ECE-205 Practice Quiz 3

(No Calculators)

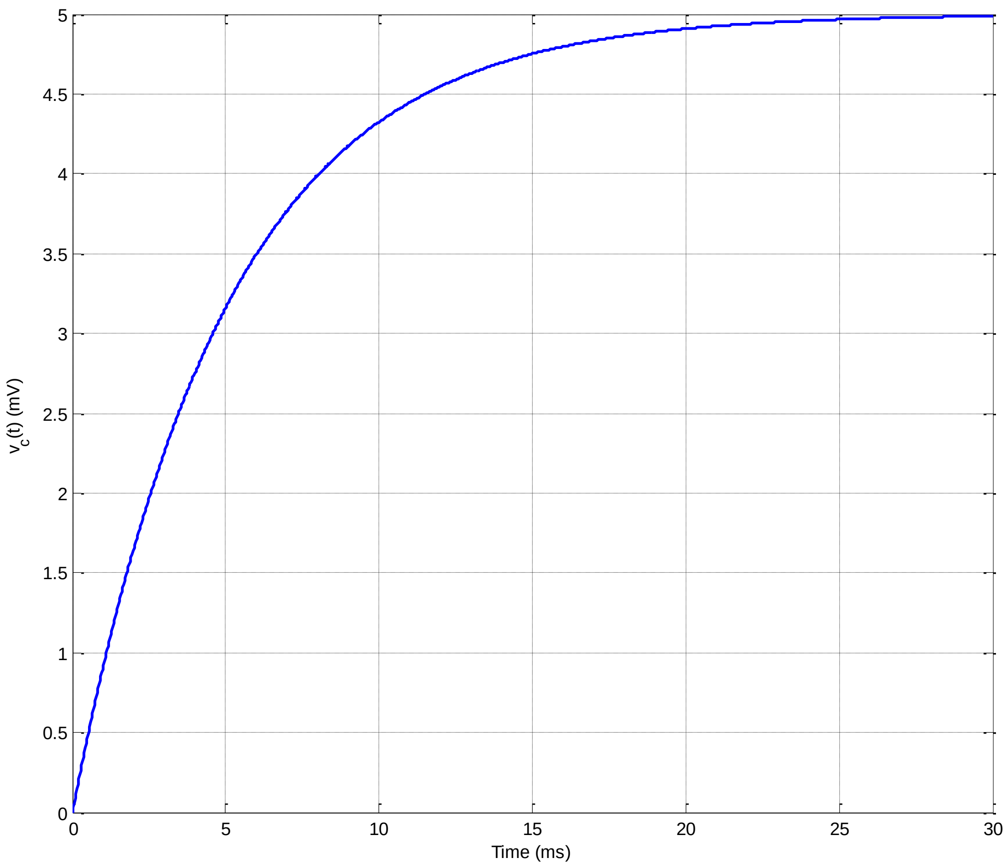
1) A first order system has a time constant $\tau = 0.1$ seconds. The system will be within 2% of its final value in (choose the smallest possible time)

a) 0.1 seconds b) 0.2 seconds c) 0.3 seconds d) 0.4 seconds e) 0.5 seconds f) 1 second

2) A first order system has a time constant $\tau = 0.05$ seconds. The system will be within 2% of its final value in (choose the smallest possible time)

a) 0.1 seconds b) 0.2 seconds c) 0.3 seconds d) 0.4 seconds e) 0.5 seconds f) 1 second

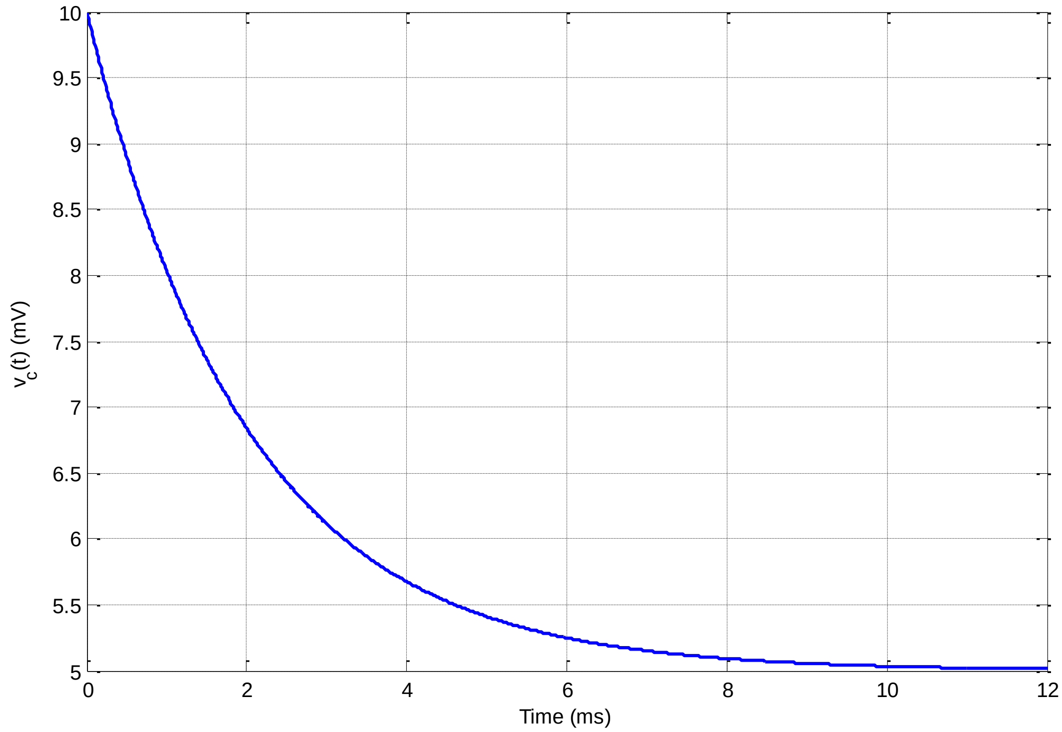
3) The following figure shows a capacitor charging.



Based on this figure, the best estimate of the **time constant** for this system is

a) 1 ms b) 2.5 ms c) 5 ms d) 7.5 ms e) 10 me f) 15 ms g) 30 ms

4) The following figure shows a capacitor discharging.



Based on this figure, the best estimate of the **time constant** for this system is

a) 1 ms b) 2 ms c) 3 ms d) 4 ms e) 6 me f) 10 ms g) 12 ms

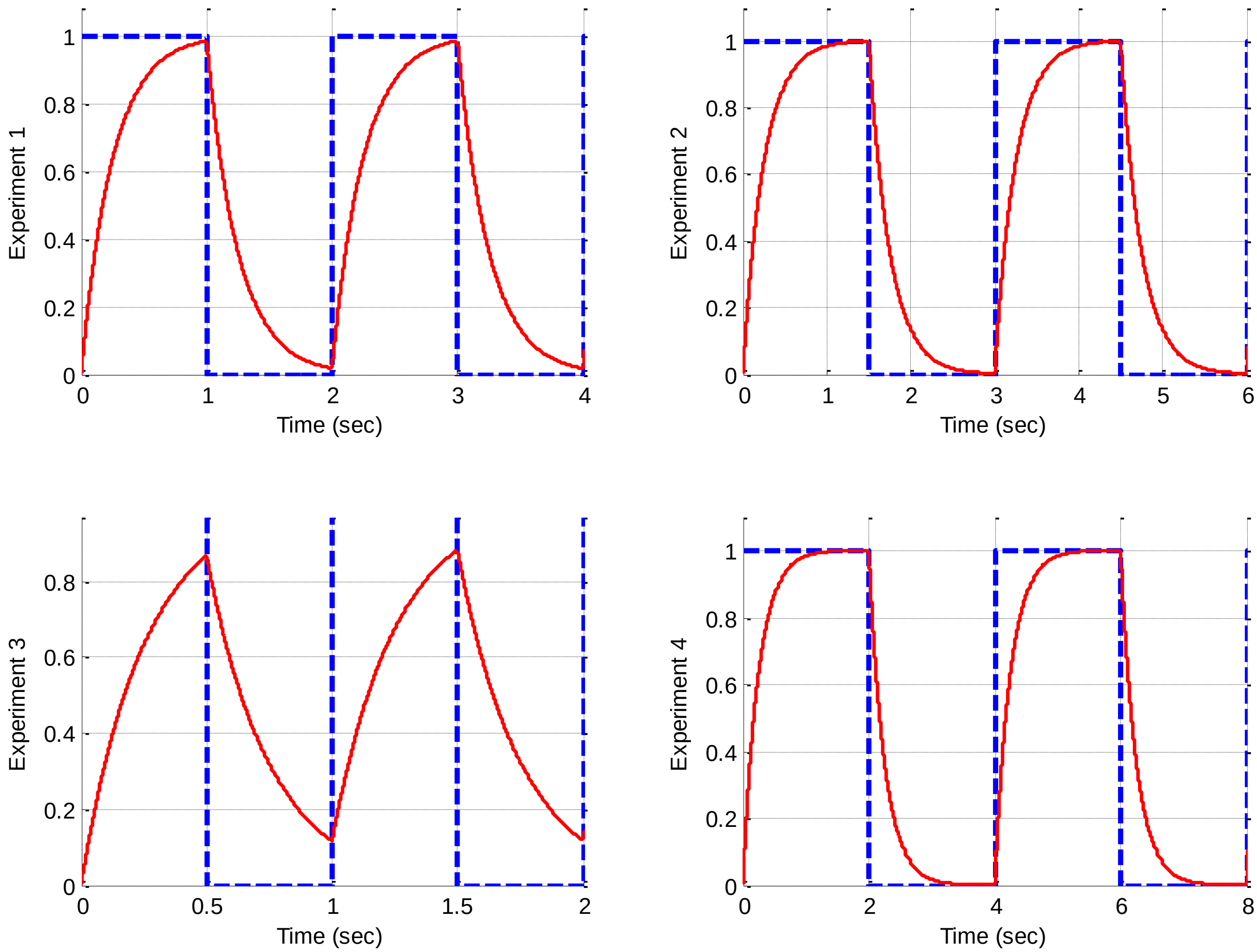
5) Assume we have a first order system in standard form, and the input is a step. The usual form used to compute the response of the system is

a) $y(t) = [y(0) - y(\infty)]e^{-t/\tau} + y(0)$ b) $y(t) = [y(\infty) - y(0)]e^{-t/\tau} + y(0)$

c) $y(t) = [y(\infty) - y(0)]e^{-t/\tau} + y(\infty)$ d) $y(t) = [y(0) - y(\infty)]e^{-t/\tau} + y(\infty)$

6) Assume we are trying to use measure the time constant of a first order system experimentally using the fall time of the system (the fall time corresponds to the rise time, but we use this when the signal is decaying). The input to the system is the rectangular pulse shown in the dotted line. Which of the experiments can we use? (Circle all that can be used)

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



7) 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) $y(t) = c_1 e^{-2t} + c_2 e^{-t} + 2$ b) $y(t) = c_1 e^{-2t} + c_2 e^{-t} + 4$ c) $y(t) = c_1 e^{2t} + c_2 e^{t} + 4$

d) $y(t) = c_1 e^{2t} + c_2 e^{t} + 2$ e) $y(t) = 2 + c\sin(2t + \theta)$ f) none of these

8) For the second order equation $\ddot{y}(t)+4\dot{y}(t)+4y(t) \;=\; 2\,x(t)$ 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

9) 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

10) 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

11) Assume we have a solution of the form $y(t)=c_1e^{-2t}+c_2te^{-2t}+2$ 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) $c_1+c_2=-2,\ -2c_1+-2\,c_2=0$

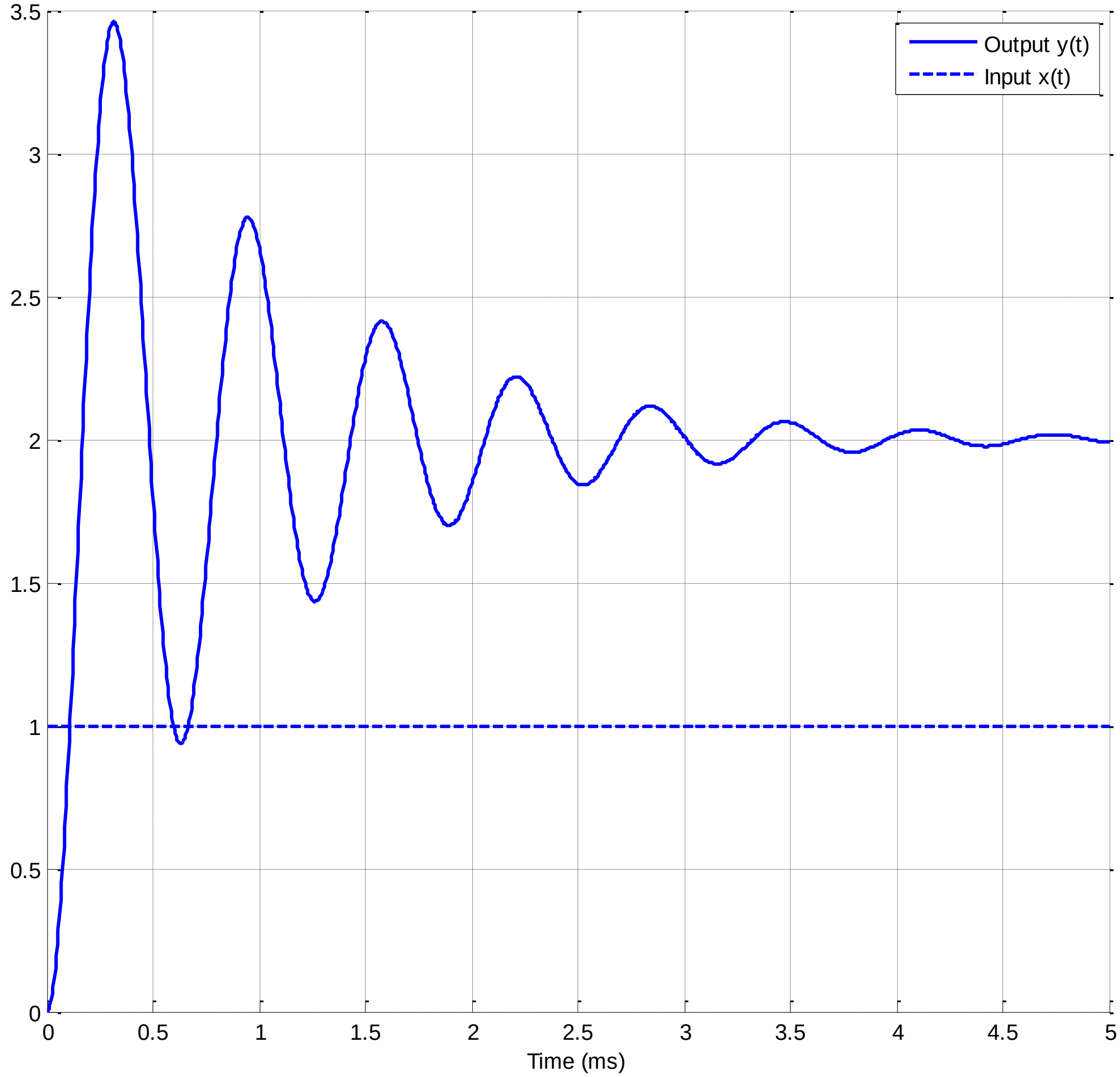
d) $c_1+c_2=-2,\ -2c_1+2\,c_2=0$ e) $c_1=2,\ 2c_1+2\,c_2=0$ f) none of these

12) 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 13-16 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) 350 % b) 250 % c) 200% d) 150 % e) 100 % f) 75%

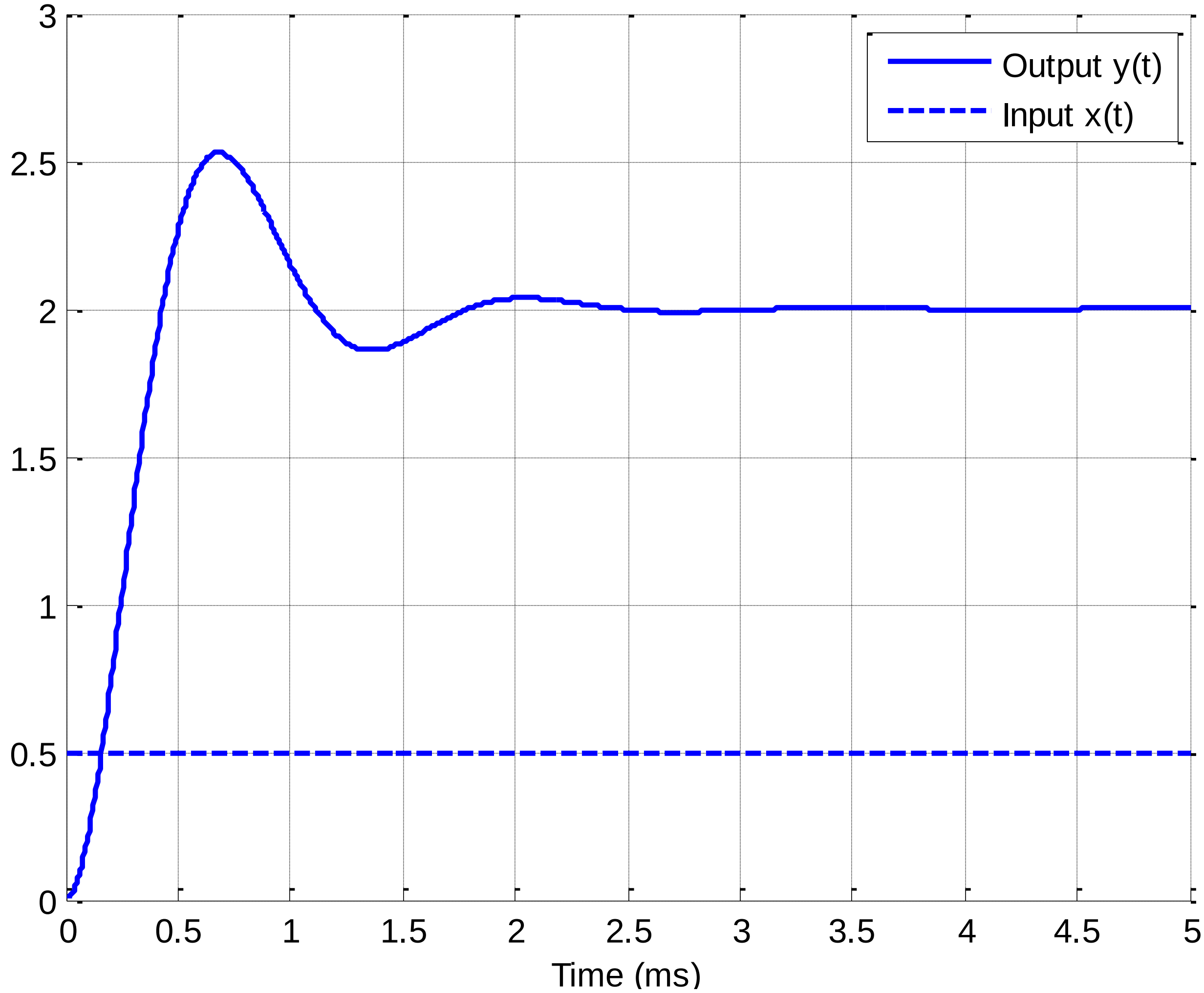
14) The (2%) settling time for this system is best estimated as

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

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

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

Problems 17-19 refer the following graph showing the response of a second order system to a step input.



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

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

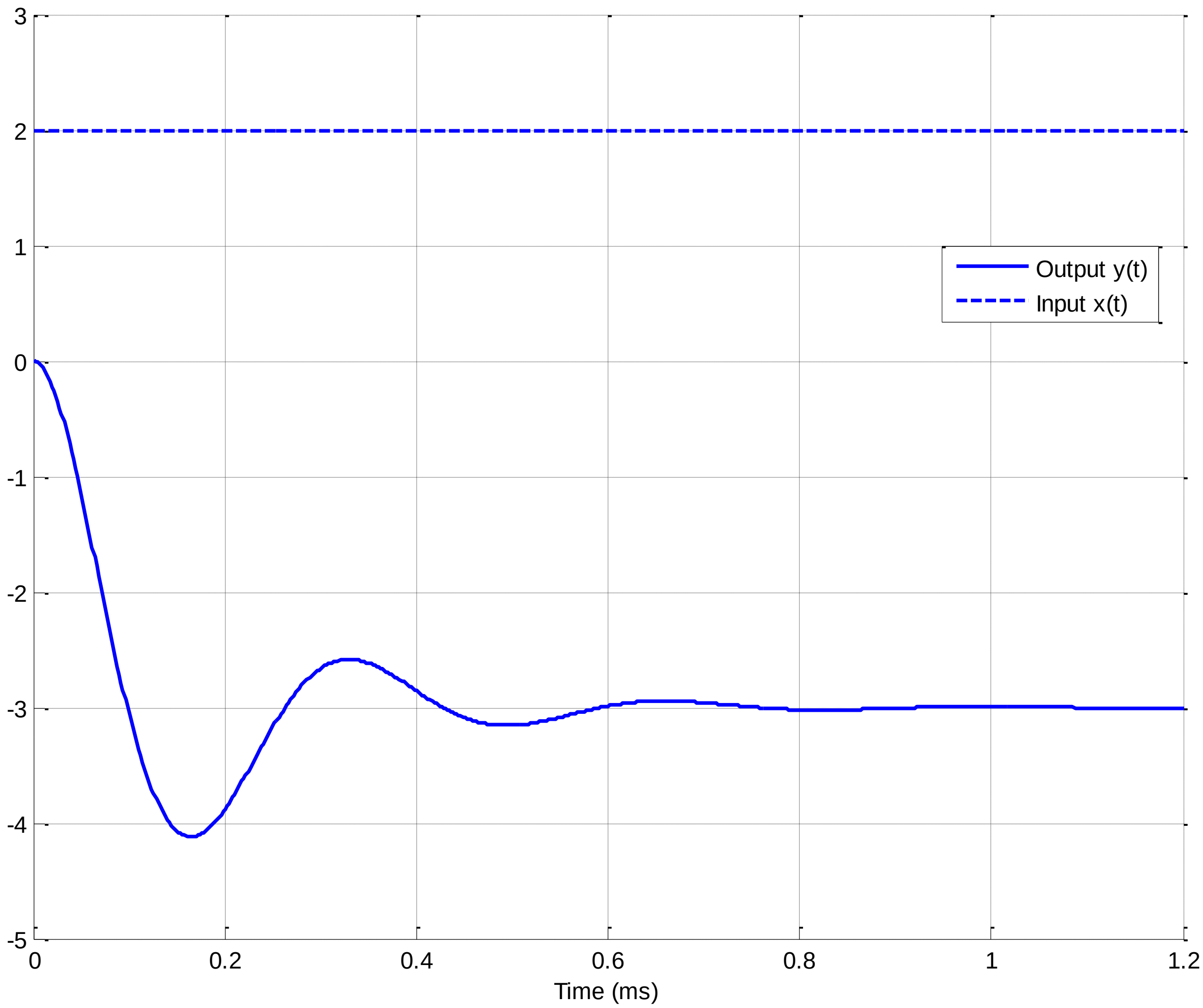
18) The (2%) settling time for this system is best estimated as

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

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

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

Problems 20-22 refer the following graph showing the response of a second order system to a step input.



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

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

21) 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

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

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

23) For the differential equation $\dot{y}(t)+2y(t)=x(t)$ with intial time $t_0=0$ and initial value $y(0)=0$, the output of the system at time t for an arbitrary input $x(t)$ can be written as

a) $y(t)=\int_0^t e^{2(t-\lambda)}x(\lambda)d\lambda$ b) $y(t)=\int_0^t e^{-2(t-\lambda)}x(\lambda)d\lambda$ c) $y(t)=\int_0^t e^{-\frac{1}{2}(t-\lambda)}x(\lambda)d\lambda$ d) $y(t)=\int_0^t e^{\frac{1}{2}(t-\lambda)}x(\lambda)d\lambda$

24) For the differential equation $2\dot{y}(t)+y(t)=x(t)$ with intial time $t_0=0$ and initial value $y(0)=0$, the output of the system at time t for an arbitrary input $x(t)$ can be written as

a) $y(t)=\int_0^t e^{\frac{1}{2}(t-\lambda)}x(\lambda)\mathrm{d}\lambda$ b) $y(t)=\frac{1}{2}\int_0^t e^{\frac{1}{2}(t-\lambda)}x(\lambda)\mathrm{d}\lambda$ c) $y(t)=2\int_0^t e^{\frac{1}{2}(t-\lambda)}x(\lambda)\mathrm{d}\lambda$

d) $y(t)=\int_0^t e^{-\frac{1}{2}(t-\lambda)}x(\lambda)\mathrm{d}\lambda$ e) $y(t)=\frac{1}{2}\int_0^t e^{-\frac{1}{2}(t-\lambda)}x(\lambda)\mathrm{d}\lambda$ f) $y(t)=2\int_0^t e^{-\frac{1}{2}(t-\lambda)}x(\lambda)\mathrm{d}\lambda$

25) For the differential equation $\dot{y}(t)+2y(t)=2x(t)$ with intial time $t_0=0$ and initial value $y(0)=1$, the output of the system at time t for an arbitrary input $x(t)$ can be written as

a) $y(t)=e^{+2t}+\int_0^t e^{-2(t-\lambda)}x(\lambda)d\lambda$ b) $y(t)=e^{-2t}+\int_0^t e^{-2(t-\lambda)}x(\lambda)d\lambda$ c) $y(t)=e^{+2t}+\int_0^t e^{2(t-\lambda)}x(\lambda)d\lambda$

d) $y(t)=e^{-2t}+\int_0^t e^{2(t-\lambda)}x(\lambda)d\lambda$ e) $y(t)=e^{-2t}+2\int_0^t e^{2(t-\lambda)}x(\lambda)d\lambda$ f) none of these

26) For the differential equation $\dot{y}(t)-3y(t)=e^{3t}x(t-1)$ with intial time $t_0=1$ and initial value $y(1)=2$, the output of the system at time t for an arbitrary input $x(t)$ can be written as

a) $y(t)=2e^{3(t-1)}+\int_1^t e^{3t}x(\lambda-1)d\lambda$ b) $y(t)=2e^{-3(t-1)}+\int_1^t e^{3t}x(\lambda-1)d\lambda$ c) $y(t)=2e^{-3(t-1)}+\int_1^t e^{-3t}x(\lambda-1)d\lambda$

d) $y(t)=2e^{-3(t-1)}+\int_1^t e^{-3(t-\lambda)}x(\lambda-1)d\lambda$ e) $y(t)=2e^{3(t-1)}+\int_1^t e^{3(t-\lambda)}x(\lambda-1)d\lambda$ f) none of these

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