

ELEC 372

Supplementary Problem Set #2

Not to be handed in

These problems form the foundation of Quiz #2

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1. Consider a system described by the nonlinear differential equation

$$\ddot{y} \ln x + \dot{x}(\dot{y})^{3/2} + x^2 y = 1$$

Let x_0 and y_0 be positive real numbers.

- (a) Assuming that (x_0, y_0) is a system equilibrium point, find a relation between x_0 and y_0 .
- (b) Linearize the system around the equilibrium (x_0, y_0) .
2. Linearize the nonlinear differential equation

$$x(\dot{y})^2 + x\dot{x}\dot{y} + x\sqrt{y} = 2$$

around the equilibrium point $(x, y) = (1, 4)$.

3. Write down differential equations describing the mechanical system of Figure 2.1.

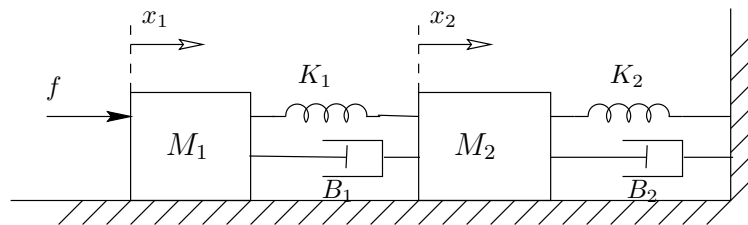


Figure 2.1: A mechanical translational system.

4. In the the mechanical system of Figure 2.2, the friction coefficient between each body and the surface is equal to 1. Find the transfer function $\frac{X_2(s)}{F(s)}$.
5. In the electromechanical system of Figure 2.3, assume that all torque generated by the motor is delivered to the loads. Write down differential equations relating θ_1 and θ_2 to e_a .
6. In each of the block diagrams of Figure 2.4, find the transfer function $\frac{Y(s)}{U(s)}$.

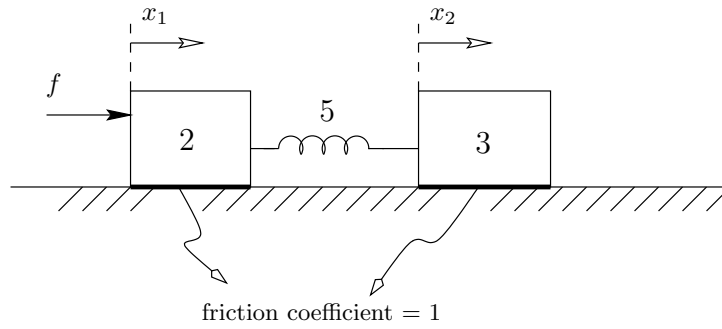


Figure 2.2: A mechanical translational system.

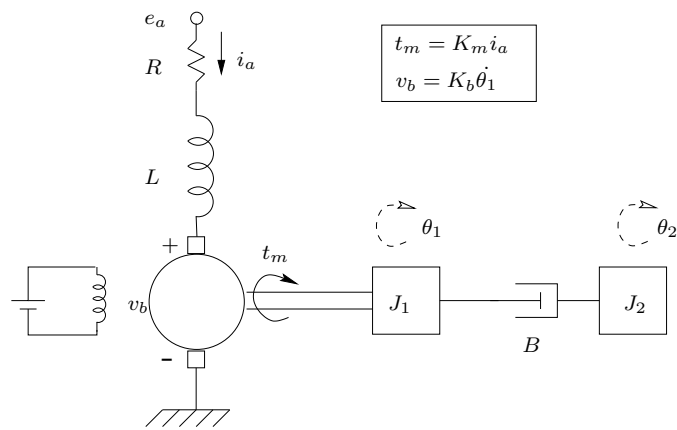


Figure 2.3: An electromechanical system.

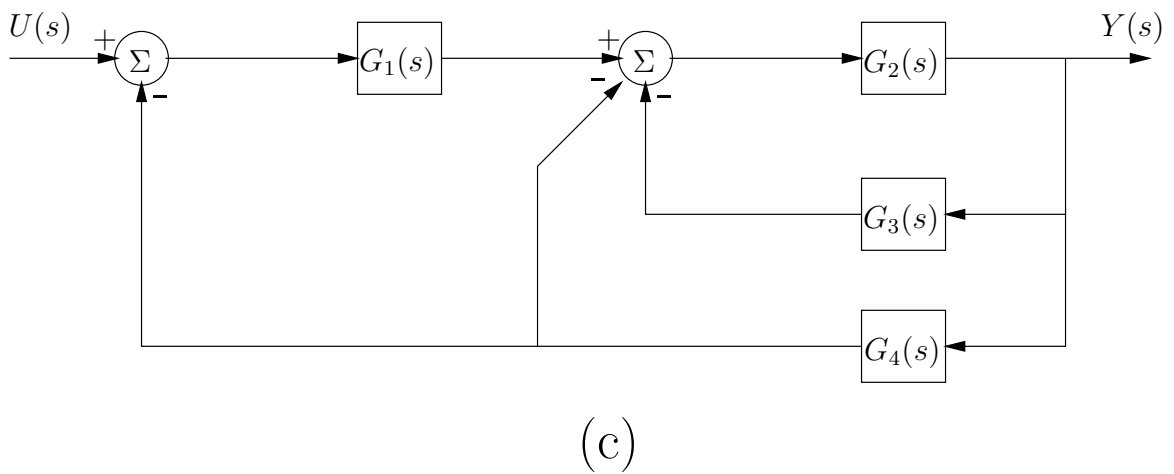
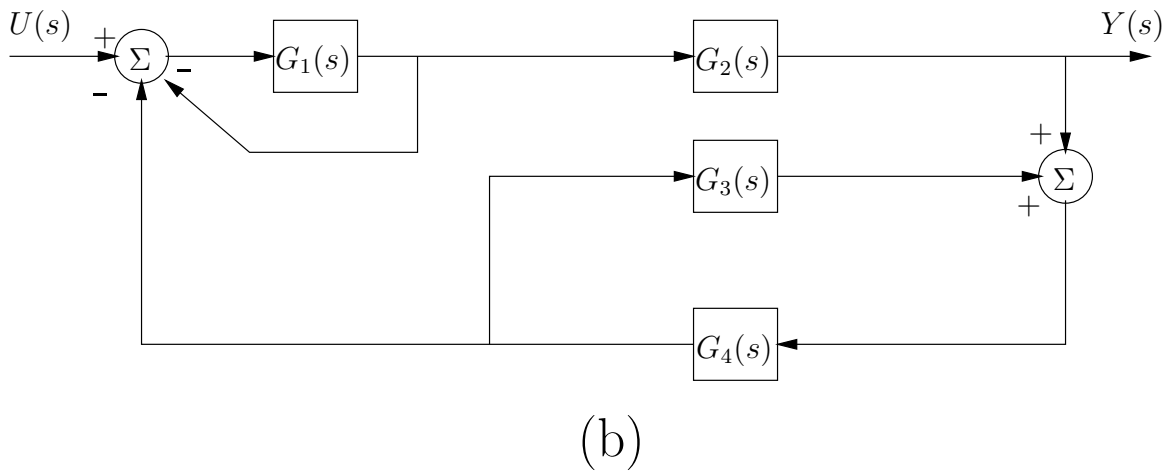
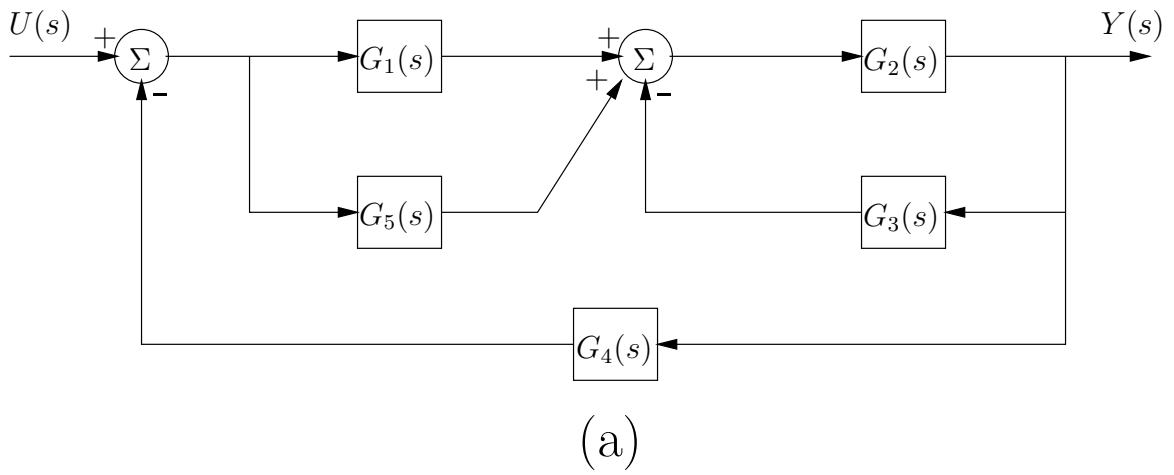


Figure 2.4: Block diagrams.