

## ECE-320, Practice Quiz #1

Problems 1 and 2 refer to the following transfer function  $H(s) = \frac{2s+1}{(s+1)^2+4}$

1) 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)  $e^{-4t} \cos(t), e^{-4t} \sin(t)$

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

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

Problems 3 and 4 refer to the impulse responses of six different systems given below:

$$h_1(t) = [1 + e^{-t}]u(t)$$

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

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

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

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

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

3) The number of (asymptotically) **magnally stable systems** is a) 0 b) 1 c) 2 d) 3

4) The number of (asymptotically) **unstable systems** is a) 0 b) 1 c) 2 d) 3

5) Which of the following transfer functions represents a (asymptotically) **stable** system?

$$G_a(s) = \frac{s-1}{s+1} \quad G_b(s) = \frac{1}{s(s+1)} \quad G_c(s) = \frac{s}{s^2-1}$$

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

- 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 6 and 7 refer to the following impulse responses of six different systems

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

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

$$h_3(t) = [2e^{-2t} + t^3 \sin(t)]u(t)$$

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

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

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

- 6) The number of (asymptotically) **unstable** systems is   a) 1   b) 2   c) 3   d) 4  
 7) The number of (asymptotically) **marginally stable** systems is   a) 1   b) 2   c) 3   d) 4

Problems 8 and 9 refer to a system with poles at  $-2+5j$ ,  $-2-5j$ ,  $-10+j$ ,  $-10-j$ , and  $-20$

- 8) The best estimate of the **settling time** for this system is  
 a) 2 seconds   b) 0.4 seconds   c) 4/5 seconds   d) 0.2 seconds

9) The **dominant pole(s)** of this system are a)  $-2+5j$  and  $-2-5j$  b)  $-10+j$  and  $-10-j$  c)  $-20$

10) Which of the following transfer functions represents a (asymptotically) **stable** system?

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

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

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

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

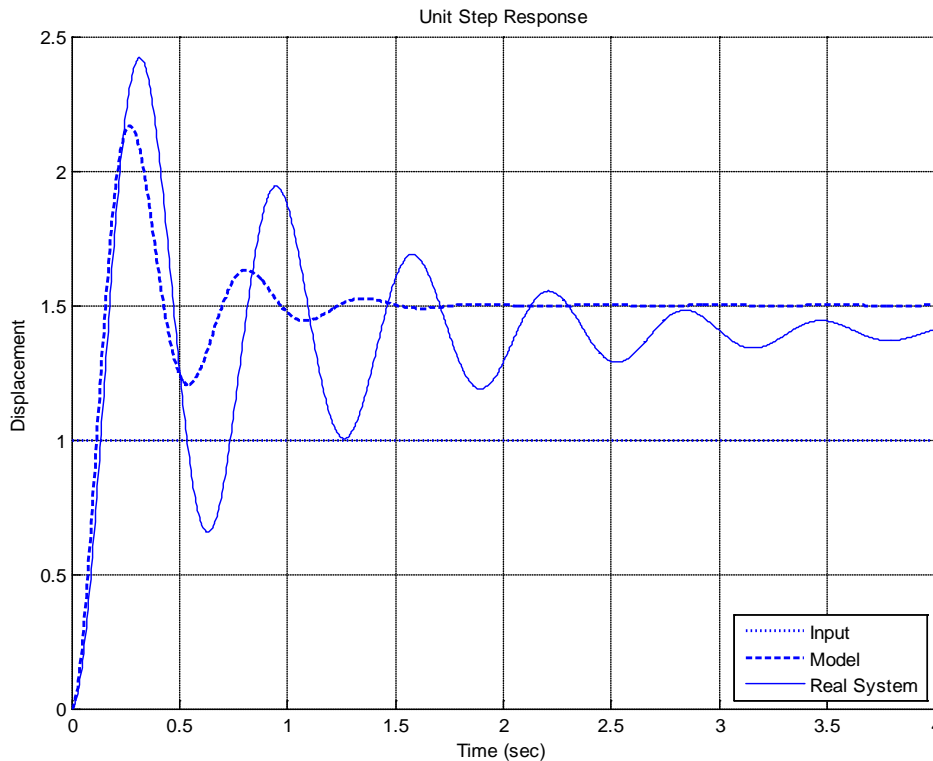
$$G_e(s) = \frac{(s-1-j)(s-1+j)}{(s+2)^2}$$

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

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 11-13 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.

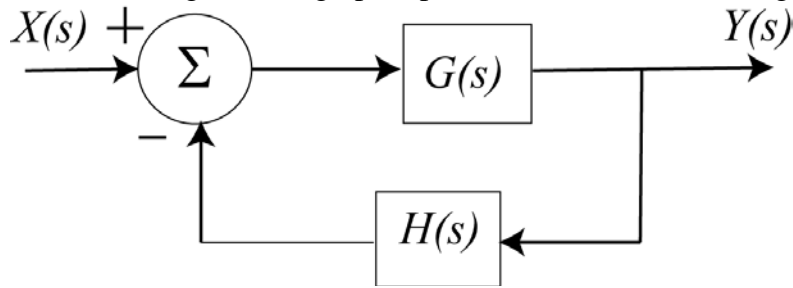


11) In order to make the model better match the real system, the **damping ratio** of the **model** should be a) increased b) decreased c) left alone d) impossible to determine

12) 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

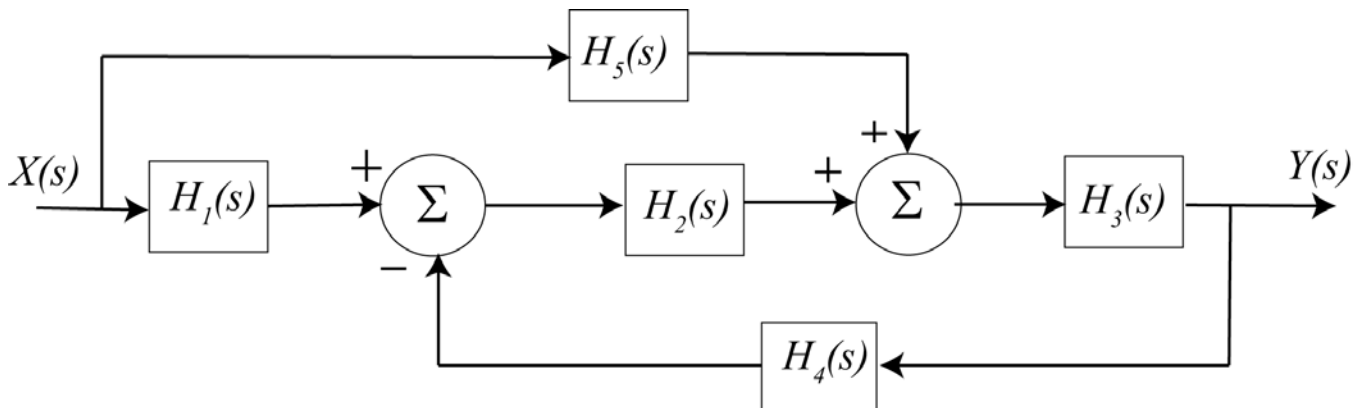
13) In order to make the model better match the real system, the **static gain** of the **model** should be a) increased b) decreased c) left alone d) impossible to determine

For problems 14-18, consider the signal flow graph representation of the following block diagram.



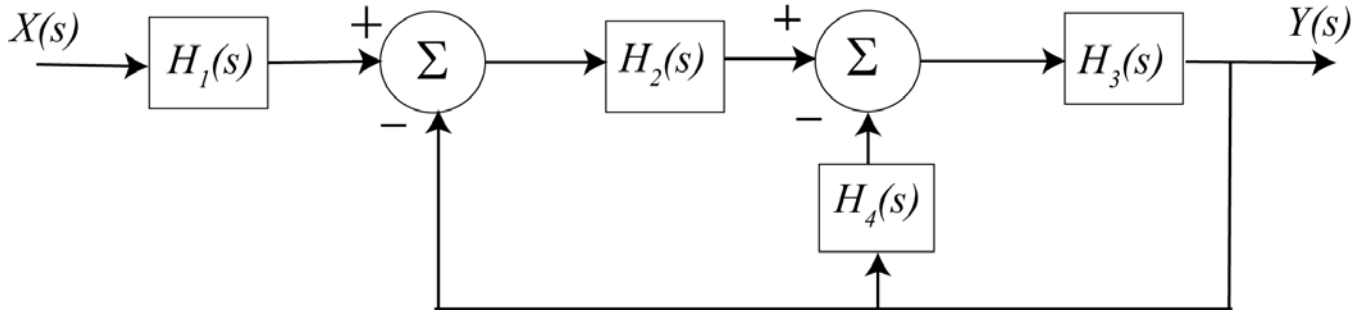
- 14) The **path** is a) 1 b)  $G$  c)  $H$  d)  $GH$  e) none of these
- 15) The **loop** is a) 1 b)  $G$  c)  $H$  d)  $GH$  e) none of these
- 16) The **determinant** ( $\Delta$ ) is a) 1 b)  $1-GH$  c)  $1+GH$  d) none of these
- 17) The **cofactor** is a) 1 b)  $G$  c)  $H$  d)  $GH$  e) none of these
- 18) The **transfer function** is a) 1 b)  $G$  c)  $GH$  d)  $\frac{G}{1-GH}$  e)  $\frac{G}{1+GH}$

For problems 19-21, consider the signal flow graph representation of the following block diagram.



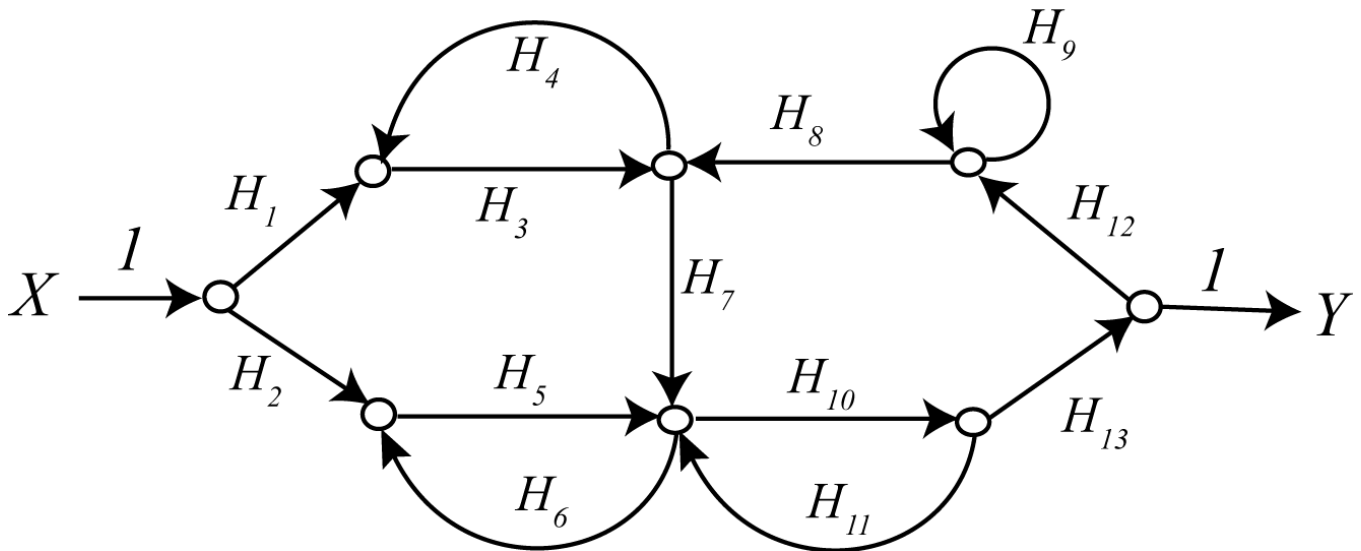
- 19) How many **paths** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 20) How many **loops** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 21) The **determinant** ( $\Delta$ ) is a) 1 b)  $1-H_2H_3H_4$  c)  $1+H_2H_3H_4$  d) none of these
- 22) The **transfer function** is a) 1 b)  $\frac{H_3H_5 + H_1H_2H_3}{1 + H_2H_3H_4}$  c)  $\frac{H_3H_5 + H_1H_2H_3}{1 - H_2H_3H_4}$

For problems 23 – 26 consider the signal flow graph representation of the following block diagram.



- 23) How many **paths** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 24) How many **loops** are there? a) 0 b) 1 c) 2 d) 3 e) 4
- 25) The **determinant** ( $\Delta$ ) is a) 1 b)  $1 - H_2H_3 - H_3H_4$  c)  $1 + H_2H_3 + H_3H_4$  d) none of these
- 26) The **transfer function** is a) 1 b)  $\frac{H_1H_2H_3}{1 - H_2H_3 - H_3H_4}$  c)  $\frac{H_1H_2H_3}{1 + H_2H_3 + H_3H_4}$

For problems 27-29 consider the following signal flow graph



- 27) How many **paths** are there? a) 1 b) 2 c) 3 d) 4
- 28) How many **loops** are there? a) 2 b) 3 c) 4 d) 5 e) 6 f) 7
- 29) Are any of the **cofactors** equal to 1? a) yes b) no

Answers: 1-a, 2-c, 3-d, 4-b, 5-c, 6-b, 7-a, 8-a, 9-a, 10-a, 11-b, 12-b, 13-b, 14-b, 15-e, 16-c, 17-a, 18-e, 19-c, 20-b, 21-c, 22-b, 23-b, 24-c, 25-c, 26-c, 27-b, 28-d, 29-b