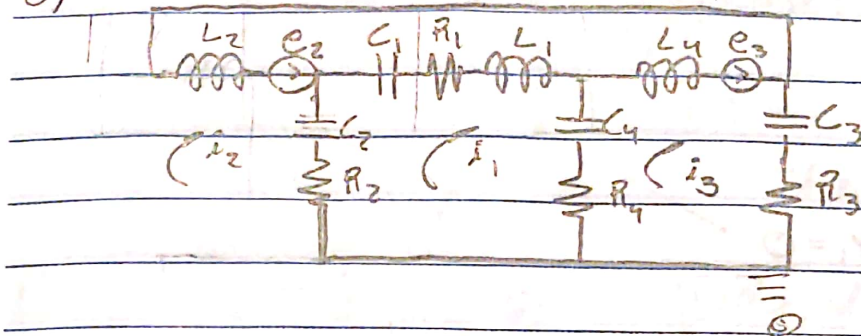


3)



$$\textcircled{1} L_1 \dot{i}_1 + R_1 L_1 + \frac{1}{C_1} \int \dot{i}_1 + R_2 (i_1 - i_2) + \frac{1}{C_2} \int (i_1 - i_2) + R_4 (i_1 - i_3) + \frac{1}{C_4} \int (i_1 - i_3) = 0$$

$$\textcircled{2} L_2 \dot{i}_2 + R_2 (i_2 - i_1) + \frac{1}{C_2} \int (i_2 - i_1) + R_3 (i_2 - i_3) + \frac{1}{C_3} \int (i_2 - i_3) - e_2 = 0$$

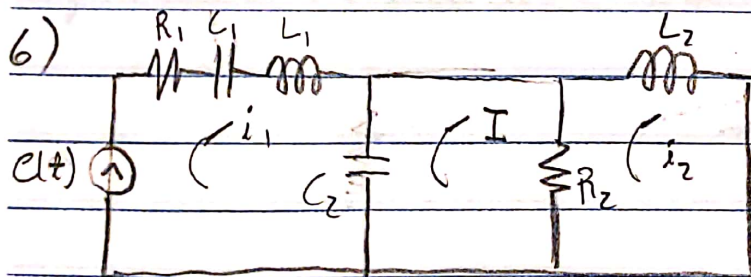
$$\textcircled{3} L_4 \dot{i}_3 + R_4 (i_3 - i_1) + \frac{1}{C_4} \int (i_3 - i_1) + R_3 (i_3 - i_2) + \frac{1}{C_3} \int (i_3 - i_2) - e_3 = 0$$

Fazendo a analogia:

$$\textcircled{1} m_1 \ddot{x}_1 + (b_1 + b_2 + b_4) \dot{x}_1 + (K_1 + K_2 + K_4) x_1 - b_2 \dot{x}_2 - K_2 x_2 - b_4 \dot{x}_4 - K_4 x_4 = 0 \quad \checkmark$$

$$\textcircled{2} m_2 \ddot{x}_2 + (b_1 + b_2) \dot{x}_2 + (K_1 + K_2) x_2 - b_3 \dot{x}_3 - K_3 x_3 - b_2 \dot{x}_1 - K_2 x_1 = f_2(t) \quad \checkmark$$

$$\textcircled{3} m_3 \ddot{x}_3 + (b_4 + b_3) \dot{x}_3 + (K_3 + K_4) x_3 - b_3 \dot{x}_2 - K_3 x_2 - b_4 \dot{x}_1 - K_4 x_1 = f_3(t) \quad \checkmark$$



$$\textcircled{1} L_1 \dot{i}_1 + R_1 i_1 + \frac{1}{C_1} \int i_1 + \frac{1}{C_2} \int (i_1 - I) - e(t) = 0$$

$$\textcircled{2} L_2 \dot{i}_2 + R_2 (i_2 - I) = 0$$

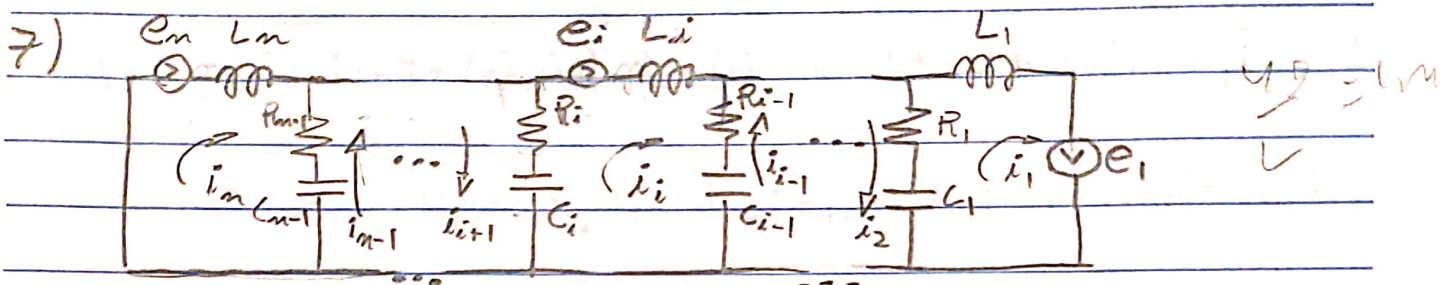
$$\textcircled{3} R_2 (I - i_2) + \frac{1}{C_2} \int (I - i_1) = 0$$

Fazendo a analogia:

$$\textcircled{1} m_1 \ddot{x}_1 + b_1 \dot{x}_1 + (k_1 + k_2)x_1 - k_2 x_2 = f_1(t) \quad \checkmark$$

$$\textcircled{2} m_2 \ddot{x}_2 + b_2 \dot{x}_2 - b_2 x_1 = 0 \quad \checkmark$$

$$\textcircled{x} b_2 x - b_2 \dot{x}_2 + k_2 x - k_2 x_1 = 0 \quad \checkmark$$



1ª vagão:

$$m_1 \ddot{x}_1 + b_1 \dot{x}_1 + k_1 x_1 - b_1 \dot{x}_2 - k_1 x_2 = f_1(t)$$

Último vagão:

$$m_n \ddot{x}_n + b_n \dot{x}_n + k_n x_n - b_{n-1} \dot{x}_{n-1} - k_{n-1} x_{n-1} = f_n(t)$$

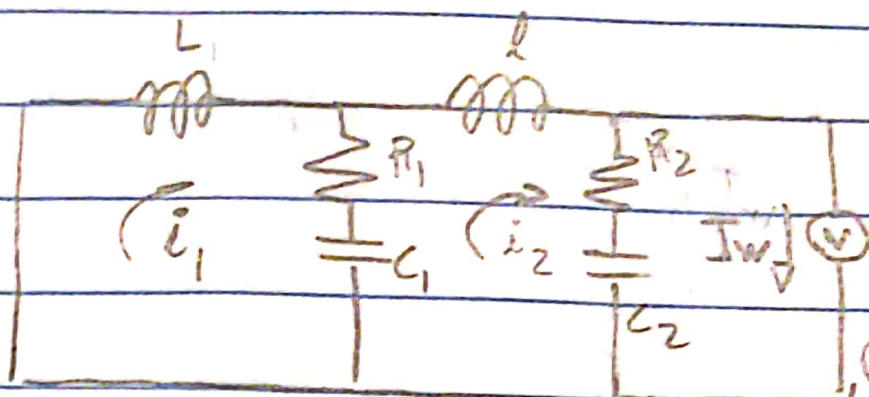
i-ésimo vagão: ($1 < i < n$),

$$m_i \ddot{x}_i + (b_i + b_{i-1}) \dot{x}_i + (k_i + k_{i-1}) x_i - b_i \dot{x}_{i+1} - k_i x_{i+1} - b_{i-1} \dot{x}_{i-1} - k_{i-1} x_{i-1} = f_i(t)$$

$i \in \mathbb{N}$

Onde $f_i(t) = M_i(t) - g_i \sin \theta_i(t)$

8) a)

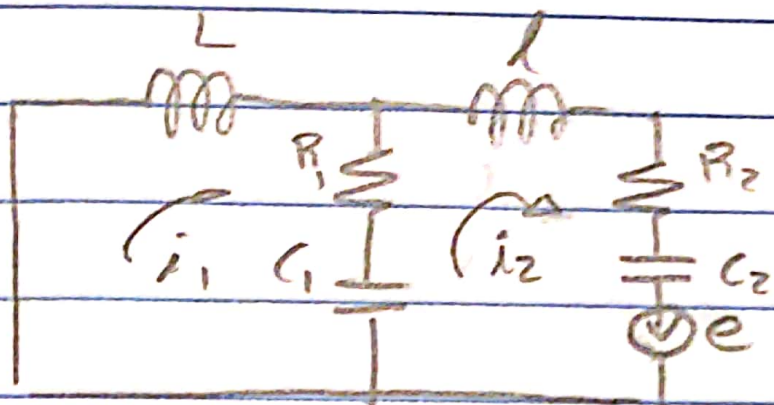


$$\textcircled{1} M\ddot{x}_1 + b_1\dot{x}_1 + k_1x_1 - b_1\dot{x}_2 - k_2x_2 = 0$$

$$\textcircled{2} m\ddot{x}_2 + (b_1 + b_2)\dot{x}_2 + (k_1 + k_2)x_2$$

$$- b_1\dot{x}_1 - k_1x_1 = b_2\dot{u}(t) + k_2u(t)$$

b)



$$\textcircled{1} M\ddot{x}_1 + b_1\dot{x}_1 + k_1x_1 - b_1\dot{x}_2 - k_2x_2 = 0$$

$$\textcircled{2} m\ddot{x}_2 + (b_1 + b_2)\dot{x}_2 + (k_1 + k_2)x_2$$

$$- b_1\dot{x}_1 - k_1x_1 = u(t)$$