

## Homework #2, BioE 2696/ECE 2695 Control Theory in Neuroscience, Spring 2009

**Problem 1.** Find the inverse Laplace transforms of the following functions.

(a)  $F(s) = \frac{5}{s(s+1)(s+2)}$ ; (b)  $F(s) = \frac{s-30}{s(s^2+4s+29)}$ .

**Problem 2.** Given that  $f(t) = 4e^{-2(t-3)}1(t-3)$ .

(a) Find Laplace transform of  $df(t)/dt$  by differentiating  $f(t)$  and then using the Laplace transform tables.

(b) Find Laplace transform of  $df(t)/dt$  by using the theorem for differentiation.

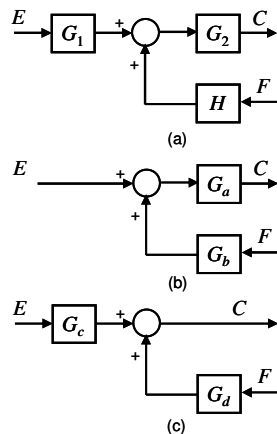


Figure 1

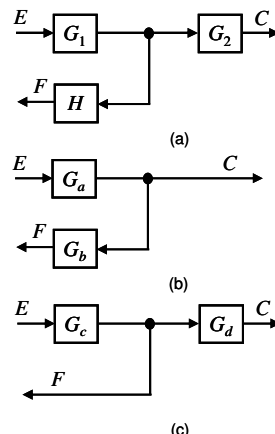


Figure 2

**Problem 3.** Given the block diagrams of Figure 1.

(a) Find the transfer functions  $G_a$  and  $G_b$  such that the block diagram of (b) is equivalent to that of (a).

(b) Find the transfer functions  $G_c$  and  $G_d$  such that the block diagram of (c) is equivalent to that of (a).

**Problem 4.** Given the block diagrams of Figure 2.

(a) Find the transfer functions  $G_a$  and  $G_b$  such that the block diagram of (b) is equivalent to that of (a).

(b) Find the transfer functions  $G_c$  and  $G_d$  such that the block diagram of (c) is equivalent to that of (a).

**Problem 5.** Suppose the input-output relation of a system is given by

$$y(t) = \int_0^{+\infty} e^{-(t-\tau)} u(\tau) d\tau.$$

Determine and explain whether the system is (a) linear, (b) time-invariant, (c) causal, (d) memoryless.