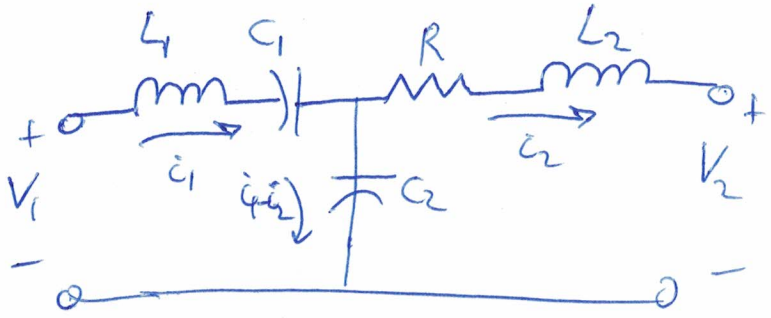
F2019 PS 2 EE128/ME134

Problem 1.

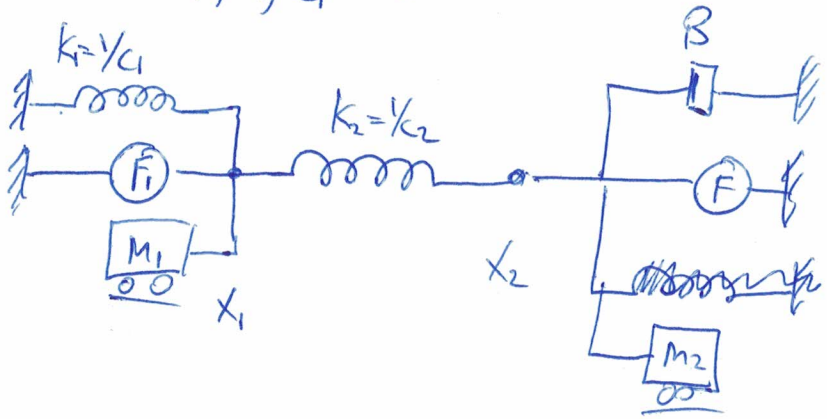


$i_1 \rightarrow \dot{x}_1$ $\quad L_1 \rightarrow M_1$ $\quad L_2 \rightarrow M_2$

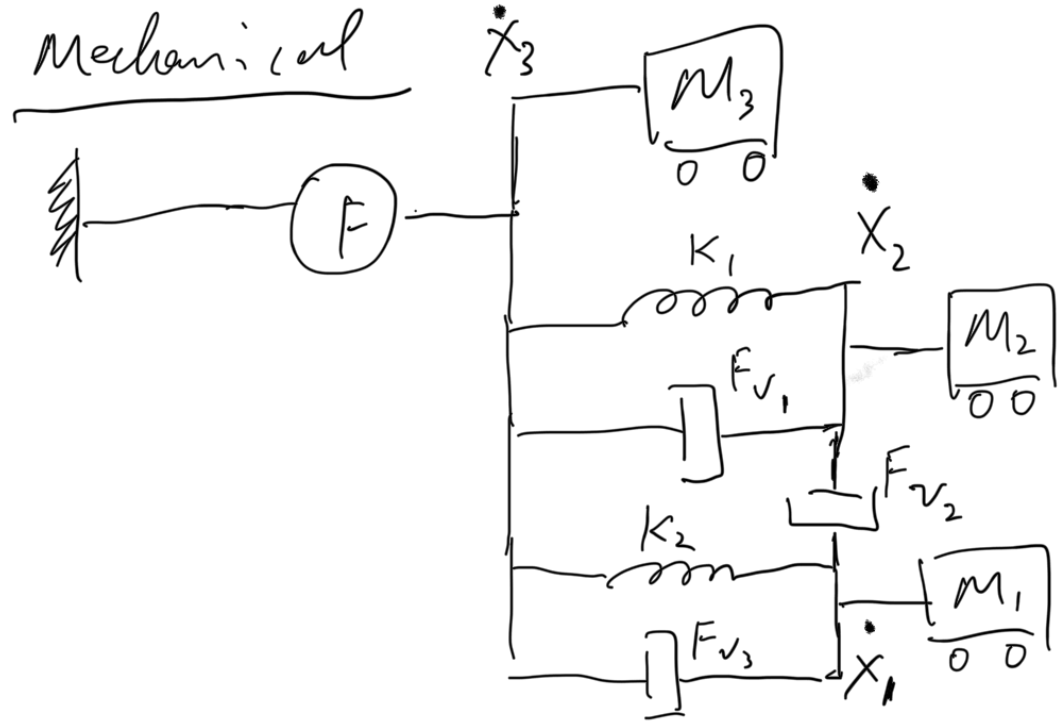
$i_2 \rightarrow \dot{x}_2$ $\quad C_1 \rightarrow K_1 = 1/C_1$ $\quad V_1 \rightarrow F_1$

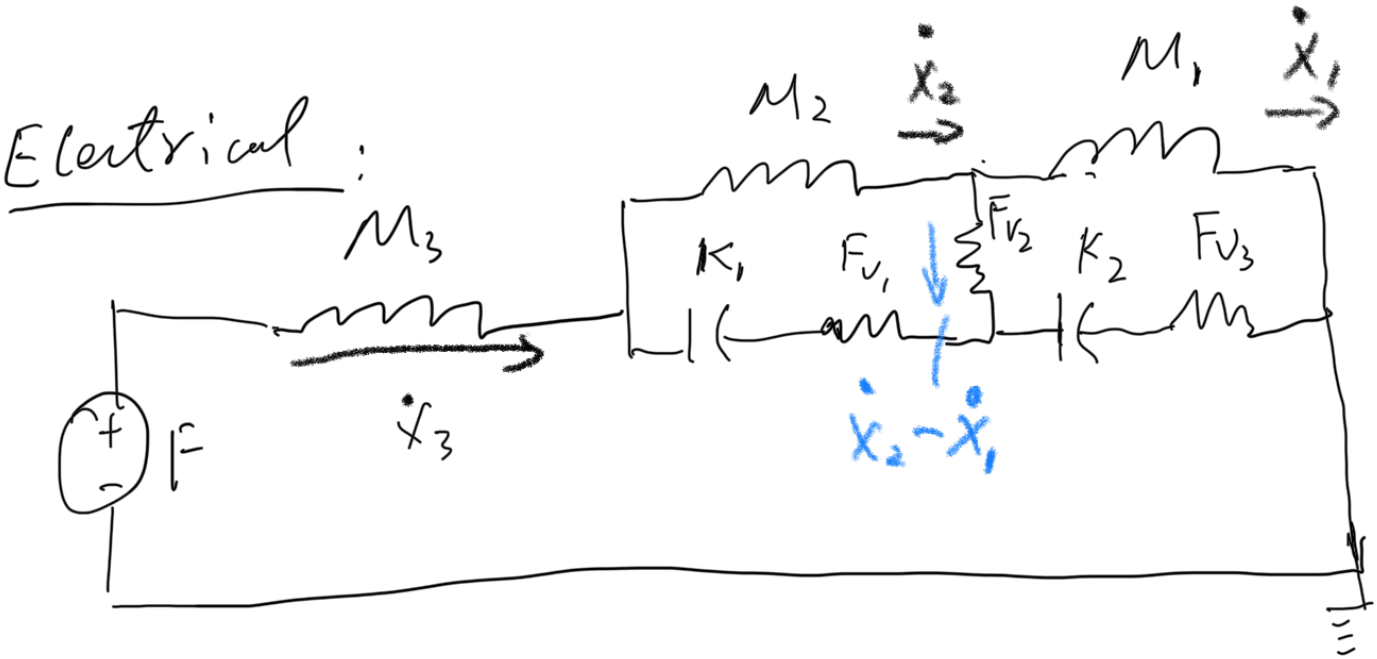
$R \rightarrow B$ $\quad V_2 \rightarrow F_2$

Note V_1, L_1, C_1 all have same current $i_1 = \dot{x}_1$. Also R, L_2, V_2 have current $i_2 = \dot{x}_2$



PS2 Problem 2





PS2 Prob 5

a) $X(s) = \dfrac{U(s)}{s^3 + 12s^2 + 45s + 50}$

$\mathcal{L}^{-1}\{X(s)\} = \dfrac{d^3x}{dt^3} = u - 12\cdot\dfrac{d^2x}{dt^2} - 45\dfrac{dx}{dt} - 50x$

$x = x_1,\ \dot{x}_1 = x_2,\ \dot{x}_2 = x_3,\ \dot{x}_3 = \dfrac{d^3x}{dt^3}$

$\dot{X} = Ax + Bu$

$= \begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -50 & -45 & -12 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$

$Y(s) = (s^3 + s^2)X(s)$

$y(t) = \mathcal{L}^{-1}\{Y(s)\} = \dfrac{d^3x}{dt^3} + \dfrac{d^2x}{dt^2}$

$= u - 12\cdot\dfrac{d^2x}{dt^2} - 45\dfrac{dx}{dt} - 50x + \dfrac{d^2x}{dt^2}$

$y = Cx + Du$

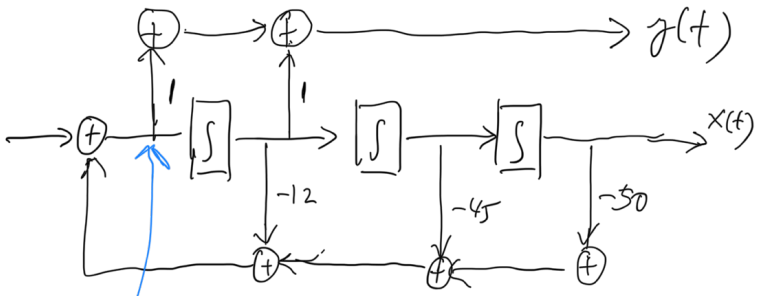
$= \begin{bmatrix} -50 & -45 & -11 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + u(t)$

$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -50 & -45 & -12 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$

$C = \begin{bmatrix} -11 & -45 & -50 \end{bmatrix} \quad D = 1$

b) $y(t) = u(t) - 11\cdot\dfrac{d^2x}{dt^2} - 45\dfrac{dx}{dt} - 50x$

c)



d) $\dfrac{d^3x(t)}{dt^3}$