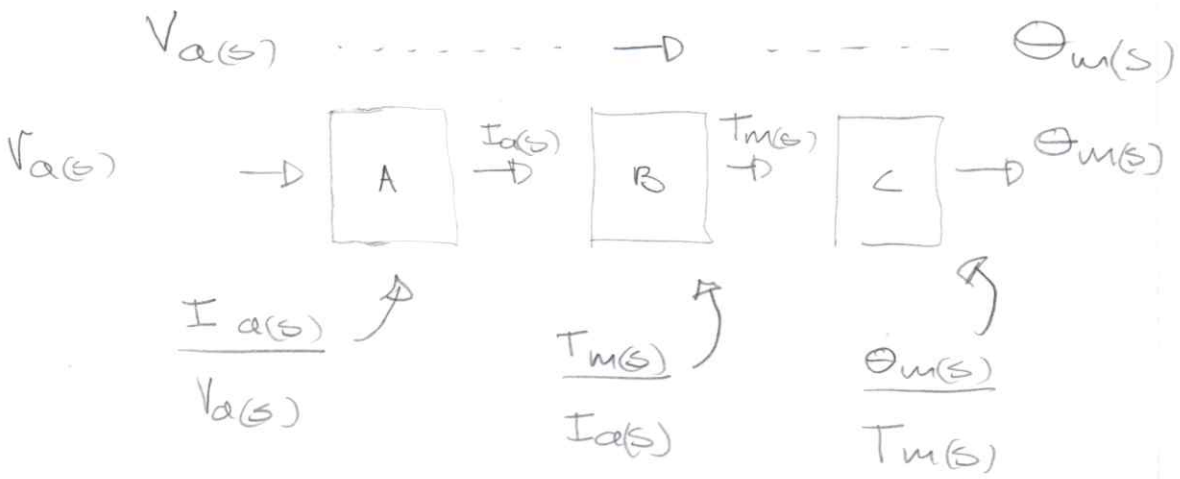
8(a) $G(s) = \dfrac{\Theta_m(s)}{V_a(s)}$



$$V_{a(s)} = (R_a + LS)\, I_{a(s)} + (K_b S)\, \Theta_{m(s)}$$

$$(JS^2 + BS)\, \Theta_{m(s)} = T_{m(s)}$$

$$\boxed{\frac{1}{JS^2 + BS}} = \frac{\Theta_{m(s)}}{T_{m(s)}} \quad (C)$$

$T_{m(t)} = K_I\, i_{a(t)}$ Dado $e_b = K_b \omega_m$

$T_{m(s)} = K_I\, I_{a(s)}$ Formulas.

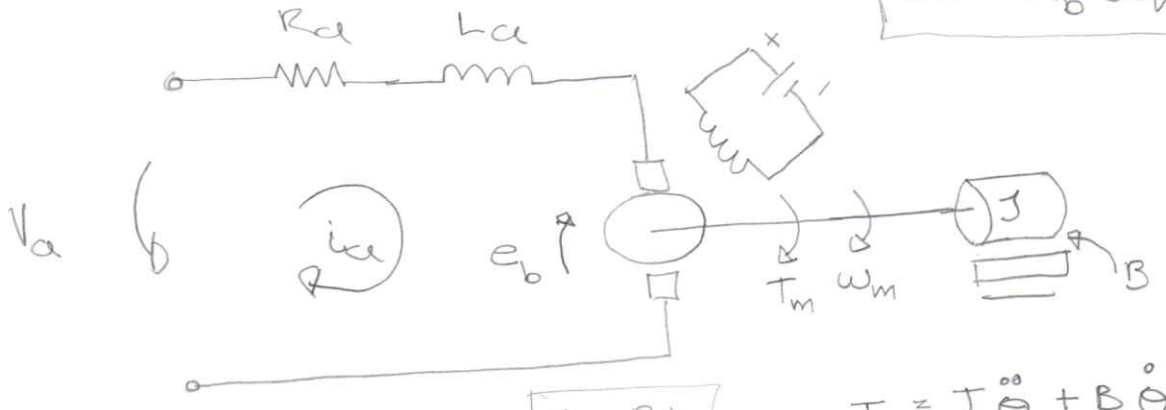
$$\frac{T_{m(s)}}{I_{a(s)}} = \boxed{K_I} \quad (B)$$

$$I_{a(s)} = \frac{V_{a(s)}}{R_a + LS} - \frac{K_b S}{R_a LS}\, \Theta_{m(s)}$$

$$= V_{a(s)} \times \frac{1}{R_a LS} - \Theta_{m(s)} \times \frac{K_b S}{R_a LS}$$

8 a)

$$e_b = K_b \omega_m$$



$$U = RI \qquad T_m = J\ddot{\theta}_m + B\dot{\theta}_m$$

(1) $$V_a = R_a i_{a(t)} + L \frac{d}{dt} i_{a(t)} + e_b$$

$$\sum T_{(t)} = J \alpha_{(t)} \qquad e_b = K_b \cdot \omega_m$$

(2) $$T_m - B\omega_m = J\alpha_m$$

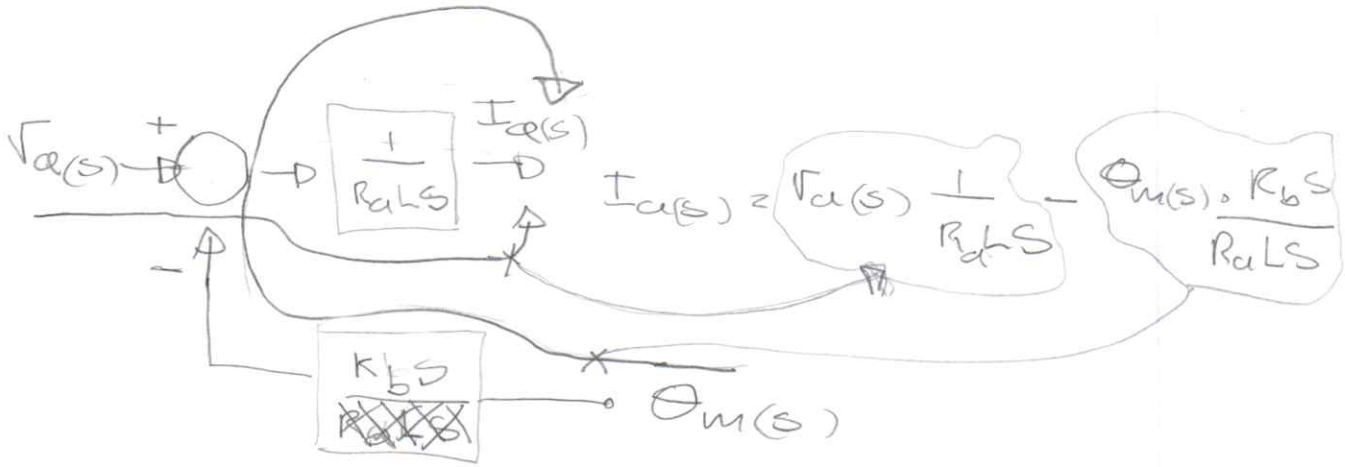
$$\begin{cases} V_{a(t)} = R_a i_{a(t)} + L \frac{d}{dt} i_{a(t)} + K_b \dot{\theta}_m \\ J\alpha_m = T_m - B\omega_m \end{cases}$$

o motor trata-se como um amortecedor da corrente electrica em movimento angular $e_b = K_b \cdot \omega_{motor(t)} = K_b \dot{\theta}_{m(t)}$

$\mathcal{L}$

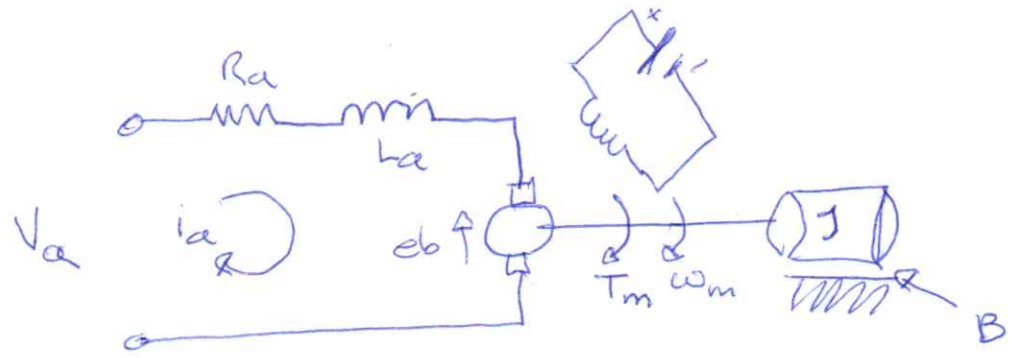
$$\begin{cases} V_{a(t)} = R_a I_{a(s)} + L s I_{a(s)} + K_b s \theta_{m(s)} \\ J s^2 \theta_{m(s)} = T_{m(s)} - B s \theta_{m(s)} \end{cases}$$

8 a)


$V_a(s)$
+
−
$\frac{1}{R_a L s}$
$I_a(s)$
$K_b s$
$\Theta_m(s)$
$I_a(s) = V_a(s) \frac{1}{R_a L s} - \Theta_m(s) \cdot \frac{K_b s}{R_a L s}$

— // —

Motor DC



$$
\begin{cases}
V_{a(t)} = R_a\, i_{a(t)} + L_a \dfrac{d}{dt}\{i_{a(t)}\} + e_{b(t)} \\
e_{b(t)} = K_b \cdot \omega_m = K_b \dfrac{d}{dt}\{\theta_{m(t)}\} \\
T_{m(t)} = J \dfrac{d^2}{dt}\{\theta_{m(t)}\} + B \dfrac{d}{dt}\{\theta_{m(t)}\} \\
T_{m(t)} = K_I\, i_{a(t)}
\end{cases}
$$

$$
FT = \frac{\theta_{m(s)}}{V_{a(s)}} = \frac{K_I}{(sL_a + R_a)(s^2 J + sB) + s K_b K_I}
$$

not used.

$$
\frac{\theta_{m(s)}}{V_{a(s)}} = \frac{\theta_{m(s)}}{T_{m(s)}} \cdot \frac{T_{m(s)}}{I_{a(s)}} \cdot \frac{I_{a(s)}}{V_{a(s)}}
$$