ECE-205 Practice Quiz 2

1) A **standard form** for a first order system, with input $x(t)$ and output $y(t)$, is

a) $\frac{1}{\tau}\frac{dy(t)}{dt} + y(t) = Kx(t)$ b) $\tau\frac{dy(t)}{dt} + y(t) = Kx(t)$ c) $\frac{dy(t)}{dt} + \tau\, y(t) = Kx(t)$

d) $\frac{dy(t)}{dt} + \tau\, y(t) = \frac{1}{K}x(t)$ e) $\tau\frac{dy(t)}{dt} + y(t) = \frac{1}{K}x(t)$ f) $\frac{dy(t)}{dt} + \tau y(t) = Kx(t)$

2) The units of the time constant, τ, are a) 1/[time unit] b) [time unit] c) neither of these

Problems 3 -5 refer to a system described by the differential equation $5\dot{y}(t) + 2y(t) = 4x(t)$.

3) If the input is a step of amplitude 2, $x(t) = 2u(t)$, then the **steady state value** of the output will be

a) $y(t) = 8$ b) $y(t) = 4$ c) $y(t) = 2$ d) none of these

4) The **time constant** of this system is

a) $\tau = 5$ b) $\tau = 2.5$ c) $\tau = 1.0$ d) none of these

5) The **static gain** of this system is

a) $K = 4$ b) $K = 2$ c) $K = 5$ d) none of these

Problems 6 -8 refer to a system described by the differential equation $2\dot{y}(t) + 3y(t) = 5x(t)$.

6) If the input is a step of amplitude 2, $x(t) = 2u(t)$, then the **steady state value** of the output will be

a) $y(t) = 10$ b) $y(t) = 5$ c) $y(t) = 3.33$ d) none of these

7) The **time constant** of this system is

a) $\tau = 2$ b) $\tau = 0.4$ c) $\tau = 0.667$ d) none of these

8) The **static gain** of this system is

a) $K = 3$ b) $K = 1.667$ c) $K = 5$ d) none of these

9) A **standard form** for a second order system, with input $x(t)$ and output $y(t)$, is

a) $\ddot{y}(t) + \zeta\omega_n \dot{y}(t) + \omega_n^2 y(t) = K\omega_n^2 x(t)$ b) $\ddot{y}(t) + 2\zeta\omega_n \dot{y}(t) + \omega_n^2 y(t) = Kx(t)$

c $\ddot{y}(t) + 2\zeta\omega_n \dot{y}(t) + \omega_n^2 y(t) = K\omega_n^2 x(t)$ d) $\ddot{y}(t) + 2\zeta\omega_n \dot{y}(t) + y(t) = Kx(t)$

Problems 10-13 refer to a system described by the differential equation $\ddot{y}(t) + 0.4\dot{y}(t) + 4y(t) = 6x(t)$

10) If the input is a step of amplitude 2, $x(t) = 2u(t)$, then the **steady state value** of the output will be

a) $y(t) = 2$ b) $y(t) = 6$ c) $y(t) = 12$ d) none of these

11) The **natural frequency** of this system is

a) $\omega_n = 1$ b) $\omega_n = 2$ c) $\omega_n = 4$ d) none of these

12) The **damping ratio** of this system is

a) $\zeta = 0.1$ b) $\zeta = 0.2$ c) $\zeta = 0.4$ d) none of these

13) The **static gain** of the system is

a) $K = 6$ b) $K = 4$ c) $K = 1.5$ d) none of these

Problems 14-17 refer to a system described by the differential equation $4\ddot{y}(t) + \dot{y}(t) + y(t) = 3x(t)$

14) If the input is a step of amplitude 2, $x(t) = 2u(t)$, then the **steady state value** of the output will be

a) $y(t) = 2$ b) $y(t) = 6$ c) $y(t) = 12$ d) none of these

15) The **natural frequency** of this system is

a) $\omega_n = 0.25$ b) $\omega_n = 0.5$ c) $\omega_n = 4$ d) none of these

16) The **damping ratio** of this system is

a) $\zeta = 0.25$ b) $\zeta = 1$ c) $\zeta = 0.5$ d) none of these

17) The **static gain** of the system is

a) $K = 6$ b) $K = 4$ c) $K = 1.5$ d) none of these

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

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

20) 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

21) 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

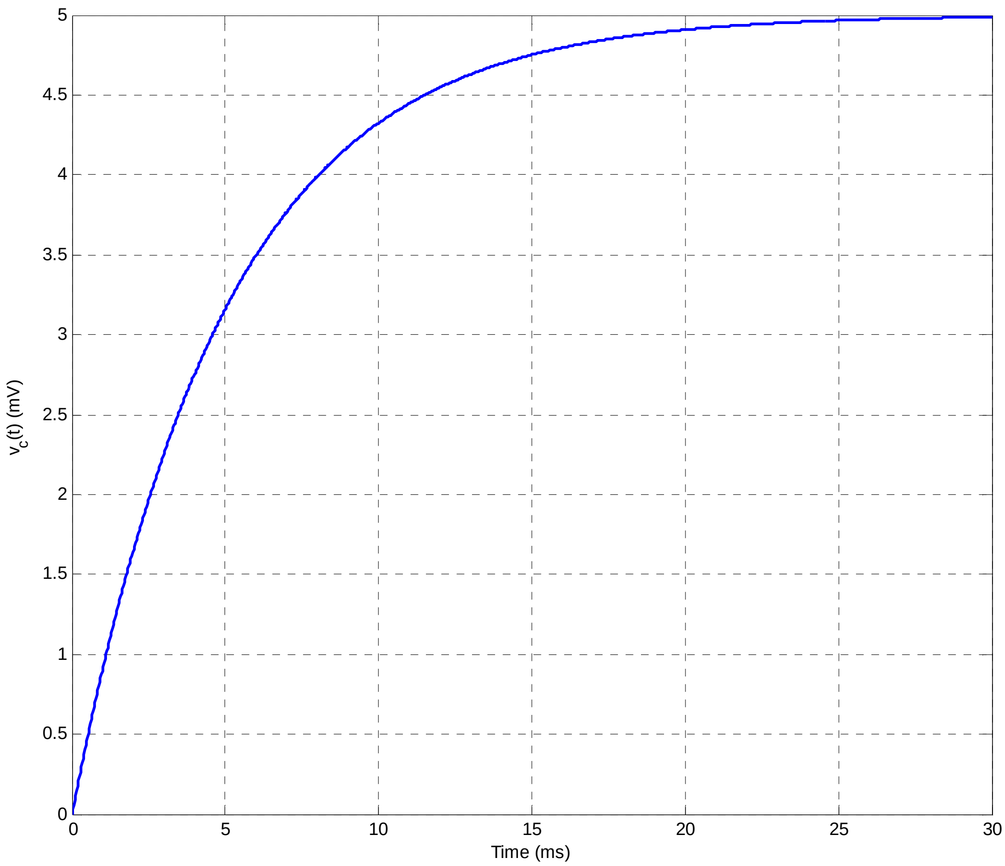
22) A first order system has a time constant $\tau = 0.1$ seconds. The system will be within 2% of its final value in (choose the smallest possible time)

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

23) 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

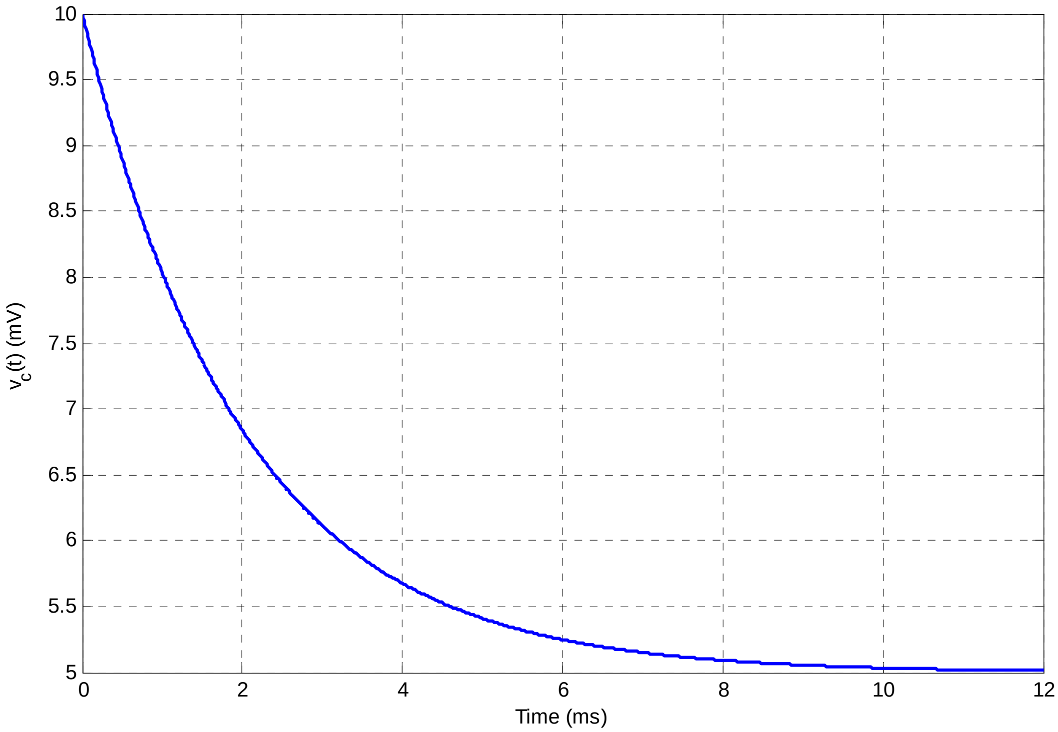
24) The following figure shows a capacitor charging.



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

25) 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

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

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

18-b, 19-e, 20-f, 21-a, 22-d, 23-b, 24-c, 25-b, 26-d