# ECE-205 Practice Quiz 2

# (No Calculators)

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,  $\tau$ , 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

<b>9</b> ) A	A standard form	for a second	order system.	with input x(	t) and output	y(t).	is
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a) 
$$\ddot{y}(t) + \zeta \omega_n \dot{y}(t) + \omega_n^2 y(t) = K \omega_n^2 x(t)$$
 b)  $\ddot{y}(t) + 2\zeta \omega_n \dot{y}(t) + \omega_n^2 y(t) = K x(t)$ 

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

$$\label{eq:constraints} \begin{array}{ll} \mathbf{c} \ \ddot{\mathbf{y}}(t) + 2\zeta\omega_{n}\dot{\mathbf{y}}(t) + \omega_{n}^{2}\mathbf{y}(t) = K\omega_{n}^{2}\mathbf{x}(t) & \mathrm{d}) \ \ddot{\mathbf{y}}(t) + 2\zeta\omega_{n}\dot{\mathbf{y}}(t) + \mathbf{y}(t) = K\mathbf{x}(t) \end{array}$$

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) 
$$\omega_{-}=1$$

b) 
$$\omega_{-}=2$$

c) 
$$\omega_n = 4$$

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) 
$$\zeta = 0.4$$

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) 
$$K = 1.5$$

c) K=1.5 d) none of these

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

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) 
$$v(t) = 12$$

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) 
$$\omega_n = 4$$

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) 
$$\zeta = 0.5$$

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) 
$$K = 1.5$$

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) 
$$y(t) = \int_{0}^{t} e^{\frac{1}{2}(t-\lambda)} x(\lambda) d\lambda$$
 b)  $y(t) = \frac{1}{2} \int_{0}^{t} e^{\frac{1}{2}(t-\lambda)} x(\lambda) d\lambda$  c)  $y(t) = 2 \int_{0}^{t} e^{\frac{1}{2}(t-\lambda)} x(\lambda) d\lambda$ 

d) 
$$y(t) = \int_{0}^{t} e^{-\frac{1}{2}(t-\lambda)} x(\lambda) d\lambda$$
 e)  $y(t) = \frac{1}{2} \int_{0}^{t} e^{-\frac{1}{2}(t-\lambda)} x(\lambda) d\lambda$  f)  $y(t) = 2 \int_{0}^{t} e^{-\frac{1}{2}(t-\lambda)} x(\lambda) d\lambda$ 

**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)  $y(t) = e^{+2t} + \int_{0}^{t} e^{2(t-\lambda)} x(\lambda) d\lambda$ 

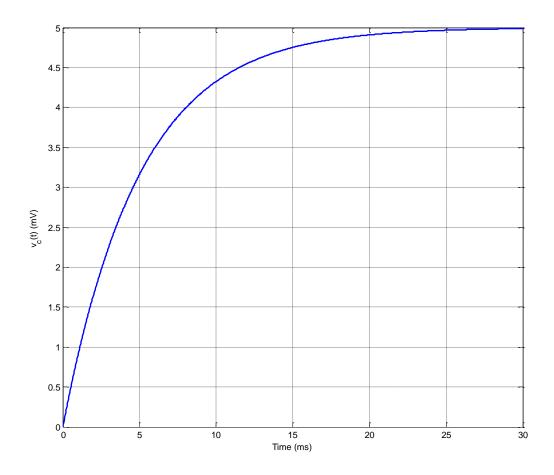
d) 
$$y(t) = e^{-2t} + \int_0^t e^{2(t-\lambda)} x(\lambda) d\lambda$$
 e)  $y(t) = e^{-2t} + 2\int_0^t e^{2(t-\lambda)} x(\lambda) d\lambda$  f) none of these

**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

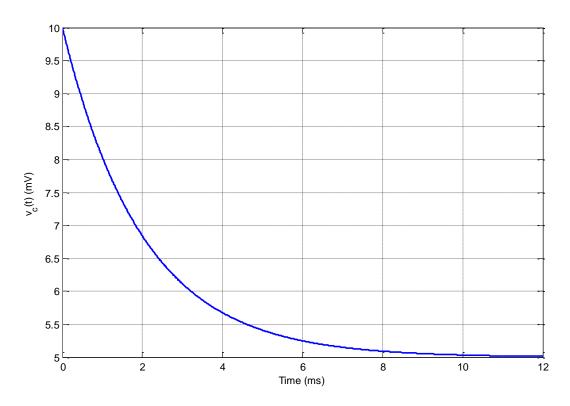
- 22) A first order system has a time constant  $\tau = 0.1$  seconds. The system will be within 2% of its final value in (choose the smallest possible time)
- a) 0.1 seconds b) 0.2 seconds c) 0.3 seconds d) 0.4 seconds e) 0.5 seconds f) 1 second
- 23) A first order system has a time constant  $\tau = 0.05$  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)  $y(t) = [y(0) y(\infty)]e^{-t/\tau} + y(\infty)$

27) If  $z = \frac{1-j}{2-j}$ , the **magnitude** of z, |z| is

- a)  $\sqrt{\frac{2}{5}}$  b) 0 c)  $\sqrt{\frac{2}{3}}$  d) none of these

**28)** If z = -1 - j, the **phase** of z,  $\angle z$ , is

- b)  $-45^{\circ}$  c)  $90^{\circ}$  d)  $-90^{\circ}$  e) none of these a) 45°

**29)** If  $z = \frac{j}{1-i}$ , the **phase** of z,  $\angle z$ , is

- a)  $45^{\circ}$  b)  $-45^{\circ}$  c)  $135^{\circ}$  d)  $-135^{\circ}$  e) none of these

**30)** If  $z = \frac{2+j}{3-2i}$ , the **complex conjugate** of z,  $z^*$ , is

a)  $z = \frac{2+j}{3-2j}$  b)  $z = \frac{2+j}{3+2j}$  c)  $z = \frac{2-j}{3+2j}$  d) none of these

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, 27-a, 28-e, 29-c, 30-c