

ECE-320 Quiz #1

Problems 1 and 2 refer to the impulse responses of six different systems given below:

$$h_1(t) = [t + e^{-t}] u(t)$$

$$h_2(t) = e^{-2t} u(t)$$

$$h_3(t) = [2 + \sin(t)] u(t)$$

$$h_4(t) = [1 - t^3 e^{-0.1t}] u(t)$$

$$h_5(t) = [1 + t + e^{-t}] u(t)$$

$$h_6(t) = [te^{-t} \cos(5t) + e^{-2t} \sin(3t)] u(t)$$

- 1) The number of **stable systems** is a) 0 b) 1 c) 2 d) 3
- 2) The number of **unstable systems** is a) 0 b) 1 c) 2 d) 3
- 3) Which of the following transfer functions represents a **stable** system?

$$G_a(s) = \frac{s-1}{s+1}$$

$$G_b(s) = \frac{1}{s(s+1)}$$

$$G_c(s) = \frac{s}{s^2-1}$$

$$G_d(s) = \frac{s+1}{(s+1+j)(s+1-j)}$$

$$G_e(s) = \frac{(s-1-j)(s-1+j)}{s}$$

$$G_f(s) = \frac{(s-1-j)(s-1+j)}{(s+1-j)(s+1+j)}$$

- a) all but G_c b) only G_a , G_b , and G_d c) only G_a , G_d , and G_f
 d) only G_d and G_f e) only G_a and G_d

Problems 4 and 5 refer to the following transfer function

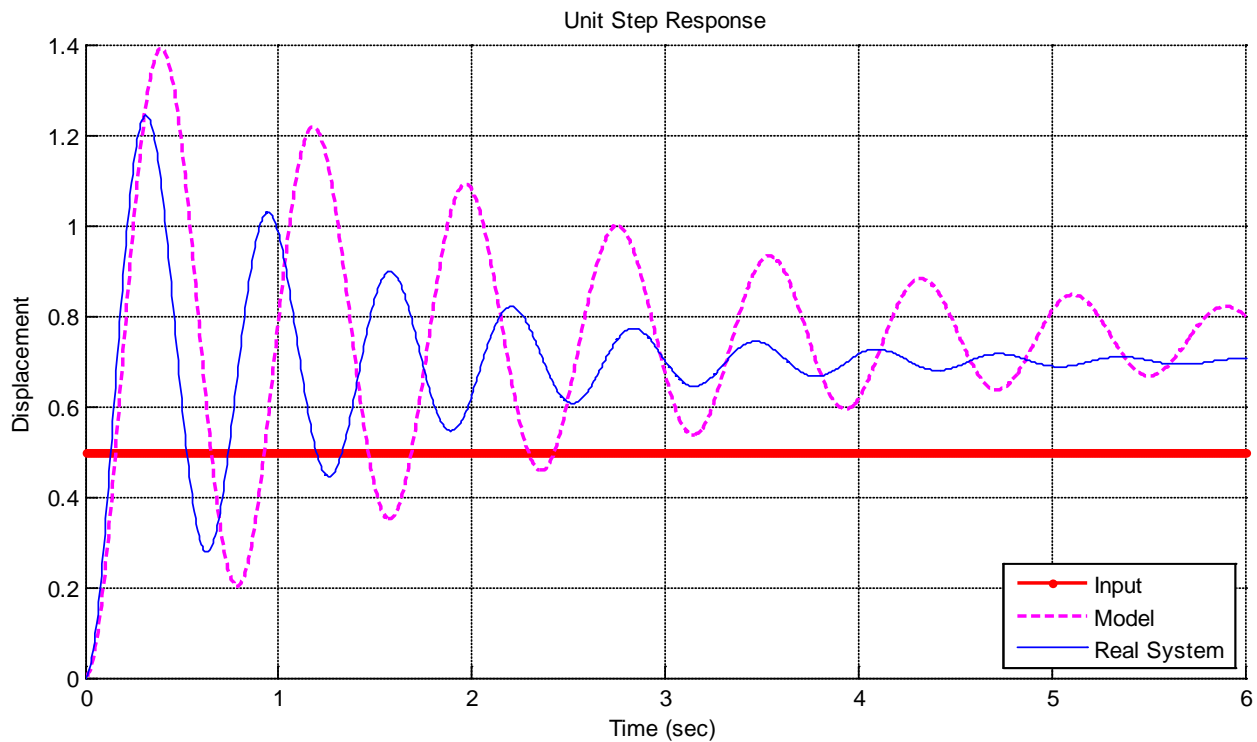
$$H(s) = \frac{2s+1}{(s+2)^2+1}$$

- 4) For this transfer function, the corresponding impulse response $h(t)$ is composed of which terms?
- a) $e^{-t} \cos(2t), e^{-t} \sin(2t)$ b) $e^{-2t} \cos(t), e^{-2t} \sin(t)$
 c) $e^{-t} \cos(4t), e^{-t} \sin(4t)$ d) $e^{-4t} \cos(t), e^{-4t} \sin(t)$

5) The **poles** of the transfer function are

- a) $2 \pm j$ b) $-2 \pm j$
 c) $-1 \pm 2j$ d) $-1 \pm 4j$

Problems 6-8 refer to the figure below, which shows the unit step response of a real 2nd order system and the unit step response of a second order model we are trying to match to the real system.



6) In order to make the model better match the real system, the *damping ratio* of the *model* should be

- a) increased b) decreased c) left alone d) impossible to determine

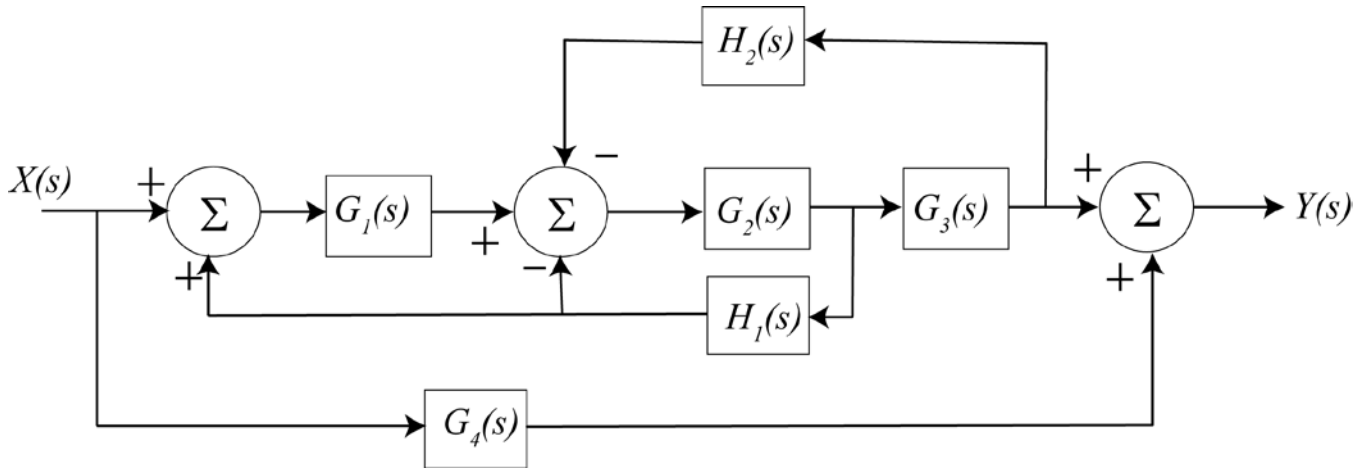
7) In order to make the model better match the real system, the *natural frequency* of the *model* should be

- a) increased b) decreased c) left alone d) impossible to determine

8) In order to make the model better match the real system, the *static gain* of the *model* should be

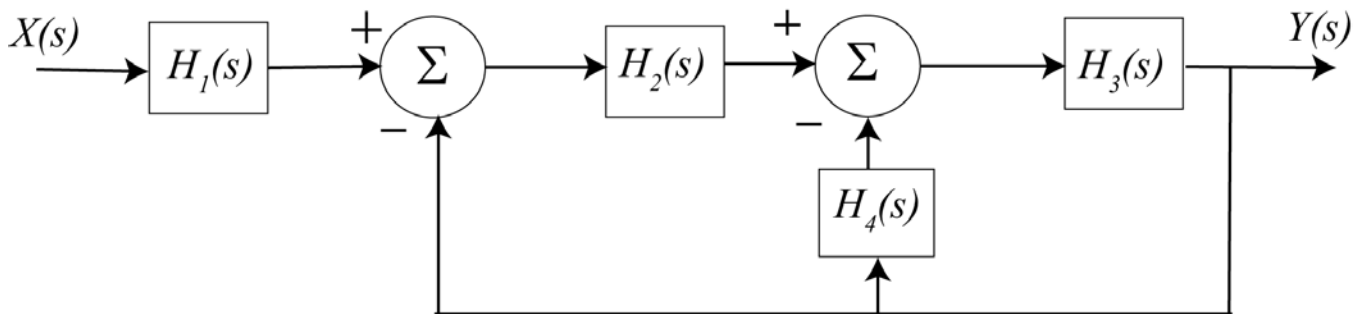
- a) increased b) decreased c) left alone d) impossible to determine

Problems 9 – 11 refer to the signal flow graph representation of the following block diagram.



- 9) How many **paths** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 10) How many **loops** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 11) Are any of the **cofactors** equal to 1? a) yes b) no

For problems 12 – 15 consider the signal flow graph representation of the following block diagram.



- 12) How many **paths** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 13) How many **loops** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 14) The **determinant** (Δ) is a) 1 b) $1 - H_2H_3 - H_3H_4$ c) $1 + H_2H_3 + H_3H_4$ d) none of these
- 15) The **transfer function** is a) 1 b) $\frac{H_1H_2H_3}{1 - H_2H_3 - H_3H_4}$ c) $\frac{H_1H_2H_3}{1 + H_2H_3 + H_3H_4}$