ECE-320, Practice Quiz #1

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

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:

$$h_1(t) = [1+e^{-t}]u(t)$$
$$h_2(t) = e^{-2t}u(t)$$
$$h_3(t) = [2+\sin(t)]u(t)$$
$$h_4(t) = [1-t^3e^{-0.1t}]u(t)$$
$$h_5(t) = [1+t+e^{-t}]u(t)$$
$$h_6(t) = [te^{-t}\cos(5t)+e^{-2t}\sin(3t)]u(t)$$

3) The number of (asymptotically) **maginally 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?

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

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

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

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

$$h_1(t)=[te^{-t}]u(t)$$
$$h_2(t)=e^{-2t}u(t)$$
$$h_3(t)=[2e^{-2t}+t^3\sin(t)]u(t)$$
$$h_4(t)=[1-t^3e^{-0.1t}]u(t)$$
$$h_5(t)=[1+t+e^{-t}]u(t)$$
$$h_6(t)=[te^{-t}\cos(5t)+e^{-2t}\sin(3t)]u(t)$$

6) The number of (asymptitcally) **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?

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

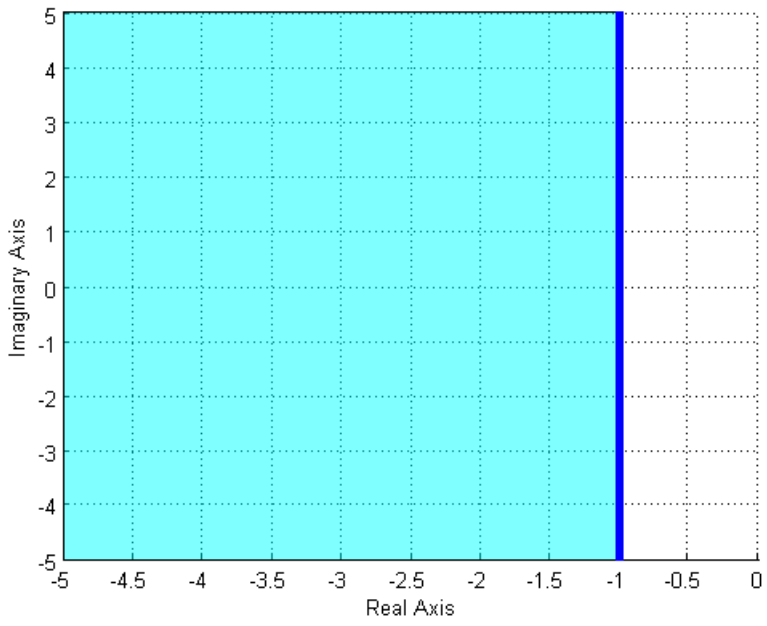
$$G_d(s)=\frac{s+1}{(s+1+j)(s+1-j)} \qquad G_e(s)=\frac{(s-1-j)(s-1+j)}{(s+2)^2} \qquad G_f(s)=\frac{(s-1-j)(s-1+j)}{(s+1-j)(s+1+j)}$$

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

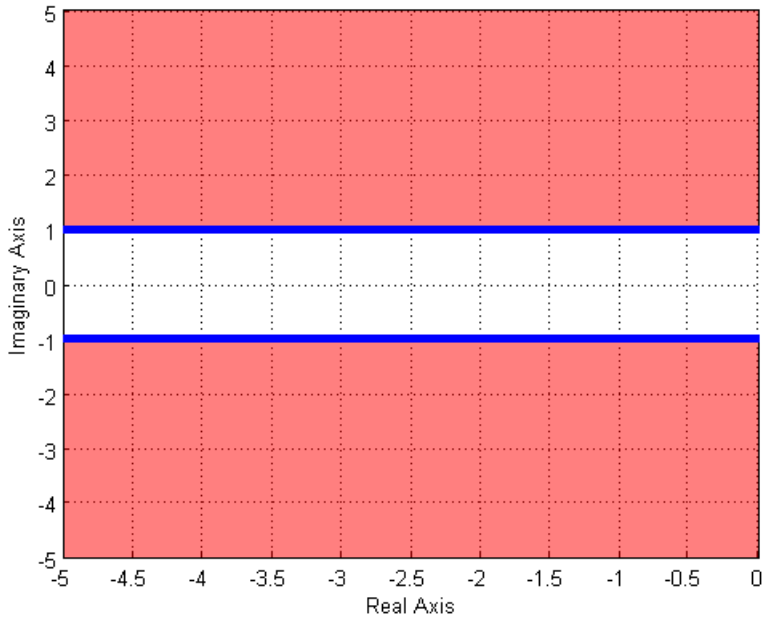
11) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

a) $T_s \le 1$ b) $T_s \ge 1$ c) $T_s \ge 4$ d) $T_s \le 4$ e) none of these



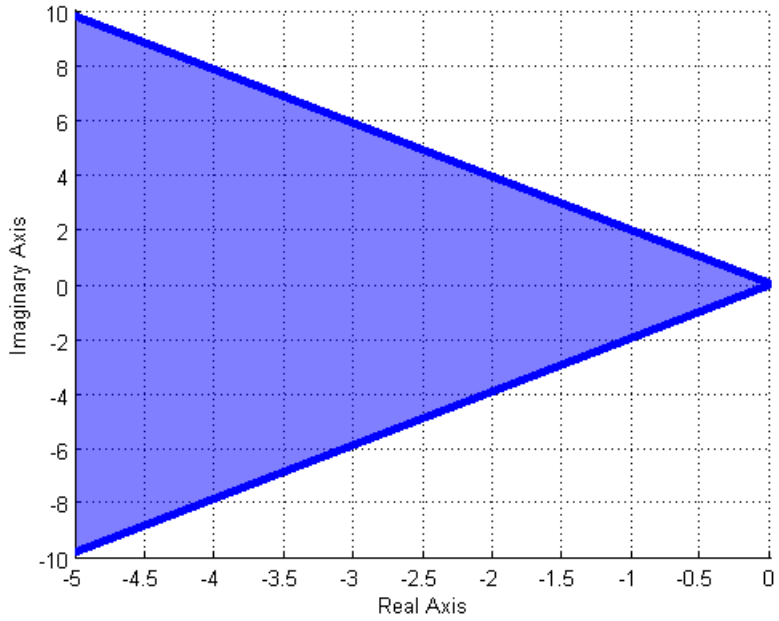
12) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

a) $T_p \le 1$ b) $T_p \ge 1$ c) $T_p \ge \pi$ d) $T_p \le \pi$ e) none of these



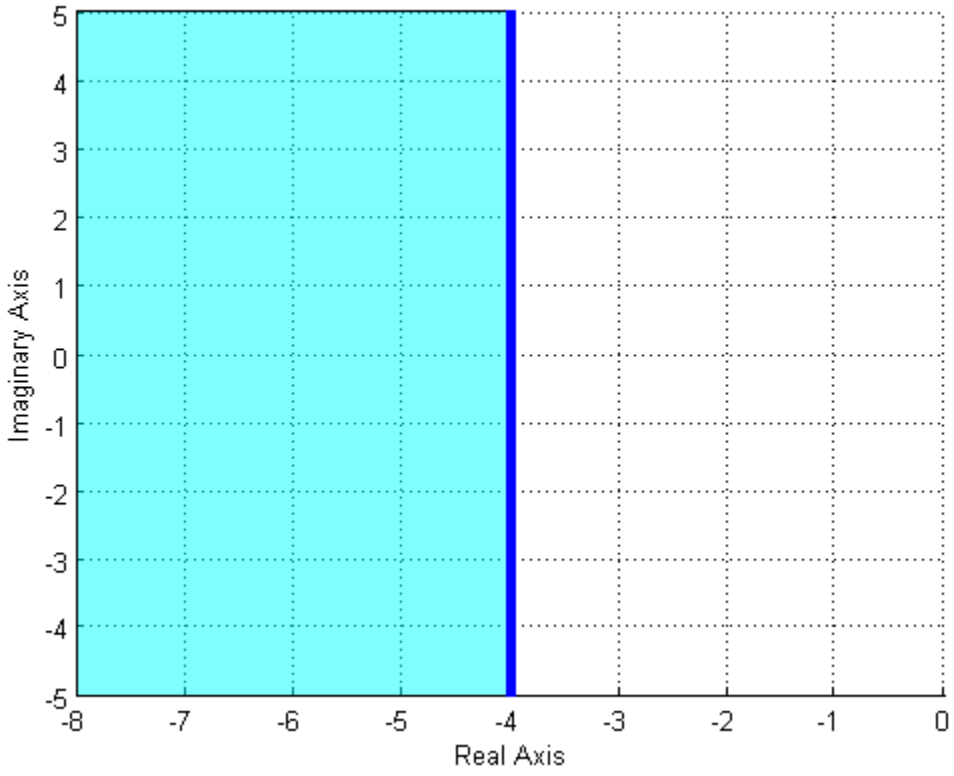
13) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

a) $PO \ge 20\%$ b) $PO \le 20\%$



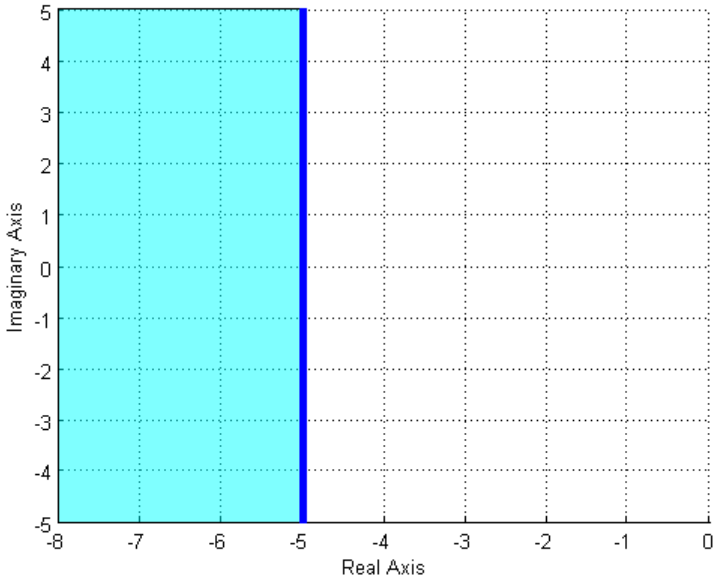
14) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

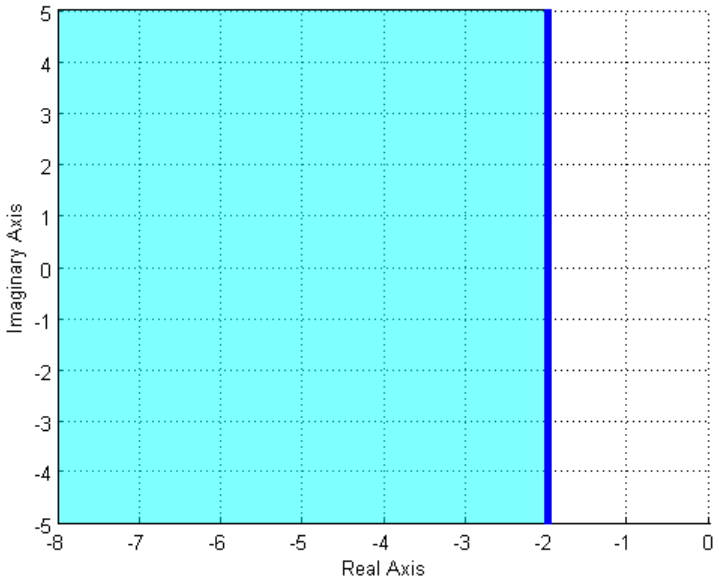
a) $T_s \le 1$ b) $T_s \ge 1$ c) $T_s \ge 4$ d) $T_s \le 4$ e) none of these



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 settling time** for our system?

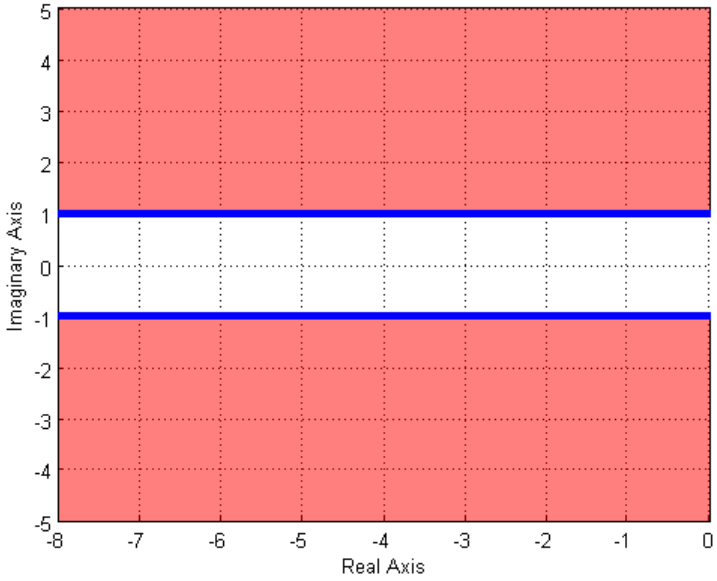
a) the region in the top figure b) the region in the bottom figure

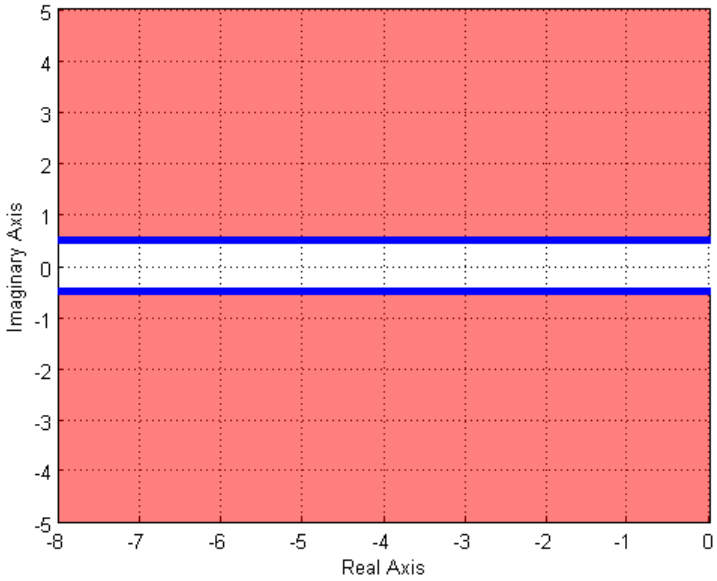




16) Assuming we are allowed to place our poles only in the (dark) shaded areas, which of the following two shaded regions will in general result in a **smaller time to peak** for our system?

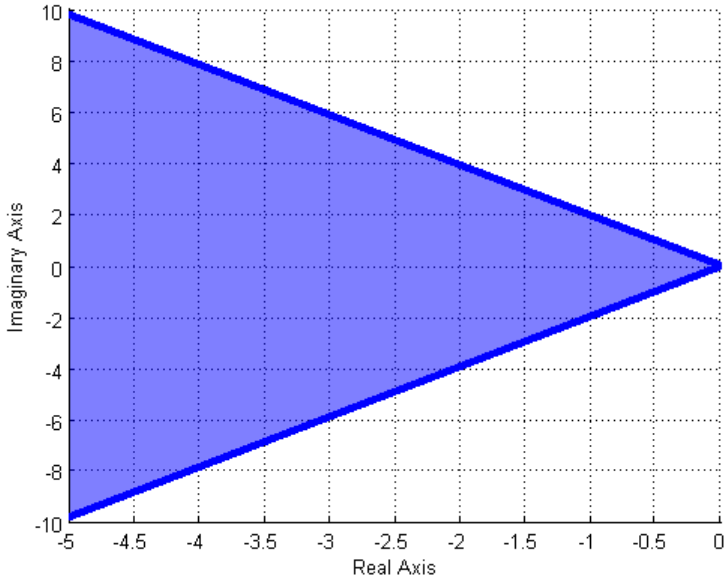
a) the region in the top figure b) the region in the bottom figure

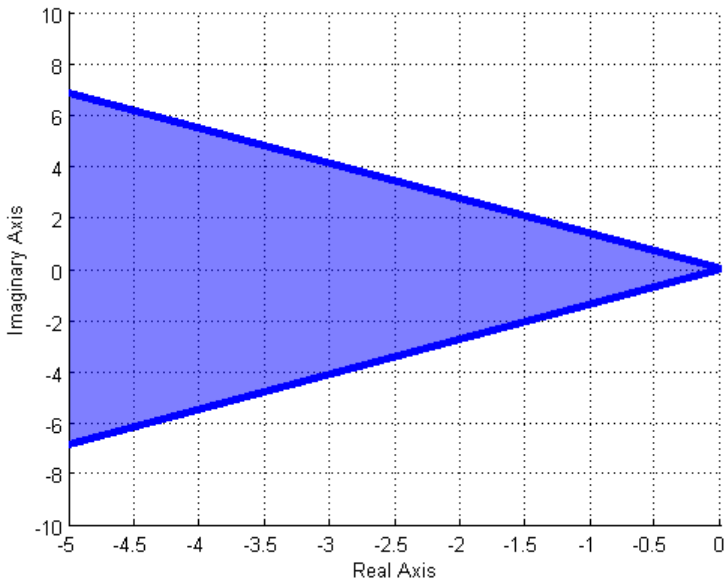




17) One of the shaded regions below shows the possible pole locations for a percent overshoot less than 10%, and the other shows the possible pole locations for a percent overshoot less than 20%. Which of the two graphs shows the possible pole locations for a percent overshoot less than 20%?

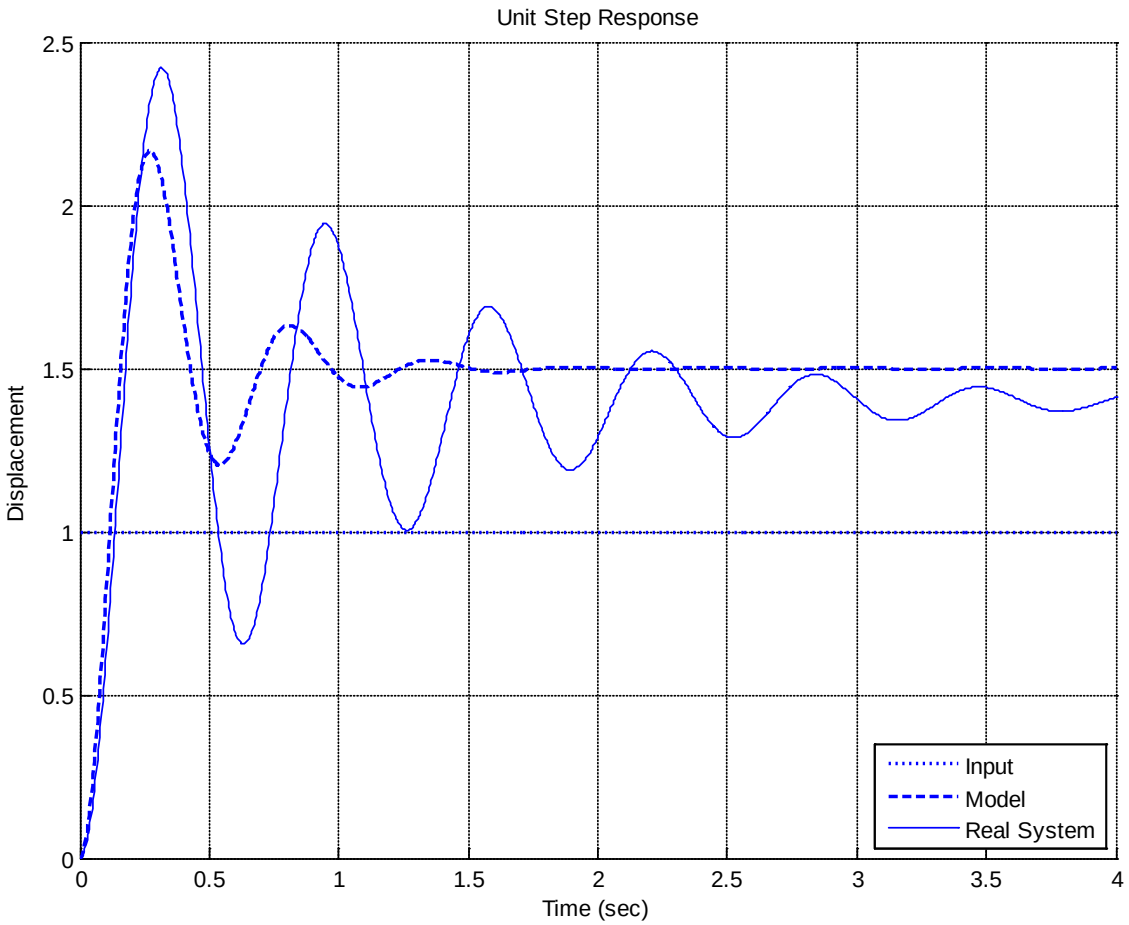
a) the region in the top figure b) the region in the bottom figure





CCC

Problems 18-20 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.



18) 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

19) 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

20) 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

Answers: 1-a, 2-c, 3-d, 4-b, 5-c, 6-b, 7-a, 8-a, 9-a, 10-a, 11-d, 12-d, 13-b, 14-a, 15-a, 16-a, 17-a, 18-b, 19-b, 20-b