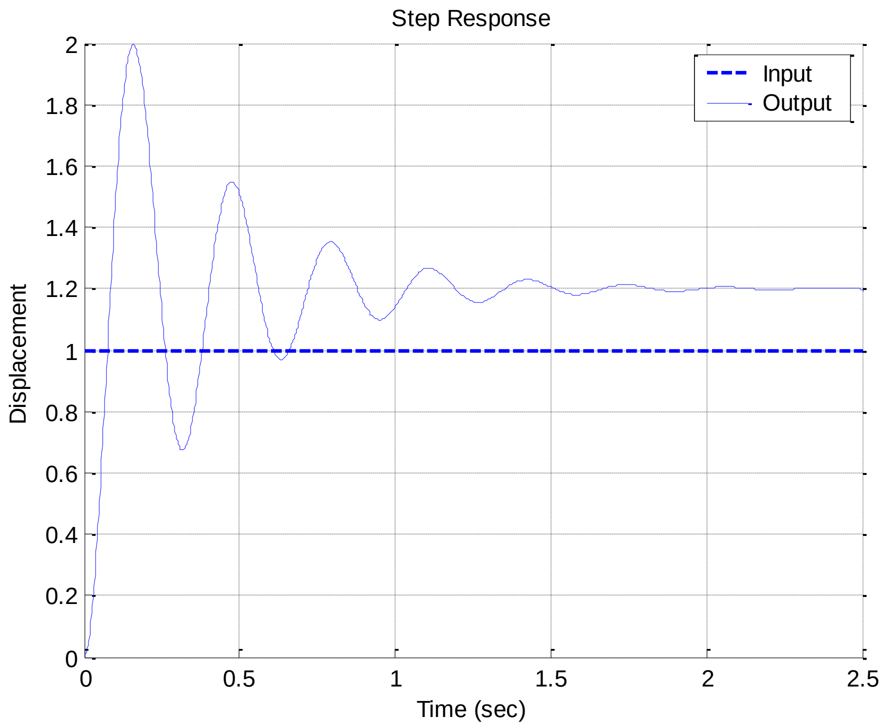
ECE-320, Practice Quiz #2

Problems 1and 2 refer to the **unit step response** of a system, shown below



1) The best estimate of the **steady state error** for a **unit step input** is

a) 0.2 b) -0.2 c) 1.0 d) -0.0

2) The best estimate of the **percent overshoot** is a) 200% b) 100% c) 67% d) 20%

3) The **unit step response** of a system is given by $y(t) = 0.5u(t) - tu(t) - t^4 e^{-t}u(t) + e^{-t}u(t)$

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

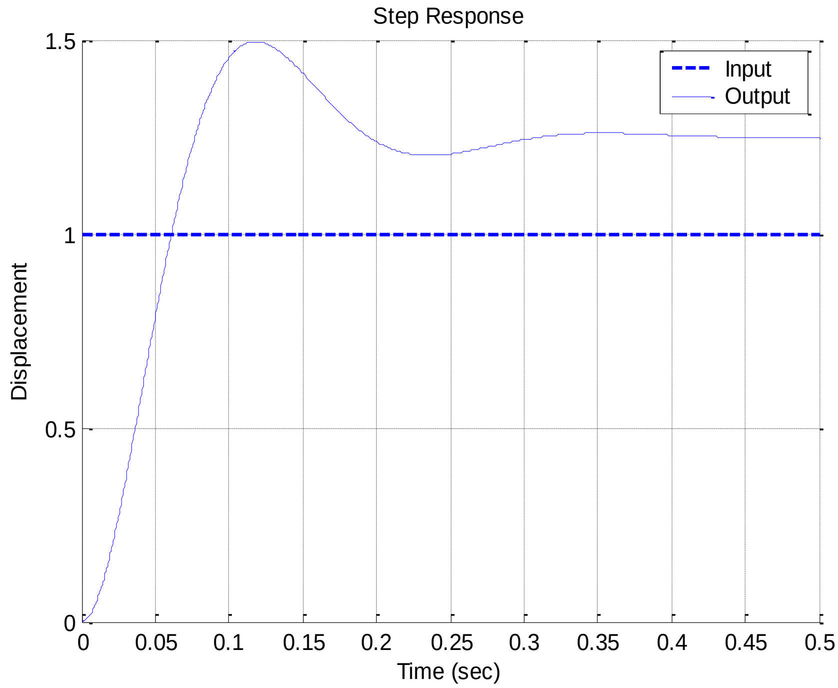
a) ∞ b) 0.5 c) 2.0 d) -0.5 e) impossible to determine

4) The **unit step response** of a system is given by $y(t) = 0.5u(t) - t^4 e^{-t}u(t) + e^{-t}u(t)$

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

a) ∞ b) 0.5 c) 2.0 d) -0.5 e) impossible to determine

Problems 5 and 6 refer to the **unit step response** of a system, shown below

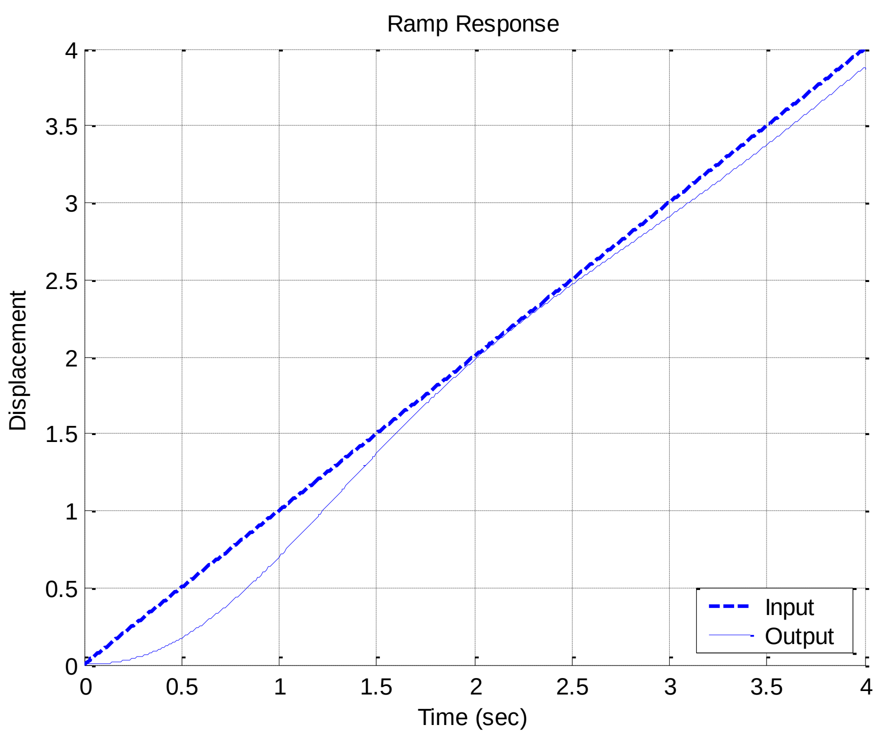


5) The best estimate of the **steady state error** for a **unit step input** is

a) 0.50 b) 0.25 c) -0.25 d) 0.0 e) impossible to determine

6) The best estimate of the **percent overshoot** is a) 20% b) 50% c) 25% d) 150%

7) The **unit ramp response** of a system is shown below:



The best estimate of the **steady state error** is a) 0.1 b) -0.1 c) 0 d) 0.4 e) -0.4

8) The **unit ramp response** of a system is given by $y(t) = -0.5u(t) + tu(t) + e^{-t}u(t)$.

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

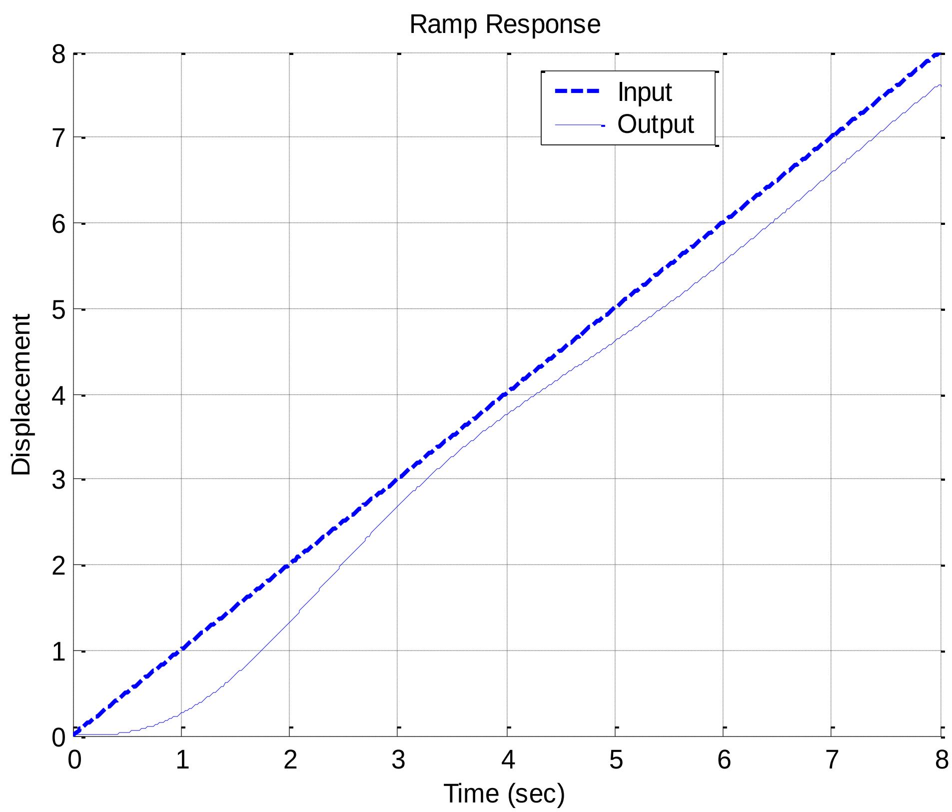
a) 0.5 b) 2.0 c) 1.0 d) ∞ e) -0.5

9) The **unit ramp response** of a system is given b $y(t) = -0.5u(t) - 2tu(t) + e^{-t}u(t)$.

The best estimate of the **steady state error** for a **unit ramp input** is

a) 0.5 b) 2.0 c) 1.0 d) ∞

10) The **unit ramp response** of a system is shown below:



The best estimate of the **steady state error** is a) 0.8 b) 0.6 c) 0.4 d) 0.2

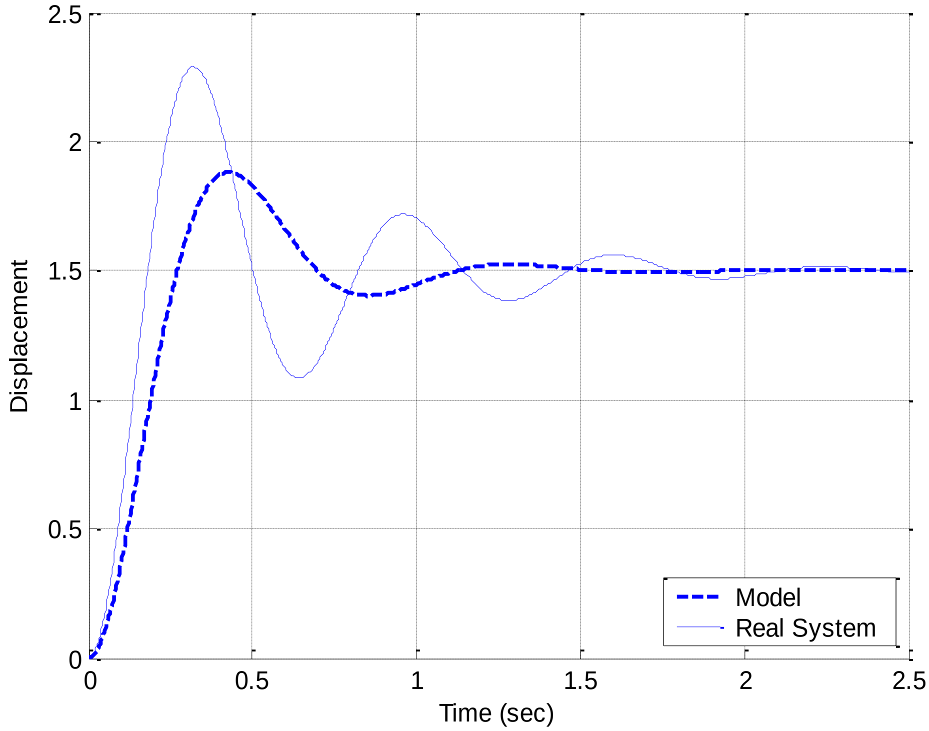
Problems 11 and 12 refer to a system with poles at -2+5j. -2-5j. -10+j, -10-j, and -20

11) 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

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

Problems 13 and 14 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.



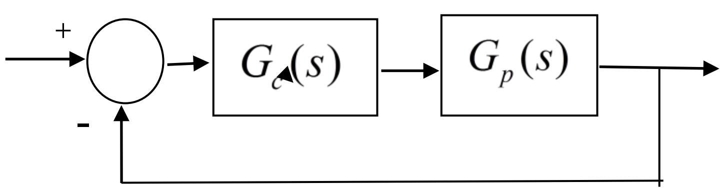
13) In order to make the model better match the real system, the ***damping ratio*** of the ***model*** should be

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

14) 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

15) For the following system

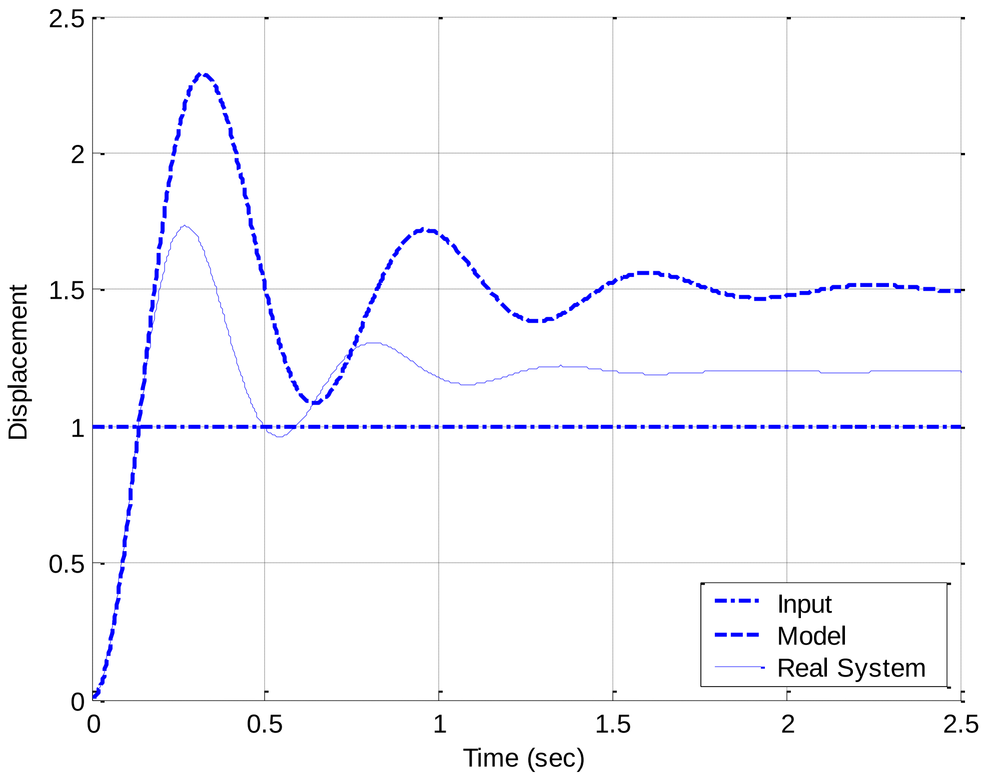


the pole of the controller $G_c(s)$ is at -15
the poles of the plant $G_p(s)$ are at -1 and -2
the poles of the closed loop system are at -7.1, -5.43 +3.98j, -5.43 -3.98j

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

Problems 16-18 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.



16) In order to make the model better match the real system, the **<u>damping ratio</u>** of the ***model*** should be

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

17) In order to make the model better match the real system, the **<u>natural frequency</u>** of the ***model*** should be

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

18) In order to make the model better match the real system, the **<u>static gain</u>** of the ***model*** should be

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

19) 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

Problems 20 and 21 refer to the impulse responses of six different systems given below:

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

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

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

Problems 22 and 23 refer to the following impulse responses of six different systems

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

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

23) The number of **marginally stable** systems is a) 1 b) 2 c) 3 d) 4

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

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

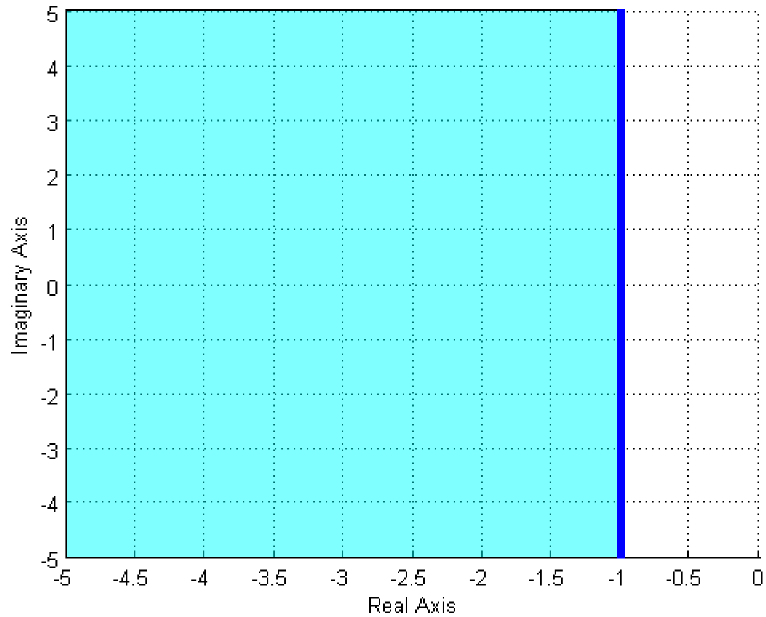
$$G_d(s) = \frac{s+1}{(s+1+j)(s+1-j)} \qquad G_e(s) = \frac{(s-1-j)(s-1+j)}{(s+2)^2} \qquad G_f(s) = \frac{(s-1-j)(s-1+j)}{(s+1-j)(s+1+j)}$$

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

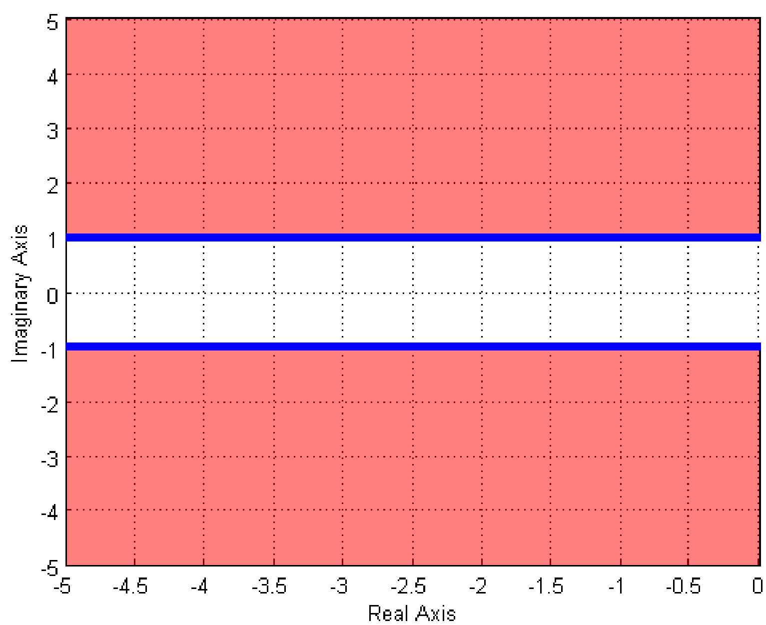
25) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

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



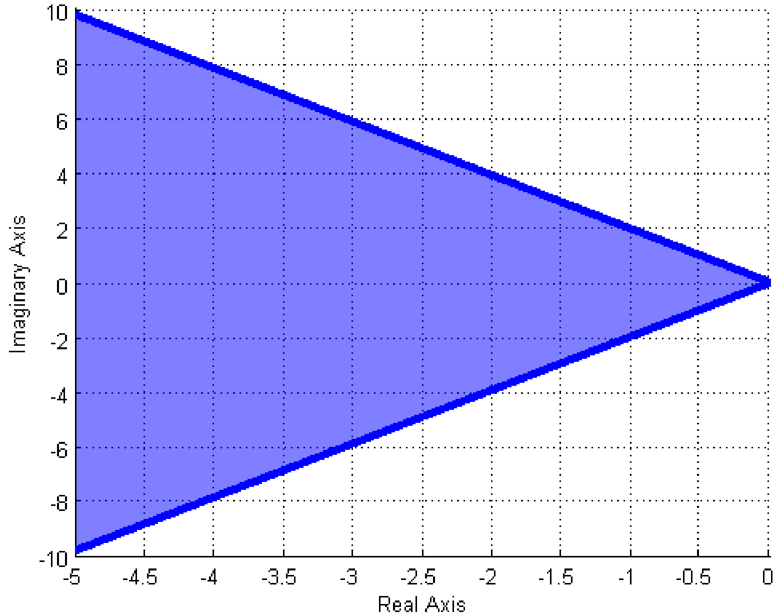
26) The (dark) shaded area in the s-plane figure below shows the possible pole location for an ideal second order system that meets which of the following constraints?

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



27) 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) $PO \geq 20\%$ b) $PO \leq 20\%$



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