Assignments - Weekly NPTEL 2024

1) Let $\delta(t)$ denote the impulse function. Then, $\delta(at)$ equals **1 point**

- $a\delta(t)$
- $\frac{1}{|a|}\delta(t)$
- $|a|\delta(t)$
- $\frac{1}{a}\delta(t)$

Yes, the answer is correct.
Score: 1

Accepted Answers:
$\frac{1}{|a|}\delta(t)$

2) Consider the signal $x(t) = 1 - |t|$ for $|t| \leq 1$ and 0 otherwise, input to an LTI system with impulse response $h(t) = u(t+2) - u(t-2)$. Which of the following statements is true regarding the output **1 point**

- The peak value is 2 and occurs only at $t = 0$
- Peak is 1 and occurs for $-1 \leq t \leq 1$
- The minimum is -1 and occurs at $t = -2, +2$
- None of these

No, the answer is incorrect.
Score: 0

Accepted Answers:
Peak is 1 and occurs for $-1 \leq t \leq 1$

3) The energy of the signal $x(t) = \frac{\sin(Ft)}{t}$ is **1 point**

- $2F$
- F
- $2\pi F$
- πF

No, the answer is incorrect.
Score: 0

Accepted Answers:
πF

4) The quantity $\int_{-\infty}^{\infty} \sin(u)\delta(6u - 15\pi)du$ equals **1 point**

- $\frac{1}{6}$
- $\frac{1}{3}$
- $-\frac{1}{3}$
- $-\frac{1}{6}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{6}$

5) The value of $\int_{-\infty}^{\infty} \varphi(t + a)\delta'(t)dt$ equals **1 point**

- $-\varphi'(-a)$
- $\varphi'(0)$
- $-\varphi'(a)$
- $-\varphi'(0)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\varphi'(a)$

6) An example of a random signal is **1 point**

- Noise
- Complex sinusoid
- Exponential signal
- Unit step

No, the answer is incorrect.
Score: 0

Accepted Answers:
Noise

7) The value of $\int_{-\infty}^{\infty} \sin(\frac{t}{3})\delta'(\frac{t}{2})dt$ is

1 point

- $-\frac{4}{3}$
- 0
- $-\frac{2}{3}$
- $\frac{3}{2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{4}{3}$

8) Consider a signal $x(n) = \sin(\frac{8\pi n}{18})$. The signal $x(n)$ belongs to which of the following classes of signals?

1 point

i. Discrete time signals
ii. Power Signals
iii. Energy Signals
iv. Periodic signals

- i, ii, iii and iv
- Only i, iii, and iv
- Only ii, iii, iv
- Only i, ii and iv

No, the answer is incorrect.
Score: 0

Accepted Answers:
Only i, ii and iv

9) The energy of the signal $x(t) = \frac{1}{2}\frac{\sin(8t)}{t}$ is

1 point

- 4
- 2
- 2π
- π

No, the answer is incorrect.
Score: 0

Accepted Answers:
2π

10) Area under impulse is

1 point

- 0
- 2
- ∞
- 1

No, the answer is incorrect.
Score: 0

Accepted Answers:
1

1) An eigenfunction of the LTI system is **1 point**

- $\cos(2\pi f_0 t)$
- $\sin(2\pi f_0 t)$
- $\mathrm{sinc}(kt)$
- $e^{j2\pi f_0 t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$e^{j2\pi f_0 t}$

2) Consider the signal $e^{j\frac{3\pi}{7}t} + e^{j\frac{5\pi}{9}t}$. Its fundamental period is **1 point**

- 56
- 126
- 112
- 158

No, the answer is incorrect.
Score: 0

Accepted Answers:
126

3) Consider signal $x(t)$ defined as **1 point**

$$x(t) = \begin{cases} 1 & -1 \le t < 0 \\ -1 & 0 \le t < 1 \\ 0 & \text{otherwise} \end{cases}$$

given as input to LTI system with impulse response $h(t) = 1$ for $0 \le t \le 1$ and 0 otherwise. Which of the following statements is true about the resulting output signal

- $\frac{dy(t)}{dt} = -1$ for $-1 \le t < 0$
- $\frac{dy(t)}{dt} = -2$ for $0 \le t < 1$
- $y(t)$ is decreasing in the interval $1 \le t < 2$
- Maximum value of $y(t)$ is 2

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{dy(t)}{dt} = -2$ for $0 \le t < 1$

4) Consider the modulator denoted by $T(x(t)) = x(t)e^{2\pi f_c t}$. The modulator is **1 point**

- Time-invariant but not linear
- Neither linear nor time-invariant
- Linear but not time-invariant
- Both linear and time-invariant

No, the answer is incorrect.
Score: 0

Accepted Answers:
Linear but not time-invariant

5) A linear time-invariant (LTI) system has to satisfy **1 point**

- Only additivity and homogeneity properties
- Additivity, homogeneity and time-invariance properties
- Only homogeneity property
- Only additivity property

No, the answer is incorrect.
Score: 0

Accepted Answers:
Additivity, homogeneity and time-invariance properties

6) Consider the input $x(n) = \alpha^n u(n)$ given to a discrete time LTI system with impulse response $h(n) = \beta^n u(-n)$. The output $y(n)$ is given as ***1 point***

- $y(n) = \begin{cases} \frac{\alpha^n}{1-\frac{\alpha}{\beta}}, & \text{for } n \geq 0 \\ \frac{\beta^n}{1-\frac{\alpha}{\beta}}, & \text{for } n < 0 \end{cases}$
- $y(n) = \begin{cases} \frac{(\alpha/\beta)^n}{1-\frac{\alpha}{\beta}}, & \text{for } n \geq 0 \\ \frac{(\beta/\alpha)^n}{1-\frac{\alpha}{\beta}}, & \text{for } n < 0 \end{cases}$
- $y(n) = \begin{cases} \frac{(\beta/\alpha)^n}{1-\frac{\alpha}{\beta}}, & \text{for } n \geq 0 \\ \frac{(\alpha/\beta)^n}{1-\frac{\alpha}{\beta}}, & \text{for } n < 0 \end{cases}$
- $y(n) = \begin{cases} \frac{\alpha^{-n}}{1-\frac{\alpha}{\beta}}, & \text{for } n \geq 0 \\ \frac{\beta^{-n}}{1-\frac{\alpha}{\beta}}, & \text{for } n < 0 \end{cases}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$y(n) = \begin{cases} \frac{\alpha^n}{1-\frac{\alpha}{\beta}}, & \text{for } n \geq 0 \\ \frac{\beta^n}{1-\frac{\alpha}{\beta}}, & \text{for } n < 0 \end{cases}$

7) Consider the signal $x(t) = 2 - |t|$ for $|t| \leq 1$ and 0 otherwise, input to an LTI system with impulse response $h(t) = u(t+3) - u(t-3)$. Which of the following statements is true regarding the output *1 point*

- Peak value is 2 and occurs for $-2 \leq t \leq 2$
- Peak value is 1 and occurs for $-1 \leq t \leq 1$
- Peak value is 4 and occurs for $-2 \leq t \leq 2$
- Peak value is 3 and occurs for $-2 \leq t \leq 2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
Peak value is 3 and occurs for $-2 \leq t \leq 2$

8) Consider a system with the following property. If input $x_i(t)$ yields output $y_i(t)$, then any input $\sum_i^N x_i(t)$ yields output $\sum_i^N y_i(t)$. This property is termed as *1 point*

- Additivity
- Causality
- Homogeneity
- Time-invariance

No, the answer is incorrect.
Score: 0

Accepted Answers:
Additivity

9) The even component of $e^{\sigma t}$, for σ real is given as *1 point*

- $\sinh(\sigma t)$
- $\cos(\sigma t)$
- $\cosh(\sigma t)$
- $\sin(\sigma t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\cosh(\sigma t)$

10) An ideal capacitor has capacitance C, with the output voltage $v(t)$ and input current $i(t)$ across it related as *1 point*

$$v(t) = \frac{1}{C}\int_{-\infty}^{t} i(\tau)d\tau$$

This input-output system corresponding to the capacitor is

- Memoryless but not causal
- Both causal and memoryless
- Causal but not memoryless
- Neither causal nor memoryless

No, the answer is incorrect.
Score: 0

Accepted Answers:
Causal but not memoryless

1) Consider a system with the following property. If input $x(t)$ yields output $y(t)$, then any input $x(t - t_0)$ yields output $y(t - t_0)$, where t_0 is any time-shift. This property is termed as **1 point**

- Causality
- Homogeneity
- Time-invariance
- Additivity

No, the answer is incorrect.
Score: 0

Accepted Answers:
Time-invariance

2) Consider the system described by the linear differential equation $2\frac{dy(t)}{dt} + 3y(t) = x(t)$, where $x(t), y(t)$ are the input and output signals respectively. If $y(0) = 2$ and input signal $x(t) = e^{-t}u(t)$, the particular solution to the differential equation above for $t > 0$ is **1 point**

- $2e^{-t}$
- e^{-t}
- $e^{-\frac{3}{2}t}$
- $2e^{-\frac{3}{2}t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
e^{-t}

3) Consider an input current source $i(t)$ in parallel with resistance 2Ω and inductance $4H$. The current $i_L(t)$ through the inductor is the output. The input-output relation for this system is **1 point**

- $2\frac{d}{dt}i_L(t) + i_L(t) = i(t)$
- $\frac{1}{2}\frac{d}{dt}i_L(t) + i_L(t) = i(t)$
- $\frac{d}{dt}i_L(t) + 2i_L(t) = i(t)$
- $\frac{d}{dt}i_L(t) + i_L(t) = \frac{1}{2}i(t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2\frac{d}{dt}i_L(t) + i_L(t) = i(t)$

4) Consider the system with impulse response $h(n) = \alpha^n u(-n), \alpha > 1$. Let $u(n)$ denote the discrete time unit step signal. Given that signal $x(n) = u(n) - u(n-N-1)$ is applied as input to the above system. The output of the system is

1 point

- $\begin{cases} 0 & \text{for } n > N \\ \frac{1-\alpha^{n-N-1}}{1-\alpha^{-1}} & \text{for } 0 \le n \le N \\ \frac{\alpha^n(1-\alpha^{-(N+1)})}{1-\alpha^{-1}} & \text{for } n \le -1 \end{cases}$
- $\begin{cases} 0 & \text{for } n < -N \\ \left(\frac{1-\alpha^{n+N+1}}{1-\alpha}\right) & \text{for } -N \le n \le N \\ \alpha^{n-N}\frac{(1-\alpha^{2N+1})}{1-\alpha} & \text{for } n > N \end{cases}$
- $\begin{cases} 0 & \text{for } n > N \\ \alpha^{n-1}\left(\frac{1-\alpha^{N-1}}{1-\alpha^{-1}}\right) & \text{for } 0 \le n \le N \\ \frac{(1-\alpha^{-(n+1)})}{1-\alpha^{-1}} & \text{for } n \le -1 \end{cases}$
- $\begin{cases} \frac{1-\alpha^{-(N+1)}}{1-\alpha^{-1}} & \text{for } n > N \\ \alpha^n\left(\frac{1-\alpha^{n-N-1}}{1-\alpha^{-1}}\right) & \text{for } 0 \le n \le N \\ 0 & \text{for } n \le -1 \end{cases}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\begin{cases} 0 & \text{for } n > N \\ \frac{1-\alpha^{n-N-1}}{1-\alpha^{-1}} & \text{for } 0 \le n \le N \\ \frac{\alpha^n(1-\alpha^{-(N+1)})}{1-\alpha^{-1}} & \text{for } n \le -1 \end{cases}$

5) Consider an input voltage source $v(t)$ in series with resistance R and capacitance C. The voltage $v_c(t)$ across the capacitor is the output. The input-output relation for this system is **_1 point_**

- $v(t) = RCv_c(t) + \frac{dv_c(t)}{dt}$
- $v(t) = v_c(t) + \frac{C}{R}\frac{dv_c(t)}{dt}$
- $v(t) = \frac{R}{C}v_c(t) + \frac{dv_c(t)}{dt}$
- $v(t) = v_c(t) + RC\frac{dv_c(t)}{dt}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$v(t) = v_c(t) + RC\frac{dv_c(t)}{dt}$

6) Consider the LTI system with impulse response $e^{-t}u(t)$. Its eigenvalue corresponding to the eigenfunction $e^{\frac{1}{2}t}$, is **_1 point_**

- 2
- $\frac{1}{2}$
- $\frac{2}{3}$
- $e^{\frac{1}{2}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{2}{3}$

7) Consider the system $2y(n) = y(n-1) + 2x(n)$ at initial rest. The impulse response of the system is **_1 point_**

- $2u(n)$
- $2^n u(-n)$
- $2^n u(n)$
- $2^{-n}u(n)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2^{-n}u(n)$

8) Consider a system with the following property. If input $x(t)$ yields output $y(t)$, then any input $\alpha x(t)$ yields output $\alpha y(t)$, where α is any scalar. ***1 point***
This property is termed as

- Homogeneity
- Causality
- Additivity
- Time-invariance

No, the answer is incorrect.
Score: 0

Accepted Answers:
Homogeneity

9) Consider the system described by the linear differential equation $\frac{dy(t)}{dt} + \alpha y(t) = x(t)$, where $x(t), y(t)$are the input and output signals respectively. If $y(0) = y_0$ and input signal $x(t) = Ce^{-\beta t}$, the particular solution for this system is ***1 point***

- $y_0 e^{-\alpha t}$
- $\frac{C}{\alpha - \beta}\left(e^{-\beta t} - e^{-\alpha t}\right)$
- $\frac{C}{\alpha - \beta} e^{-\beta t}$
- $y_0 e^{-\beta t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{C}{\alpha - \beta} e^{-\beta t}$

10) The quantity $\int_{-\infty}^{\infty} \sin(u)\delta(\alpha u - \beta\pi)\, du$, where $\alpha, \beta > 0$ equals ***1 point***

- $\frac{1}{\alpha}\sin(\frac{\beta\pi}{\alpha})$
- $\alpha \sin(\frac{\alpha\pi}{\beta})$
- $\sin(\frac{\beta\pi}{\alpha})$
- $\sin(\frac{\alpha\pi}{\beta})$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{\alpha}\sin(\frac{\beta\pi}{\alpha})$

1) Let $H(s)$ represent the transfer function of a stable LTI system. Then, which of the following statements is true for the ROC of $H(s)$ *1 point*

- It must include the $j\omega$ axis
- It is of the form $\mathrm{Re}\{s\} < \sigma_{\max}$
- It is of the form $\mathrm{Re}\{s\} < \sigma_{\min}$
- It is of the form $\mathrm{Re}\{s\} > \sigma_{\max}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
It must include the $j\omega$ axis

2) Consider the signal $x(t) = e^{-3t}u(t-2) - e^{5t}u(4-t)$. The Laplace transform $X(s)$ of this signal is *1 point*

- $\frac{e^{3}e^{-2s}}{s+3} + \frac{e^{-5}e^{-4s}}{s-5}$
- $\frac{e^{-2s}}{s+3} + \frac{e^{-4s}}{s-5}$
- Does not exist
- $\frac{e^{-6}e^{-2s}}{s+3} + \frac{e^{20}e^{-4s}}{s-5}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{e^{-6}e^{-2s}}{s+3} + \frac{e^{20}e^{-4s}}{s-5}$

3) The Laplace transform of $t^2 e^{-at}u(-t)$, for $\mathrm{Re}\{s\} < -\mathrm{Re}\{a\}$, is *1 point*

- $\frac{1}{(s+a)^3}$
- $\frac{2}{(s+a)^2}$
- $-\frac{1}{(s+a)^2}$
- $-\frac{2}{(s+a)^3}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{2}{(s+a)^3}$

4) The Laplace transform of $\sin(-4t)u(t)$ is *1 point*

- $-\frac{4}{s^2+16}$
- $\frac{s}{s^2+16}$
- $-\frac{s}{s^2+16}$
- $\frac{4}{s^2+16}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{4}{s^2+16}$

5) Consider signal $x(t)$ with Laplace transform $X(s)$. The Laplace transform of $tx(-t)$ is **1 point**

- $sX(s)$
- $\frac{dX(-s)}{ds}$
- $-\frac{d}{ds}X(-s)$
- $\frac{dX(s)}{ds}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{d}{ds}X(-s)$

6) Consider the signal $x(t) = e^{-2t}u(t) + e^{4t}u(-t)$. The Laplace transform $X(s)$ of this signal is **1 point**

- $-\frac{6}{(s-2)(s+4)}$
- $-\frac{6}{(s+2)(s-4)}$
- $\frac{2}{(s+2)(s-4)}$
- Does not exist

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{6}{(s+2)(s-4)}$

7) The Laplace transform of the impulse response of an LTI system is given to be a polynomial in s. The relation between the input $x(t)$ and output $y(t)$ of the LTI system in the time domain can be described by **1 point**

- a linear constant coefficient differential equation involving $x(t), y(t)$and higher order derivatives of $y(t)$ only
- a linear constant coefficient differential equation involving $x(t), y(t)$and higher order derivatives of both $x(t), y(t)$
- a linear constant coefficient differential equation involving $x(t), y(t)$and higher order derivatives of $x(t)$ only
- a non-linear differential equation involving $x(t), y(t)$and higher order derivatives of both $x(t), y(t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
a linear constant coefficient differential equation involving $x(t), y(t)$and higher order derivatives of $x(t)$ only

8) Let signal $x(t)$ have Laplace transform $X(s)$. Then, the Laplace transform of $x(-\frac{t}{5})$ is **1 point**

- $-5X(5s)$
- $5X(-5s)$
- $-\frac{1}{5}X\left(\frac{s}{5}\right)$
- $-5X(-5s)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$5X(-5s)$

9) Consider the signal $x(t) = e^{-3t}u(t-4) - e^{-2t}u(2-t)$. The Laplace transform $X(s)$ of this signal is **0 points**

- $\frac{e^{-12}\,e^{-4s}}{s+3} + \frac{e^{4}e^{-2s}}{s-2}$
- $\frac{e^{-6}\,e^{-4s}}{s-3} + \frac{e^{2}e^{-2s}}{s+2}$
- $\frac{e^{-3}\,e^{-3s}}{s+3} + \frac{e^{-2}e^{2s}}{s-2}$
- Does not exist

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{e^{-12}\,e^{-4s}}{s+3} + \frac{e^{4}e^{-2s}}{s-2}$

10) The inverse Laplace transform of $\frac{1}{s-\alpha}$ with ROC $\text{Re}\{s\} > \alpha$ is **1 point**

- $-e^{-\alpha t}u(t)$
- $e^{\alpha t}u(t)$
- $-e^{\alpha t}u(-t)$
- $-e^{-\alpha t}u(-t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$e^{\alpha t}u(t)$

1) Consider the Laplace transform X(s) has a pole p_i of multiplicity r. In the partial fraction expansion of $X(s)$, the coefficient of $\frac{1}{(s-p_i)^r}$ is **1 point**

- $(s-p_i)^r X(s)|_{s=p_i}$
- $\frac{1}{r!}\frac{d^r}{ds^r}(s-p_i)^r X(s)|_{s=p_i}$
- $\frac{d^r}{ds^r}(s-p_i)^r X(s)|_{s=p_i}$
- $\frac{1}{r!}(s-p_i)^r X(s)|_{s=p_i}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(s-p_i)^r X(s)|_{s=p_i}$

2) Consider the Laplace transform $X(s) = \frac{-1}{(s+1)(s+2)^2}$ with ROC $\mathrm{Re}\{s\} > -1$. Consider the partial fraction expansion of $X(s)$ given as $X(s) = \frac{c_1}{s+1} + \frac{\lambda_1}{s+2} + \frac{\lambda_2}{(s+2)^2}$. The value of λ_1 is **1 point**

- 2
- -1
- 1
- -2

No, the answer is incorrect.
Score: 0

Accepted Answers:
1

3) Consider the Laplace transform $X(s) = \frac{(s+4)e^{-3s}}{s^2+5s+6}$ and ROC $-3 < \mathrm{Re}\,\{s\} < -2$. The inverse Laplace transform is given as **1 point**

- $e^6e^{-2t}u(-t+3) + 2e^9e^{-3t}u(-t+3)$
- $2e^6e^{-2t}u(t-3) - e^9e^{3t}u(-t+3)$
- $-2e^6e^{-2t}u(-t+3) - e^9e^{-3t}u(t-3)$
- $-2e^6e^{-2t}u(-t+3) + e^9e^{-3t}u(-t+3)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-2e^6e^{-2t}u(-t+3) - e^9e^{-3t}u(t-3)$

4) Consider the signal $x(t) = e^{-5t}u(-t) + e^{3t}u(t)$. The Laplace transform $X(s)$ of this signal is

1 point

- $\frac{8}{(s-5)(s+3)}$
- Does not exist
- $-\frac{8}{(s+5)(s-3)}$
- $\frac{8}{(s+5)(s-3)}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
Does not exist

5) Consider the LTI system with input $x(t)$ and output $y(t)$ related by the differential equation below

1 point

$$\frac{d^2y(t)}{dt^2} - 2\frac{dy(t)}{dt} = 3y(t) + x(t).$$

If the given system is stable, its impulse response is

- $-\frac{1}{4}e^{3t}u(-t) - \frac{1}{4}e^{-t}u(t)$
- $-\frac{1}{4}e^{-3t}u(t) - \frac{1}{4}e^{t}u(-t)$
- $\frac{1}{4}e^{-3t}u(t) + \frac{1}{4}e^{t}u(-t)$
- $-\frac{1}{4}e^{-3t}u(-t) - \frac{1}{4}e^{t}u(t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{1}{4}e^{3t}u(-t) - \frac{1}{4}e^{-t}u(t)$

6) The inverse Laplace transform of $\frac{3}{(s+2)^2+9}$ with ROC $\text{Re}\{s\} > -2$ is **1 point**

- $e^{-2t}\cos(3t)u(t)$
- $e^{-2t}\sin(3t)u(t)$
- $e^{-3t}\sin(2t)u(t)$
- $e^{-2t}\cos(3t)u(-t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$e^{-2t}\sin(3t)u(t)$

7) Consider the Laplace transform $X(s) = \frac{s^2+9s+16}{(s+2)(s+3)^2}$ with ROC $\text{Re}\{s\} > -2$. Consider the partial fraction expansion of $X(s)$ given as $X(s) = \frac{c_1}{s+2} + \frac{\lambda_1}{s+3} + \frac{\lambda_2}{(s+3)^2}$. The value of λ_1 is **1 point**

- 2
- 1
- -2
- -1

No, the answer is incorrect.
Score: 0

Accepted Answers:
-1

8) Let $H(s)$ represent the transfer function of a causal LTI system. Then, which of the following statements is true for the ROC of $H(s)$ **1 point**

- It is of the form $\text{Re}\{s\} < \sigma_{\max}$
- It is of the form $\text{Re}\{s\} < \sigma_{\min}$
- It is of the form $\text{Re}\{s\} > \sigma_{\max}$
- It must include the $j\omega$ axis

No, the answer is incorrect.
Score: 0

Accepted Answers:
It is of the form $\text{Re}\{s\} > \sigma_{\max}$

9) The inverse Laplace transform of $\frac{s}{s^2+16}$ with ROC $\mathrm{Re}\{s\} < 0$ is **1 point**

- $-\cos(4t)u(t)$
- $\cos(4t)u(-t)$
- $-\cos(4t)u(-t)$
- $\cos(4t)u(t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\cos(4t)u(-t)$

10) The inverse Laplace transform of $\frac{1}{s+\alpha}$, for ROC $\mathrm{Re}\{s\} > -\alpha$, is **1 point**

- $e^{-\alpha t}u(t)$
- $-e^{-\alpha t}u(t)$
- $e^{-\alpha t}u(-t)$
- $-e^{-\alpha t}u(-t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$e^{-\alpha t}u(t)$

1) Let $X(z)$ denote the z-transform of $x(n)$. The z-transform of $x(n_0 - n)$ is **1 point**

- $z^{n_0}X(z)$
- $z^{n_0}X\left(\frac{1}{z}\right)$
- $z^{-n_0}X\left(\frac{1}{z}\right)$
- $z^{-n_0}X(z)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$z^{-n_0}X\left(\frac{1}{z}\right)$

2) The z-transform of the impulse response corresponding to an LTI system described by a difference equation is a **1 point**

- Exponential function of z
- Linear function of z
- Rational function of z
- Polynomial function of z

No, the answer is incorrect.
Score: 0

Accepted Answers:
Rational function of z

3) Given the signal $5^{-n+1}u(n+1) - 4^n u(-n-1)$. The region of convergence of its z-transform is **_1 point_**

- $4 < |z| < 5$
- $\frac{1}{5} < |z| < 4$
- $\frac{1}{4} < |z| < 5$
- $|z| < 5$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{5} < |z| < 4$

4) The z-transform of $\cos\left(\frac{\pi}{3}n\right)u(n)$ is **_1 point_**

- $\frac{z^2-\frac{z}{2}}{z^2-z+1}$
- $\frac{z^2}{z^2-z+1}$
- $\frac{\frac{z}{2}}{z^2-z+1}$
- $\frac{\frac{\sqrt{3}}{2}z}{z^2-z+1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{z^2-\frac{z}{2}}{z^2-z+1}$

5) Let $X(z)$ denote the z-transform of $x(n)$. The z-transform of $n^2x(n)$ is **_1 point_**

- $z^2\frac{d^2}{dz^2}X(z)$
- $z\frac{d}{dz}X(z) + \frac{d^2}{dz^2}X(z)$
- $\frac{d}{dz}X(z) + z^2\frac{d^2}{dz^2}X(z)$
- $z\frac{d}{dz}X(z) + z^2\frac{d^2}{dz^2}X(z)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$z\frac{d}{dz}X(z) + z^2\frac{d^2}{dz^2}X(z)$

6) If $X(z)$ is the z-transform of a real signal $x(n)$, which of the following properties holds true **_1 point_**

- If z_0 is a zero of $X(z)$, then z_0^* is also a zero of $X(z)$
- If z_0 is a zero of $X(z)$, then $\frac{1}{z_0}$ is a pole of $X(z)$
- If z_0 is a zero of $X(z)$, then $\frac{1}{z_0}$ is also a zero of $X(z)$
- If z_0 is a zero of $X(z)$, then $\frac{1}{z_0^*}$ is also a zero of $X(z)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
If z_0 is a zero of $X(z)$, then z_0^* is also a zero of $X(z)$

7) Let $X(z)$ denote the z-transform of $x(n)$. The z-transform of $nx(n)$ is **1 point**

- $z\frac{dX(z)}{dz}$
- $zX(z)$
- $-z\frac{dX(z)}{dz}$
- $\frac{1}{z}\frac{dX(z)}{dz}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-z\frac{dX(z)}{dz}$

8) The z-transform of $na^n u[n]$ with ROC $|z| > |a|$ is **1 point**

- $\frac{z^{-1}}{(1-az^{-1})^2}$
- $\frac{az^{-1}}{(1-az^{-1})^2}$
- $\frac{a}{(1-az^{-1})^2}$
- $\frac{az^{-1}}{1-az^{-1}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{az^{-1}}{(1-az^{-1})^2}$

9) Consider the signal $\left(\frac{1}{2}\right)^{-n+1} u(-n-4) + \left(\frac{1}{6}\right)^{n+2} u(n-2)$. The region of convergence (ROC) of its z-transform is **1 point**

- $\frac{1}{6} < |z| < 2$
- $2 < |z| < 6$
- $\frac{1}{2} < |z| < 6$
- $\frac{1}{6} < |z| < \frac{1}{2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{6} < |z| < 2$

10) For a discrete time LTI system to be neither causal nor anti-causal, the ROC of the z-transform of its impulse response **1 point**

- must be of the form $|z| > r_{\max}$
- must be of the form $r_1 < |z| < r_2$
- must be of the form $|z| < r_{\min}$
- must include the unit-circle

No, the answer is incorrect.
Score: 0

Accepted Answers:
must be of the form $r_1 < |z| < r_2$

1) For a discrete time LTI system to be anti-causal, the ROC of the z-transform of its impulse response

1 point

- must be of the form $|z| > r_{\max}$
- must include the unit-circle
- must be of the form $r_1 < |z| < r_2$
- must be of the form $|z| < r_{\min}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
must be of the form $|z| < r_{\min}$

2) The inverse z-transform of $\frac{2z^2-11z}{z^2-z-6}$ for a causal system is

1 point

- $3 \times (-2)^n u(n) - 3^n u(n)$
- $-3 \times 2^n u(n) + 2 \times 3^n u(n)$
- $(-2)^n u(n+1) + 4 \times 3^n u(n-1)$
- $2^n u(n) + 2 \times 3^n u(n)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$3 \times (-2)^n u(n) - 3^n u(n)$

3) The inverse z-transform of $\frac{z^3}{z-a}$ with ROC $|z| < |a|$ is

1 point

- $a^{n+2} u(-n-3)$
- $-a^{n+2} u(n-3)$
- $-a^{n+2} u(-n-3)$
- $a^{n+2} u(n-3)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-a^{n+2} u(-n-3)$

4) The inverse z–transform of $e^{az^{-1}}$ with ROC $|z| > |a|$ is **1 point**

- $\frac{1}{n}a^{-n}u(n)$
- $\frac{1}{n}a^{n}u(n-1)$
- $\frac{1}{n!}a^{n}u(n)$
- $na^{n}u(n-1)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{n!}a^{n}u(n)$

5) For a discrete time LTI system to be BIBO stable, the ROC of the z-transform of its impulse response **1 point**

- must include the unit-circle
- must be of the form $|z| > r_{\max}$
- must be of the form $|z| < r_{\min}$
- must be of the form $r_1 < |z| < r_2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
must include the unit-circle

6) The inverse z-transform of $\frac{2z^2-5z}{z^2-5z+6}$ for ROC $2 < |z| < 3$ is **1 point**

- $3^{n}u(-n-1) - 2^{n}u(n)$
- $3^{n}u(n) + 2^{n}u(n)$
- $-3^{-n}u(-n-1) + 2^{n}u(n)$
- $-3^{n}u(-n-1) + 2^{n}u(n)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-3^{n}u(-n-1) + 2^{n}u(n)$

7) The inverse z−transform of $\frac{z}{z^2-\sqrt{2}z+1}$ with ROC $|z| > 1$ is **_1 point_**

- $\cos\left(\frac{\pi}{4}n\right)u(n)$
- $\sqrt{2}\cos\left(\frac{\pi}{4}n\right)u(n)$
- $\sqrt{2}\sin\left(\frac{\pi}{4}n\right)u(n)$
- $\sin\left(\frac{\pi}{4}n\right)u(n)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sqrt{2}\sin\left(\frac{\pi}{4}n\right)u(n)$

8) The inverse z−transform of $-\frac{z}{z+a}$, with ROC $|z| < |a|$, is **_1 point_**

- $a^{-n}u(n-1)$
- $(-a)^n u(-n-1)$
- $-a^{-n}u(-n-1)$
- $-(-a)^n u(-n-1)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$(-a)^n u(-n-1)$

9) The coefficient λ_r corresponding to the term $\frac{1}{z-p_i}$ in the partial fraction expansion of $\frac{X(z)}{z}$, where p_i is a pole of multiplicity r, is **_1 point_**

- $\frac{1}{(r-1)!}\frac{d^{r-1}}{dz^{r-1}}(z-p_i)^r \frac{X(z)}{z}\Big|_{z=p_i}$
- $\frac{d^r}{dz^r}(z-p_i)^r \frac{X(z)}{z}\Big|_{z=p_i}$
- $(z-p_i)^r \frac{X(z)}{z}\Big|_{z=p_i}$
- $\frac{1}{r!}(z-p_i)^r \frac{X(z)}{z}\Big|_{z=p_i}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{(r-1)!}\frac{d^{r-1}}{dz^{r-1}}(z-p_i)^r \frac{X(z)}{z}\Big|_{z=p_i}$

10) The inverse z−transform of $\frac{3z^2-19z}{z^2-z-12}$ for a stable system is **_1 point_**

- $-4 \times (-3)^n u(-n-1) + 4^n u(-n-1)$
- $3^n u(-n-1) - \frac{1}{4} \times (-4)^n u(-n-1)$
- $4 \times 3^{-n} u(n) + 4^{-n} u(n)$
- $3^{-n} u(-n-1) + 4 \times (-4)^{-n} u(-n-1)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-4 \times (-3)^n u(-n-1) + 4^n u(-n-1)$

1) Which of the following is NOT one of the Dirichlet conditions for existence of the Fourier transform of a continuous aperiodic signal $x(t)$ **_1 point_**

$x(t)$ is absolutely integrable

$x(t)$ can be unbounded at a finite number of discontinuities in any interval

$x(t)$ has a finite number of maxima and minima in any finite interval

$x(t)$ has a finite number of discontinuities within any finite interval and is finite at each of these discontinuities

No, the answer is incorrect.
Score: 0

Accepted Answers:
$x(t)$ can be unbounded at a finite number of discontinuities in any interval

2) The Fourier transform of the unit-step function $u(t)$ is **_1 point_**

$\frac{1}{j\omega}$

$\frac{1}{2j\omega}$

$\frac{1}{2}\pi\delta(\omega) + \frac{1}{j\omega}$

$\pi\delta(\omega) + \frac{1}{j\omega}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\pi\delta(\omega) + \frac{1}{j\omega}$

3) Given periodic signal $x(t)$ with fundamental frequency ω_0 and complex exponential Fourier series $\sum_{k=-\infty}^{\infty} c_k e^{jk\omega_0 t}$, its power is **_1 point_**

$\sum_{k=-\infty}^{\infty} |c_k|^2$

$\frac{1}{T_0}\sum_{k=-\infty}^{\infty} |c_k|^2$

$T_0\sum_{k=-\infty}^{\infty} |c_k|^2$

$\frac{2}{T_0}\sum_{k=-\infty}^{\infty} |c_k|^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sum_{k=-\infty}^{\infty} |c_k|^2$

4) Let $x(t)$ have the Fourier transform $X(\omega)$. Then, the inverse Fourier transform of $\frac{1}{2\pi}x(-\omega)$ is **_1 point_**

$\frac{1}{2\pi}X(-t)$

$X(t)$

$\frac{1}{4\pi^2}X(t)$

$\frac{1}{2\pi}X(t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{4\pi^2}X(t)$

5) Consider the signal $x(t)$ with the Fourier transform $X(\omega)$. The Fourier transform of $\frac{d}{dt}x(t)$ is **1 point**

- $j\omega X(\omega)$
- $-j\omega X(\omega)$
- $\frac{j\omega}{2\pi}X(\omega)$
- $2\pi j\omega X(\omega)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$j\omega X(\omega)$

6) The coefficients in the complex exponential Fourier series of $\cos^2\left(t+\frac{\pi}{6}\right)$ are **1 point**

- $\frac{1}{2}, -\frac{1}{4}\left(\frac{1}{2}+j\frac{\sqrt{3}}{2}\right), -\frac{1}{4}\left(\frac{1}{2}-j\frac{\sqrt{3}}{2}\right)$
- $\frac{1}{2}, \frac{1}{4}\left(\frac{\sqrt{3}}{2}+j\frac{1}{2}\right), \frac{1}{4}\left(\frac{\sqrt{3}}{2}-j\frac{1}{2}\right)$
- $\frac{1}{2}, \frac{1}{4}\left(\frac{1}{2}+j\frac{\sqrt{3}}{2}\right), \frac{1}{4}\left(\frac{1}{2}-j\frac{\sqrt{3}}{2}\right)$
- $\frac{1}{2}, \frac{1}{4}\left(-\frac{\sqrt{3}}{2}+j\frac{1}{2}\right), -\frac{1}{4}\left(-\frac{\sqrt{3}}{2}-j\frac{1}{2}\right)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{2}, \frac{1}{4}\left(\frac{1}{2}+j\frac{\sqrt{3}}{2}\right), \frac{1}{4}\left(\frac{1}{2}-j\frac{\sqrt{3}}{2}\right)$

7) Consider the signal $\mathrm{x}(t)$ defined as below **1 point**

$$\mathrm{x}(t) = \begin{cases} -1, & t > 0 \\ 1, & t < 0 \\ 0, & t = 0 \end{cases}$$

Its Fourier transform is

- $\frac{2j}{\omega}$
- $\frac{2}{j\omega}$
- $\pi\delta(\omega) + \frac{1}{j\omega}$
- $j\omega$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{2j}{\omega}$

8) Consider a real periodic signal $x(t)$ with fundamental frequency ω_0. The coefficient c_k corresponding to $e^{jk\omega_0 t}$ in the complex exponential Fourier series and a_k corresponding to $\cos(k\omega_0 t), k \neq 0,$ in the trignometric Fourier series are related as **1 point**

- $a_k = -2\mathrm{Re}\{c_k\}$
- $a_k = 2\mathrm{Im}\{c_k\}$
- $a_k = -2\mathrm{Im}\{c_k\}$
- $a_k = 2\mathrm{Re}\{c_k\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$a_k = 2\mathrm{Re}\{c_k\}$

9) Consider the Gaussian pulse $e^{-\frac{t^2}{2a}}$ with Fourier transform $X(w)$. If $X(0) = 8$, the value of the constant a is **1 point**

- $\frac{16\sqrt{2}}{\sqrt{\pi}}$
- $\frac{64}{\pi^2}$
- $\sqrt{32}\pi$
- $\frac{32}{\pi}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{32}{\pi}$

10) Let $x(t)$ and $y(t)$ be two signals with Fourier transforms coefficients $X(\omega), Y(\omega)$, respectively. Then, the quantity $\int_{-\infty}^{\infty} X(\omega)Y^*(-\omega)d\omega$ equals **1 point**

- $2\pi \int_{-\infty}^{\infty} x(t)y^*(-t)dt$
- $\int_{-\infty}^{\infty} x(-t)y^*(t)dt$
- $2\pi \int_{-\infty}^{\infty} x^*(-t)y(t)dt$
- $\frac{1}{2\pi} \int_{-\infty}^{\infty} x^*(t)y(-t)dt$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2\pi \int_{-\infty}^{\infty} x(t)y^*(-t)dt$

1) The impulse response of the Hilbert transform is **1 point**

- $\frac{1}{\pi t}$
- $\frac{\pi}{t}$
- $\frac{t}{\pi}$
- $\frac{1}{2\pi t}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{\pi t}$

2) The Parseval's relation for a continuous time signal $x(t)$ is given as **1 point**

- $\int_{-\infty}^{\infty} |x(t)|^2 dt = \int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$
- $\int_{-\infty}^{\infty} |x(t)|^2 dt = 2\pi \int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$
- $\int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{(2\pi)^2} \int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$
- $\int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\int_{-\infty}^{\infty} |x(t)|^2 dt = \frac{1}{2\pi} \int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$

3) Consider the transfer function $H(w) = \frac{(100+jw)}{(1+jw)(10+jw)(1000+jw)^2}$. For the frequency range $w \gg 1000$, the Bode plot of the magnitude of the transfer function is

1 point

- Increases as 20 dB/ decade
- Decreases as 40 dB/ decade
- Decreases as 60 dB/ decade
- Decreases as 20 dB/ decade

No, the answer is incorrect.
Score: 0

Accepted Answers:
Decreases as 60 dB/ decade

4) The 3 dB frequency of the RC filter in rad/s is

1 point

- RC
- $\frac{1}{\sqrt{RC}}$
- $\frac{1}{RC}$
- $\sqrt{\frac{R}{C}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{RC}$

5) Consider the frequency response $H(\omega) = \frac{(100+j\omega)^2}{(1+j\omega)(10+j\omega)(1000+j\omega)}$. The Bode magnitude plot between $100 \ll \omega \ll 1000$ **1 point**

Increases at 40 dB/ decade

Is constant

Decreases at 40 dB/decade

Increases at 20 dB/decade

No, the answer is incorrect.
Score: 0

Accepted Answers:
Is constant

6) Consider a pure sinusoid of frequency $60\,Hz$ sampled at $f_s = 150\,Hz$ using a unit impulse train. The original sinusoid can be recovered by passing the sampled signal through an ideal low pass filter with unity gain and any cut-off frequency f_c in the range **1 point**

$60\,Hz < f_c < 90\,Hz$

$60\,Hz < f_c < 120\,Hz$

$60\,Hz < f_c < 210\,Hz$

$60\,Hz < f_c < 150\,Hz$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$60\,Hz < f_c < 90\,Hz$

7) The Fourier transform of signal $x(t) = te^{-at}u(t), a > 0$ is **1 point**

$\frac{\omega}{j\omega+a}$

$-\frac{1}{(j\omega+a)^2}$

$\frac{1}{(j\omega+a)^2}$

$\frac{1}{\omega^2+a^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{(j\omega+a)^2}$

8) Consider the periodic impulse train $\delta_{T_0} = T_0 \sum_{k=-\infty}^{\infty} \delta(t - kT_0)$ with period T_0. The coefficients c_k of its complex exponential Fouerier series are **1 point**

- 1
- $\frac{2}{T_0}$
- $\frac{1}{T_0}$
- $\frac{1}{2\pi}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
1

9) The Fourier transform of signal $x(t) = e^{-a|t|}, a > 0$ is **1 point**

- $\frac{2\omega}{\omega^2+a^2}$
- $\frac{a}{a^2+\omega^2}$
- $\frac{2a}{\omega^2+a^2}$
- $-\frac{2a}{(jw+a)^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{2a}{\omega^2+a^2}$

10) Consider a periodic real signal $x(t)$ with fundamental frequency ω_0. The coefficient c_k corresponding to $e^{jk\omega_0 t}$ in the complex exponential Fourier series and a_k corresponding to $\cos(k\omega_0 t)$ in the trigonometric Fourier series are related as **1 point**

- $a_k = 2\ \mathrm{Im}\{c_k\}$
- $a_k = 2\ \mathrm{Re}\{c_k\}$
- $a_k = -2\ \mathrm{Im}\{c_k\}$
- $a_k = 2j\ \mathrm{Im}\{c_k\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$a_k = 2\ \mathrm{Re}\{c_k\}$

1) The frequency domain Gaussian pulse $\sqrt{\frac{\pi}{4}}e^{-\frac{\omega^2}{8}}$ has the inverse Fourier transform **1 point**

- $\sqrt{\frac{\pi}{2}}e^{-\frac{t^2}{2}}$
- $\sqrt{\frac{\pi}{2}}e^{-4t^2}$
- $\frac{1}{\sqrt{2}}e^{-2t^2}$
- e^{-2t^2}

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{\sqrt{2}}e^{-2t^2}$

2) Let $x(t) = \cos(2\pi f_0 t)$ and $\hat{x}(t)$ denote its Hilbert transform. The signal $x(t)\cos(2\pi f_c t) - \hat{x}(t)\sin(2\pi f_c t)$ is **1 point**

- $\cos(2\pi(f_c - f_0)t)$
- $\sin(2\pi(f_c - f_0)t)$
- $\sin(2\pi(f_c + f_0)t)$
- $\cos(2\pi(f_c + f_0)t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\cos(2\pi(f_c + f_0)t)$

3) Consider a pure sinusoid of frequency 100 Hz sampled at $f_s = 250$ Hz using a unit impulse train. The original sinusoid can be recovered by passing the sampled signal through an ideal low pass filter with unity gain and any cutoff frequency f_c only in the range **1 point**

- $100\,Hz < f_c < 150\,Hz$
- $100\,Hz < f_c < 120\,Hz$
- $100\,Hz < f_c < 250\,Hz$
- $100\,Hz < f_c < 200\,Hz$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$100\,Hz < f_c < 150\,Hz$

4) Consider signal $x(t)$ with Fourier transform $X(\omega)$ sampled using the impulse train $\frac{\omega_s}{2\pi}\sum_{k=-\infty}^{\infty}\delta\left(t-k\frac{2\pi}{\omega_s}\right)$. The Fourier transform of the resulting signal is

1 point

- $\frac{\omega_s}{2\pi}\sum_{k=-\infty}^{\infty} X\left(\omega - k\omega_s\right)$
- $\omega_s \sum_{k=-\infty}^{\infty} X(\omega - \omega_s)$
- $\frac{\omega_s^2}{4\pi^2}\sum_{k=-\infty}^{\infty} X(\omega - k\omega_s)$
- $\sum_{k=-\infty}^{\infty} X\left(\omega - k\omega_s\right)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\omega_s^2}{4\pi^2}\sum_{k=-\infty}^{\infty} X(\omega - k\omega_s)$

5) Let $x(t) = \sin(2\pi f_0 t)$ and $\hat{x}(t)$ denote its Hilbert transform. The signal $x(t)\cos(2\pi f_c t) - \hat{x}(t)\sin(2\pi f_c t)$ is

1 point

- $\cos(2\pi(f_c - f_0)t)$
- $\sin(2\pi(f_c + f_0)t)$
- $-\cos(2\pi(f_c + f_0)t)$
- $-\sin(2\pi(f_c - f_0)t)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\sin(2\pi(f_c + f_0)t)$

6) The Fourier transform of $\frac{\sin(2t)}{t}$ is

1 point

- π for $|\omega| \le 2$ and 0 otherwise
- $\frac{1}{\pi}$ for $|\omega| \le 1$ and 0 otherwise
- π for $|\omega| \le 1$ and 0 otherwise
- 1 for $|\omega| \le 2$ and 0 otherwise

No, the answer is incorrect.
Score: 0

Accepted Answers:
π for $|\omega| \le 2$ and 0 otherwise

7) Consider a serial RC circuit with $R = 36M\Omega$ and $C = 285pF$. A unit-step voltage is applied across this circuit. The rise time for this RC circuit, defined as the time taken for the voltage across the capacitor to rise from 10% of its final value to 90% of its final value, is approximately ***1 point***

- $343.25\ \mu s$
- $4.5\ ms$
- $22.5\ ms$
- $585.2\ ms$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$22.5\ ms$

8) Let the signal $x(t)$ have the Fourier transform $X(\omega) = 2\frac{\cos(2\omega)\sin(\omega)}{\omega}$. The value of the signal $x(-2)$ is ***1 point***

- $\frac{1}{2}$
- 1
- $\frac{1}{4}$
- 0

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{2}$

9) The minimum sampling frequency required to sample the signal $\frac{\sin(8\pi t)}{2\pi t}\cos(8\pi t)$ without aliasing equals ***1 point***

- $2\ Hz$
- $4\ Hz$
- $8\ Hz$
- $16\ Hz$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$16\ Hz$

10) Consider a pure sinusoid of frequency $5\ kHz$ sampled at $f_s = 7.5\ kHz$ using a unit impulse train. The sampled signal is filtered with an ideal low pass filter with unity gain and cut off frequency $f_c = 11\ kHz$. The resulting output contains sinusiods of frequencies ***1 point***

- $5\ kHz$ only
- $2.5\ kHz,\ 5\ kHz$ only
- $2.5kHz,\ 5\ kHz,\ 10kHz$ only
- $5\ kHz,\ 10kHz$ only

No, the answer is incorrect.
Score: 0

Accepted Answers:
$2.5kHz,\ 5\ kHz,\ 10kHz$ *only*

1) Consider $x(n)$ has DTFT $X(\Omega)$. Then $n^2 x(n)$ has DTFT **1 point**

- $\frac{d^2X(\Omega)}{d\Omega^2}$
- $j2\pi\frac{dX(\Omega)}{d\Omega}$
- $j\frac{d^2X(\Omega)}{d\Omega^2}$
- $-\frac{d^2X(\Omega)}{d\Omega^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{d^2X(\Omega)}{d\Omega^2}$

2) Consider the DTFT $X(\Omega) = 1, |\Omega| \leq 2$ and 0 for $2 < |\Omega| \leq \pi$. Its inverse DTFT is **1 point**

- $\frac{\sin(2n)}{n}$
- $\frac{\sin(2n)}{\pi n}$
- $\frac{\sin(\pi 2n)}{n}$
- $\pi\frac{\sin(2n)}{n}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\sin(2n)}{\pi n}$

3) The DTFT of $-\sin(\Omega_0 n)$ is **1 point**

- $-j\pi\delta(\Omega - \Omega_0) + j\pi\delta(\Omega + \Omega_0)$
- $\pi\delta(\Omega - \Omega_0) + \pi\delta(\Omega + \Omega_0)$
- $\pi\delta(\Omega - \Omega_0) - \pi\delta(\Omega + \Omega_0)$
- $j\pi\delta(\Omega - \Omega_0) - j\pi\delta(\Omega + \Omega_0)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$j\pi\delta(\Omega - \Omega_0) - j\pi\delta(\Omega + \Omega_0)$

4) Consider $x(n) = u(n + \frac{N-1}{2}) - u(n - \frac{N+1}{2})$, where $u(n)$ is the unit-step signal and N is odd. Then, the DTFT of $x(n)$ is **1 point**

- $e^{-j\Omega(N-1)}\frac{\sin(\Omega N)}{\sin(\Omega)}$
- $\frac{\sin(\Omega N)}{\sin(\Omega)}$
- $\frac{\sin(\frac{\Omega N}{2})}{\sin(\frac{\Omega}{2})}$
- $e^{-j\Omega\frac{(N-1)}{2}}\frac{\sin(\frac{\Omega N}{2})}{\sin(\frac{\Omega}{2})}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\sin(\frac{\Omega N}{2})}{\sin(\frac{\Omega}{2})}$

5) The IDFT coefficients $x(n)$ of the finite length sequence $X(k), 0 \leq k \leq N-1$, are defined as **1 point**

- $x(n) = \Sigma_{k=0}^{N-1} X(k)e^{j2\pi\frac{kn}{N}}$
- $x(n) = \frac{1}{N}\Sigma_{k=0}^{N-1} X(k)e^{j2\pi\frac{kn}{N}}$
- $x(n) = N\Sigma_{k=0}^{N-1} X(k)e^{-j2\pi\frac{kn}{N}}$
- $x(n) = \Sigma_{k=0}^{N-1} X(k)e^{-j2\pi\frac{kn}{N}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$x(n) = \frac{1}{N}\Sigma_{k=0}^{N-1} X(k)e^{j2\pi\frac{kn}{N}}$

6) Which of the transforms below is best suited to represent a discrete time aperiodic signal $x(n)$ of infinite duration **1 point**

- Discrete Time Fourier Transform (DTFT)
- Fourier Transform (FT)
- Complex Exponential Fourier Series (CEFS)
- Discrete Fourier Transform (DFT)

No, the answer is incorrect.
Score: 0

Accepted Answers:
Discrete Time Fourier Transform (DTFT)

7) Consider the accumulator with output $y(n) = \Sigma_{k=-\infty}^{n} x(k)$. Let $X(\Omega)$ denote the DTFT of $x(n)$. The DTFT of $y(n)$, denoted by $Y(\Omega)$, is **1 point**

- $\frac{X(\Omega)}{1-e^{-j\Omega}}$
- $\pi X(\Omega)\delta(\Omega) + \frac{X(0)}{1-e^{-j\Omega}}$
- $\pi X(0)\delta(\Omega) + (1-e^{-j\Omega})X(\Omega)$
- $\pi X(0)\delta(\Omega) + \frac{X(\Omega)}{1-e^{-j\Omega}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\pi X(0)\delta(\Omega) + \frac{X(\Omega)}{1-e^{-j\Omega}}$

8) The DTFT of $\cos(\Omega_0 n)$ is **1 point**

- $\pi\delta(\Omega - \Omega_0) - \pi\delta(\Omega + \Omega_0)$
- $\frac{1}{2}\pi\delta(\Omega - \Omega_0) + \frac{1}{2}\pi\delta(\Omega + \Omega_0)$
- $\pi\delta(\Omega - \Omega_0) + \pi\delta(\Omega + \Omega_0)$
- $2\pi\delta(\Omega - \Omega_0) + 2\pi\delta(\Omega + \Omega_0)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\pi\delta(\Omega - \Omega_0) + \pi\delta(\Omega + \Omega_0)$

9) Consider the DTFT $X(\Omega) = 1, |\Omega| \leq W$ and 0 for $W < |\Omega| \leq \pi$. Its inverse DTFT is **1 point**

- $\frac{\sin(Wn)}{n}$
- $\frac{\sin(\pi Wn)}{n}$
- $\pi\frac{\sin(Wn)}{n}$
- $\frac{\sin(Wn)}{\pi n}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{\sin(Wn)}{\pi n}$

10) The 2×2 DFT matrix is given as **1 point**

- $\begin{bmatrix} 1 & 1 \\ j & -j \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 \\ -1 & 1 \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$
- $\begin{bmatrix} 1 & j \\ 1 & -j \end{bmatrix}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

1) Consider an LTI system with phase response $\varphi(\omega)$. Its group and phase delays, respectively, at $\omega = \omega_0$ are given as **_1 point_**

$-\frac{\varphi(\omega_0)}{\omega_0}, -\omega_0\varphi(\omega_0)$

$\frac{d\varphi(\omega)}{d\omega}\Big|_{\omega=\omega_0}, \frac{d^2\varphi(\omega)}{d\omega^2}\Big|_{\omega=\omega_0}$

$-\frac{d\varphi(\omega)}{d\omega}\Big|_{\omega=\omega_0}, -\frac{\varphi(\omega_0)}{\omega_0}$

$-\omega_0\varphi(\omega_0), \frac{d^2\varphi(\omega)}{d\omega^2}\Big|_{\omega=\omega_0}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$-\frac{d\varphi(\omega)}{d\omega}\Big|_{\omega=\omega_0}, -\frac{\varphi(\omega_0)}{\omega_0}$

2) The IDFT of $\frac{e^{-j\Omega}}{(1-ae^{-j\Omega})^2}, |a| < 1$ is **_1 point_**

$na^{n-1}u(n-1)$

$(n+1)a^n u(n)$

$na^n u(n)$

$(n-1)a^{n-1}u(n)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$na^{n-1}u(n-1)$

3) The 8– pt DFT of $\{2,3,2,3,2,3,2,3\}$ is **_1 point_**

$\{5,-1,5,-1,5,-1,5,-1\}$

$\{5,5,5,5,5,5,5,5\}$

$\{20,0,0,0,-4,0,0,0\}$

$\{4,0,0,0,20,0,0,0\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\{20,0,0,0,-4,0,0,0\}$

4) Let $x_1(n), x_2(n)$ have the DFTs $X_1(k), X_2(k)$, respectively, and $\circledast$ denote the circular convolution. The DFT of $x_1(n)x_2(n)$, is **_1 point_**

- $NX_1(k) \circledast X_2(k)$
- $X_1(k)X_2(k)$
- $X_1(k) \otimes X_2(k)$
- $\frac{1}{N}X_1(k) \circledast X_2(k)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{N}X_1(k) \circledast X_2(k)$

5) Consider $x(n) = \cos\left(\frac{\pi n}{2}\right)$ for $0 \leq n \leq 3$ and $h(n) = \{2, -1, 3, -2\}$. The circular convolution of $x(n)$ and $h(n)$ is **_1 point_**

- $\{-1, 1, 1, -1\}$
- $\{1, 1, -1, -1\}$
- $\{1, -1, -1, 1\}$
- $\{-1, 1, -1, 1\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\{-1, 1, 1, -1\}$

6) If $x(n)$ has DFT $X(k)$, then $X(n)$ has DFT **_1 point_**

- $Nx(k)$
- $Nx(-k \mod N)$
- $x(-k \mod N)$
- $x(k)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$Nx(-k \mod N)$

7) Consider $x(n) = \sin\left(\frac{\pi n}{2}\right)$ for $0 \le n \le 3$ and $h(n) = \{4, 2, 1, 3\}$. The circular convolution of $x(n)$ and $h(n)$ is *1 point*

- $\{3, 1, -3, -1\}$
- $\{1, 3, -1, -3\}$
- $\{5, 1, 3, -1\}$
- $\{4, 6, -4, -6\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\{1, 3, -1, -3\}$

8) The 2×2 IDFT matrix is given as *1 point*

- $\frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 \\ j & -j \end{bmatrix}$
- $\frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & -j \end{bmatrix}$
- $\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}$

9) The 8-pt DFT of $\{4, 0, 0, 0, 6, 0, 0, 0\}$ is *1 point*

- $\{-2, 10, 2, -10, -2, 10, 2 - 10\}$
- $\{10, 10, 10, 10, 10, 10, 10, 10\}$
- $\{10, -2, -10, 2, 10, -2, -10, 2\}$
- $\{10, -2, 10, -2, 10, -2, 10, -2\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\{10, -2, 10, -2, 10, -2, 10, -2\}$

10) Consider $x(n) = \cos\left(\frac{\pi n}{2}\right)$ for $0 \le n \le 3$ and $h(n) = \{-1, 2, -3, 4\}$. The circular convolution of $x(n)$ and $h(n)$ is *1 point*

- $\{2, 2, -2, -2\}$
- $\{-2, 2, 2, -2\}$
- $\{2, -2, -2, 2\}$
- $\{-2, -2, 2, 2\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\{2, -2, -2, 2\}$