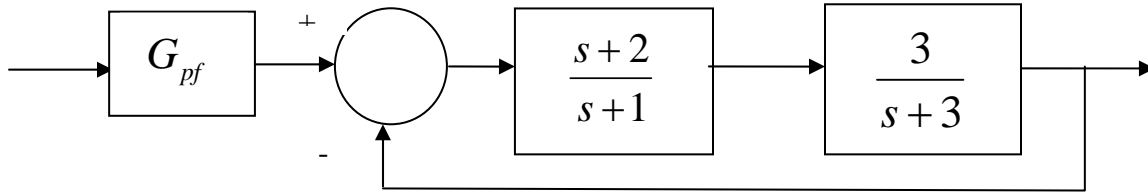


**ECE-320, Quiz #3**

1) For the following system:



the value of the prefilter  $G_{pf}$  that produces **a steady state error** of zero for a unit step input is:

- a) 1    b) 3/2    c) 5/2    d) 1/3

Problems 2 and 3 refer to the impulse responses of six different systems given below:

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

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

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

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

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

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

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

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

4) The **unit step response** of a system is given by  $y(t) = -u(t) - t^4 e^{-t}u(t) + e^{-2t}u(t)$

The **steady state error** for a unit step input for this system is best estimated as

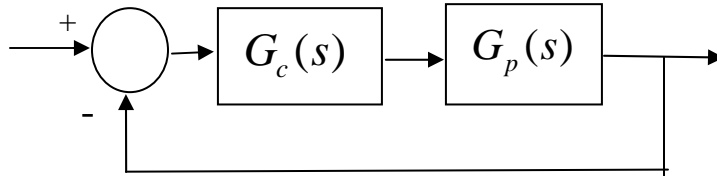
- a)  $\infty$     b) 0.5    c) 2.0    d) impossible to determine

5) The **unit ramp response** of a system is given by  $y(t) = -2u(t) + tu(t) + e^{-t}u(t)$  .

The best estimate of the **steady state error** is

- a) 0.5    b) 2.0    c) 1.0    d)  $\infty$

6) For the following system



the pole of the controller  $G_c(s)$  is at -15

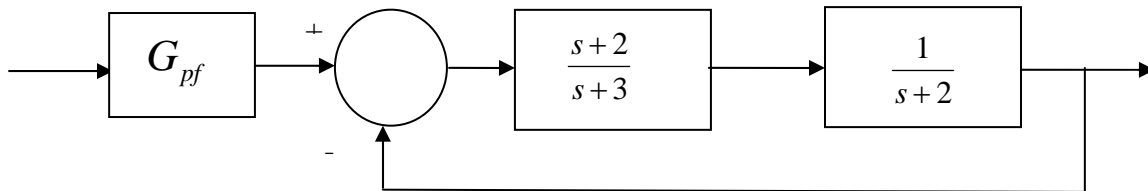
the poles of the plant  $G_p(s)$  are at -1 and -2

the poles of the closed loop system are at -7.1, -5.43 + 3.98j, -5.43 - 3.98j

The best estimate of the settling time of the closed loop system is

- a) 4 seconds    b)  $\frac{4}{15}$  seconds    c)  $\frac{4}{7.1}$  seconds    d)  $\frac{4}{5.43}$  seconds

7) For the following system:



the value of the prefilter  $G_{pf}$  that produces a **steady state error** of zero for a unit step input is:

- a) 1    b) 3/2    c) 4    d) 1/3

8) Which of the following transfer functions represents a **stable** system?

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

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

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

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

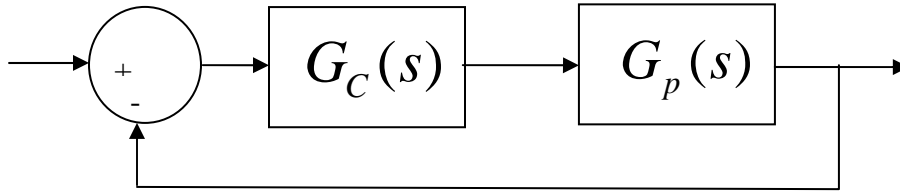
$$G_e(s) = \frac{(s-1-j)(s-1+j)}{s}$$

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

- 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  $G_d$

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9) Assume we are using model matching to determine the controller in the following system.



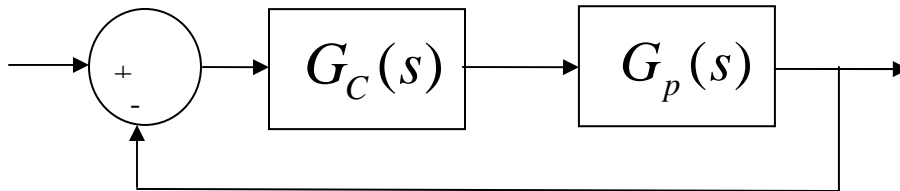
The plant is given by  $G_p(s) = \frac{s+1}{s^2+2s+2}$

Circle any of the following closed loop transfer functions are acceptable

$$G_A(s) = \frac{s-1}{s+1} \quad G_B(s) = \frac{s+1}{s^2+2s+2} \quad G_C(s) = \frac{s-1}{s-3}$$

$$G_D(s) = \frac{s-1}{(s+2)^2} \quad G_E(s) = \frac{1}{s^2+s+1} \quad G_F(s) = \frac{1}{s+1}$$

10) Assume we are using model matching to determine the controller in the following system.



The plant is given by  $G_p(s) = \frac{s-1}{s+1}$

Circle any of the following closed loop transfer functions are acceptable

$$G_A(s) = \frac{s-1}{s^2+1} \quad G_B(s) = \frac{s+1}{s^2+2s+2} \quad G_C(s) = \frac{s+1}{s+3}$$

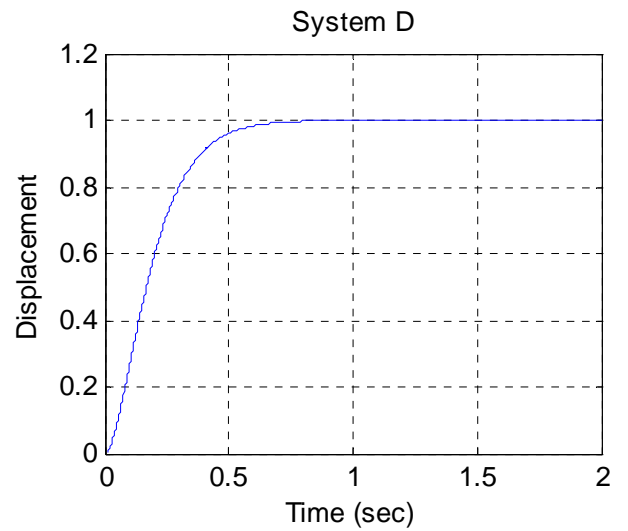
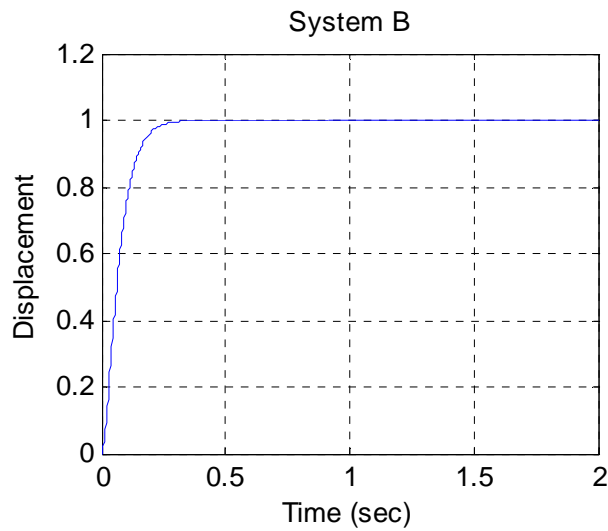
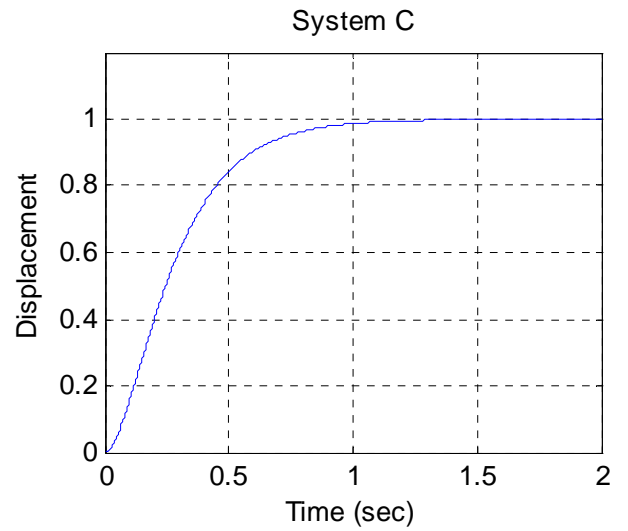
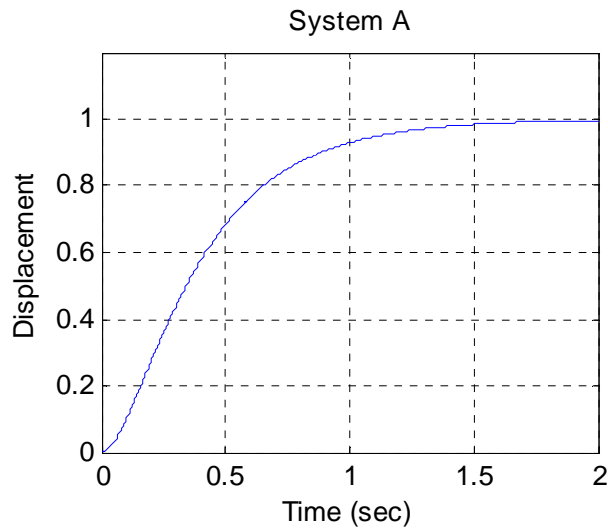
$$G_D(s) = \frac{s-1}{(s+2)^2} \quad G_E(s) = \frac{1}{s^2+s+1} \quad G_F(s) = \frac{1}{s+1}$$

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11) The **unit step responses** of four systems with real poles is shown below. Which system will have the **largest bandwidth**?

- a) System A   b) System B   c) System C   d) System D

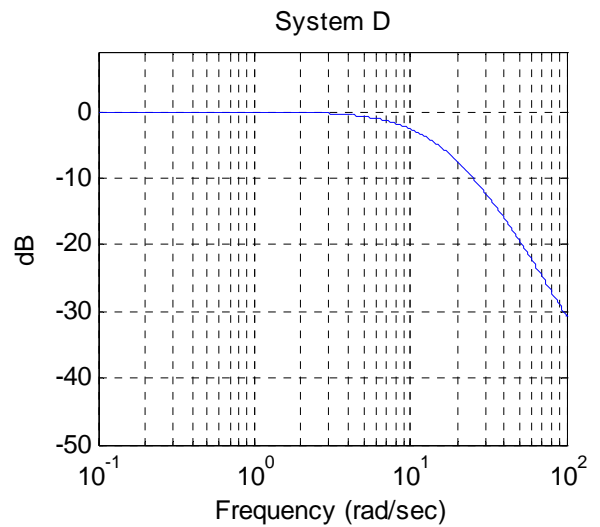
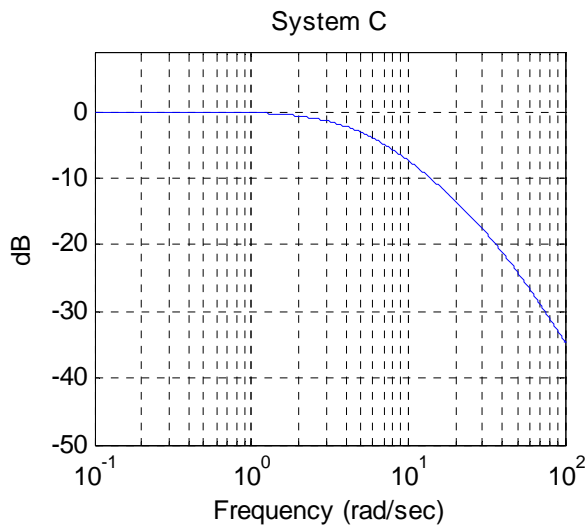
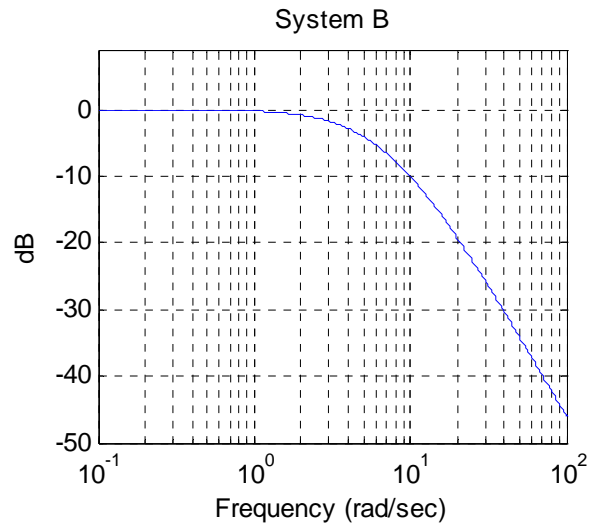
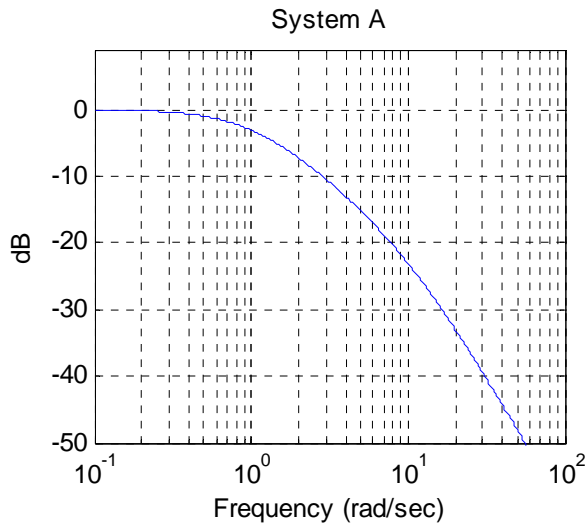


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12) The magnitude of the frequency response of four systems with real poles is shown below. Which system will have the smallest **settling time**?

- a) System A   b) System B   c) System C   d) System D

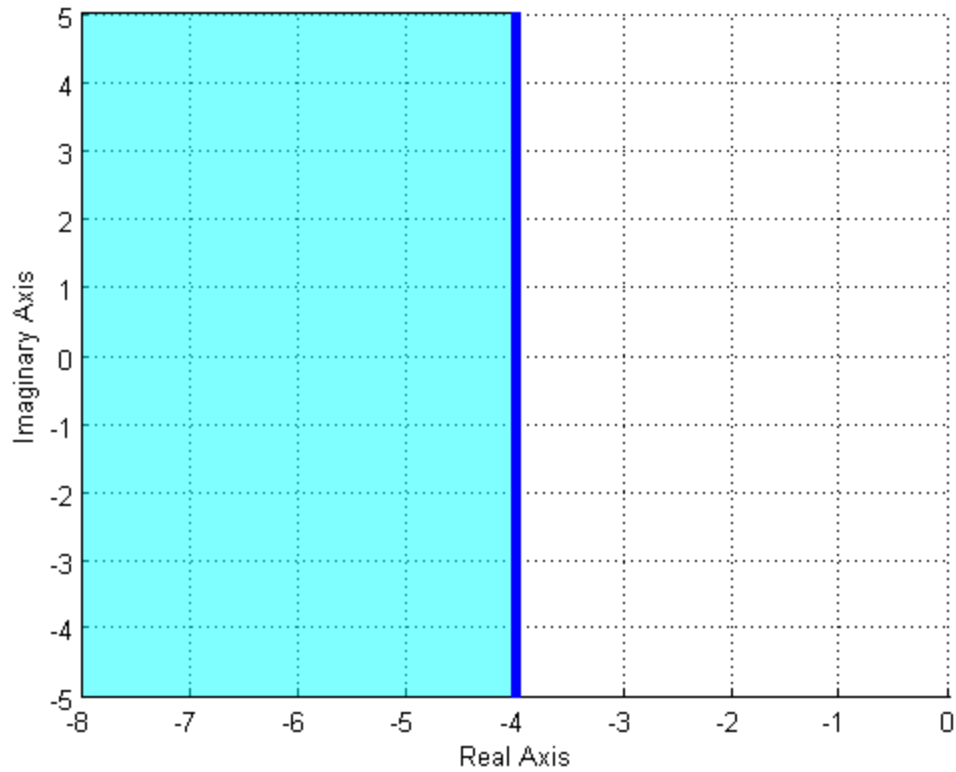


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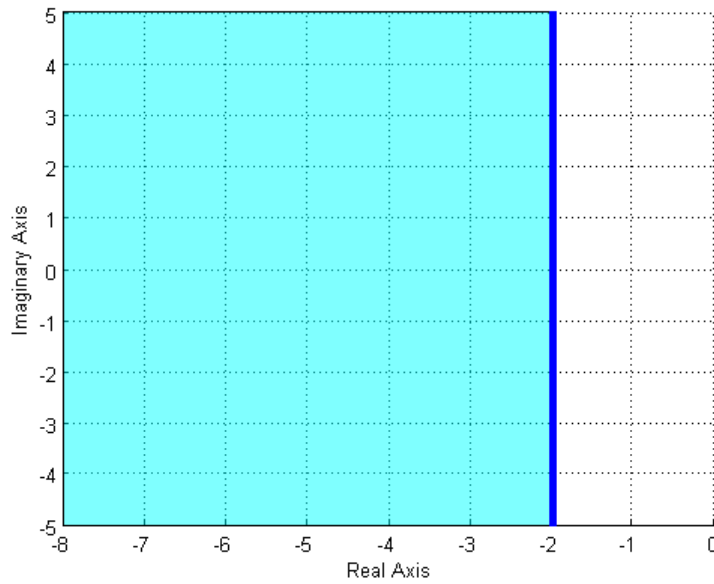
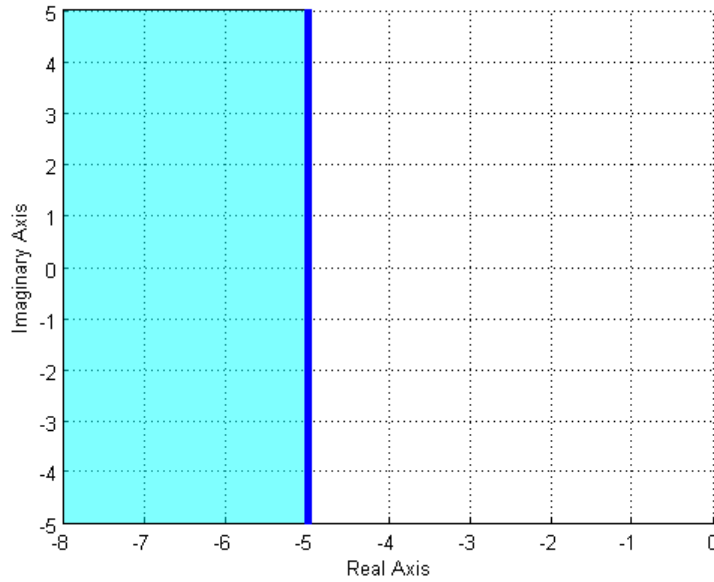
**13)** The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

- a)  $T_s \leq 1$    b)  $T_s \geq 1$    c)  $T_s \geq 4$    d)  $T_s \leq 4$    e) none of these



14) Assuming we are allowed to place our poles only in the (dark) shaded areas, which of the following two shaded regions will in general result in a **smaller settling time** for our system?

- a) the region in the top figure    b) the region in the bottom figure

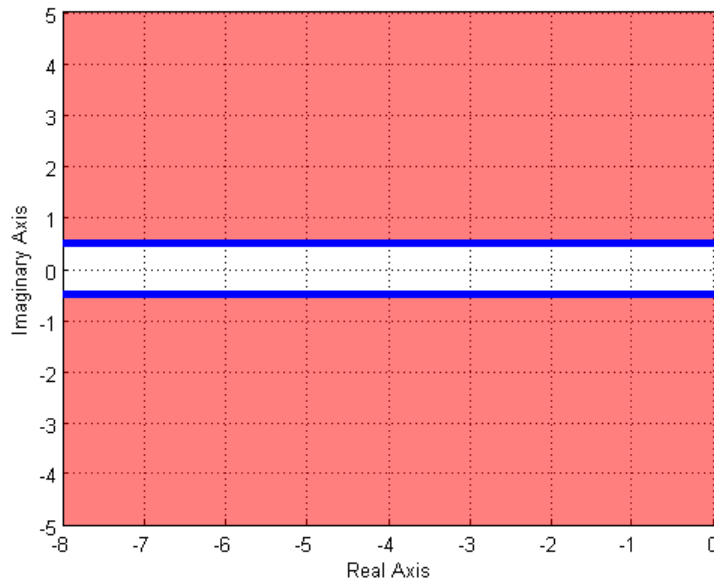
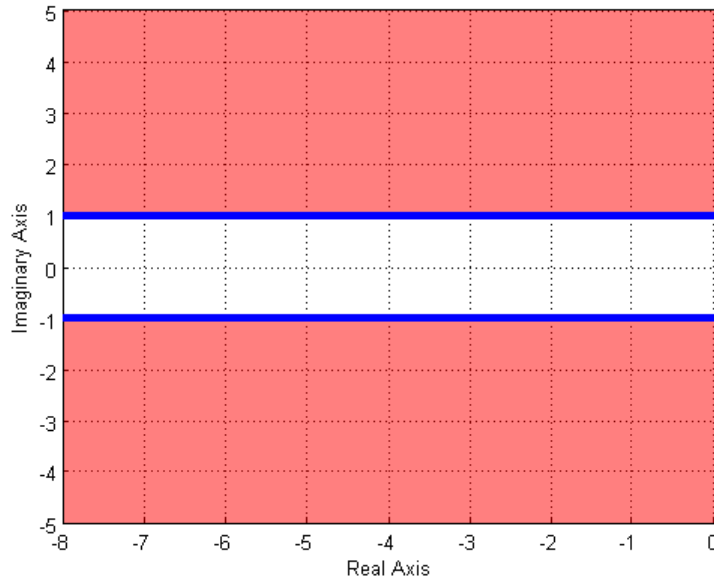


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**15)** Assuming we are allowed to place our poles only in the (dark) shaded areas, which of the following two shaded regions will in general result in a **smaller time to peak** for our system?

- a) the region in the top figure    b) the region in the bottom figure





**16)** One of the shaded regions below shows the possible pole locations for a percent overshoot less than 10%, and the other shows the possible pole locations for a percent overshoot less than 20%. Which of the two graphs shows the possible pole locations for a percent overshoot less than 20%?

- a) the region in the top figure    b) the region in the bottom figure

