ME 41100 System Dynamics and Control

Midterm 1 Name:

Problem 1. (20 points) Find the transfer functions $Y(s)/R(s)$ for the block diagrams shown in Fig. 1 and Fig. 2.

1)

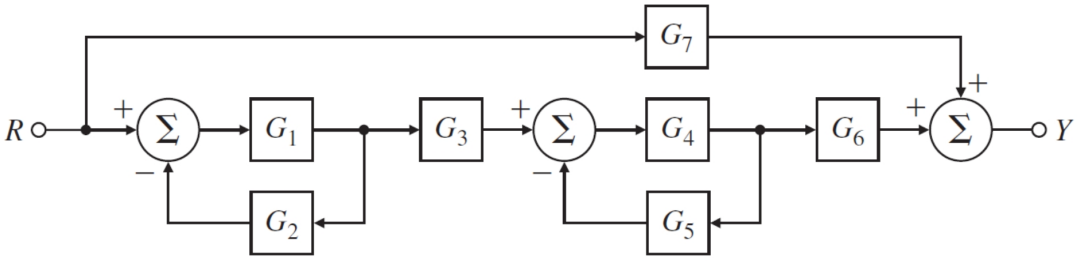

Figure 1: Block diagram.

2)

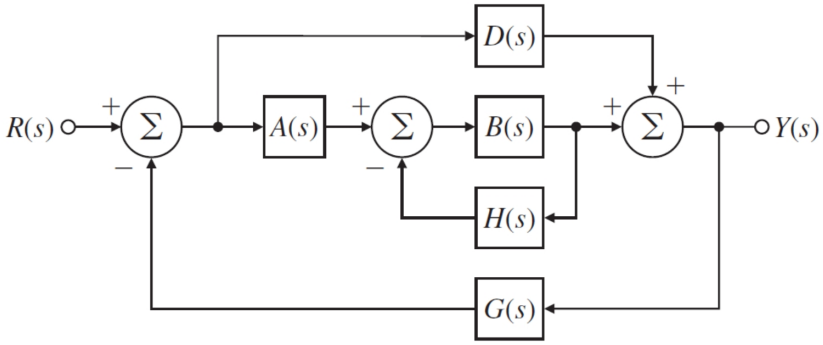

Figure 2: Block diagram.

Problem 2. (20 points) Find the time function corresponding to each of the following Laplace transforms using partial-fraction expansions.

1) $F_1(s) = \dfrac{2(s+3)}{(s+1)(s^2+16)}$

2) $F_2(s) = \dfrac{2(s^2+s+1)}{s(s+1)^2}$

Problem 3. (30 points)

1) For the system shown in Figure 3, suppose that $k_1 = k, k_2 = k_3 = 2k$, and $m_1 = m_2 = m$. Obtain the equations of motion in terms of x_1 and x_2.

2) Derive the transfer function $X_1(s)/F(s)$ of the mechanical system shown in Figure 3.

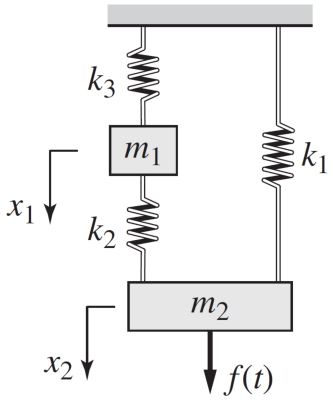

Figure 3: Mechanical system.

Problem 4. (30 points)

1) Derive the transfer function $V_o(s)/V_s(s)$ of the electrical circuit shown in Figure 4.

2) What is the order of the system? What are the zeros and the poles?

3) Assume that $R_1 = R_2 = 1\ \Omega$ and $C = 0.5\ F$. What are the rise time and the settling time of the step response of the system?

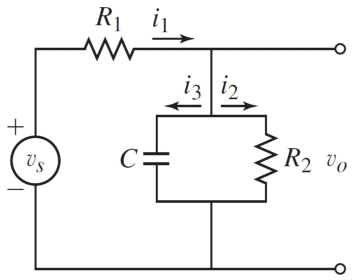

Figure 4: Electrical system.