



Course #: 804465–Automatic Control Lab #3

Modeling of Dynamic Systems

Objective

- To demonstrate mathematical modeling of control systems and components.
- To obtain transfer function of the systems
- To draw block diagram of the system
- To demonstrate how computer solutions (Simulink) are used to obtain the response of these models.

Modeling of Mechanical Systems

• Mass Spring Friction System

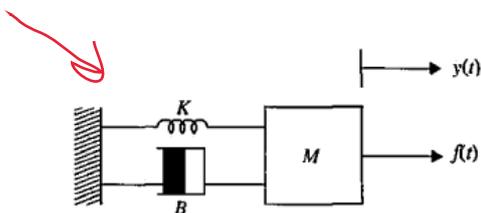


Fig a: Mass Spring Friction System

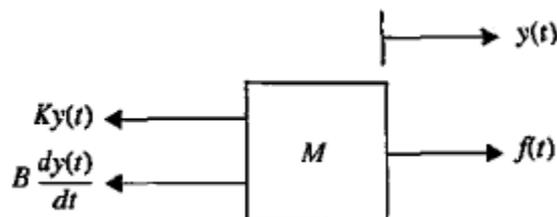


Fig b: Free Body Diagram

a. The force equation of the system is:

$$f(t) - B \frac{dy(t)}{dt} - Ky(t) = M \frac{d^2y(t)}{dt^2} \quad \text{O.D.E}$$

b. Transfer Function obtained from a.

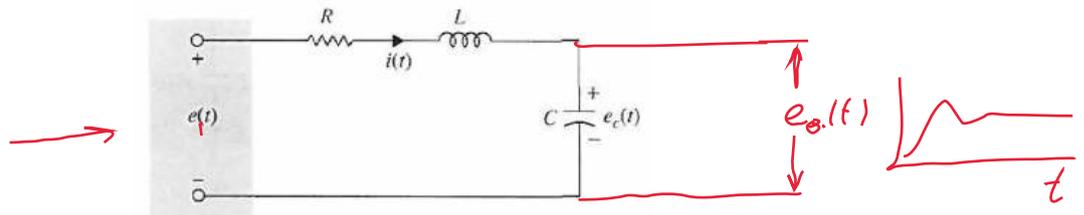
$$\frac{Y(s)}{F(s)} = \frac{1}{Ms^2 + Bs + K} \quad \text{TF}$$

c. Block diagram representation.



Modeling of Electric Systems

- RLC Electrical Network System**



Electrical Schematic Diagram of RLC Network

a. The equation of the system is:

$$e(t) = e_R + e_L + e_C$$

Where

$$e_R(t) = i(t)R \quad e_L(t) = L \frac{di(t)}{dt} \quad e_C(t) = \int \frac{i(t)}{C} dt$$

ODE
 Make a Simulink model for these equations
 Step response

b. Transfer Function obtained from a.

$$\frac{E_C(s)}{E(s)} = \frac{1}{1 + RCs + LCs^2} \quad \text{TF}$$

H(s)

c. Block diagram representation.

R =
C =
L =