Name: Rashad Bhuiyan Student #: 400 263 180

SFWRENG3DX4 Tutorial Quiz 3 Wednesday: Transfer functions for Mechanical Systems

1. **Linear Mechanical Systems** (10 marks)

   Consider the system show below:

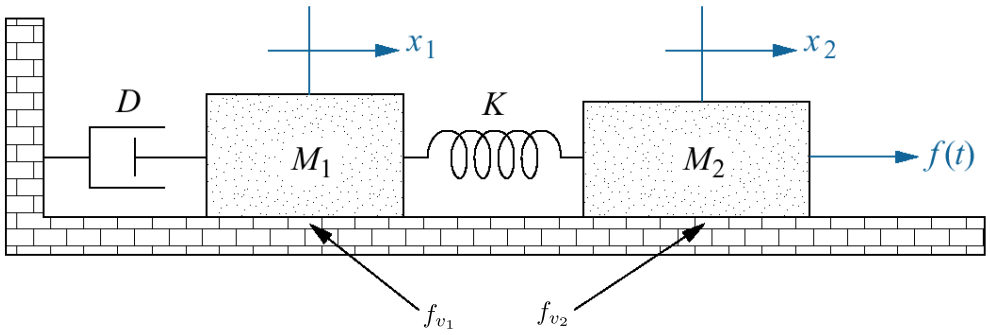
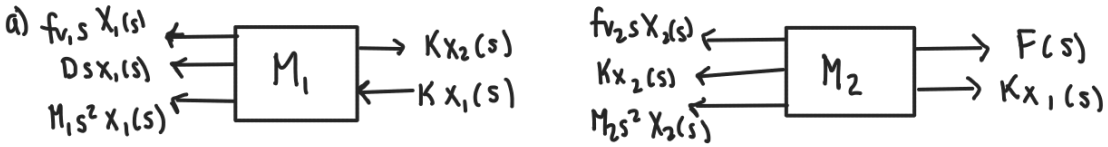


Figure 1: Linear Mechanical System

   (a) (5 marks) Draw the free body diagrams for the system shown in Fig. 1 and write down the equations of motion for the system in the Laplace domain.

   (b) (5 marks) Find the transfer function, $\frac{X_2(s)}{F(s)}$.

a)



$$M_1: \; f_{v_1} s X_1(s) + D s X_1(s) + M_1 s^2 X_1(s) = K(X_2(s) - X_1(s))$$

$$M_2: \; f_{v_2} s X_2(s) + K(X_2(s) - X_1(s)) + M_2 s^2 X_2(s) = F(s)$$

b)

$$F(s) = f_{v_2} s X_2(s) + K[X_2(s) - X_1(s)] + M_2 s^2 X_2(s)$$

$$F(s) = X_2(s)\left[f_{v_2} s + K\left[1 - \frac{X_1(s)}{X_2(s)}\right] + M_2 s^2\right]$$

$$\frac{X_2(s)}{F(s)} = \frac{1}{\left[f_{v_2} s + K\left[1 - \frac{X_1(s)}{X_2(s)}\right] + M_2 s^2\right]}$$