Lista 9 - PME3380

quarta-feira, 3 de novembro de 2021 19:21

Nome: Gabriel Tetsuo Haga nºUSP: 11260680

Ex. 1 a) · Calor acumulado: $q_{ta} = C \left(\frac{d\theta}{dt}\right) \dot{\theta}$

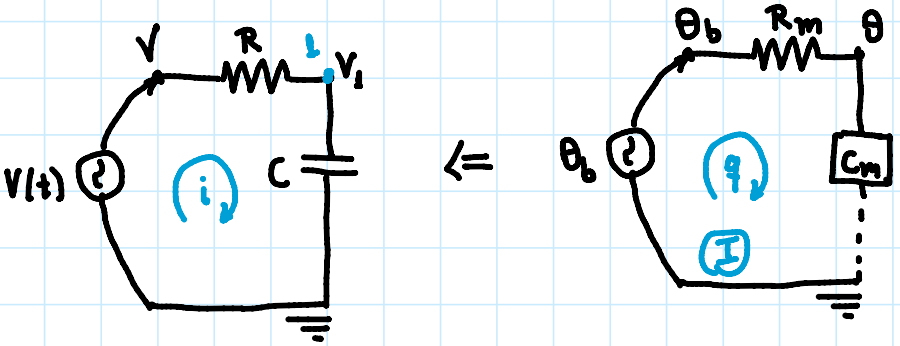
· Calor recebido: $q_{tr} = \theta_1$ θ_m

· Pelo balanço de energ: $q_a = q_r \Rightarrow C_m \cdot \dot{\theta} = \frac{\theta_b - \theta}{R_m} \Rightarrow$

$\Rightarrow \underbrace{C_m \cdot R_m}_{\tau_m} \cdot \dot{\theta} + \theta = \theta_b = \boxed{\tau_m \cdot \dot{\theta} + \theta = \theta_b}$

$\tau_m \rightarrow$ Constante de tempo

b) · Analogia $\theta \rightarrow V$; $q \rightarrow$



· Método prático: Nó 1:

$V_1 \left(CD + \frac{1}{R}\right) - V \cdot \frac{1}{R} = 0$

· Pela analogia: $\theta \cdot \left(C_m D + \frac{1}{R_m}\right) - \theta_b \cdot \frac{1}{R_m} = 0 \Rightarrow$

$\Rightarrow C_m \cdot \dot{\theta} + \frac{\theta}{R_m} = \frac{\theta_b}{R_m} \Rightarrow \underbrace{C_m \cdot R_m}_{\tau_m} \dot{\theta} + \theta = \theta_b \Rightarrow$

$\Rightarrow \boxed{\tau_m \cdot \dot{\theta} + \theta = \theta_b}$

Ex. 2 a) · Balanço de energia:

→ Mercúrio:

$C_m \frac{d\theta}{} = \theta_v - \quad \Rightarrow \boxed{C_m \frac{d\theta}{} + \frac{\theta}{} = \theta_x}$

→ Mercúrio:

$$C_m \frac{d\theta}{dt} = \theta_v - \frac{\theta}{R} \Rightarrow \boxed{C_m \frac{d\theta}{dt} + \frac{\theta}{R_m} = \frac{\theta_v}{R_m}}$$

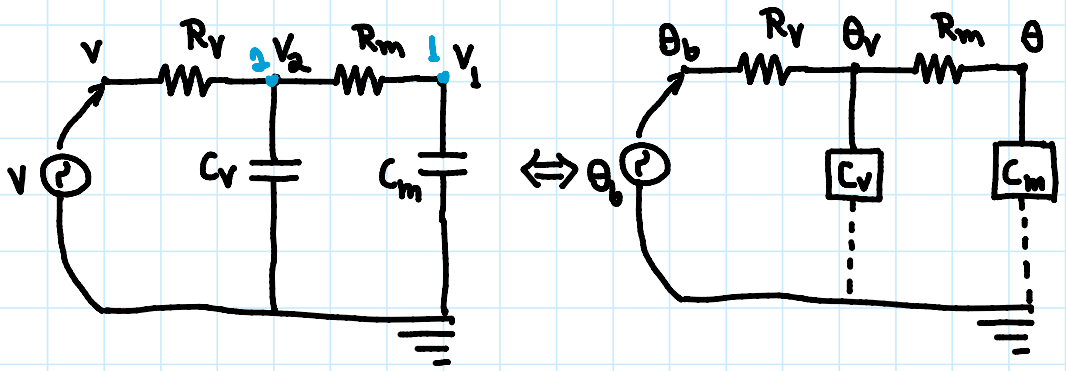
Acumulado — Tax recebida

→ Vidro:

$$C_v \frac{d\theta_v}{dt} = \frac{\theta_b - \theta_v}{R_v} \quad \frac{\theta_v - \theta}{R_m} \Rightarrow \boxed{C_v \cdot \frac{d\theta_v}{dt} + \left(\frac{1}{R_v} + \frac{1}{R_m}\right)\theta_v = \frac{\theta_b}{R_v} + \frac{\theta}{R_m}}$$

Acumulado — Taxa recebida do ambie — Taxa perdida para o mercúrio

b) · Circuito análogo:



· Pelo método prático:

→ Nó 1:

$$V_1\left(C_m D + \frac{1}{R_m}\right) - V_2 \cdot \frac{1}{R_m} = 0 \Rightarrow \theta\left(C_m D + \frac{1}{R_m}\right) - \theta_v \cdot \frac{1}{R_m} = 0 \Rightarrow$$

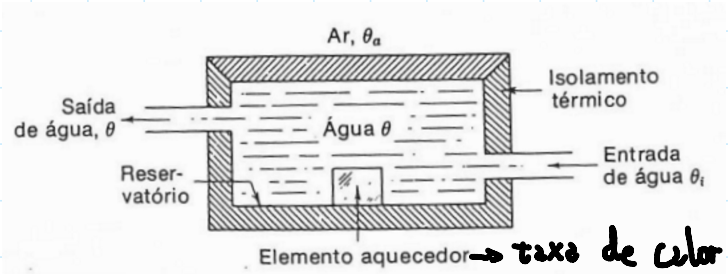
$$\Rightarrow \boxed{C_m \dot{\theta} + \frac{\theta}{R_m} = \frac{\theta_v}{R_m}}$$

→ Nó 2:

$$V_2\left(C_v D + \frac{1}{R_v} + \frac{1}{R_m}\right) - V_1 \cdot \frac{1}{R_m} - V \cdot \frac{1}{R_v} = 0 \Rightarrow \theta_v \cdot \left(C_v D + \frac{1}{R_v} + \frac{1}{R_m}\right) - \frac{\theta}{R_m} - \frac{\theta_b}{R_v} = 0 \Rightarrow$$

$$\Rightarrow \boxed{C_v \frac{d\theta_v}{dt} + \left(\frac{1}{R_v} + \frac{1}{R_m}\right)\theta_v = \frac{\theta}{R_m} + \frac{\theta_b}{R_v}}$$

Ex.3



→ taxa de calor gerado: q

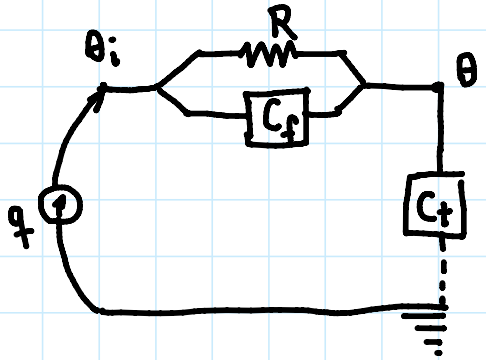
· Pela 1ª Lei:

$$M \cdot c_p \cdot \dot{\theta} = q + \dot{m} \cdot c_p \cdot (\theta_i - \theta) - \frac{\theta - \theta_i}{R} + \dot{W} \Rightarrow$$

($\dot{W} = 0$ → sem trabalho)

$$\Rightarrow \boxed{M \cdot c_p \cdot \dot{\theta} + \left(\dot{m} c_p + \frac{1}{R}\right)\theta = \left(\dot{m} \cdot c_p + \frac{1}{R}\right)\theta_i + q}$$

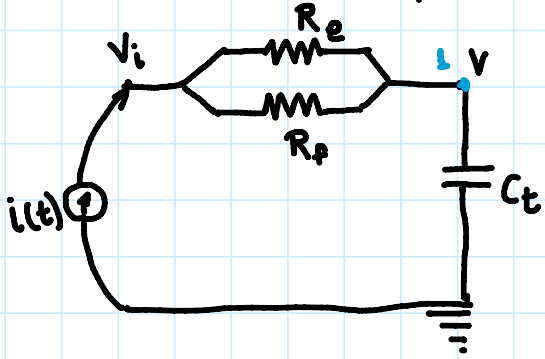
a) · Circuito térmico equivalente (analogia tipo 2):



$C_f = \dot{m} c_p$

$C_t = M c_p$

b) · Circuito elétrico equivalente tipo 2:

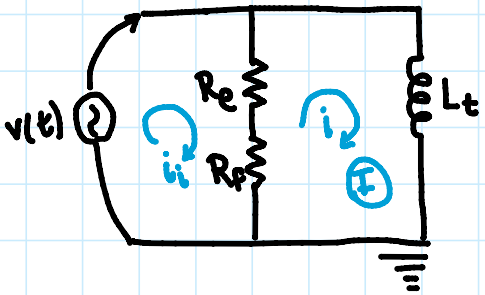


$R_e = R$

$R_f = \frac{1}{C_f}$

$C_t = C_t$

· Circuito elétrico equivalente tipo 1:



$R_e = \frac{1}{R}$

$R_f = C_f$

$L_t = C_t$

c) · Pelo método prático:

→ Nó 1:

$$V \cdot \left(C_t D + \frac{1}{R_f} + \frac{1}{R_e}\right) - V_i \left(\frac{1}{R_f} + \frac{1}{R_e}\right) = i(t) \Rightarrow \theta \cdot \left(C_t D + C_f + \frac{1}{R}\right) - \theta_i \left(C_f + \frac{1}{R}\right) = q \Rightarrow$$

$$\Rightarrow C_t \cdot \dot{\theta} + \left(C_f + \frac{1}{R}\right)\theta = q + \left(C_f + \frac{1}{R}\right)\theta_i \Rightarrow \boxed{M c_p \dot{\theta} + \left(\dot{m} c_p + \frac{1}{R}\right)\theta = \left(\dot{m} \cdot c_p + \frac{1}{R}\right)\theta_i + q}$$

→ Malha (I):

$$i_i\left(L_t D + R_f + R_e\right) - i_i\left(R_f + R_e\right) = V(t) \Rightarrow \theta_i\left(C_t D + C_f + \frac{1}{R}\right) - \theta_i\left(C_f + \frac{1}{R}\right) = q_t \Rightarrow$$

$$\Rightarrow C_t\dot{\theta} + \left(C_f + \frac{1}{R}\right)\theta = q_t + \left(C_f + \frac{1}{R}\right)\theta_i \Rightarrow \boxed{Mc_p\cdot\dot{\theta} + \left(\dot{m}c_p + \frac{1}{R}\right)\theta = \left(\dot{m}c_p + \frac{1}{R}\right)\theta_i + q_t}$$