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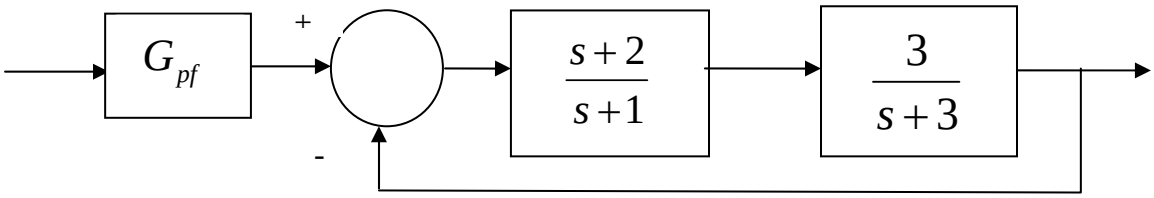
ECE-320, Quiz #3

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) ∞ 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) ∞

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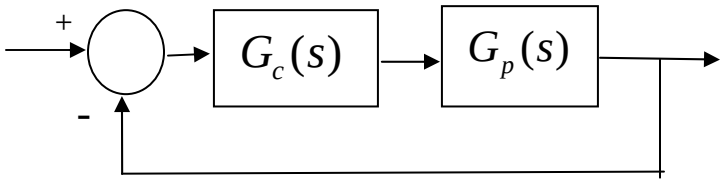
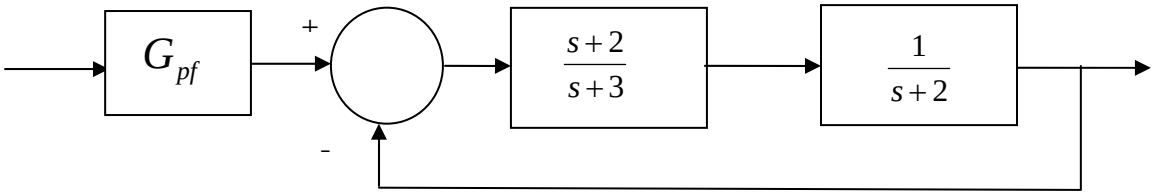
6) For the following system



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?

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

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

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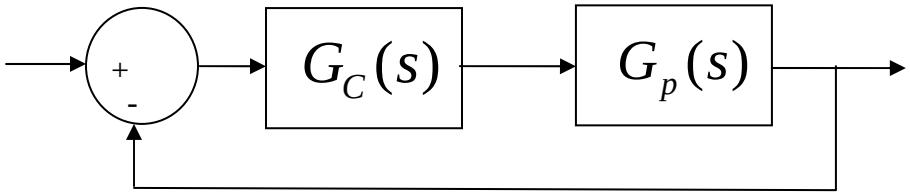
9) Assume we are using model matching to determine the controller in the following system.

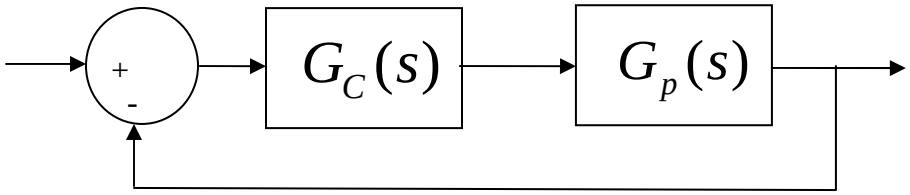


The plant is given by $G_p(s) = \dfrac{s+1}{s^2+2s+2}$

Circle any of the following closed loop transfer functions are acceptable

$$G_A(s) = \frac{s-1}{s+1} \qquad G_B(s) = \frac{s+1}{s^2+2s+2} \qquad G_C(s) = \frac{s-1}{s-3}$$
$$G_D(s) = \frac{s-1}{(s+2)^2} \qquad G_E(s) = \frac{1}{s^2+s+1} \qquad G_F(s) = \frac{1}{s+1}$$

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



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

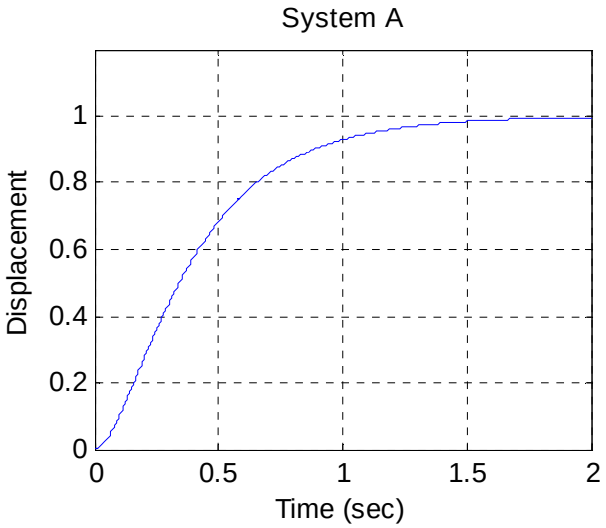
Circle any of the following closed loop transfer functions are acceptable

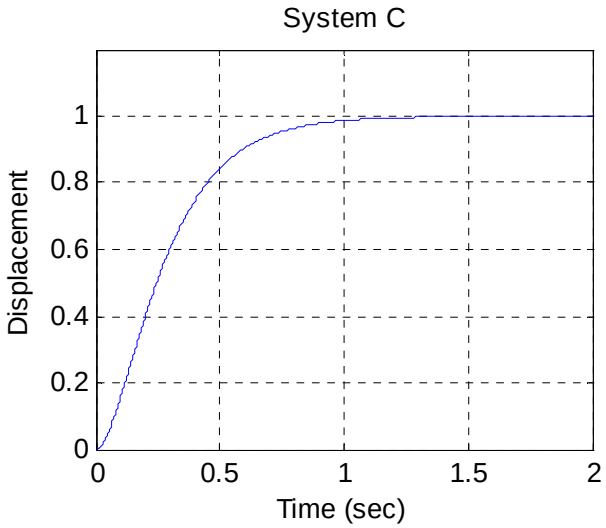
$$G_A(s) = \frac{s-1}{s^2+1} \qquad G_B(s) = \frac{s+1}{s^2+2s+2} \qquad G_C(s) = \frac{s+1}{s+3}$$
$$G_D(s) = \frac{s-1}{(s+2)^2} \qquad G_E(s) = \frac{1}{s^2+s+1} \qquad G_F(s) = \frac{1}{s+1}$$

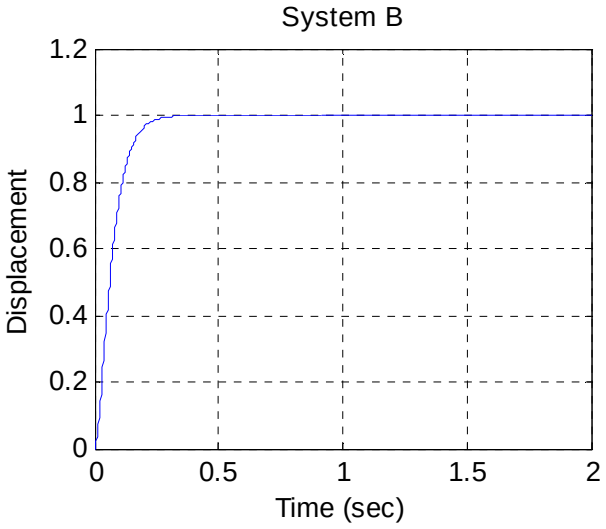
Name _____ Mailbox _____

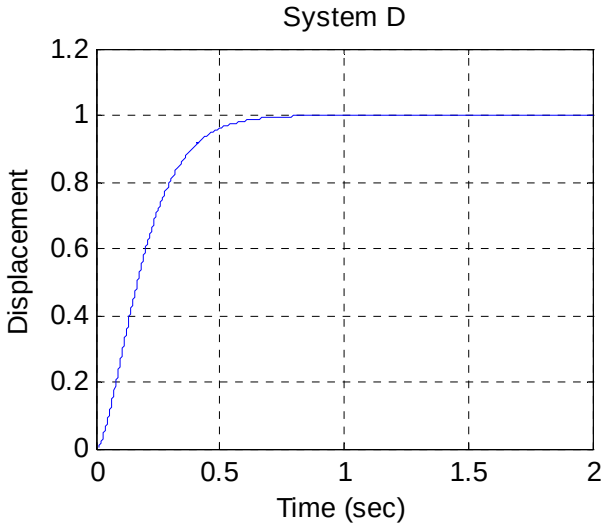
11) The **unit step responses** of four systems with real poles is shown below. Which system will have the **largest bandwidth**?

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









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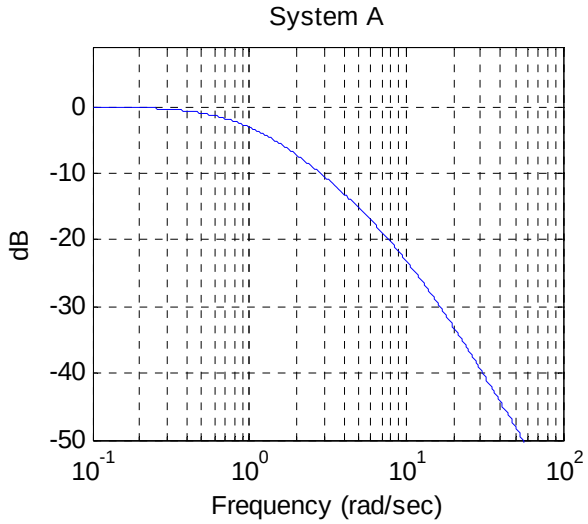
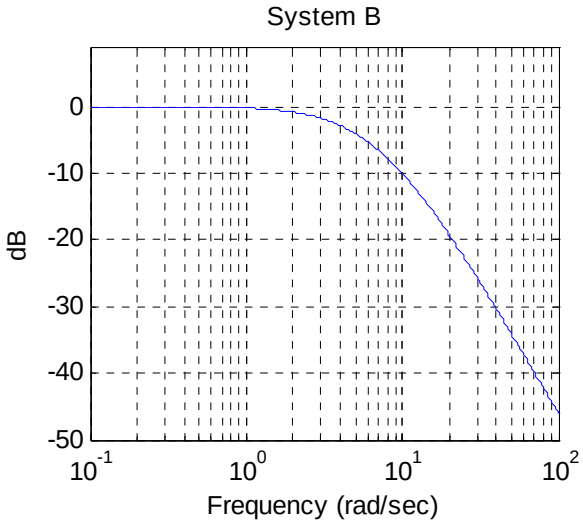
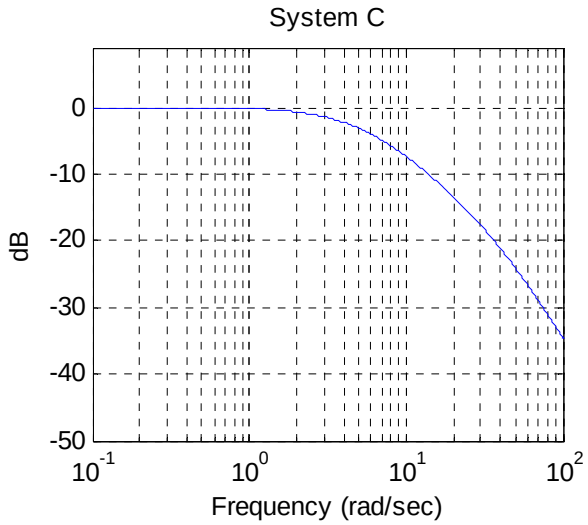
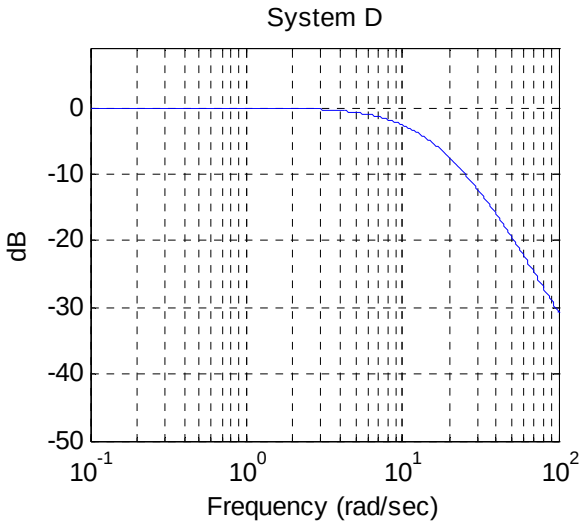
12) The magnitude of the frequency response of four systems with real poles is shown below. Which system will have the smallest **settling time**?

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









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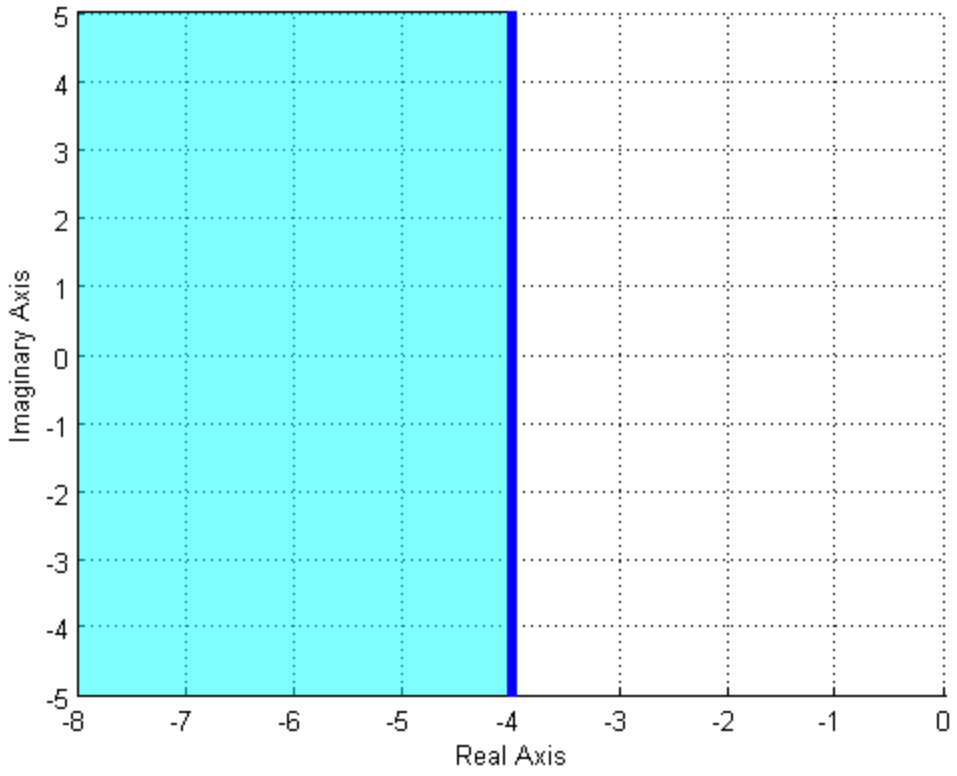
13) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

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



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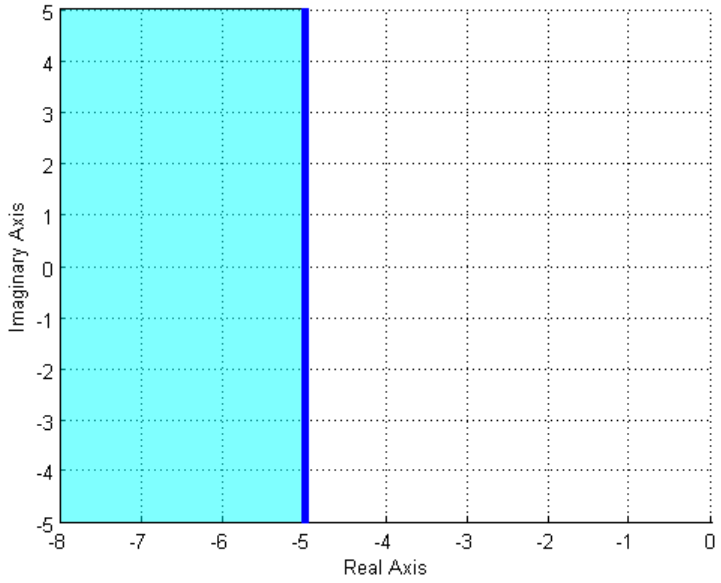
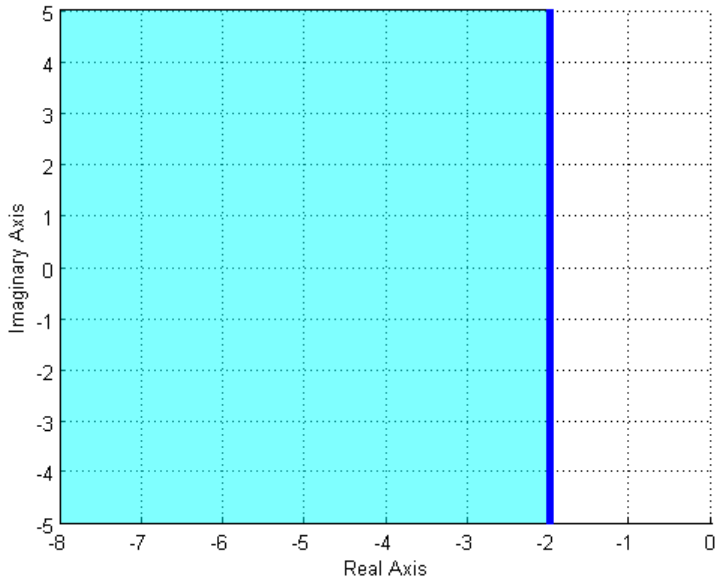
14) Assuming we are allowed to place our poles only in the (dark) shaded areas, which of the following two shaded regions will in general result in a **smaller settling time** for our system?

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





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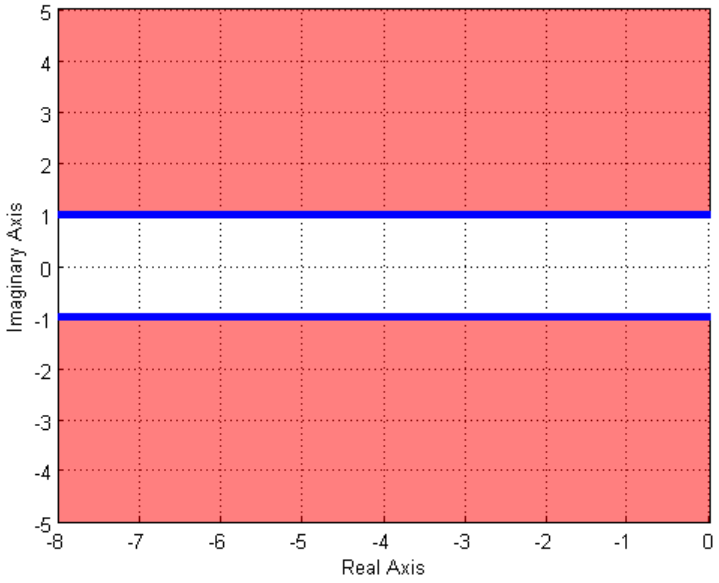
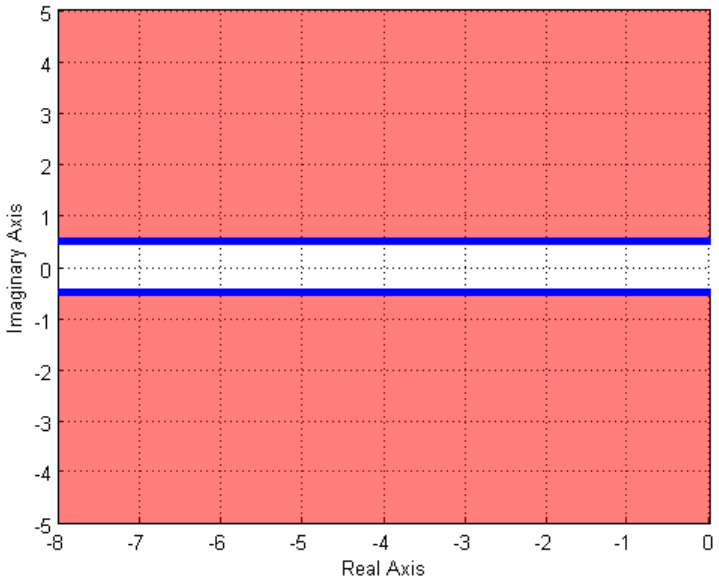
15) Assuming we are allowed to place our poles only in the (dark) shaded areas, which of the following two shaded regions will in general result in a **smaller time to peak** for our system?

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





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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