Homework 3

Due Mar 2 at 11:59pm **Points** 10 **Questions** 10
Available Feb 20 at 8am - Mar 2 at 11:59pm **Time Limit** None
Allowed Attempts Unlimited

Take the Quiz Again

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	31 minutes	10 out of 10

Correct answers are hidden.

Score for this attempt: **10** out of 10
Submitted Mar 2 at 12:23pm
This attempt took 31 minutes.

Question 1

1 / 1 pts

An LTIC system is specified by the equation

($D^2 + 5D + 6$) y(t) = (D + 1) f(t)

What is the characteristic polynomial, of this system?

(a). $\lambda^2 + 5\lambda + 6 = \lambda + 1$

(b). $\lambda^2 + 5\lambda + 6 = 0$

(c). $(\lambda^2 + 5\lambda + 6)\lambda = (\lambda + 1)\lambda$

- a
- b

c

Question 2

1 / 1 pts

What are the characteristic roots for question 1?

(a). $\lambda = 0$

(b). $\lambda = -1$

(c). $\lambda_1 = -2, \ \lambda_2 = -3$

a

b

c

Question 3

1 / 1 pts

Suppose the zero-input system response of an LTIC system is $y_0(t) = c_1 e^{-3t} + c_2 e^{-5t}$,
If the initial conditions are $y_0(0) = 3$, and $\dot{y_0}(0) = -5$, find $y_0(t)$.

(a). $y_0(t) = -2e^{-3t} - 2e^{-5t}$

(b). $y_0(t) = 3e^{-3t} - 5e^{-5t}$

(c). $y_0(t) = 5e^{-3t} - 2e^{-5t}$

- a
- b
- c

Question 4

1 / 1 pts

Suppose $y(t) = te^{-3t}$, what is the first derivative $\dot{y}(t)$?

Tips: When y(t) = g(t) h(t), $\dot{y}(t) = \dot{g}(t)h(t) + g(t)\dot{h}(t)$.

The first derivative of (ct) is: $c\,\dot{t} = c$, *where c is a constant.*

The first derivative of (t^n) is: $(\dot{t^n}) = n\,t^{n-1}$.

The first derivative of (e^{-nt}) is: $(\dot{e^{-nt}}) = -n\,e^{-nt}$

(a). $\dot{y}(t) = \dot{t} \times e^{-3t} + t \times \left(\dot{e^{-3t}}\right) = e^{-3t} - 3te^{-3t}$

(b). $\dot{y}(t) = e^{-3t}$

(c). $\dot{y}(t) = t$

- a
- b
- c

Question 5

1 / 1 pts

An LTIC system is specified by the equation

$(D^2 + 4D + 4)y(t) = D\, f(t)$

If the initial conditions are $y_0(0) = 3$, and $\dot{y_0}(0) = -4$, find $y_0(t)$

(a). $y_0(t) = c_1 e^{-2t} + c_2 e^{-2t}$, $c_1 = 3$, $c_2 = -4$

(b). $y_0(t) = c_1 e^{-2t} + c_2 t e^{-2t}$, $c_1 = 3$, $c_2 = 2$

(c). None of the above.

- a
- b
- c

Question 6

1 / 1 pts

The unit impulse response of an LTIC system is $h(t) = e^{-t}u(t)$, where u(t) is unit step function. Find this system's zero-state response y(t) if the input f(t) is $e^{-2t}u(t)$

Tips: The LTIC system's zero-state response

$$y(t) = f(t) * h(t) = \int_{-\infty}^{\infty} f(\tau)\, h(t-\tau) d\,\tau$$

When $x \to \infty$, $(e^{-nx}) \to 0$.

$$\int_0^{\infty} e^{-nx}\, d\,x = \left[\frac{e^{-nx}}{-n} \right] \begin{matrix} x = \infty \\ x = 0 \end{matrix} = 0 - \frac{e^0}{-n} = \frac{1}{n}\,, \quad \text{where n > 0.}$$

$$\int_0^{\infty} e^{-nx+m}\, d\,x = e^m \int_0^{\infty} e^{-nx}\, d\,x = e^m \left[\frac{e^{-nx}}{-n} \right] \begin{matrix} x = \infty \\ x = 0 \end{matrix} = e^m (0 - \frac{e^0}{-n}) = \frac{e^m}{n}\,, \quad \text{where n > 0.}$$

(a). $y(t) = f(t) * h(t)$

$= \int_{-\infty}^{\infty} e^{-2\tau} u(\tau) e^{-(t-\tau)} u(t-\tau)\, d\,\tau$

$= \int_0^t e^{-2\tau} e^{-(t-\tau)}\, d\,\tau$

$= e^{-t} \int_0^t e^{-\tau}\, d\,\tau$

$= e^{-t} \left[\frac{e^{-\tau}}{-1} \right] \tau = t \; \tau = 0$

$= e^{-t} \left[\frac{e^{-t}}{-1} - \frac{e^{0}}{-1} \right]$

$= (e^{-t} - e^{-2t})$ $\quad where\ t \geq 0.$ $\quad$ y(t) = 0 where t < 0.

$So \quad y(t) = (e^{-t} - e^{-2t}) u(t)$

(b). $y(t) = f(t) * h(t) = e^{-t}\, u(t)$

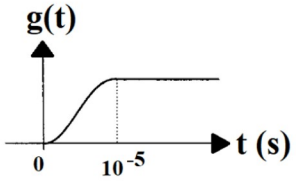
(c). $y(t) = f(t) * h(t) = e^{-2t}\, u(t)$

- (•) a
- ( ) b
- ( ) c

Question 7

1 / 1 pts

The unit step response g(t) for a certain communication channel is shown below. What is time-constant (rise-time) T_h of this system?



(a). $T_h = 10^{-5} s$
(b). $T_h = 10^{-3} s$
(c). None of the above.

- (•) a

b

c

Question 8

1 / 1 pts

What is the bandwidth B of the channel described in question 7?

(a). $B = \frac{1}{T_h} = 10^5\ Hz$

(b). $B = \frac{1}{T_h} = 10^3\ Hz$

(c). None of the above.

a

b

c

Question 9

1 / 1 pts

A certain communication channel has a bandwidth B of 10 kHz.

A pulse of 0.5 ms duration is transmitted over this channel.

Determine the width (duration) of the received pulse.

Tip: The rise time Th of the system = 1/bandwidth, which indicates how much time it takes the system to fully responds to the input signal. Th $\frac{1}{B} = \frac{1}{10\ k}\ seconds = \frac{1}{10}\ ms = 0.1\ ms.$

(a). (0.5 + 0.1) = 0.6 ms

(b). 0.5 ms

(c). (0.5 - 0.1) = 0.4 ms

a

b

c

Question 10

1 / 1 pts

Supposed the received pulse width is 10 ms interval. The maximum pulse rate (to avoid interference between successful pulse) is

(a). $\frac{1}{10 \times 10^{-3}} = 100\ pulses/second$

(b). $10\ pulses/second$

(c). $1\ pulse/second$

a

b

c

Quiz Score: **10** out of 10