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State	Finished
Completed on	Wednesday, 23 March 2022, 4:50 PM
Time taken	44 mins 51 secs
Marks	8.50/20.00
Grade	**1.70** out of 4.00 (**43**%)

Question 1

Correct

Mark 1.00 out of 1.00

A discrete time signal is given by $x[n] = cos^2[\frac{\pi}{8}n]$. If the complex Fourier series coefficients of the signal are represented as C_k. The value of C_{15} is

Select one:

a. 0.25 ✓

b. 0.5

c. 0.75

d. 1

e. Incomplete question or none of the options is correct

Your answer is correct.

The correct answer is: 0.25

Question 2

Correct

Mark 1.00 out of 1.00

The signal $cos(10\pi t + \pi/4)$ is ideally sampled at a sampling frequency of $15\ Hz$. The sampled signal is passed through a filter with impulse response $\left(\frac{sin(\pi t)}{\pi t}\right) cos(40\pi t - \pi/2)$. The filter output is?

Select one:

a. $\frac{15}{2}\left(\frac{sin(\pi t)}{\pi t}\right) cos(40\pi t + \pi/4)$

b. $\frac{15}{2} cos(40\pi t - \pi/4)$ ✓

c. $\frac{15}{2} cos(10\pi t - \pi/4)$

d. $\frac{15}{2}\left(\frac{sin(\pi t)}{\pi t}\right) cos(40\pi t - \pi/2)$

e. Incomplete question or none of the options is correct.

Your answer is correct.

The correct answer is: $\frac{15}{2} cos(40\pi t - \pi/4)$

Question 3

Incorrect

Mark 0.00 out of 1.00

Let $x(t)$ be a signal with Nyquist Rate ω_o. The Nyquist Frequency of the signal $x(t)cos(\omega_o t)$ will be

Select one:

a. $\frac{1}{2}\omega_o$

b. $\frac{3}{2}\omega_o$

c. ω_o

d. $3\omega_o$ ✗

e. Incomplete question or none of the options is correct

Your answer is incorrect.

The correct answer is: $\frac{3}{2}\omega_o$

Question 4

Incorrect

Mark 0.00 out of 1.00

The first six points of the 8-point DFT of a real valued sequence are 2.5, 0.5 − j1.5, 0, 1.5 − j2, 0 and 1.5 + j2. The last two points of the DFT are respectively

Select one:

a. 0.5 + j1.5, 2.5 ✗

b. 0, 0.5 - j1.5

c. 0, 0.5 + j1.5

d. 0.5 - j1.5, 2.5

e. Incomplete question or none of the options is correct.

Your answer is incorrect.

Using Conjugate symmetric property of DFT, we have:

$$X(k) = X^*(N-k)$$

$$X(6) = X^*(2) = 0$$

$$X(7) = X^*(1) = 0.5 + j1.5$$

The correct answer is: 0, 0.5 + j1.5

Question 5

Incorrect

Mark 0.00 out of 1.00

Suppose we are given the following information about a periodic signal $x[n]$ with period 8 and Fourier coefficients a_k:

$$a_k = -a_{k-4} \qquad x[2n+1] = (-1)^n$$

What is the value of $\sum_{n=0}^{7} |x[n]|$?

Select one:

- a. 2
- b. 6 ✗
- c. 0
- d. Incomplete question or none of the options is correct.
- e. 4

Your answer is incorrect.

Using DTFS property: $e^{jM(2\pi/N)n}x[n] \longleftrightarrow a_{k-M}$

$\therefore (-1)^n x[n] = e^{j(2\pi/N)(N/2)n} \longleftrightarrow a_{k-N/2}$

$(-1)^n x[n] \longleftrightarrow a_{k-4} \qquad (\because N = 8)$

$x[n] = -(-1)^n x[n]$

$\therefore x[2n] = 0$

$x[1] = x[5] = \ldots = 1 \qquad x[3] = x[7] = \ldots = -1$

$\sum_{n=0}^{7} |x[n]| = 4$

The correct answer is: 4

Question 6

Partially correct

Mark 0.50 out of 1.00

A signal x(t) with Fourier transform $X(\omega)$ undergoes impulse-train sampling to generate $x_p(t) = \sum_{-\infty}^{\infty} x(nT)\delta(t-nT)$ where $T = 10^{-4}$. For which of the following sets of constraints on $x(t)$ and/or $X(\omega)$, does the sampling theorem **guarantee** that $x(t)$ can be recovered exactly from $x_p(t)$? (Select one or more)

Select one or more:

- [x] a. $\mathfrak{Re}\{X(\omega)\} = 0 \quad \text{for} \quad |\omega| > 5000\pi$ ✗
- [ ] b. $X(\omega) = 0 \quad \text{for} \quad |\omega| > 5000\pi$
- [ ] c. Incomplete question or none of the options is correct.
- [ ] d. $X(\omega) = 0 \quad \text{for} \quad |\omega| > 15000\pi$
- [x] e. $x(t)$ real and $X(\omega) = 0 \quad \text{for} \quad \omega > 5000\pi$ ✓

Your answer is partially correct.

You have correctly selected 1.

a) $X(\omega) = 0 \quad \text{for} \quad |\omega| > 5000\pi$:

Nyquist rate $= 2 \times 5000\pi = 10000\pi$

The sampling period must at most be $= \frac{2\pi}{10000\pi} = 2 \times 10^{-4}$

Therefore signal can be recovered.

b) $X(\omega) = 0 \quad \text{for} \quad |\omega| > 15000\pi$:

Nyquist rate $= 2 \times 15000\pi = 30000\pi$

The sampling period must at most be $= \frac{2\pi}{30000\pi} = 0.66 \times 10^{-4} < \quad \text{given samping period} \quad = 10^{-4}$

Therefore signal cannot be recovered.

c) $\mathfrak{Re}\{X(\omega)\} = 0 \quad \text{for} \quad |\omega| > 5000\pi$:

$\because$ $\mathfrak{Im}\{X(\omega)\}$ is not specified so cannot guarantee recovery.

d) $x(t)$ real and $X(\omega) = 0 \quad \text{for} \quad \omega > 5000\pi$:

same as (a)

The correct answers are: $X(\omega) = 0 \quad \text{for} \quad |\omega| > 5000\pi$

, $x(t)$ real and $X(\omega) = 0 \quad \text{for} \quad \omega > 5000\pi$

Question **7**

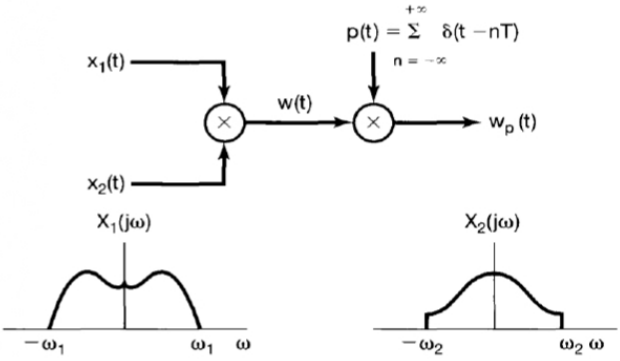
Incorrect

Mark 0.00 out of 1.00

In the system shown in Figure, two functions of time, $x_1(t)$ and $x_2(t)$, are multiplied together, and the product $w(t)$ is sampled by a periodic impulse train. $x_1(t)$ is band limited to ω_1, and $x_2(t)$ is band limited to ω_2:

$$X_1(\omega) = 0, \quad |\omega| \geq \omega_1$$
$$X_2(\omega) = 0, \quad |\omega| \geq \omega_2$$

Determine the maximum sampling interval T such that $w(t)$ is recoverable from $w_p(t)$ through the use of an ideal lowpass filter.:



Select one:

a. $\frac{2\pi}{\omega_1+\omega_2}$

b. $\frac{\pi}{\omega_2-\omega_1}$

c. Incomplete question or none of the options is correct.

d. $\frac{\pi}{\omega_1+\omega_2}$

e. $\frac{2\pi}{\omega_2-\omega_1}$

Your answer is incorrect.

$W(\omega) = \frac{1}{2\pi}[X_1(\omega) * X_2(\omega)]$

$W(\omega) = 0, \quad |\omega| \geq \omega_1 + \omega_2$

$\therefore$ Nyquist rate $\omega_s = 2(\omega_1 + \omega_2)$

$\therefore$ max sampling period $= \frac{2\pi}{\omega_s} = \frac{\pi}{(\omega_1+\omega_2)}$

The correct answer is: $\frac{\pi}{\omega_1+\omega_2}$

Question 8

Incorrect

Mark 0.00 out of 1.00

The DFT of a 4-point sequence $x[n] = \{3(n=0), 2, 3, 4\}$ is $X(k) = \{12(k=0), 2j, 0, -2j\}$.

If $X_1(k)$ is the DFT of 12-point sequence $x_1[n] = \{3, 0, 0, 2, 0, 0, 3, 0, 0, 4, 0, 0\}$, the value of $\frac{|X_1(8)|}{|X_1(11)|}$ is?

Select one:

- a. 8
- b. 12
- c. 4 ✗
- d. Incomplete question or given options not correct
- e. 6

Your answer is incorrect.

$x_1(n) = x(\frac{n}{3})$

DFT of $x_1(n)$ is given as:

$X_1(k) = \sum_{n=0}^{11} x_1(n) e^{-j2\pi kn/12}$

$X_1(8) = \sum_{n=0}^{11} x_1(n) e^{-j4\pi n/3} = 12$

$X_1(1) = \sum_{n=0}^{11} x_1(n) e^{-j\pi n/6} = 2j$

$X_1(11) = X_1^*(1) = -2j$

$\therefore \frac{|X_1(8)|}{|X_1(11)|} = 6$

The correct answer is: 6

Question 9

Correct

Mark 1.00 out of 1.00

Consider the following three discrete-time signals with a fundamental period of 6:

$x[n] = 1 + cos\frac{2\pi n}{6}$, $y[n] = sin(\frac{2\pi n}{6} + \frac{\pi}{4})$, $z[n] = x[n]y[n]$.

The Fourier series coefficient C_0 of $z[n]$ is:

Select one:

- a. $\frac{cos(\pi/4)}{2}$ ✓
- b. $cos(\pi/8)$
- c. $cos(\pi/4)$
- d. Incomplete question or none of the options is correct.
- e. $\frac{cos(\pi/8)}{2}$

Your answer is correct.

The correct answer is: $\frac{cos(\pi/4)}{2}$

Question 10

Incorrect

Mark 0.00 out of 1.00

The signal $x(t) = sin(14000\pi t)$, where t is in seconds is sampled at a rate of 9000 samples per second. The sampled signal is the input to an ideal low pass filter with frequency response $H(f)$ as follows:

$$H(f) = \begin{cases} 1, & |f| \leq 12kHz \\ 0, & |f| > 12kHz \end{cases}$$

What is the number of sinusoids in the output and their frequencies in kHz?

Select one:

- a. Number=3, frequencies=2, 7, 11
- b. Number=2, frequencies=2, 7 ✗
- c. Incomplete question or none of the option is correct.
- d. Number=2, frequencies=7, 11
- e. Number=1, frequencies=7

Your answer is incorrect.

The correct answer is: Number=3, frequencies=2, 7, 11

Question 11

Incorrect

Mark 0.00 out of 1.00

Let the 8-point DFT of a sequence $x[n]$ be $X[k] = k + 1, 0 \leq k \leq 7$. The value of $\sum_{n=0}^{3} x[2n]$ is ___

Answer: 8 ✗

$X(k) = \sum_{n=0}^{7} x[n]e^{-j2\pi kn/8}$

$X(0) = \sum_{n=0}^{7} x[n]$

$X(4) = \sum_{n=0}^{7} x[n]e^{-j\pi n}$

Add above two equations:

$$X(0) + X(4) = 2\sum_{n=0}^{3} x[2n]$$

$$\implies \frac{(1+5)}{2} = 3 \qquad (\because X(k) = k+1)$$

The correct answer is: 3

Question 12

Correct

Mark 1.00 out of 1.00

Let $x(n)$ be a real and odd periodic signal with period N=7 and Fourier Coeffecients a_k. Given that $a_{15} = 1.5j \quad a_{16} = 2j \quad a_{17} = 2.5j$, determine the value of $(a_0 + a_{-1} + a_{-2} + a_{-3})^2$

Answer: -36 ✓

Since $x(n)$ is real and odd, we have: $a_0 = 0$ and

$-a_{-1} = a_1 = a_{15} = 1.5j$

$-a_{-2} = a_2 = a_{16} = 2j$

$-a_{-3} = a_1 = a_{17} = 2.5j$

$\therefore (a_0 + a_{-1} + a_{-2} + a_{-3})^2 = (0 - 1.5j - 2j - 2.5j)^2 = -36$

The correct answer is: -36

Question 13

Incorrect

Mark 0.00 out of 1.00

A discrete-time periodic signal $x[n]$ is real valued and has a fundamental period $N = 5$. The nonzero Fourier series coefficients for $x[n]$ are

$$a_0 = 2, \quad a_2 = a_{-2}^* = 2e^{j\pi/6}, \quad a_4 = a_{-4}^* = e^{j\pi/3}$$

$x[n]$ can be expressed as: $x[n] = A_0 + \sum_{k=1}^{\infty} A_k sin(\omega_k n + \phi_k)$. The value of $\sum_{k=0}^{\infty} A_k + \frac{5}{\pi}\sum_{k=1}^{\infty}\omega_k$

Answer: 13 ✗

$$\begin{aligned} x(n) &= \sum_{k=-\infty}^{\infty} a_k e^{jk2\pi n/N} \\ &= 2 + 2[e^{j(\pi/6+4\pi n/5)} + e^{-j(\pi/6+4\pi n/5)}] + [e^{j(\pi/3+8\pi n/5)} + e^{-j(\pi/3+8\pi n/5)}] \\ &= 2 + 4cos(4\pi n/5 + \pi/6) + 2cos(8\pi n/5 + \pi/3) \\ &= 2 + 4sin(4\pi n/5 + 2\pi/3) + 2sin(8\pi n/5 + 5\pi/6) \end{aligned}$$

$A_0 = 2, A_1 = 4, A_2 = 2, \omega_1 = 4\pi/5, \omega_2 = 8\pi/5$

$\therefore \sum_{k=0}^{\infty} A_k + \frac{5}{\pi}\sum_{k=1}^{\infty}\omega_k = 20$

The correct answer is: 20

Question 14

Incorrect

Mark 0.00 out of 1.00

Let $x(t)$ be a continuous -time, real-valued signal band-limited to F Hz. The Nyquist sampling rate in Hz, for $y(t) = x(0.5t) + x(t) - x(2t)$ is 2 ✗ F.

The correct answer is: 4

Question 15

Incorrect

Mark 0.00 out of 1.00

Consider a continuous time signal defined as

$x(t) = \frac{sin(\pi t/2)}{\pi t/2} * \sum_{n=-\infty}^{\infty} \delta(t - 10n)$

where, '*' denotes the convolution operation and t is in seconds. The Nyquist sampling rate (in samples\ sec) for $x(t)$ is 0.5 ✗

The correct answer is: 0.4

Question 16

Correct

Mark 1.00 out of 1.00

Let $x[n] = 1 + cos\left(\frac{\pi n}{8}\right)$ be a periodic signal with period 16. Its DFS coefficients are defined by $a_k = \frac{1}{16}\sum_{n=0}^{15} x[n] exp(-j\frac{\pi k n}{8})$ for all k. The value of the coefficient a_{31} is 0.50 ✓ .

The correct answer is: 0.5

Question 17

Correct

Mark 1.00 out of 1.00

Let,

$$x[n] = \begin{cases} 1, & 0 \leq n \leq 7 \\ 0, & 8 \leq n \leq 9 \end{cases}$$

be a periodic signal with fundamental period N = 10 and Fourier series coefficients a_k.

$g[n] = x[n] - x[n-1]$. The Fourier coefficients of $g[n]$ be b_k. The relation between a_k and b_k is

$a_k = \frac{b_k}{1-exp(-j(2\pi/10)k)} = \frac{(b/10)[1-exp(-j(2\pi/10)8k)]}{exp(-j(2\pi/10)k)}$ where b is 1 ✓ .

The correct answer is: 1

Question 18

Correct

Mark 2.00 out of 2.00

A continuous-time signal $x(t)$ is obtained at the output of an ideal lowpass filter with cutoff frequency $\omega_c = 1000\pi$. If impulse-train sampling is performed on $x(t)$, which of the following sampling periods would guarantee that $x(t)$ can be recovered from its sampled version using an appropriate lowpass filter?

Select one or more:

- [x] a. $T = 0.5 \times 10^{-3}$ ✓
- [ ] b. $T = 2 \times 10^{-3}$
- [x] c. $T = 10^{-4}$ ✓

Your answer is correct.

The correct answers are: $T = 0.5 \times 10^{-3}$

, $T = 10^{-4}$

Question 19

Incorrect

Mark 0.00 out of 1.00

Consider a real, odd and periodic signal $x(t)$ whose Fourier Series representation is expressed by $x(t) = \sum_{k=0}^{5} (\frac{1}{2})^k sin(k\pi t)$. Let $x_i(t)$ represent the signal obtained by performing impulse-train sampling on $x(t)$ using a sampling period of $T = 0.2$. Consider the following statement:

Aliasing will not occur when this impulse-train sampling is performed on $x(t)$.

Is the above statement true or false?

Select one:

- (•) True ✗
- ( ) False

The correct answer is 'False'.

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