-degree-of-freedom system of mass M_1, stiffness k_1 and damper b. The secondary system (Neutralizer) consists of mass M_2 attached to the primary system using a spring of stiffness k_{12}. The primary system is subjected to harmonic excitation F(t) = 1*sin(2*t). Develop a Simulink Model of dynamic vibration absorber based on the given equations and data below.



Equation-

$$M_1 \frac{d^2 y_1}{dt^2} + k_{12}(y_1 - y_2) + b\frac{dy_1}{dt} + k_1 y_1 = F(t)$$

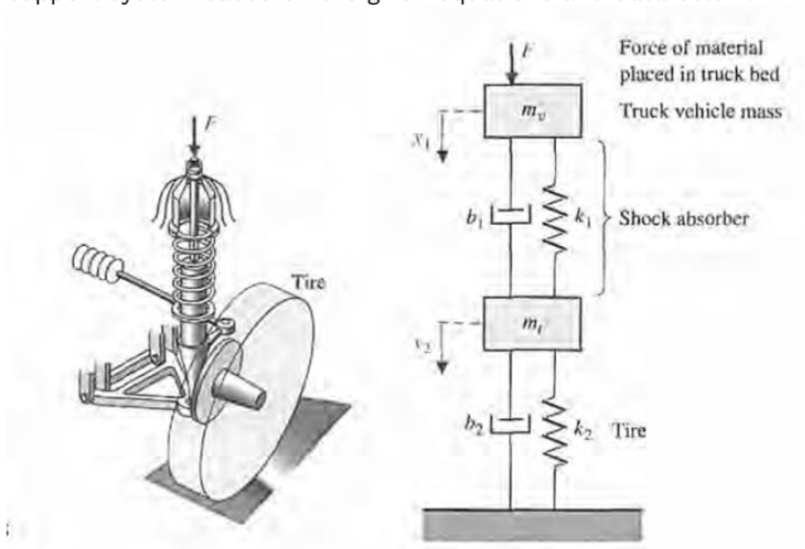
$$M_2 \frac{d^2 y_2}{dt^2} + k_{12}(y_2 - y_1) = 0$$

Where,

M_1 = 20 Kg, M_2 = 200 Kg, k_1 = 100 N/m, b = 100 N-s/m

Que 4.	Tower – Simulink	Block – Math Modeling

A load added to a truck result in a force *F* on the support spring, and the tire flexes as shown in Figure. The model for the tire movement is shown in Figure. Develop a Simulink Model of truck support system based on the given equations and data below.



➢ **Equation-**

$$m_v \frac{d^2x_1}{dt^2} = F - k_1(x_1 - x_2) - b_1 \frac{d}{dt}(x_1 - x_2)$$

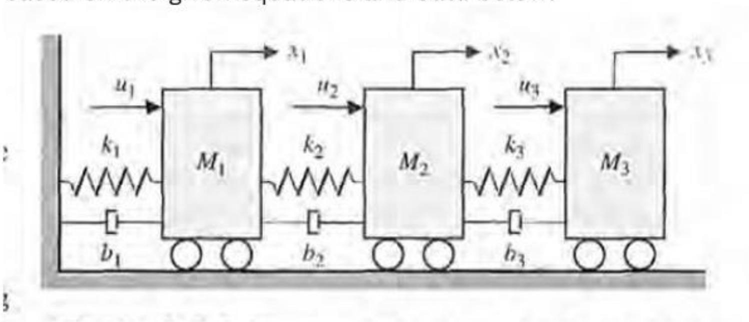
$$m_t \frac{d^2x_2}{dt^2} = k_1(x_1 - x_2) + b_1 \frac{d}{dt}(x_1 - x_2) - k_2x_2 - b_2 \frac{d}{dt} x_2$$

$Where,$

$$m_v = 2500\ kg, m_t = 200\ kg, k_1 = 80 \frac{kN}{m}, k_2 = 500 \frac{kN}{m}, b_1 = 350\ N.\frac{s}{m}, b_2 = 15020\ N.\frac{s}{m}$$

Que 5.	Tower – Simulink	Block – Math Modeling

For the three-cart system illustrated in Figure, obtain the equations of motion. The system has three inputs u_1, u_2 and u_3 and three outputs x_1, x_2 *and* x_3. Obtain three second-order ordinary differential equations with constant coefficients. Develop a Simulink Model of three cart system based on the given equations and data below.



- **Equation-**

1. $M_3\frac{d^2x_3}{dt^3} + b_3\frac{dx_3}{dt} + k_3x_3 = u_3 + b_3\frac{dx_2}{dt} + k_3x_2$

2. $M_2\frac{d^2x_2}{dt^2} + (b_2 + b_3)\frac{dx_2}{dt} + (k_2 + k_3)\,x_2 = u_2 + b_3\frac{dx_3}{dt} + k_3x_3 + b_2\frac{dx_1}{dt} + k_2x_1$

3. $M_1\frac{d^2x_1}{dt^2} + (b_1 + b_2)\frac{dx_1}{dt} + (k_1 + k_2)\,x_1 = u_1 + b_2\frac{dx_2}{dt} + k_2x_2$

$Where,$

$M_1 = 4\,Kg\,, M_2 = 2\,Kg, M_3 = 1\,Kg$

$k_1 = 3\frac{N}{s}\,, k_2 = 1\frac{N}{s}, k_3 = 1\frac{N}{s},$

$b_1 = b_2 = b_3 = 1\frac{N.sec}{m}$