ELECTRICAL ENGINEERING

Signals and Systems

Multiple Select Questions : Workbook Sheet

Chapter 1. Introduction

Q.1 For unit impulse function $\delta(t)$. Which of the following relation holds true?

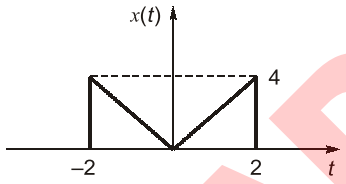
(a) $\delta(-2t) = \frac{1}{2}\delta(t)$

(b) $\int_{-\infty}^{\infty} x(t) \cdot \delta(t - t_1)dt = x(t_1)$

(c) $\int_{-\infty}^{t} \delta(\tau)\, d\tau = 1$

(d) $\frac{du(t)}{dt} = \delta(t)$

Q.2 The mathematical expression for the signal $x(t)$ shown in figure, can be written as



(a) $4\,u(t+2) - 2r(t+2) + 4r(t) - 2r(t-2) - 4u(t-2)$

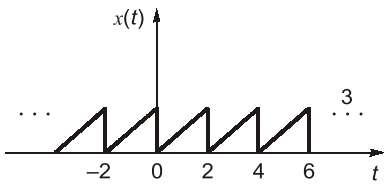
(b) $x(t) = \begin{cases} 2|t|; & |t| < 2 \\ 0; & \text{otherwise} \end{cases}$

(c) $x(t) = -2t[u(t+2) - u(t)] + 2t[u(t) - u(t-2)]$

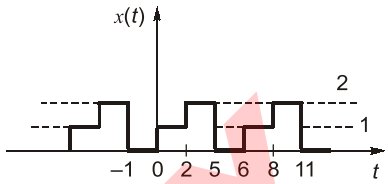
(d) $4u(t+2) - 2r(t+2) + 2r(t) - 2r(t-2) - 4u(t-2)$

Q.3 For which of the following signals, power is "3 units"

(a)



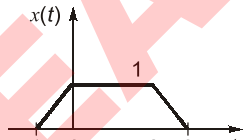
(b)

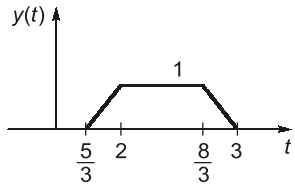


(c) $x(t) = 3e^{j\omega_0 t}$

(d) $x(t) = \sqrt{3}\sin\omega_0 t + \sqrt{3}\cos\omega_0 t$

Q.4 Which of the following procedure is correct to obtained $y(t)$ from $x(t)$?





Which of the following procedure is correct to obtain $y(t)$ from $x(t)$?

(a) First compress $x(t)$ by a factor of '3', then shift to right by '2' time units

(b) First compress $x(t)$ by a factor of '3' then shift to right by '6' time units

(c) First shift $x(t)$ the right by '6' time units then compress by a factor of '3'

(d) First shift $x(t)$ to the right by '2' time units then compress by a factor of '3'

Q.5 A continuous time system is governed by the following equation

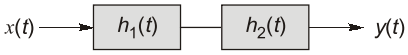
$$y(t) = \int_{-\infty}^{t} \sin\tau \cdot x(\tau)\, d\tau$$

where $y(t)$ and $x(t)$ are output and input respectively. The system is

(a) Linear (b) Unstable

(c) Time-variant (d) Causal

Q.6 Consider the cascade of two LTI systems



Impulse response of system 1 is

$$h_1(t) = e^{-2t}u(t)$$

and impulse response of system 2 is

$$h_2(t) = e^{-3t}u(t)$$

which of the following statements is/are correct?

(a) The overall impulse response is $h(t) = (e^{-2t} - e^{-3t})\,u(t)$

(b) The overall transfer function of the resultant system will be

$$H(s) = \frac{1}{(s+2)(s+3)}$$

(c) The impulse response of resultant system will be absolutely integrable

(d) The overall system is static

Chapter 2. Continuous Time Fourier Series

Q.1 Consider the following three continuous time signals with fundamental period of 1/2 and their Fourier coefficients

$$x(t) = \cos(4\pi t) \overset{FS}{\rightleftharpoons} a_k$$

$$y(t) = \sin(4\pi t) \overset{FS}{\rightleftharpoons} b_k$$

$$z(t) = x(t)\,y(t) \overset{FS}{\rightleftharpoons} c_k$$

Then the correct statements is/are

(a) Fourier series coefficient of $x(t)$ is $a_k = \frac{1}{2j}$ for $k = 1, -1$

(b) Fourier series coefficient of $y(t)$ is $b_1 = b_{-1}^* = \frac{1}{2j}$

(c) $c_2 = c_{-2}^* = \frac{1}{4j}$

(d) $z(t)$ is real and odd function

Q.2 Let $x(t)$ be periodic signal whose Fourier series coefficients c_k are

$$c_k = \begin{cases} 2 & K = 0 \\ j\left(\frac{1}{2}\right) & \text{otherwise} \end{cases}$$

then choose the correct statement/s

(a) $x(t)$ is real (b) $x(t)$ is even

(c) $\frac{dx(t)}{dt}$ is even (d) $\frac{dx(t)}{dt}$ is imaginary

Q.3 Let $x(t) = \begin{cases} t & 0 \le t \le 1 \\ 2-t & 1 \le t \le 2 \end{cases}$

For a periodic signal with fundamental period of $T = 2$ and Fourier coefficient a_k. Let Fourier series coefficient of $\frac{dx(t)}{dt}$ is b_k.

Then select the correct statement(s).

(a) The value of a_0 is 0.5

(b) The value of b_0 of $\frac{dx(t)}{dt}$ is 0

(c) The Fourier coefficient of $\frac{dx(t)}{dt}$ is

$$b_k = \frac{1}{j\pi k}[1 - e^{-j\pi k}]$$

(d) The Fourier coefficient of $x(t)$ is

$$a_k = \frac{-1}{\pi^2 k^2}[1 - e^{-j\pi k}]$$

Q.4 Suppose $x(t) = \sqrt{2}\sin(\pi t) + \sqrt{2}\cos(\pi t)$

having Fourier series coefficient a_k

then select the correct statements about $x(t)$

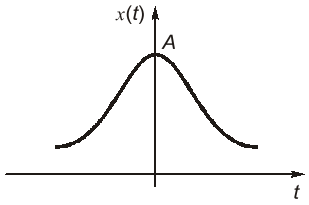
(a) $x(t)$ is real and odd (b) $a_k = -a_{-k}$

(c) Time period $T = 2$ (d) $\frac{1}{2}\int_0^2 |x(t)|^2 = 1$

Chapter 3.
Continuous Time Fourier Transform

Q.1 Consider a signal $x(t)$ with conditions $x(0) = 4$ and $x(1) = 0.5413$.

where $x(t) = Ae^{-at^2}$.



Then select the correct staement(s) :

(a) The CTFT of $x(t)$ is $2\sqrt{2\pi}\, e^{-\frac{\omega^2}{8}}$

(b) Value of A is 4

(c) If $y(t) = x(t) * x(t)$ then resultant signal $y(t)$ is $8e^{-t^2}$

(d) If $G(\omega) = X(\omega) * X(\omega)$ then $G(\omega)$ can be given as $16\pi\sqrt{\pi}\, e^{-\frac{\omega^2}{16}}$

Q.2 The output $y(t)$ of a causal LTI system is related to input $x(t)$ by equation

$$\frac{dy(t)}{dt} + 10y(t) = \int_{-\infty}^{+\infty} x(\tau)\, z(t-\tau)\, d\tau - x(t)$$

and $z(t) = e^{-t}\, u(t) + 3\delta(t)$

Select the correct statement(s).

(a) Transfer function $H(j\omega) = \dfrac{Y(j\omega)}{X(j\omega)}$ of the system is $\dfrac{3 + 2j\omega}{(j\omega + 10)(1 + j\omega)}$

(b) Impulse response of system $h(t)$ is

$$\frac{17}{9}e^{-t}u(t) + \frac{1}{9}e^{-10t}u(t)$$

(c) $h(t)$ is complex signal

(d) $H(j\omega)$ has conjugate symmetry

Q.3 Select the correct statements about CTFT.

(a) Fourier transform exist only when Dirichlet conditions are satisfied.

(b) From Fourier transform stability and causality of system can be analysed.

(c) Magnitude and phase response of stable LTI system can be obtained by CTFT.

(d) Fourier transform is useful for signal analysis.

Q.4 Consider on LTI system whose impulse response is

$$H(j\omega) = \frac{1}{(j\omega + 2)(j\omega + 3)}$$

Then select the statements which is/are not correct?

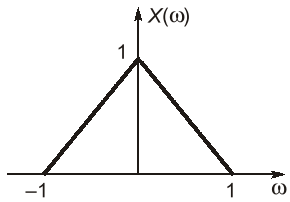
(a) 2 is an eigen function of system.

(b) $\cos 4t$ is an eigen function of system.

(c) $4e^{j2t}$ is an eigen function of system.

(d) $e^{-2t} + e^{2t}$ is an eigen function of system.

Q.5 Consider a signal $X(\omega)$



is passed through a system $h(t) = \cos\dfrac{t}{2}$

yields a signal $y(t)$ then

(a) $Y(\omega)$ is a periodic signal with a period of 2

(b) $x(t)$ is an purely imaginary and even function

(c) $y(t)$ is real valued function

(d) $Y(\omega)$ must be conjugate antisymmetric function

Chapter 4.
Laplace Transform

Q.1 Consider a continuous LTI system for which the input $x(t)$ and output $y(t)$ are related by differential equation

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

Let $X(s)$ and $Y(s)$ denote Laplace transform of $x(t)$ and $y(t)$ respectively and let $H(s)$ denote the Laplace transform of $h(t)$.
Then select the correct statement(s).

(a) $H(s) = \dfrac{1}{s^2 - s - 2}$

(b) If system is stable then

$$h(t) = -\frac{1}{3}e^{2t}u(t) - \frac{1}{3}e^{-t}u(t)$$

(c) If system is causal then

$$h(t) = \frac{1}{3}e^{2t}u(t) - \frac{1}{3}e^{-t}u(t)$$

(d) If system is neither stable nor causal then

$$h(t) = -\frac{1}{3}e^{2t}u(-t) + \frac{1}{3}e^{-t}u(-t)$$

Q.2 If $x_1(t) = e^{-2t}\,u(t)$ and $x_2(t) = e^{-3(t+1)}\,u(t+1)$ then select the correct statement(s).

(a) The unilateral Laplace transform of $x_1(t)$ is $\dfrac{1}{s+2}$

(b) The unilateral Laplace transform of $x_2(t)$ is $\dfrac{e^{-3}}{s+3}$

(c) The inverse unilateral Laplace transform of $X_1(s)\,X_2(s)$ is $e^{-2t-3}u(t) - e^{-3(t+1)}u(t)$ for $t > 0^-$

(d) The bilateral Laplace transform of $x_2(t)$ is $\dfrac{e^{s}}{s+3}$

Q.3 Consider a stable and causal system with a real impulse response $h(t)$ and system function $H(s)$. It is known that $H(s)$ is rational, one of its poles is at $(-1 + j)$ and one of it zero is at $(3 + j)$ and it has exactly two zeros at infinity
Then select the correct statement(s).

(a) $h(t)\,e^{-3t}$ is absolutely integrable

(b) $\lim\limits_{s\to\infty} H(s) = 1$

(c) $H(s)$ does not have less than four poles

(d) The ROC for $H(s)$ cannot be determine from given information

Q.4 Select the correct statements about LTI system.

(a) For each and every stable continuous time system have all of its poles in the left half of s-plane [i.e. Re{s} < 0]

(b) If a system function has more poles than zeros, the system is causal and the transfer function is rational, then the step response will be continuous at $t = 0$

(c) Step response for stable LTI system should be absolutely integrable

(d) A stable, causal system must have all of its poles and zero in left half of s-plane

Chapter 5.
Sampling Theorem and Discrete Time System

Q.1 A discrete time sequence is given below:

$$x(n)\{-2, 1, \underset{\uparrow}{2}, -1\}$$

Which of the following is/are correct?

(a) Energy of $x(n)$ is 10 units

(b) Even part of $x(n)$ is $\{-1, 0, \underset{\uparrow}{2}, 0, -1\}$

(c) Odd part of $x(n)$ is $\{-2, 1, \underset{\uparrow}{0}, -1, 2\}$

(d) $x\left(\dfrac{n}{2}\right) = \{-2, 0, \underset{\uparrow}{1}, 0, 2, 0, -1\}$

Q.2 Consider a discrete time signal $x(n)$:

$$x(n) = (-1)^n u(n)$$

Which of the following is/are correct?

(a) $x(n)$ is periodic with $N = 2$

(b) Power of $x(n)$ is 0.5

(c) The signal has infinite energy

(d) Power of $x^2(n)$ is 1

Q.3 Consider the system given below:

$$y(n) = 2^{x(n+1)}$$

Where $x(n)$ and $y(n)$ are system input and output respectively.

Which of the following is/are correct?

(a) System is non-linear

(b) System is causal

(c) System is unstable

(d) System is time-invariant

Q.4 Consider two signals $x(n) = \{\underset{\uparrow}{0}, 0, 1, 1, 1, 1\}$ and $h(n) = \{\underset{\uparrow}{1}, -2, 3\}$. The signal $y(n)$ is the convolution of $x(n)$ and $h(n)$

$$y(n) = x(n) * h(n)$$

Which of the following is/are correct?

(a) $y(n) = \{\underset{\uparrow}{0}, 0, 2, -1, 2, 2, 1, 3\}$

(b) $y(n) = \{\underset{\uparrow}{0}, 0, 1, -1, 2, 2, 1, 3\}$

(c) Energy of $y(n)$ is 23 units

(d) Energy of $y(n)$ is 20 units

Q.5 Consider the signal $x(t)$ given below:

$$x(t) = \cos 200\pi t \cdot \cos 100\pi t.$$

If this signal is sampled by periodic impluse-train with sampling frequency 600 Hz then which of the following is/are true about sampler output $x(n)$?

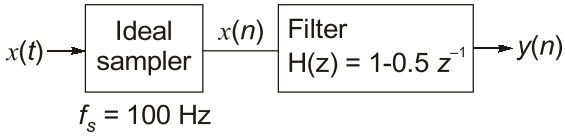
(a) $x(n) = 0.5\cos\left(\frac{\pi}{2}n\right) + 0.5\cos\left(\frac{\pi}{6}n\right)$ A

(b) $x(n) = 0.5\cos\left(\frac{\pi}{3}n\right) + 0.5\cos\left(\frac{\pi}{6}n\right)$

(c) Time period of $x(n)$ is "12"

(d) Time period of $x(n)$ is '6'

Q.6 Consider a signal processing system shown in the figure.



Where $x(t) = \cos 100\pi t$

Which of the following is/are true about $y(n)$?

(a) $y(n) = 0.5\cos(\pi n)$

(b) $y(n) = 1.5\cos(\pi n)$

(c) Power of $y(n)$ is 1.125 units

(d) Power of $y(n)$ is 0.125 units

Chapter 6. Z-Transform

Q.1 Let $x[n]$ be an absolutely summable signal with rational z-transform $X(z)$. If $X(z)$ is known to have a pole at $z = \frac{1}{2}$ then x(n) could be

(a) A finite duration signal

(b) A left-sided signal

(c) A right-sided signal

(d) A two sided signal

Q.2 The following is known about a discrete time LTI system with input $x[n]$ and output $y[n]$

if $x[n] = (-2)^n$ for all n, then $y[n] = 0$ for all n

if $x[n] = \left(\frac{1}{2}\right)^n u[n]$ for all n, then $y[n]$ for all n, is of the form

$$y[n] = \delta[n] + a\left(\frac{1}{4}\right)^n u[n]$$

$H(z)$ is the z-transform of system $h(n)$

Then select the correct statements:

(a) $H(-2) = 0$

(b) Value of $a = -\frac{9}{8}$

(c) if $x[n] = 1$ for all n, then y[n] = $-\frac{1}{4}$ for all n

(d) The value of $H(-2) = 1$

Q.3 If $X(z)$ denotes the unilateral z-transform of $x[n]$, then in terms of $X(z)$, the unilateral z-transform of

(a) $x[n+3] = z^3X(z) - x[0]z^3 - x[1]z^2 - x[2]z$

(b) $x[n-3] = z^{-3}X(z) - x[-1]z^2 + x[-2]z^{-1} - x[-3]$

(c) $x[n+3] * \delta[n-3] = z^3X(z) - x[0]z^3 - x[1]z^2 - x[2]z$

(d) $x[n+3]\,\delta[n-3] = z^{-3}x[0]$

Q.4 For the given transfer function $H(z)$ of the digital filters.

Choose the correct(s) matching option :

(a) $\dfrac{1}{1-z^{-1}}$ — High pass filter

(b) $\dfrac{(1+z^{-1})}{(1+2z^{-1})(1+3z^{-1})}$ — Low pass filter

(c) $(1+z^{-1})(1-z^{-1})(1+2z^{-1})$ — All pass filter

(d) z — All pass filter

Chapter 7. DTFT and DTFS

Q.1 Consider the rectangular pulse

$$x[n] = \begin{cases} 2, & |n| \le 2 \\ 0, & |n| > 2 \end{cases}$$

A function y[n] relates with x[n] as

$$y[n] = x\left[\frac{n}{5}\right]$$

and $g[n] = y[n-2] + y[n+2]$

Then consider the following statements out of which correct are

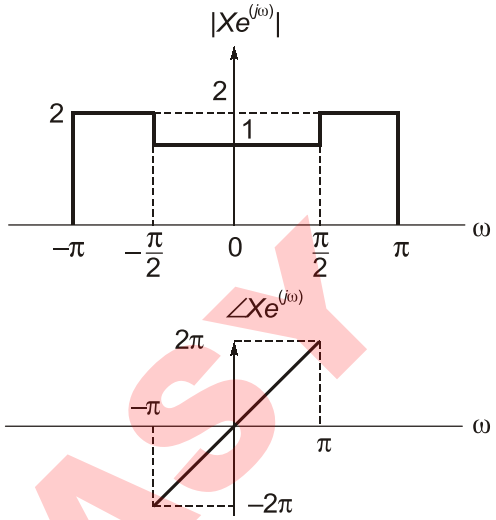
(a) DTFT of $g[n]$ is $G(e^{j\omega})$ is periodic with period of 2π

(b) DTFT of $g^*[n]$ is $\dfrac{4\sin\frac{25\omega}{2}}{\sin\frac{5\omega}{2}}\cos(2\omega)$

(c) DTFT of $y[n]$ is $\dfrac{10\sin\left(\frac{25\omega}{2}\right)}{\sin\left(\frac{5\omega}{2}\right)}$

(d) DTFT of x[–n] is $\dfrac{10Sa\left(\frac{5\omega}{2}\right)}{Sa\left(\frac{\omega}{2}\right)}$

Q.2 Consider the sequence $x[n]$ whose discrete time Fourier transform $X(e^{j\omega})$ is depicted for $-\pi \le \omega \le \pi$ as in figure



then choose the correct statements about $x[n]$

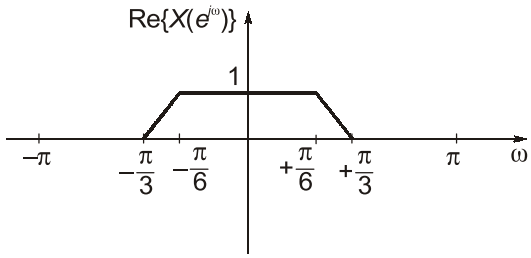
(a) $x[n]$ is real valued function with even symmetry

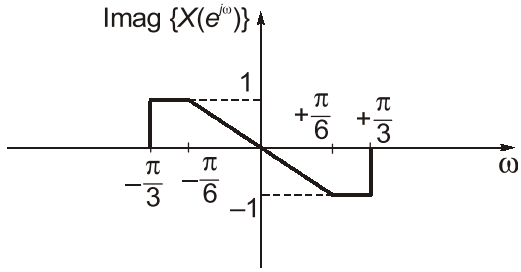
(b) $x[n]$ is real valued function only

(c) $x[n]$ has infinite energy

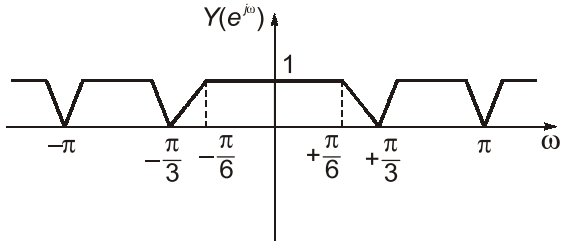
(d) $x[n]$ is non-periodic in nature

Q.3 Let $x[n]$ be the discrete time signal whose Fourier transform $X(e^{j\omega})$ is depicted in figure





at signal $y[n]$ has DTFT $Y(e^{j\omega})$ as shown in figure.



Then select the correct statement:

(a) $y[n] = x[n]\left[1 + e^{\frac{j2\pi}{3}} + e^{-\frac{j2\pi}{3}}\right]$

(b) $y[n] = \text{Even}\{x[n]\}\left[1 + e^{\frac{j2\pi}{3}} + e^{-\frac{j2\pi}{3}}\right]$

(c) $y[n]$ is complex signal

(d) $y[n]$ is real and even signal

Q.4 A LTI system with impulse response $h[n]$ and frequency response $H(e^{j\omega})$ is known to have the property that

$$\cos\omega_0 n \xrightarrow{\text{LTI system}} |\omega_0|\cos\omega_0 n$$

For $-\pi \le \omega_0 \le \pi$

Then choose the correct statement/s

(a) The frequency response $H\left(e^{j\omega}\right) = |\omega|$ when $0 \le |\omega| \le \pi$

(b) The frequency response $H\left(e^{j\omega}\right) = \omega$ when $-\pi \le \omega \le \pi$

(c) The impulse response of system is $\frac{1}{\pi}\frac{[\cos(n\pi) - 1]}{n^2}$

(d) $x[n] = e^{-\frac{j3\pi n}{5}}$ then $x[n] * h[n]$ is $\frac{3\pi}{5}e^{-\frac{j3\pi n}{5}}$

Q.5 Let $x(n)$ be the periodic extension of the sequence $[\delta(n) - \delta(n-2)]$ with period '4'

$$x(n) \Longleftrightarrow C_k$$

where C_k is DTFS coefficient of $x(n)$
Which of the following is/are true?

(a) $C_k = \frac{1 - e^{-j\pi k}}{4}$

(b) $C_k = -\frac{(-j)^{k+1}}{2}\sin\left(\frac{\pi}{2}k\right)$

(c) $C_k = \frac{1 - e^{-j2\pi k}}{4}$

(d) Period of C_k is '4'

Q.6 The DTFS, exists for the signal

(a) $x(n) = \cos 2n$

(b) $x(n) = \cos\left(\frac{\pi}{3}n\right)$

(c) $x(n) = \sum_{k=-\infty}^{\infty}\delta(n - 5k)$

(d) $x(n) = (-1)^n$

Q.7 The DTFS coefficients of sequence

$$x(n) = \cos\frac{\pi}{8}n$$

is represented as C_k. The non-zero FS coefficient are

(a) C_{31} (b) C_{-15}

(c) C_{-1} (d) C_{47}

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