HW#2. Due 3/26 AM 9:00

1. Obtain the transfer functions X(s) / F(s) and Y(s) / F(s) for the following model:

$$3\dot{x} = y \qquad \dot{y} = f(t) - 3y - 15x$$

2. Derive transfer function by Laplace transform. Use your hand and MATLAB to solve for and sketch the step and impulse responses of the following model, where the magnitude of the step input is 5:

$$3\ddot{x} + 21\dot{x} + 30x = f(t)$$

3. A system is described by the following differential equation:

$$\frac{d^3y}{dt^3} + 5\frac{d^2y}{dt^2} + 7\frac{dy}{dt} + y = \frac{d^3x}{dt^3} + 2\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 7x$$

Find the expression for the transfer function of the system, Y(s) / X(s).

4. A system is described by the following differential equation:

$$\frac{d^2x}{dt^2} + 2\frac{dx}{dt} + 3x = 1$$

With the initial conditions $x(0) = 1, \dot{x}(0) = -1$. Show a block diagram of the system, giving its transfer function and all pertinent inputs and outputs. (Hint: the initial conditions will show up as added inputs to an effective system with zero initial conditions)

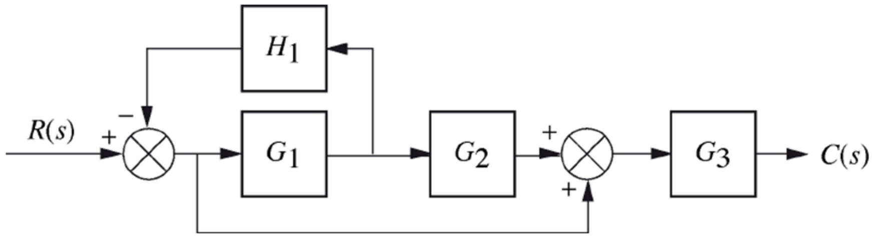
5. Use MATLAB to generate the transfer function

$$G(s) = \frac{5(s+15)(s+26)(s+72)}{s(s+55)(s^2+5s+30)(s+56)(s^2+27s+52)}$$

in the following ways:

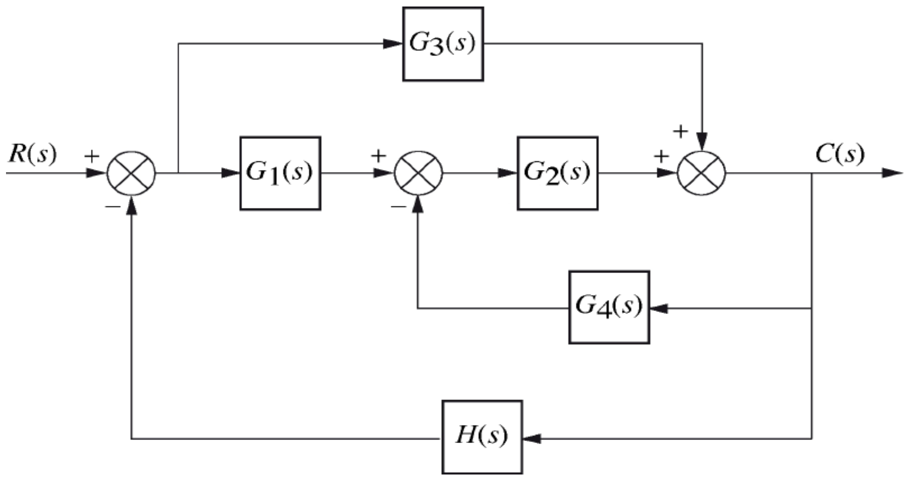
a. The ratio of factors
b. The ratio of polynomials

6. Find the closed-loop transfer function, $T(s) = C(s)/R(s)$ for the system show in Figure 6, using block diagram reduction.



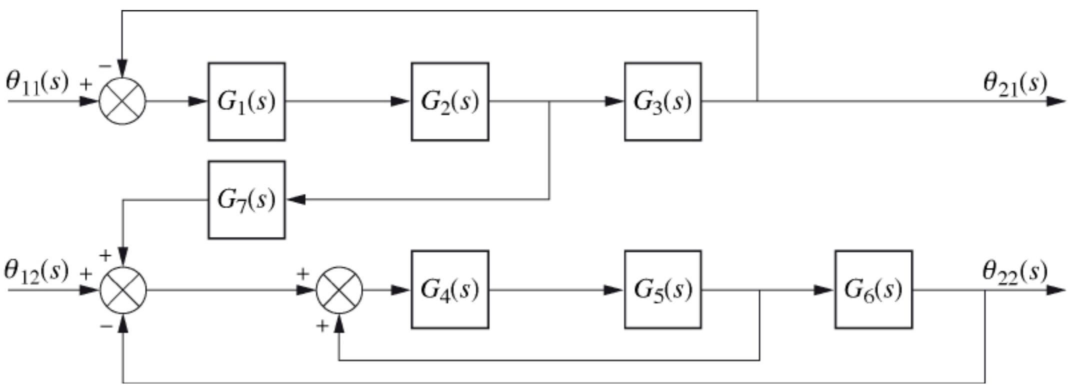
<Figure 6>

7. Reduce the system show in Figure 7 to a single transfer function, $T(s) = C(s)/R(s)$.



<Figure 7>

8. Given the block diagram of a system shown in Figure 8, find the transfer function $G(s) = \theta_{22(s)}/\theta_{11(s)}$.



<Figure 8>