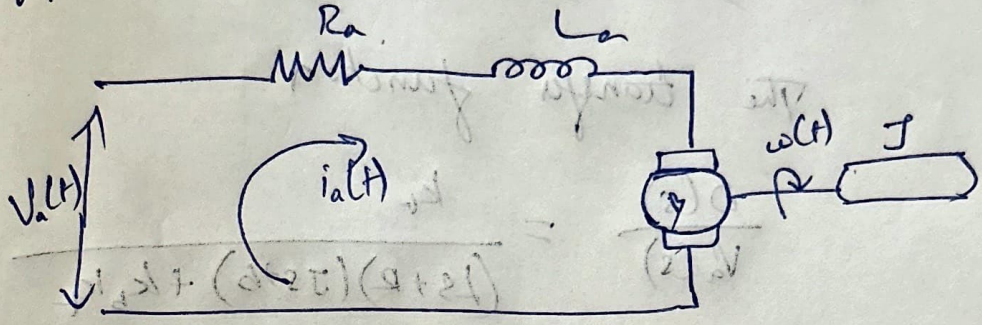
Electro - mechanical system

Converts electrical energy into mechanical energy.



$V_a(t)$ — armature voltage → i/p

$\omega(t)$ — motor speed → o/p

dynamic equations of DC motor is given as

$$L\frac{di_a(t)}{dt} + R\,i_a(t) + K_b\,\omega(t) = V_a(t)$$

$$J\frac{d\omega(t)}{dt} + b\,\omega(t) - K_t\,i_a(t) = 0$$

apply Laplace transform

$$L\,s\,i_a(s) + R\,I_a(s) + K_b\,\omega(s) = V_a(s)$$

$$Js\,\omega(s) + b\,\omega(s) - K_t\,i_a(s) = 0$$

$$\Rightarrow (Ls + R)\,i_a(s) + K_b\,\omega(s) = V_a(s) \rightarrow (1)$$

$$\Rightarrow (Js + b)\,\omega(s) - K_t\,i_a(s) = 0 \rightarrow (2)$$

find $i_a(s)$ from equation (2)

$$I_a(s) = \frac{(Js + b)\,\omega(s)}{K_t} \rightarrow (3)$$

Substitute (3) in (1) equation

$$(Ls+R)\frac{(Js+b)\omega(s)}{k_t} + Rk_b\omega(s) = V_a(s)$$

$$(Ls+R)(Js+b)\omega(s) + k_b k_t \omega(s) = k_t V_a(s)$$

The transfer function

$$\frac{\omega(s)}{V_a(s)} = \frac{k_t}{(Ls+R)(Js+b) + k_b k_t}$$