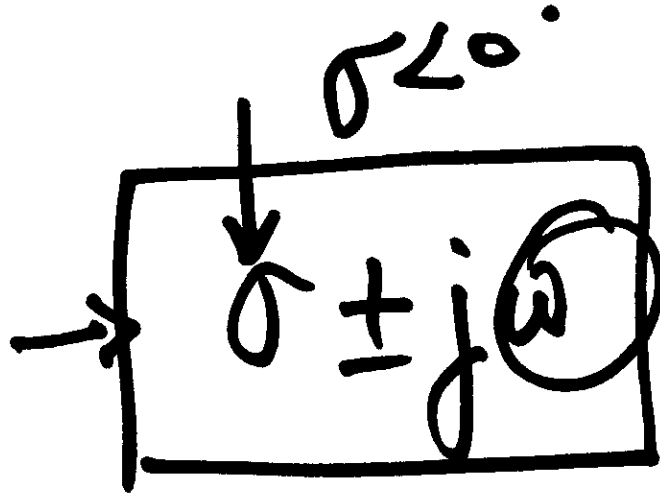
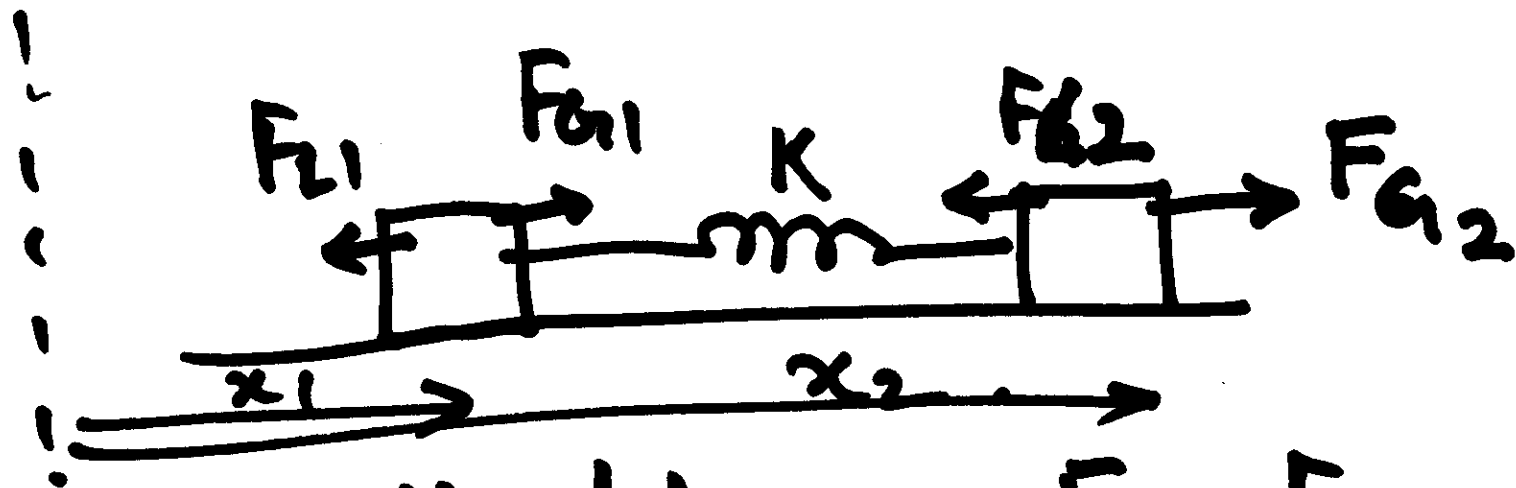


Swings

(low freq  
electro-mech  
mode).



$$\omega \approx 2\pi f_s \quad f_s \approx 1-2 \text{ Hz.}$$



$$M_1 \frac{dv_1}{dt} = F_{G1} - F_{L1} + k(x_2 - x_1 - x_0)$$

$x_2 \rightarrow$  position of

$x_1 \rightarrow$  the masses.

$x_0 \rightarrow$  unstretched length

$$\begin{bmatrix} \frac{dx_1}{dt} \\ \frac{dx_2}{dt} \\ \frac{dv_1}{dt} \\ \frac{dv_2}{dt} \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ \hline -\frac{k}{m_1} & +\frac{k}{m_1} & 0 & 0 \\ \frac{k}{m_2} & -\frac{k}{m_2} & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \times \\ \times \end{bmatrix}$$

L.A.

$$\frac{dx_1}{dt} = v_1$$

$$\frac{dx_2}{dt} = v_2.$$

$$M_1 \frac{d(v_1)}{dt} = (F_{a1} - f_{L1}) + k(x_2 - x_1 - x_0)$$

$$M_2 \frac{d(v_2)}{dt} = (f_{a2} - f_{L2}) - k(x_2 - x_1 - x_0)$$

$$\frac{d(x_1 - x_2)}{dt} = v_1 - v_2.$$

$$\frac{d(v_1 - v_2)}{dt} = -k(x_1 - x_2) + (\text{other terms})$$

$F_{a1}, F_{e1}$   
 $F_{a2}, F_{e2}$

$$\frac{d(x_{com})}{dt}$$

$$= v_{com}$$

$$(v_1, x_1) \\ (v_2, x_2)$$

$$\frac{d v_{com}}{dt}$$

$$= \frac{F_{a1} - f_{l1} + F_{a2} - f_{l2}}{(M_1 + M_2)}$$

$$x_{com} = \frac{M_1 x_1 + M_2 x_2}{M_1 + M_2}$$

$$v_{com} = \frac{M_1 v_1 + M_2 v_2}{M_1 + M_2}$$

$$\lambda_{1,2} = \pm j \sqrt{\frac{K}{m_{eq}}}$$

$$M_{eq} = \frac{M_1 M_2}{M_1 + M_2}$$

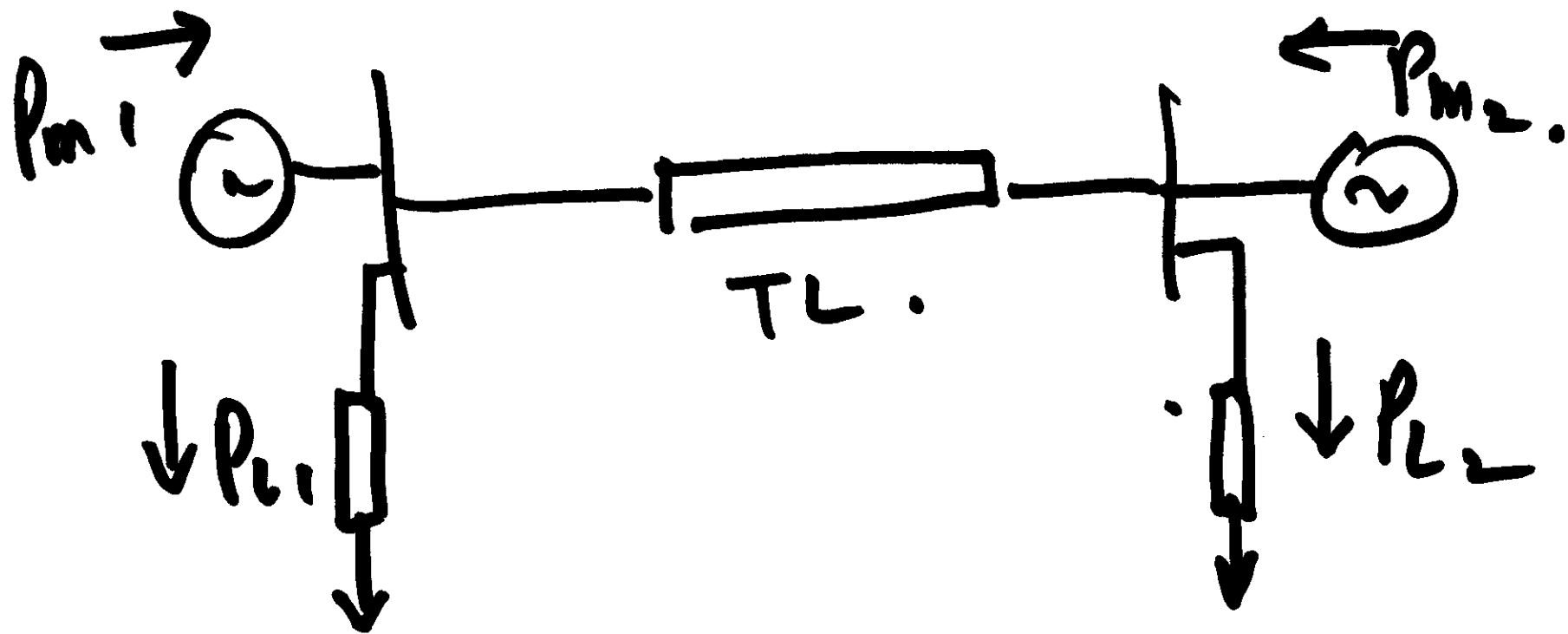
$$\lambda_{3,4} =$$

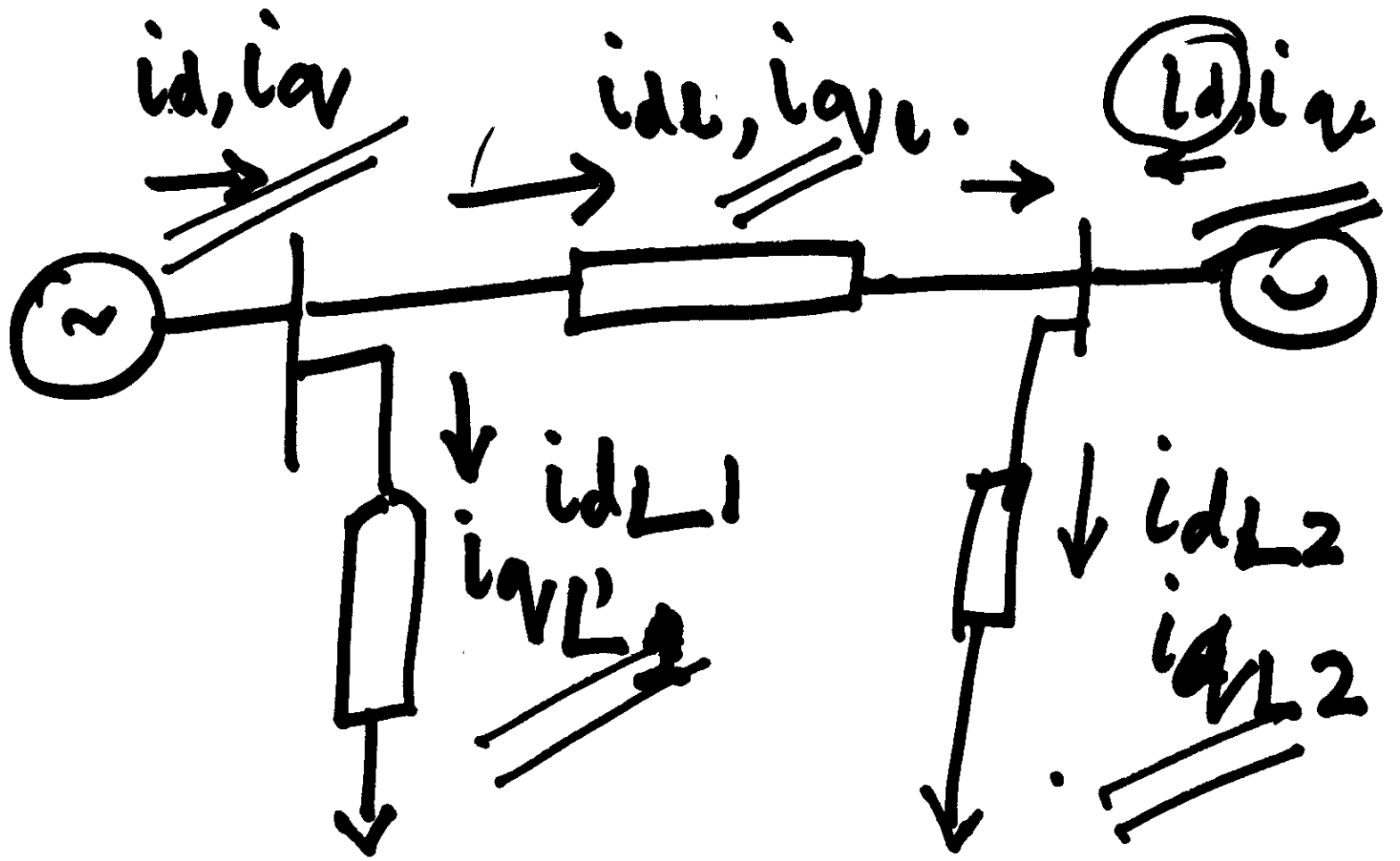
0, 0  
~  
e<sup>0t</sup>

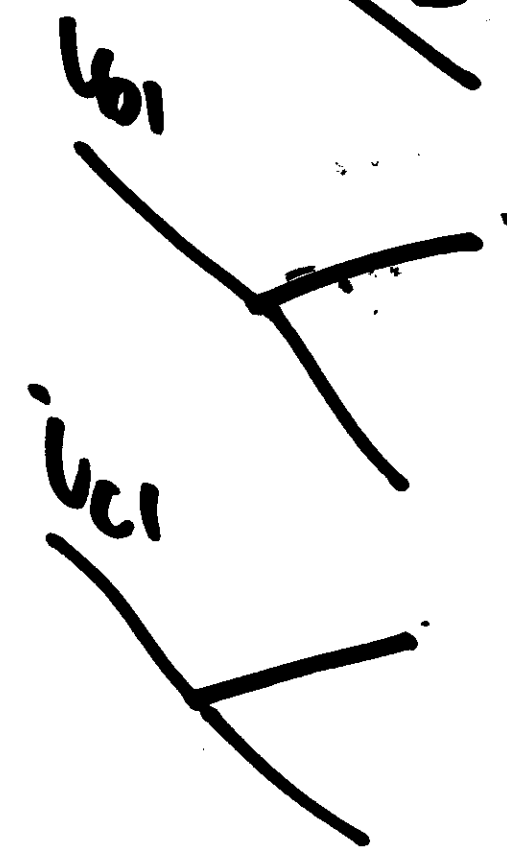
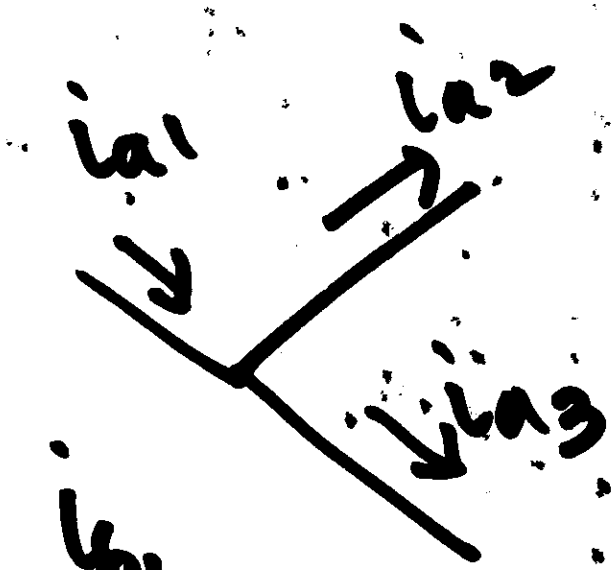
0, 0  
~  
t<sup>0</sup>











$i_{d1} = i_{d2} + i_{d3}$

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$i_{a1} = i_{a2} + i_{a3}$