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Quiz 3

1) For the second order equation $\ddot{y}(t)+7\dot{y}(t)+12y(t) \;=\; 6\,x(t)$ with an input $x(t)=2u(t)$, we should look for a solution of the form

a) $y(t)=c_1e^{-3t}+c_2e^{-4t}+6$ b) $y(t)=c_1e^{-3t}+c_2e^{-4t}+12$ c) $y(t)=c_1e^{-3t}+c_2e^{-4t}+1$

d) $y(t)=c_1e^{3t}+c_2e^{4t}+1$ e) $y(t)=c_1e^{3t}+c_2e^{4t}+6$ f) none of these

2) For the second order equation $\ddot{y}(t)+6\dot{y}(t)+9y(t) \;=\; 3\,x(t)$ with an input $x(t)=3u(t)$, we should look for a solution of the form

a) $y(t)=c_1e^{-3t}+c_2te^{-3t}+1$ b) $y(t)=c_1e^{-3t}+c_2e^{-3t}+9$ c) $y(t)=c_1e^{-3t}+c_2te^{-3t}+3$

d) $y(t)=c_1e^{3t}+c_2te^{3t}+1$ e) $y(t)=c_1e^{3t}+c_2te^{3t}+3$ f) none of these

3) For the second order equation $\ddot{y}(t)+4\dot{y}(t)+13y(t) \;=\; 26x(t)$ with an input $x(t)=u(t)$, we should look for a solution of the form

a) $y(t)=ce^{-2t}\sin(3t+\theta)+1$ b) $y(t)=ce^{-2t}\sin(3t+\theta)+13$ c) $y(t)=ce^{-3t}\sin(2t+\theta)+2$

d) $y(t)=ce^{-2t}\sin(3t+\theta)+0.5$ e) $y(t)=ce^{2t}\sin(3t+\theta)+13$ f) none of these

4) Assume we have a solution of the form $y(t)=c_1+c_2e^{-3t}+4$ and the initial conditions $y(0)=\dot{y}(0)=0$. The equations we need to solve are:

a) $c_1+c_2=4,\ 2c_2=0$ b) $c_1+c_2=-4,\ -3c_2=0$ c) $c_1+c_2=-4,\ c_1-2c_2=0$

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

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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 $y(t) = ce^{-t}\sin(2t + \theta) - 4$ 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) $c\sin(\theta) = -4, \tan(\theta) = \frac{1}{2}$ c) $c\sin(\theta) = 4, \tan(\theta) = \frac{1}{-2}$

d) $c\sin(\theta) = 4, \tan(\theta) = 2$ e) $c\sin(\theta) = 4, \tan(\theta) = \frac{1}{2}$ f) 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

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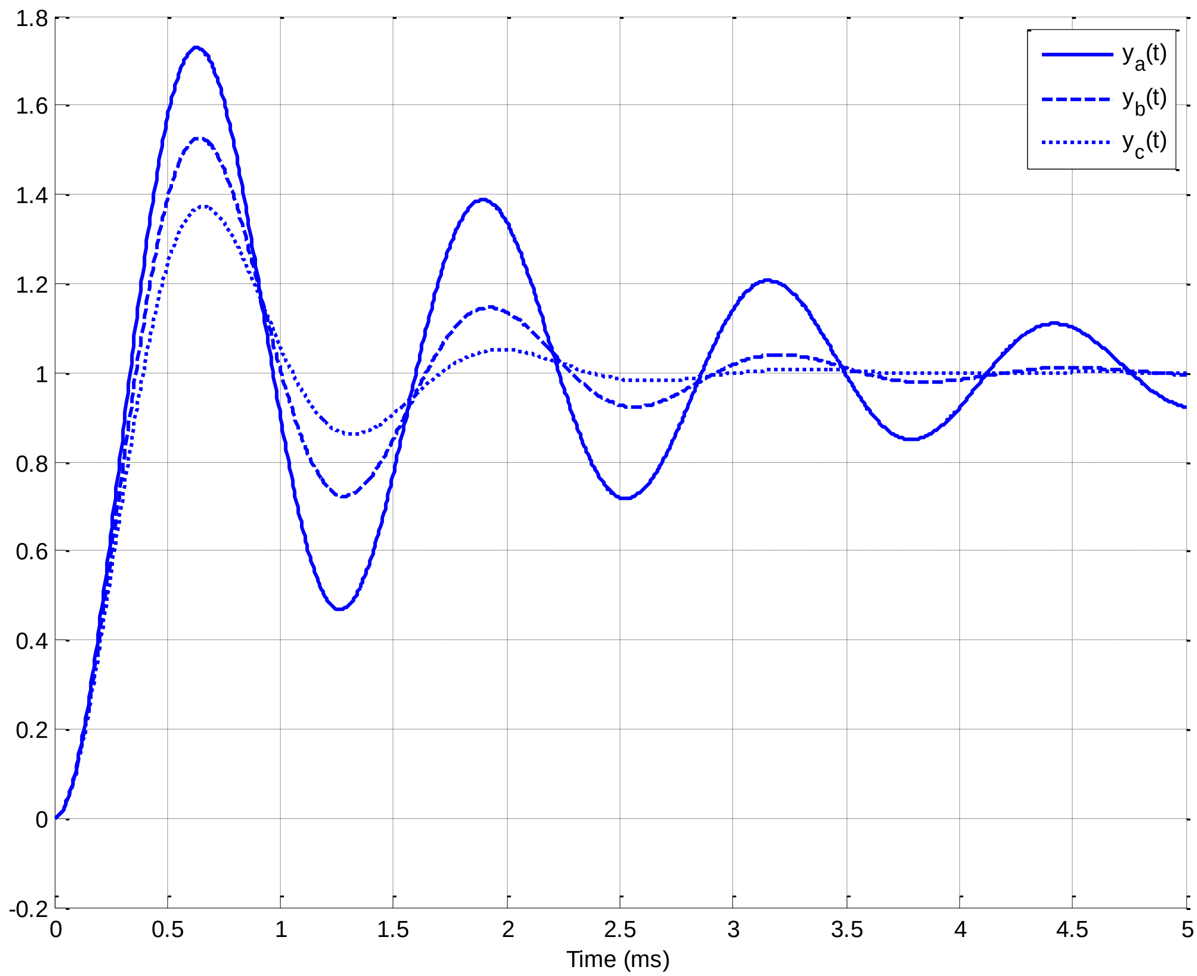
11) The following figure shows the step response of three systems. The only difference between the systems is the damping ratio, ζ .

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



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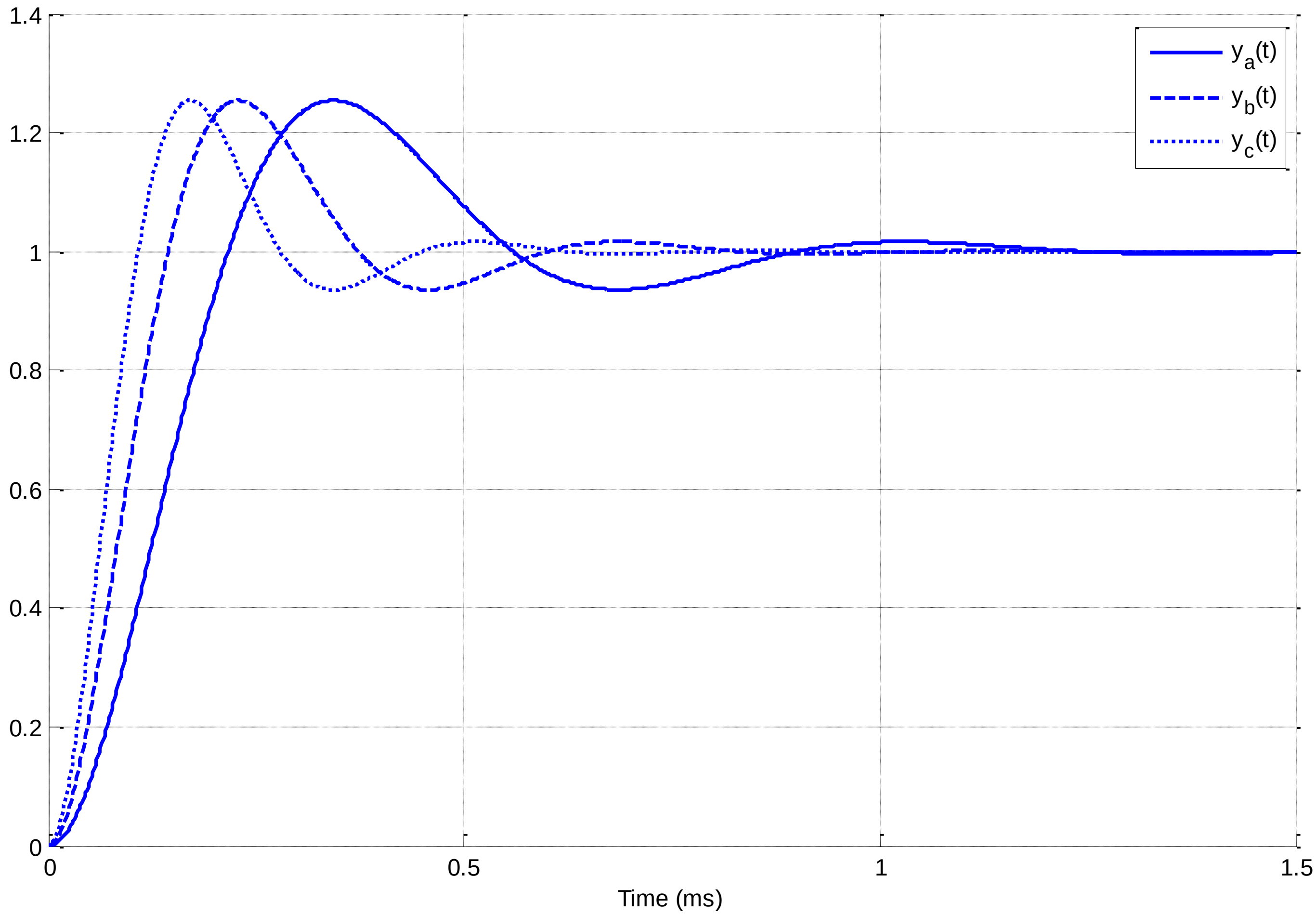
12) The following figure shows the step response of three systems. The only difference between the systems is the natural frequency, ω_n .

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



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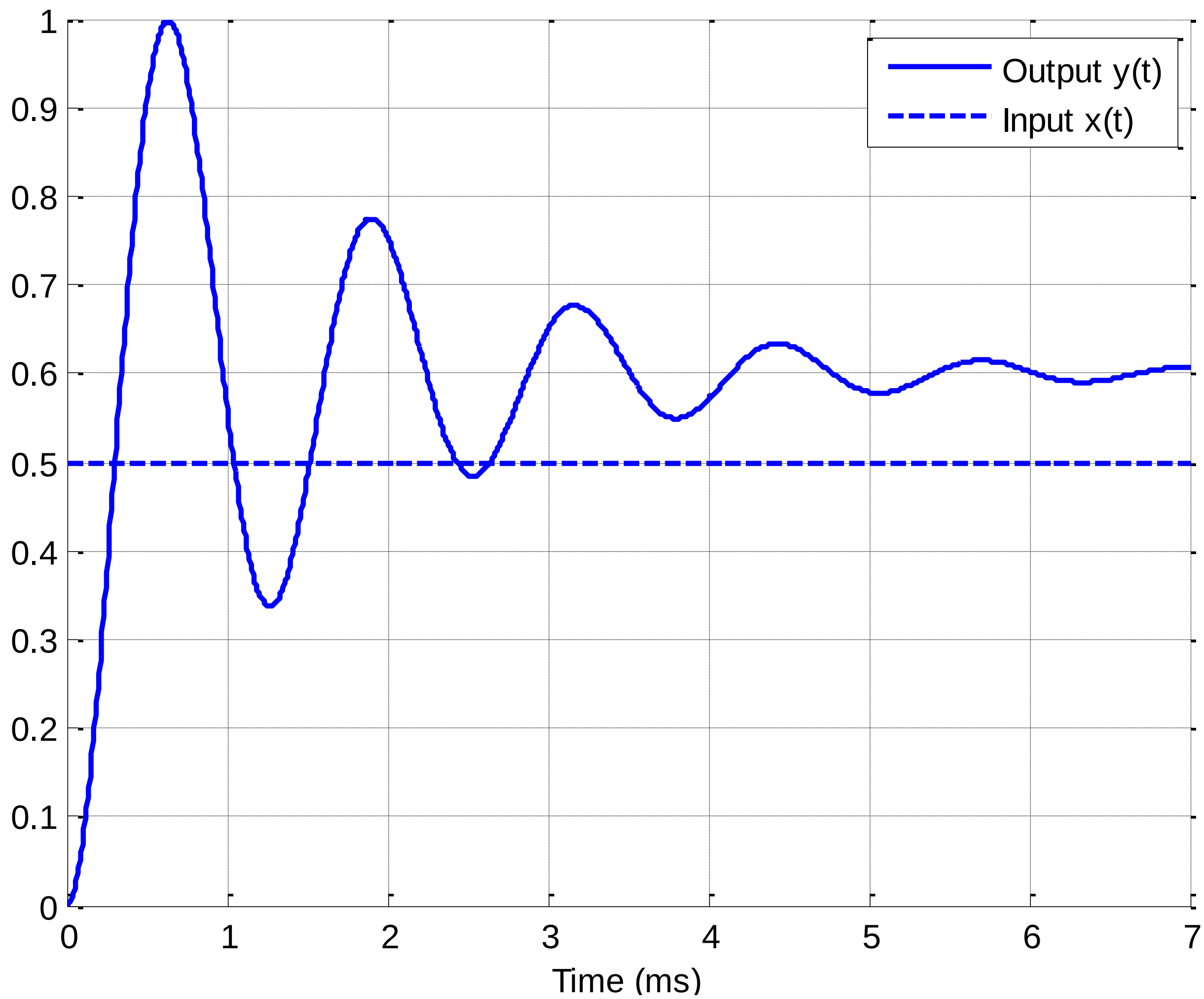
Problems 13 and 14 refer the following graph showing the response of a second order system to a step input.



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

a) 200 % b) 150 % c) 100% d) 67 % e) 50 % f) 33%

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

a) 0.1 b) 0.5 c) 1.0 d) 1.2 e) 1.5 f) 2.0

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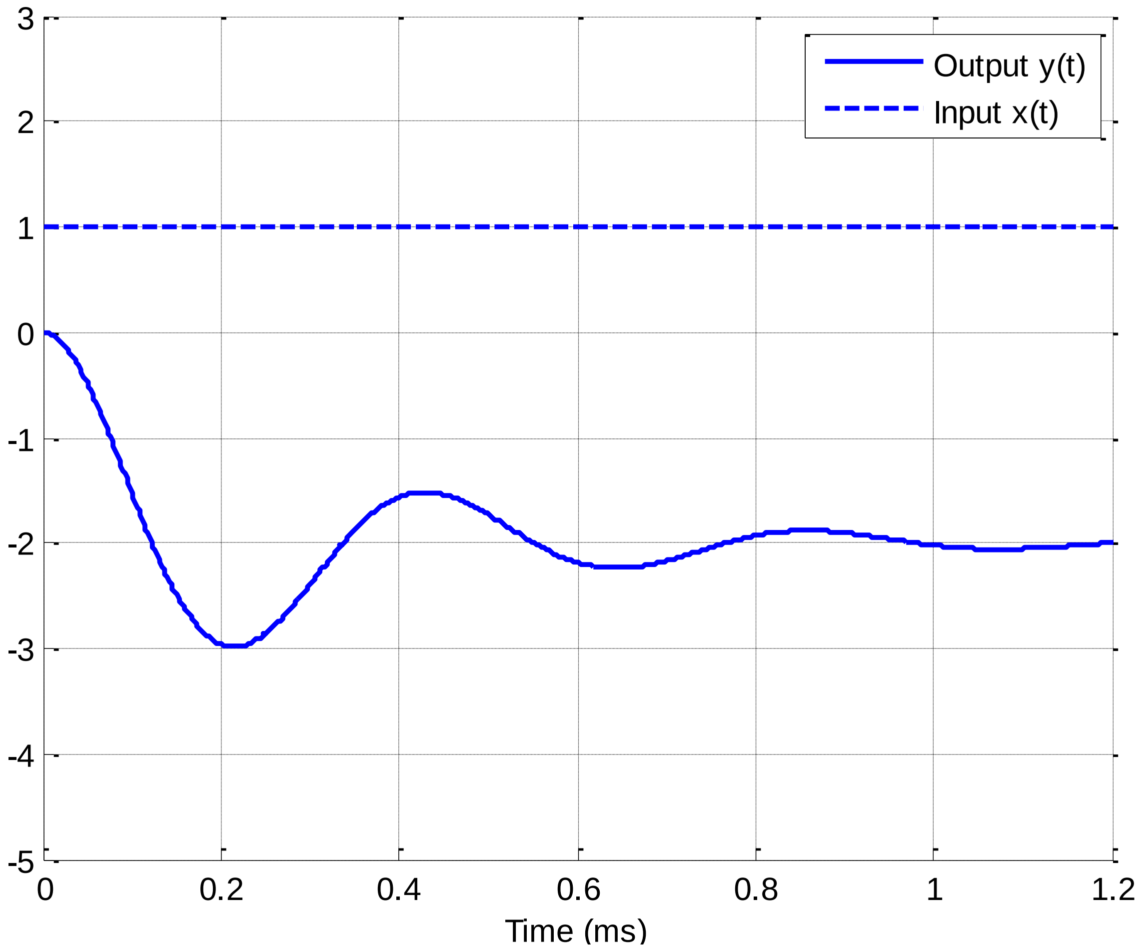
Problems 15 and 16 refer the following graph showing the response of a second order system to a step input.



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

a) 200% b) -200 % c) 100% d) -100 % e) 50 % f) -50%

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

a) 3 b) -3 c) 2 d) -2