Pre Lab 5.1 – DA32435 – Dyab Asdi – 19305

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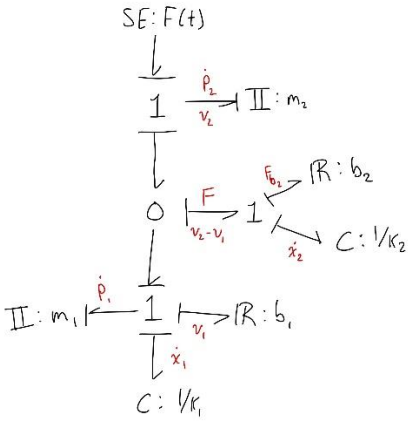
1)



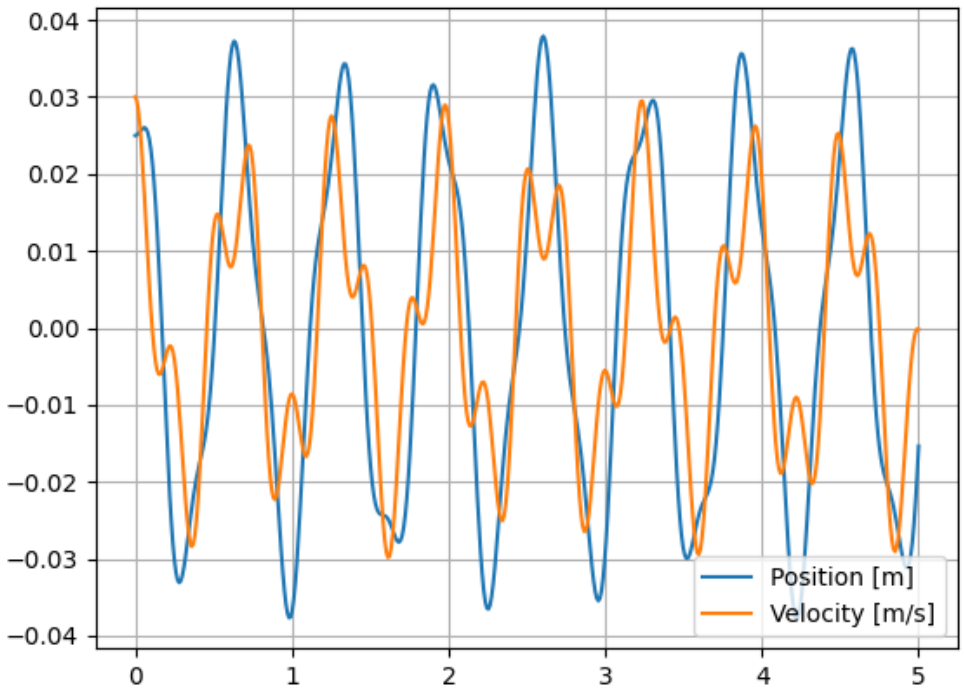
$$\dot{X} = \begin{bmatrix} x_1 \\ v_1 \\ x_2 \\ v_2 \end{bmatrix} \quad \dot{v}_1 = \frac{1}{m_1}\left[K_2 x_2 + b_2(v_2 - v_1) - K_1 x_1 - b_1 v_1\right]$$

$$\dot{v}_2 = \frac{1}{m_2}\left[F(t) - K_2 x_2 - b_2(v_2 - v_1)\right]$$

$$\frac{dx_1}{dt} = \dot{x}_1 = v_1 \qquad Y = \begin{bmatrix} \dot{v}_1 \\ \dot{v}_2 \end{bmatrix} \text{ (measured in lab)}$$

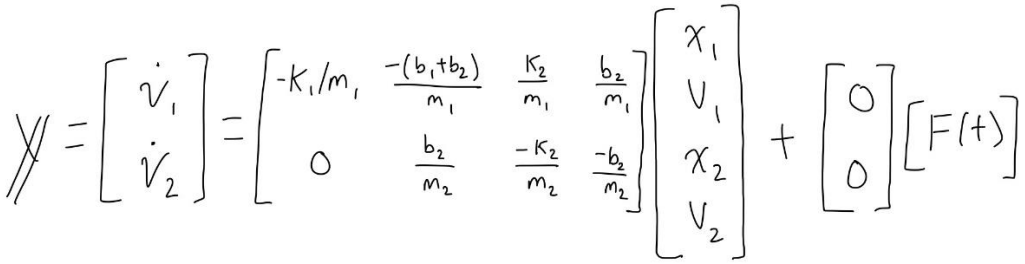
$$\frac{dx_2}{dt} = \dot{x}_2 = v_2 - v_1$$

2)



3)

We can utilize the state space equations for vdot1 and vdot2, and place them in our C matrix (cmat), giving us new output equations that represent the acceleration of each of the masses.



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31  # State Space Eqnt 2: y = Cx + Du
32  # C = 2 x 4 matrix for v1dot and v2dor
33  # x = [[x1],[v1],[x2],[v2]] (vertical 4x1 matrix)
34  # D = 2 x 1 matrix
35  cmat = np.array([[-k1/m1,-(b1+b2)/m1,k2/m1,b2/m1],[0,b2/m2,-k2/m2,-b2/m2]])
36
37  dmat = np.array([[0],[0]])
38
```

4)

For the two-story system, it is important that before we start, we measure the constants such as the masses of each story and then calculate the estimated b and k constant values. We can also use force scales in the lab to verify our theoretical values for the b and k constants. Once we have these values, using a known initial offset (pulling or pushing one of the stories to the side by a known amount), we can acquire data about each of the mass's accelerations utilizing accelerometers placed in the center of each of the stories. It is important to make sure our accelerometers are calibrated properly to ensure that we have precise and accurate data. The data then allows us to analyze the frequencies for each of the stories.