ECE-205 Practice Quiz 3

1) For the second order equation $\ddot{y}(t)+3\dot{y}(t)+2y(t) = 4x(t)$ with an input $x(t)=2u(t)$, we should look for a solution of the form

a) $y(t)=c_1e^{-2t}+c_2e^{-t}+2$ b) $y(t)=c_1e^{-2t}+c_2e^{-t}+4$ c) $y(t)=c_1e^{2t}+c_2e^{t}+4$

d) $y(t)=c_1e^{2t}+c_2e^{t}+2$ e) $y(t)=2+c\sin(2t+\theta)$ f) none of these

2) For the second order equation $\ddot{y}(t)+4\dot{y}(t)+4y(t) = 2x(t)$ with an input $x(t)=2u(t)$, we should look for a solution of the form

a) $y(t)=c_1e^{-2t}+c_2e^{-2t}+2$ b) $y(t)=c_1e^{-2t}+c_2e^{-2t}+4$ c) $y(t)=c_1e^{-2t}+c_2te^{-2t}+4$

d) $y(t)=c_1e^{-2t}+c_2te^{-2t}+2$ e) $y(t)=c_1e^{-2t}+c_2\sin(2t+\theta)$ f) none of these

3) For the second order equation $\ddot{y}(t)+4\dot{y}(t)+5y(t) = 5x(t)$ with an input $x(t)=5u(t)$, we should look for a solution of the form

a) $y(t)=ce^{-2t}\sin(t+\theta)+1$ b) $y(t)=ce^{-t}\sin(2t+\theta)+1$ c) $y(t)=ce^{-t}\sin(2t+\theta)+5$

d) $y(t)=ce^{-2t}\sin(t+\theta)+5$ e) $y(t)=ce^{2t}\sin(t+\theta)+5$ f) none of these

4) Assume we have a solution of the form $y(t)=c_1e^{-t}+c_2e^{-3t}+4$ and the initial conditions $y(0)=\dot{y}(0)=0$. The equations we need to solve are:

a) $c_1+c_2=4,\ c_1+3c_2=0$ b) $c_1+c_2=-4,\ c_1+3c_2=0$ c) $c_1+c_2=-4,\ c_1-3c_2=0$

d) $c_1+c_2=-4,\ c_1+3c_2=-4$ e) $c_1+c_2=0,\ c_1+3c_2=-4$ f) none of these

5) Assume we have a solution of the form $y(t) = c_1 e^{-2t} + c_2 t e^{-2t} + 2$ and the initial conditions $y(0) = \dot{y}(0) = 0$. The equations we need to solve are:

a) $c_1 + 2 = 0, -2c_1 + c_2 = 0$ b) $c_1 + 2 = 0, 2c_1 + 2\,c_2 = 0$ c) $c_1 + c_2 = -2, -2c_1 + -2\,c_2 = 0$

d) $c_1 + c_2 = -2, -2c_1 + 2\,c_2 = 0$ e) $c_1 = 2, 2c_1 + 2\,c_2 = 0$ f) none of these

6) Assume we have a solution of the form $y(t) = ce^{-2t}\sin(3t + \theta) + 4$ and the initial conditions $y(0) = \dot{y}(0) = 0$. The equations we need to solve are:

a) $c\sin(\theta) = -4, \tan(\theta) = \frac{3}{2}$ b) $c\sin(\theta) = 4, \tan(\theta) = \frac{3}{2}$ c) $c\sin(\theta) = 4, \tan(\theta) = \frac{-3}{-2}$

d) $c\sin(\theta) = -4, \tan(\theta) = \frac{3}{-2}$ e) none of these

Problems 7-10 assume we have a system described by a standard for of a second order system, $\ddot{y}(t) + 2\zeta\omega_n\dot{y}(t) + \omega_n^2 y(t) = K\omega_n^2 x(t)$, and the input to the system is a unit step. *Assume the system is under damped.*

7) The **percent overshoot** for the system is a function of

a) ζ only b) ω_n only c) K only d) ζ and ω_n e) ζ, ω_n, and K

8) The **settling time** for the system is a function of

a) ζ only b) ω_n only c) K only d) ζ and ω_n e) ζ, ω_n, and K

9) The **static gain** for the system is a function of

a) ζ only b) ω_n only c) K only d) ζ and ω_n e) ζ, ω_n, and K

10) The **damped frequency** for the system is a function of

a) ζ only b) ω_n only c) K only d) ζ and ω_n e) ζ, ω_n, and K

11) Assume we have an under damped second order system. If we want the **percent overshoot** to increase, what should we do to the damping ratio?

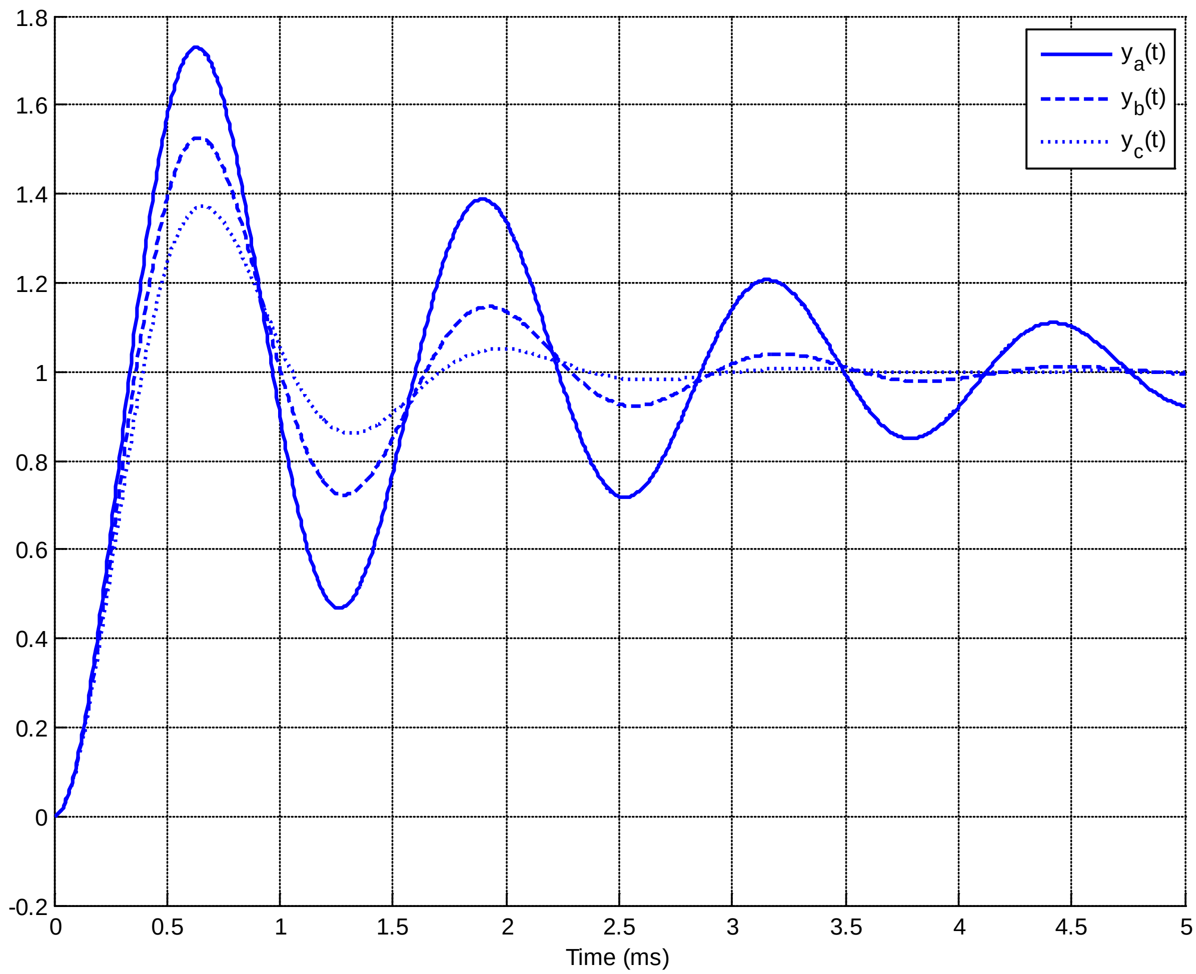
a) increase it b) decrease it c) it doesn't matter, we can't affect the percent overshoot

12) Assume we have an under damped second order system. If we want the **settling time** to decrease, what should we do to the damping ratio?

a) increase it b) decrease it c) it doesn't matter, we can't affect the percent overshoot

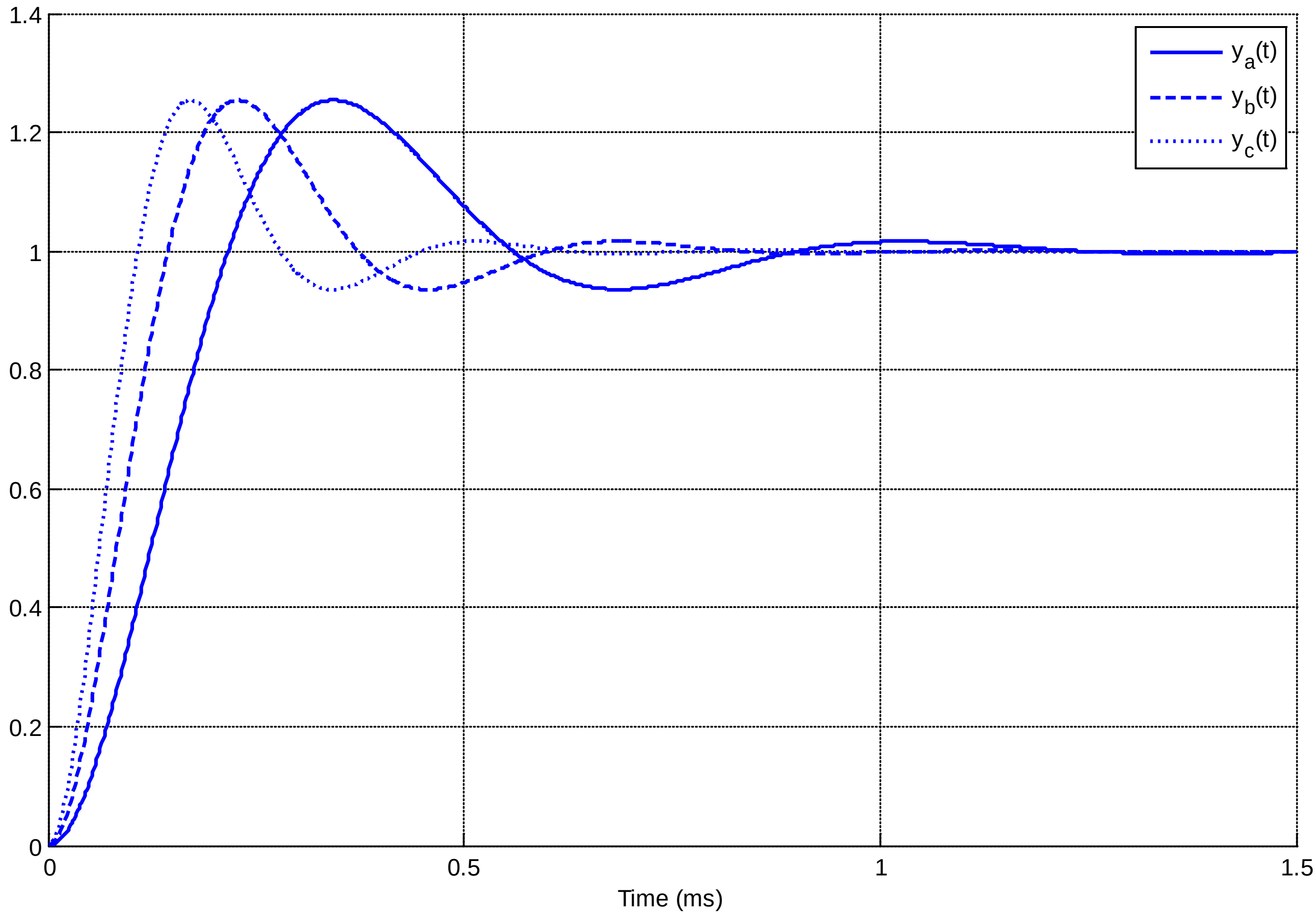
13) The following figure shows the step response of three systems. The only difference between the systems is the damping ratio, ζ .

For which system is the damping ratio the smallest? a) $y_a(t)$ b) $y_b(t)$ c) $y_c(t)$

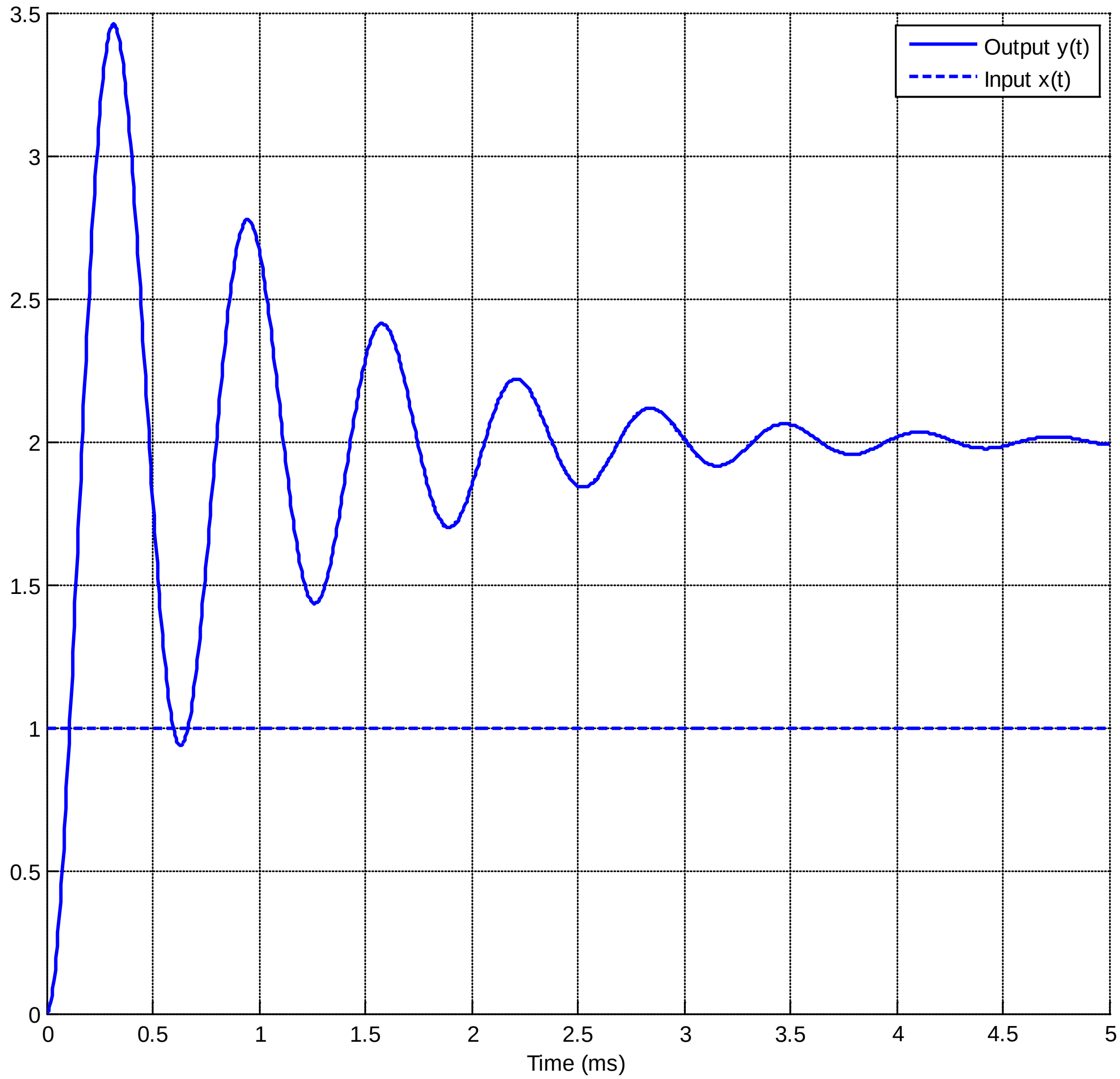


14) The following figure shows the step response of three systems. The only difference between the systems is the natural frequency, ω_n .

For which system is the natural frequency the largest? a) $y_a(t)$ b) $y_b(t)$ c) $y_c(t)$



Problems 15-18 refer the following graph showing the response of a second order system to a step input.



15) The percent overshoot for this system is best estimated as

a) 350 % b) 250 % c) 200% d) 150 % e) 100 % f) 75%

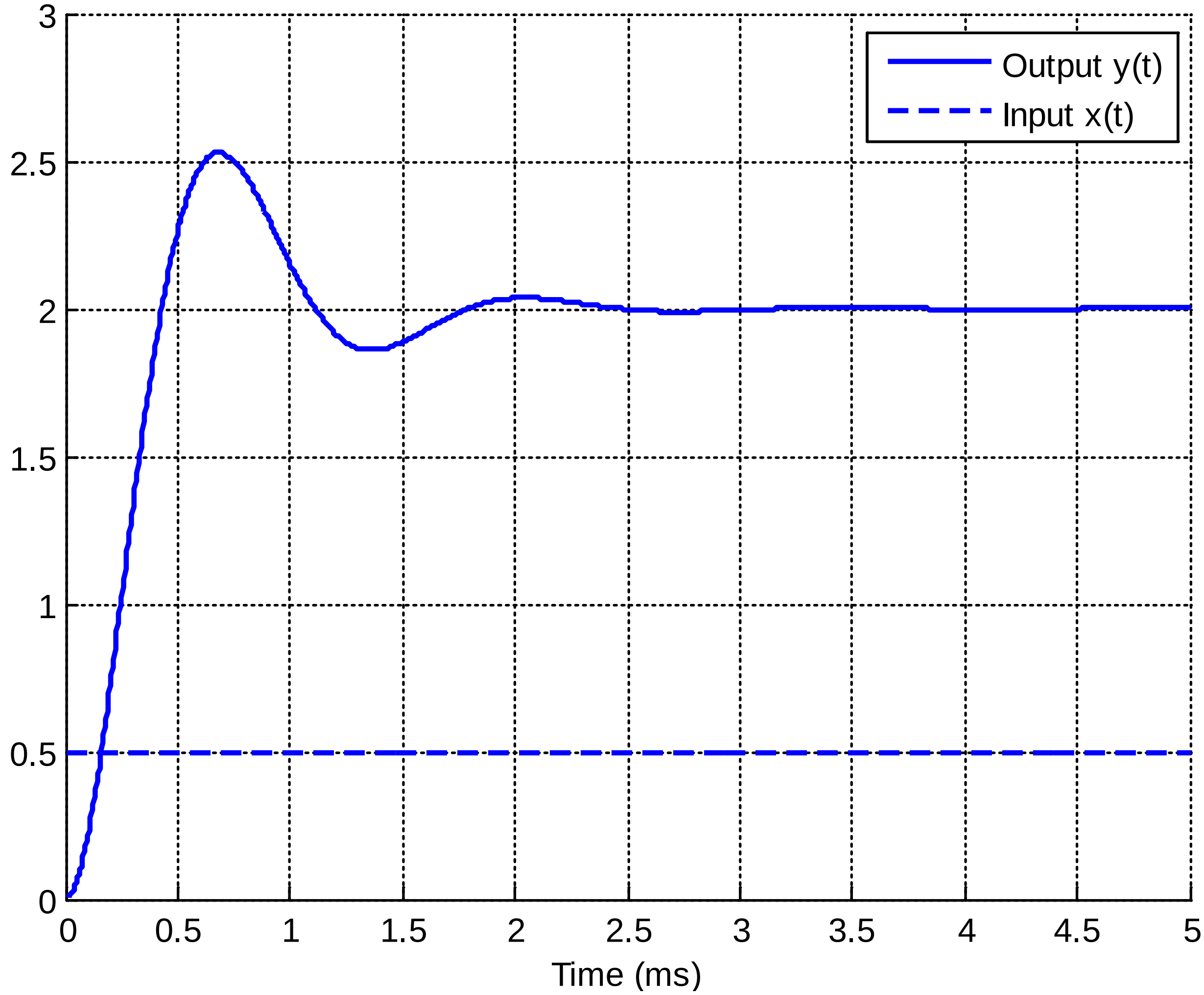
16) The (2%) settling time for this system is best estimated as

a) 1ms b) 2 ms c) 3 ms d) 4 ms

17) The time to peak for this system is best estimated as a) 0.1 ms b) 0.3 ms c) 0.9 ms

18) The static gain for this system is best estimated as a) 1 b) 2 c) 3 d) 3.5

Problems 19-21 refer the following graph showing the response of a second order system to a step input.



19) The percent overshoot for this system is best estimated as

a) 400% b) 250 % c) 200% d) 150 % e) 100 % f) 25%

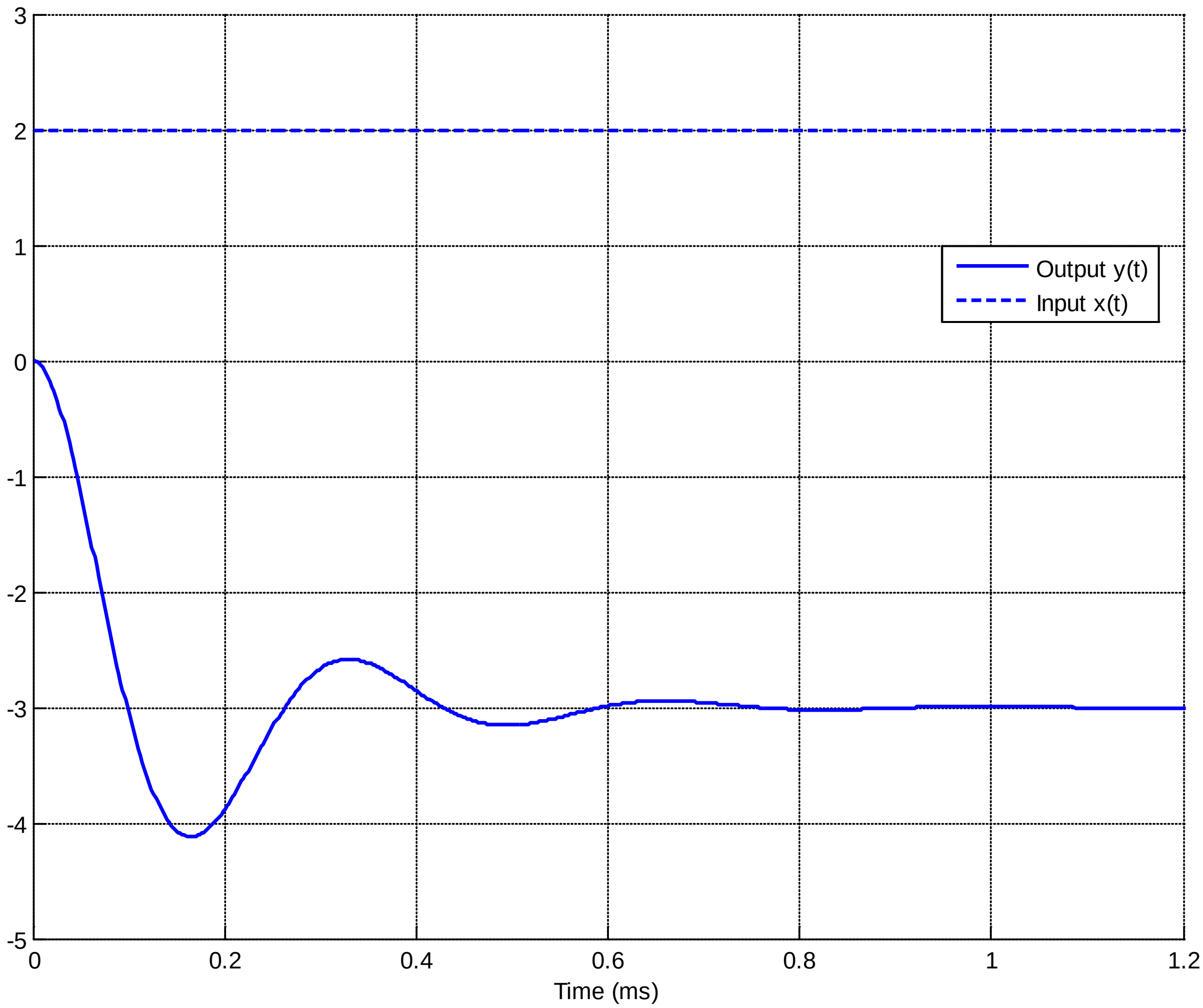
20) The (2%) settling time for this system is best estimated as

a) 1.5 ms b) 2.5 ms c) 4 ms d) 5 ms

21) The static gain for this system is best estimated as

a) 1 b) 2 c) 3 d) 4

Problems 22-24 refer the following graph showing the response of a second order system to a step input.



22) The percent overshoot for this system is best estimated as

a) 400% b) -400 % c) 300% d) -300 % e) -33% f) 33%

23) The (2%) settling time for this system is best estimated as

a) 0.3 ms b) 0.6 ms c) 1.0 ms d) 1.2 ms

24) The static gain for this system is best estimated as

a) 1.5 b) 3 c) -1.5 d) -3

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