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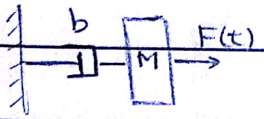
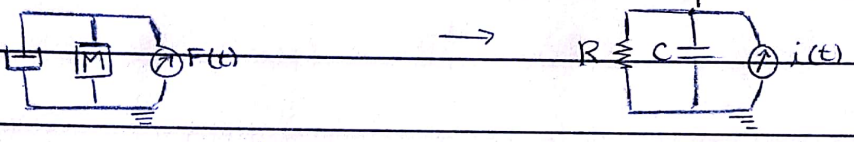
Exercícios da Aula 10/09

1)



Analogia do tipo 2:

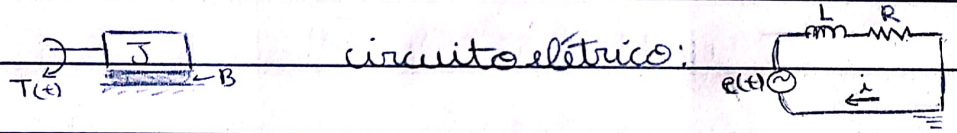
Circuito mecânico: → Circuito elétrico:



Nó 1: $V\left(CD + \frac{1}{R}\right) = i(t)$

Analogia: $v(MD+b) = F(t) \Rightarrow \boxed{M\ddot{x} + b\dot{x} = lBi}$

2) a)



circuito elétrico:

$i(LD+R) = e(t) \Rightarrow \omega(JD+B) = T(t) \Rightarrow J\ddot{\theta} + B\dot{\theta} = K \cdot i_a$

Lagrange: $T = \frac{J\omega^2}{2} + \frac{La \cdot ia^2}{2} = \frac{J\dot{\theta}^2}{2} + \frac{La\,\dot{q}_a^2}{2}$

$V = 0$

$R = \frac{B\omega^2}{2} + \frac{Ra \cdot ia^2}{2} = \frac{B\dot{\theta}^2}{2} + \frac{Ra\,\dot{q}_a^2}{2}$

$L = T - V = \frac{J\dot{\theta}^2}{2} + \frac{La\,\dot{q}_a^2}{2}$

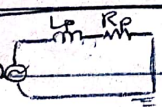
- θ: $\frac{\partial L}{\partial \dot{\theta}} = J\dot{\theta} \Rightarrow \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = J\ddot{\theta}$; $\frac{\partial L}{\partial \theta} = 0$; $\frac{\partial R}{\partial \dot{\theta}} = B\dot{\theta}$

$\boxed{J\ddot{\theta} + B\dot{\theta} = K\dot{q}_a}$

- q_a: $\frac{\partial L}{\partial \dot{q}_a} = La \cdot \dot{q}_a \Rightarrow \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_a}\right) = La\ddot{q}_a$; $\frac{\partial L}{\partial q_a} = 0$; $\frac{\partial R}{\partial \dot{q}_a} = Ra \cdot \dot{q}_a$

$\boxed{La \cdot \ddot{q}_a + Ra\,\dot{q}_a = e_a(t) - K_b(t)\,\dot{\theta}(t)}$

b) Eletroímã:



Lagrange: $T = \frac{J\dot{\theta}^2}{2} + \frac{Lp\,\dot{q}_p^2}{2}$; $V = 0$; $R = \frac{B\dot{\theta}^2}{2} + \frac{Rp \cdot \dot{q}_p^2}{2}$

- θ: $\frac{\partial L}{\partial \dot{\theta}} = J\dot{\theta} \Rightarrow \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{\theta}}\right) = J\ddot{\theta}$; $\frac{\partial L}{\partial \theta} = 0$; $\frac{\partial R}{\partial \dot{\theta}} = B\dot{\theta}$

$\boxed{J\ddot{\theta} + B\dot{\theta} = K\dot{q}_p(t)}$

- $q_p = \frac{\partial L}{\partial \dot{q}_p} = Lp\,\dot{q}_p \Rightarrow \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_p}\right) = Lp\,\ddot{q}_p$; $\frac{\partial L}{\partial q_p} = 0$; $\frac{\partial R}{\partial \dot{q}_p} = Rp\,\dot{q}_p$

$\boxed{Lp \cdot \ddot{q}_p + Rp\,\dot{q}_p = e_p(t)}$