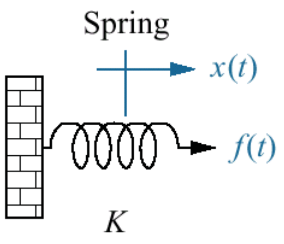
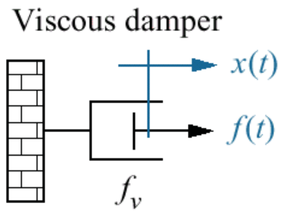
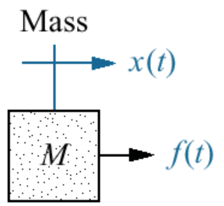
Modelado de un motor de corriente continua

Laboratorio de Sistemas de Control Aplicados

Programa

- Principios de funcionamiento básicos de un motor CC
- Ecuaciones eléctricas, mecánicas y electromecánicas del motor CC controlado por armadura
- Ecuaciones eléctricas, mecánicas y electromecánicas del motor CC controlado por campo
- Sistema combinado

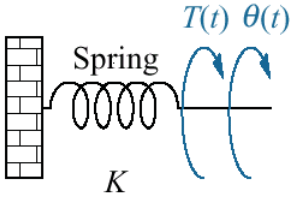
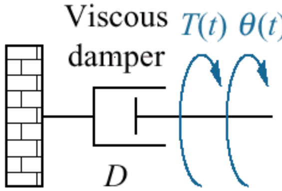
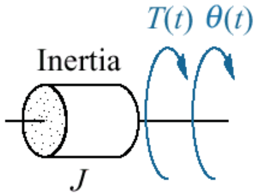
Impedancias: Mecánica translacional

Component	Force-velocity	Force-displacement	Impedance $Z_M(s) = F(s)/X(s)$
	$f(t) = K\int_0^t v(\tau)\,d\tau$	$f(t) = Kx(t)$	K
	$f(t) = f_v v(t)$	$f(t) = f_v \frac{dx(t)}{dt}$	$f_v s$
	$f(t) = M\frac{dv(t)}{dt}$	$f(t) = M\frac{d^2x(t)}{dt^2}$	Ms^2

Note: The following set of symbols and units is used throughout this book: $f(t)$ = N (newtons), $x(t)$ = m (meters), $v(t)$ = m/s (meters/second), K = N/m (newtons/meter), f_v = N-s/m (newton-seconds/meter), M = kg (kilograms = newton-seconds^2/meter).

(In the notes, we sometimes use b or B instead of f_v.)

Impedancias: Mecánica Rotacional

Component	Torque-angular velocity	Torque-angular displacement	Impedance $Z_M(s) = T(s)/\theta(s)$
	$T(t) = K\int_0^t \omega(\tau)\,d\tau$	$T(t) = K\theta(t)$	K
	$T(t) = D\omega(t)$	$T(t) = D\frac{d\theta(t)}{dt}$	Ds
	$T(t) = J\frac{d\omega(t)}{dt}$	$T(t) = J\frac{d^2\theta(t)}{dt^2}$	Js^2

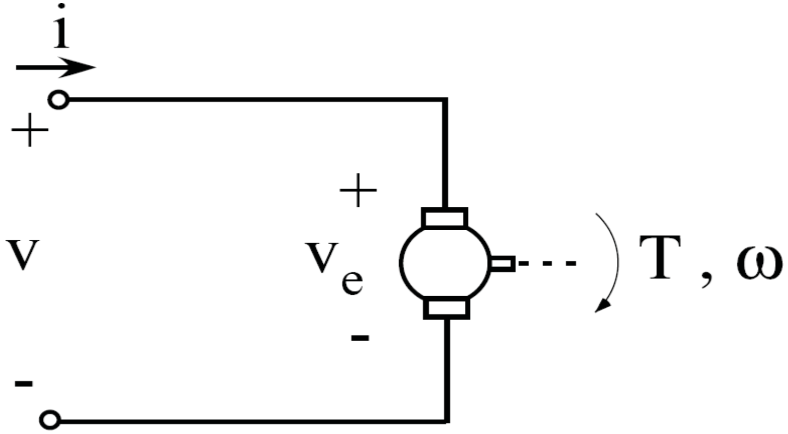
Note: The following set of symbols and units is used throughout this book: $T(t)$ = N-m (newton-meters), $\theta(t)$ = rad (radians), $\omega(t)$ = rad/s (radians/second), K = N-m/rad (newton-meters/radian), D = N-m-s/rad (newton-meters-seconds/radian), J = kg-m^2 (kilogram-meters^2 = newton-meters-seconds^2/radian).

(In the notes, we sometimes use b or B instead of D.)

Motor DC como sistema

$$P_{in} = P_{out}$$

$$i(t) * v(t) = T(t) * \omega(t)$$

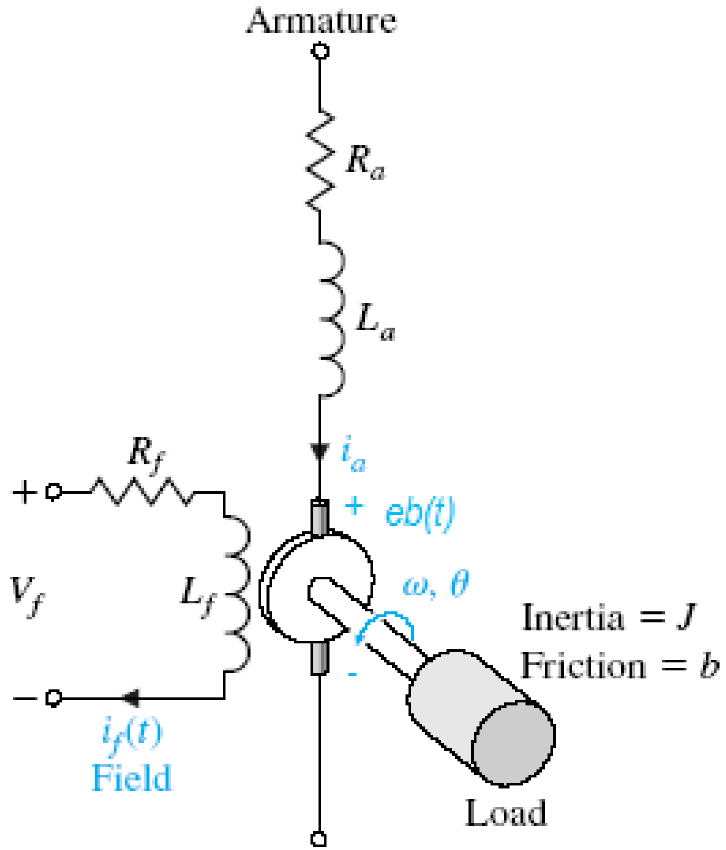


Convierte energía de un dominio
(eléctrico) a otro (mecánico)

ESQUEMA DE MOTOR DC

Consta de dos circuitos:

- Armadura
- Campo



La velocidad final del motor (sin carga) estará en función del voltaje de excitación del circuito de armadura y del circuito de campo. Normalmente se escoge fijar una de estas tensiones y regular la velocidad del motor variando la otra.

Motor DC: Control por armadura

$i_f(t) = constante$

Ecuación Eléctrica:

$$v_a(t) = R_a . i_a(t) + L_a \frac{d_{i_a}(t)}{dt} + Vb(t)$$

Ecuaciones Mecánicas:

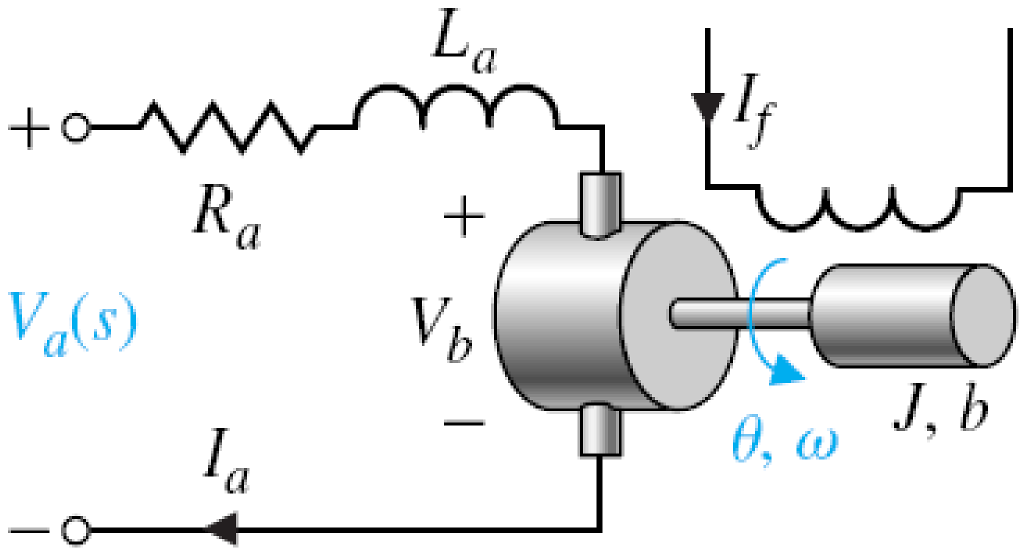
$$T_m(t) = T_L(t) + T_d(t)$$

$$T_L(t) = J \frac{d\omega(t)}{dt} + b\omega$$

Ecuaciones Electromecánicas:

$$T_m(t) = K_{ma} i_a(t)$$

$$\mathrm{Vb}(t) = Kv . \omega(\mathrm{t})$$



Motor DC: Control por campo

$i_a(t) = constante$

Ecuación Eléctrica:

$$v_s(t) = R_f . i_f(t) + L_f \frac{d_{i_f}(t)}{dt}$$

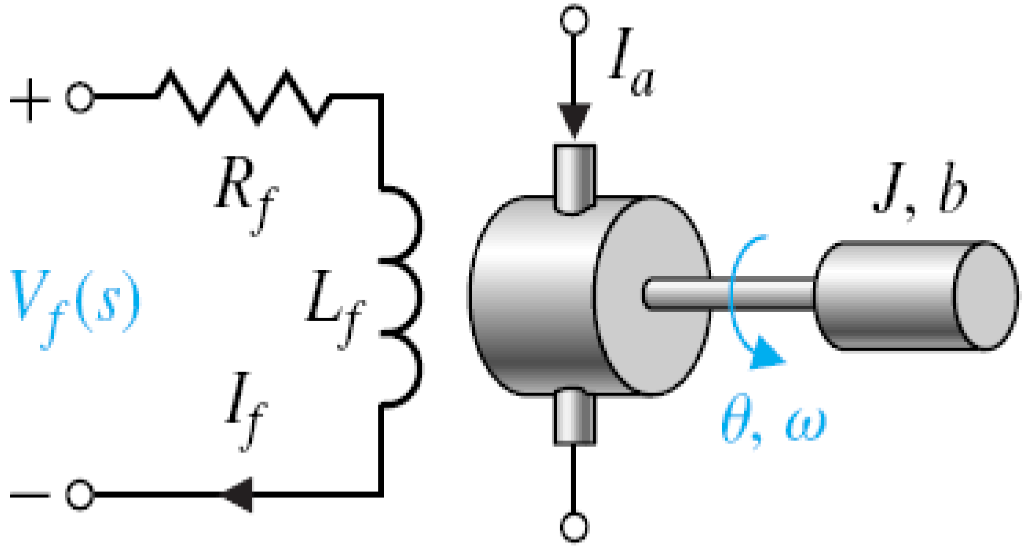
Ecuaciones Mecánicas:

$$T_m(t) = T_L(t) + T_d(t)$$

$$T_L(t) = J \frac{d\omega(t)}{dt} + b\omega$$

Ecuación Electromecánica:

$$T_m(t) = K_m i_f(t)$$



Motor DC: Nomenclaturas

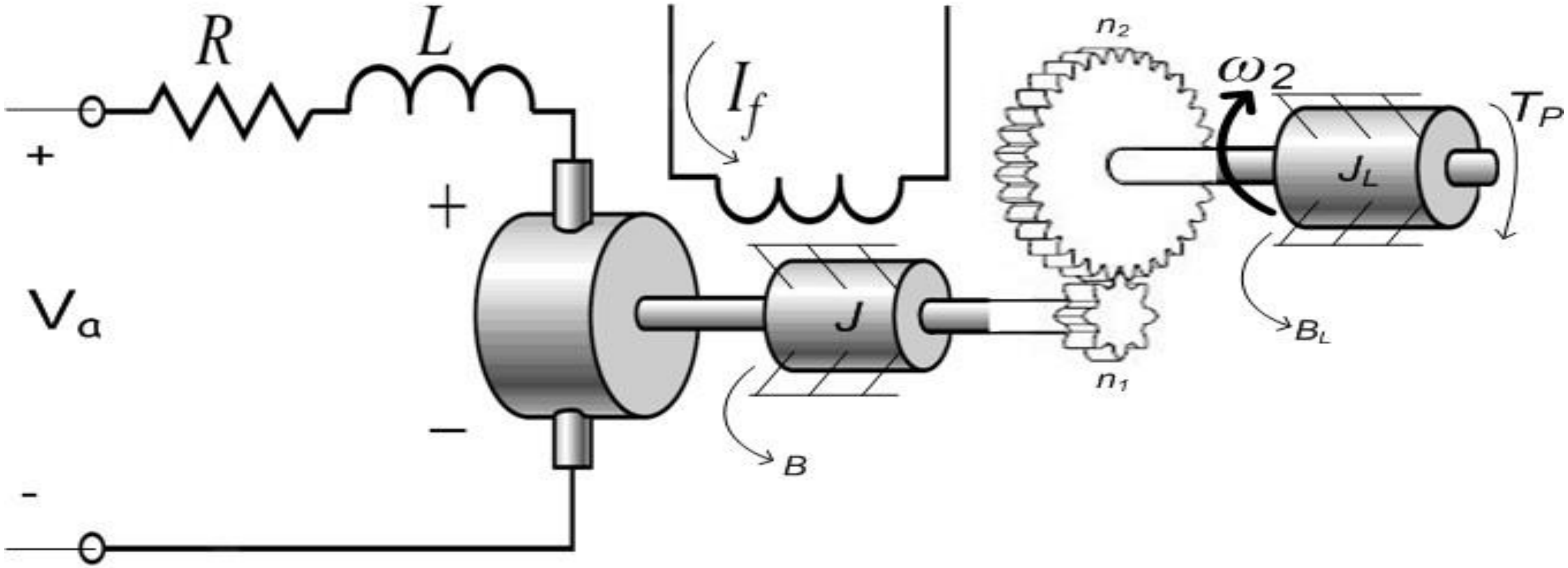
Km = Kt [Torque/Corriente]

Motor **T**orque

Kv = Kb = Ke [Voltaje/Velocidad angular]

Voltage **B**ack **E**MF (ElectroMotive Force)

Motor D.C. con acoplamiento de carga mediante tren de engranajes



Ecuaciones útiles: Engranes

$$T_1 \omega_1 = T_2 \omega_2$$

$$r_1 \Theta_1 = r_2 \Theta_2$$

$$2\pi r_1 \approx N_1$$

$$2\pi r_2 \approx N_2$$