Started on	Wednesday, 16 March 2022, 7:00 PM
State	Finished
Completed on	Wednesday, 16 March 2022, 7:45 PM
Time taken	45 mins
Marks	19.67/30.00
Grade	**2.62** out of 4.00 (**66**%)

Question 1

Correct

Mark 1.00 out of 1.00

The Fourier Transform of $x(t) = t^3 e^{-at} u(t)$, $Re\{a\} > 0$ is given by

Select one:

a. $\frac{6}{(a+j\omega)^4}$ ✓

b. $\frac{1}{(a+j\omega)^4}$

c. $\frac{3}{(a+j\omega)^4}$

d. $\frac{2}{(a+j\omega)^4}$

Your answer is correct.

The correct answer is: $\frac{6}{(a+j\omega)^4}$

Question 2

Correct

Mark 1.00 out of 1.00

The CTFT of $x(t) = \frac{2a}{a^2+t^2}$ is

$a > 0$

Select one:

a. $\pi e^{-a|\omega|}$

b. $4\pi e^{-a|\omega|}$

c. $2\pi e^{-a|\omega|}$ ✓

d. $e^{-a|\omega|}$

Your answer is correct.

The correct answer is: $2\pi e^{-a|\omega|}$

Question 3

Correct

Mark 2.00 out of 2.00

Let $x[n] = (\frac{1}{2})^n u[n]$

$y[n] = x^2[n]$ and $Y(e^{j\Omega})$ be the Fourier Transform of $y[n]$

Value of $Y(e^{j0})$ is

Select one:

- a. $\frac{4}{3}$ ✓
- b. $\frac{1}{4}$
- c. 4
- d. 2

Your answer is correct.

The correct answer is: $\frac{4}{3}$

Question 4

Correct

Mark 1.00 out of 1.00

Let $x[n] = \{1,\ 1,\ 0,\ 5\ (n = 0),\ 1\}$ which has the discrete-time Fourier Transform given by $X(e^{j\Omega})$.

The value of $\int_{-\pi}^{\pi} X(e^{j\Omega}) d\Omega$ is

Select one:

- a. 5
- b. 10π ✓
- c. 16π
- d. 4

Your answer is correct.

The correct answer is: 10π

Question 5

Correct

Mark 1.00 out of 1.00

A discrete-time signal $x[n]$ has DTFT given by $X(e^{j\Omega}) = 2 - 2e^{-j2\Omega}$.

Given that $y[n] = n \times x[n-2]$ and its DTFT is denoted by $Y(e^{j\Omega})$

The value of $Y(e^{j\Omega})$ will be

Select one:

a. $e^{-j2\Omega} - 8e^{-j4\Omega}$

b. $4e^{-j2\Omega} - 8e^{-j4\Omega}$ ✓

c. $4e^{-j2\Omega} - 4e^{-j4\Omega}$

d. $2e^{-j2\Omega} - 4e^{-j4\Omega}$

Your answer is correct.

The correct answer is: $4e^{-j2\Omega} - 8e^{-j4\Omega}$

Question 6

Correct

Mark 1.00 out of 1.00

Consider a discrete-time signal $x[n]$ given by

$x[n] = \{1,\ 0, -1,\ 3, -2\ (n = 0),\ 1, -1, -2,\ 3,\ 2,\ 1\}$

Value of $\int_{-\pi}^{\pi} |X(e^{j\Omega})|^2 d\Omega$ will be

Select one:

a. 120π

b. 100π

c. 70π ✓

d. 20π

Your answer is correct.

The correct answer is: 70π

Question 7

Correct

Mark 1.00 out of 1.00

A signal is represented as: $x(t) = \begin{cases} 1 & |t| < 1 \\ 0 & |t| > 1 \end{cases}$. The Fourier transform of the convolved signal $y(t) = x(2t) * x(\frac{t}{2})$ will be:

Select one:

a. $\frac{4}{\omega^2}\sin(\omega)$

b. $\frac{4}{\omega^2}\sin(\frac{\omega}{2})$

c. $\frac{4}{\omega^2}\sin(\frac{\omega}{2})\sin(2\omega)$

d. $\frac{4}{\omega^2}\sin(2\omega)\sin(\omega)$

Your answer is correct.

$x(t) = rect(\frac{t}{2})$

$$\begin{aligned} Y(\omega) &= \mathcal{F}\{x(2t)\}\mathcal{F}\{x(t/2)\} \\ &= \frac{sin(\omega/2)}{\omega/2}\frac{2sin(2\omega)}{\omega} \\ &= \frac{4}{\omega^2}sin(\omega/2)sin(2\omega) \end{aligned}$$

The correct answer is: $\frac{4}{\omega^2}\sin(\frac{\omega}{2})\sin(2\omega)$

Question 8

Correct

Mark 1.00 out of 1.00

Let $x(t) = \text{rect}(t - \frac{1}{2})$ where $\text{rect}(y) = \begin{cases} 1 & -\frac{1}{2} \leq y \leq \frac{1}{2} \\ 0 & \text{otherwise} \end{cases}$.

Let $\text{sinc}(y)$ be defined as $\text{sinc}(y) = \dfrac{\sin(\pi y)}{\pi y}$, then the Fourier transform of $x(t) + x(-t)$ will be:

Select one:

- a. $2\text{sinc}(\frac{\omega}{2\pi})\cos(\frac{\omega}{2})$ ✓
- b. $2\text{sinc}(\frac{\omega}{2\pi})$
- c. $\text{sinc}(\frac{\omega}{2\pi})$
- d. $\text{sinc}(\frac{\omega}{2\pi})\sin(\frac{\omega}{2})$

Your answer is correct.

$x(t) = rect(t - \frac{1}{2}) = \begin{cases} 1 & 0 \leq t \leq 1 \\ 0 & \text{otherwise} \end{cases}$

$$\begin{aligned} \mathcal{F}\{x(t)\} &= \int_0^1 e^{-j\omega t} dt \\ &= -\frac{1}{j\omega}[e^{-j\omega} - 1] \\ &= \frac{1}{j\omega}\left[\frac{e^{j\omega/2} - e^{-j\omega/2}}{e^{j\omega/2}}\right] \\ &= \frac{sin(\omega/2)}{\omega/2} e^{-j\omega/2} \end{aligned}$$

$\mathcal{F}\{x(-t)\} = X(-\omega) = \frac{sin(\omega/2)}{\omega/2} e^{j\omega/2}$

$$\begin{aligned} \mathcal{F}\{x(t) + x(-t)\} &= \frac{sin(\omega/2)}{\omega/2}(e^{j\omega/2} + e^{-j\omega/2}) \\ &= 2sinc(\omega/2\pi)cos(\omega/2) \end{aligned}$$

The correct answer is: $2\text{sinc}(\frac{\omega}{2\pi})\cos(\frac{\omega}{2})$

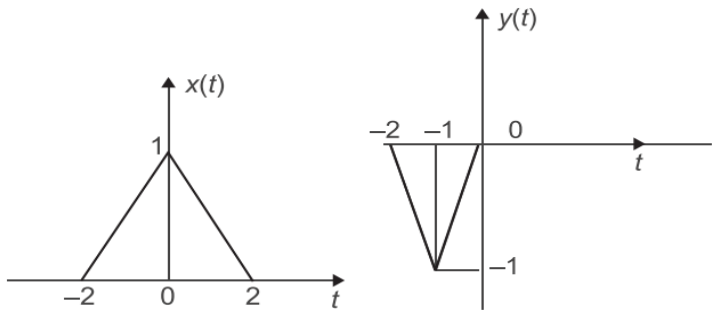
Question 9

Incorrect

Mark 0.00 out of 1.00

Two signals $x(t)$ and $y(t)$ are related as shown in the figure having Fourier transform as $X(\omega)$ and $Y(\omega)$ respectively.

Then $Y(\omega)$ in terms of $X(\omega)$ is:



Select one:

a. $-\frac{1}{2}X\left(\frac{\omega}{2}\right)\ e^{-j\omega}$

b. $-X\left(\frac{\omega}{2}\right)\ e^{j\frac{\omega}{2}}$

c. $-X\left(\frac{\omega}{2}\right)\ e^{-j\frac{\omega}{2}}$

d. $-\frac{1}{2}X\left(\frac{\omega}{2}\right)\ e^{j\omega}$

Your answer is incorrect.

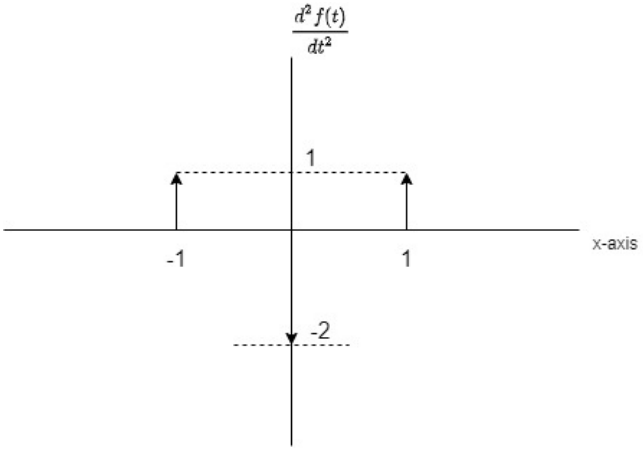
The correct answer is: $-\frac{1}{2}X\left(\frac{\omega}{2}\right)\ e^{j\omega}$

Question 10

Correct

Mark 1.00 out of 1.00

Shown in the figure is the second derivative of a function $f(t)$. The Fourier transform of $f(t)$ is:



Select one:

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

b. $1+cos(2\omega)$

c. $1+sin(\omega)$

d. $\frac{2(1-cos(\omega))}{\omega^2}$

Your answer is correct.

$\frac{d^2f(t)}{dt^2} = \delta(t+1) - 2\delta(t) + \delta(t-1)$

$$\mathcal{F}\left(\frac{d^2f(t)}{dt^2}\right) = e^{-j\omega} - 2 + e^{j\omega}$$
$$(j\omega^2)\mathcal{F}(f(t)) = 2cos(\omega) - 2$$
$$\mathcal{F}(f(t)) = \frac{2(1-cos\omega)}{\omega^2}$$

The correct answer is: $\frac{2(1-cos(\omega))}{\omega^2}$

Question 11

Correct

Mark 1.00 out of 1.00

The DTFT of a signal $g[n] = \{p(n=0), q, r, s\}$ is $G(\Omega)$. The inverse DTFT of $G(\Omega - \pi)$ is:

Select one:

a. $\{p(n=0), q, r, s\}$

b. $\{-p(n=0), q, -r, s\}$

c. $\{-p(n=0), -q, -r, -s\}$

d. $\{p(n=0), -q, r, -s\}$ ✓

Your answer is correct.

$\mathcal{F}\{G(\Omega - \pi)\} = e^{j\pi n}x(n)$

The correct answer is: $\{p(n=0), -q, r, -s\}$

Question 12

Correct

Mark 1.00 out of 1.00

For a signal $x(t)$ the Fourier transform is $X(f)$. Then the inverse Fourier transform of $X(3f+2)$ is given by

Select one:

a. $\frac{1}{2}x(\frac{t}{2})exp(j3\pi t)$

b. $\frac{1}{3}x(\frac{t}{3})exp(-j4\pi t/3)$ ✓

c. $x(3t+2)$

d. $3x(3t)exp(-j4\pi t)$

Your answer is correct.

$X[3(t+\frac{2}{3})] = \frac{1}{3}x(\frac{t}{3})exp(-j4\pi t/3).$

Applying scaling and shifting property.

The correct answer is: $\frac{1}{3}x(\frac{t}{3})exp(-j4\pi t/3)$

Question 13

Incorrect

Mark 0.00 out of 1.00

The Fourier transform of a signal $h(t)$ is $H(\omega) = \frac{(2cos\omega)(sin2\omega)}{\omega}$. The values of $h(0)$ is

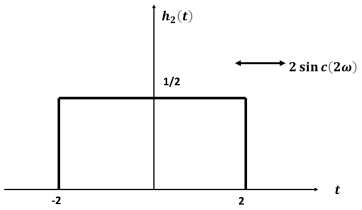
Select one:

- a. 1/4
- b. 1/2 ✗
- c. 1
- d. 2

Your answer is incorrect.

$H(\omega) = \frac{(2cos\omega)(sin2\omega)}{\omega}$ ...(1)

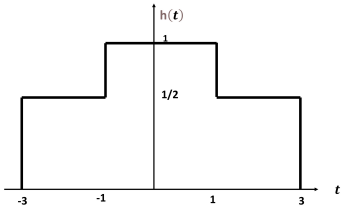
$H(\omega) = 2cos\omega\left(\frac{2sin2\omega}{2\omega}\right) = H_1(w)H_2(w)$ ...(2)



where, $H_1(w) = 2cos\omega = exp(j\omega) + exp(-j\omega)$

$H_2(w) = \frac{2sin2\omega}{2\omega} = 2sinc(2\omega)$

So, $H(w) = exp(j\omega)H_2(w) + exp(-j\omega)H_2(w)$



Therefore, $h(t) = h_2(t+1) + h_2(t-1)$.

The correct answer is: 1

Question 14

Correct

Mark 1.00 out of 1.00

Let $g(t) = exp(-\pi t^2)$, and $h(t)$ is a filter matched to $g(t)$, i.e. $h(t) = g(-t)$. If $g(t)$ is applied as input to $h(t)$, then the Fourier transform of the output is

Select one:

- a. $exp(-\pi|f|)$
- b. $exp(-\pi f^2/2)$
- c. $exp(-2\pi f^2)$ ✓
- d. $exp(-\pi f^2)$

Your answer is correct.

Fourier transform of the output =$G(f)H(f) = G(f)G(-f) = exp(-2\pi f^2)$

The correct answer is: $exp(-2\pi f^2)$

Question 15

Incorrect

Mark 0.00 out of 2.00

If a signal $x[n] = \{2\ (n=0),\ 1,\ 0, -1,\ 3\}$ is applied at input to a system whose impulse response is $h[n]$, where $h[n] = \{1\ (n=0), -3,\ 2\}$. The output of the system is denoted by $y[n]$ with DTFT $Y(e^{j\Omega})$. The value of $Y(e^{j0})$ is

Answer: 2 ✗

The correct answer is: 0

Question 16

Incorrect

Mark 0.00 out of 1.00

Consider an LTI system with magnitude response as:

$$H(f) = \begin{cases} 1 - \frac{|f|}{10} & |f| \leq 10 \\ 0 & |f| > 10 \end{cases}$$

and phase response: $arg(H(f)) = -3f$

If the input of the system is:

$x(t) = 8cos(5\pi t + \pi/4) + 10sin(20\pi t + \pi/8) + 14cos(40\pi t + \pi/16)$.

Then the average power of the output signal y(t) is:

Answer: 2 ✗

For 2.5Hz frequency: $|H(f)| = \frac{3}{4}$

For 10Hz frequency: $|H(f)| = 0$

For 20Hz frequency: $|H(f)| = 0$

Therefore output amplitude $= 8|H(f)|_{f=2.5Hz} = 6$

Average power $= \frac{6^2}{2} = 18$

The correct answer is: 18

Question 17

Correct

Mark 1.00 out of 1.00

The Fourier transform of a discrete time signal $x[n]$ is given as $X(e^{j\omega}) = \cos^2(\omega) + \sin^2(3\omega)$. The value of $4x[0] + 8x[2]$ is

Answer: 6 ✓

$$\begin{aligned} X(e^{j\omega}) &= cos^2(\omega) + sin^2(3\omega) \\ &= 1 + sin(4\omega)sin(2\omega) \\ &= 1 + \left(\frac{e^{j4\omega} - e^{-j4\omega}}{2j}\right)\left(\frac{e^{j2\omega} - e^{-j2\omega}}{2j}\right) \\ &= -\frac{1}{4}e^{j6\omega} + \frac{1}{4}e^{j2\omega} + 1 + \frac{1}{4}e^{-j2\omega} - \frac{1}{4}e^{-j6\omega} \end{aligned}$$

Comparing with standard Fourier Transform equation: $X(e^{j\omega}) = \sum_{n=-\infty}^{\infty} x[n]e^{-j\omega n}$

$x[0] = 1, \quad x[2] = \frac{1}{4}$

$4x[0] + 8x[2] = 6$

The correct answer is: 6

Question 18

Correct

Mark 1.00 out of 1.00

Consider the signal $x[n] = 6\delta[n+2] + 3\delta[n+1] + 8\delta[n] + 7\delta[n-1] + 4\delta[n-2]$. If $X(e^{j\omega})$ is the discrete-time Fourier transform of $x[n]$, then $\frac{1}{\pi}\int_{-\pi}^{\pi} X(e^{j\omega})\sin^2(2\omega)d\omega$ is equal to

Answer: 8 ✓

$\frac{1}{\pi}\int_{-\pi}^{\pi} X(e^{j\omega})\frac{1-cos4\omega}{2}d\omega$

$= \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{j\omega}) - \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{j\omega})cos4\omega d\omega$

First term $= x[0] = 8$

Second term $= \frac{1}{2\pi}\int_{-\pi}^{\pi} X(e^{j\omega})\frac{e^{j4\omega}+e^{-j4\omega}}{2}d\omega$

$= \frac{1}{2}(x[4] + x[-4] = \frac{1}{2}(0+0) = 0$

$\frac{1}{\pi}\int_{-\pi}^{\pi} X(e^{j\omega})\sin^2(2\omega)d\omega = 8$

The correct answer is: 8

Question 19

Incorrect

Mark 0.00 out of 1.00

A Fourier transform pair is given by

$(\frac{2}{3})^n u[n+3] \rightarrow \frac{Aexp(j6\pi f)}{1-\frac{2}{3}exp(-j2\pi f)}$

where, $u[n]$ denotes the unit step sequence, the value of A is

Answer: 2 ✗

The correct answer is: 3.375

Question 20

Incorrect

Mark 0.00 out of 1.00

Consider the function $g(t) = e^{-t}sin(2\pi t)u(t)$ where $u(t)$ is the unit step function. The area under $g(t)$ is

Answer: 2 ✗

The correct answer is: 0.155

Question 21

Incorrect

Mark 0.00 out of 1.00

A continuous time signal $x(t) = 4cos(200\pi t) + 8cos(400\pi t)$, where t is in seconds, is the input to a linear time invariant filter with the impulse response

$$h(t) = \begin{cases} \frac{2sin(300\pi t)}{\pi t}, & t \neq 0 \\ 600 & t = 0 \end{cases}$$

Let $y(t)$ be the output of this filter. The maximum value of $|y(t)|$ is

Answer: 2 ✗

The correct answer is: 8

Question 22

Incorrect

Mark 0.00 out of 1.00

The value of the integral $\frac{1}{2\pi}\int_{-\infty}^{\infty} sinc^2(5t)dt$ is 0.20 ✗ where, $sinc(t)$ denotes the sinc function defined as

$sinc(t) = \frac{sin(t)}{t}$

Let $x(t) = sinc(5t)$

Using Parseval

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

Therefore, $X(\omega) = \frac{2\pi}{10} rect\left(\frac{\omega}{10}\right)$

where, $rect\left(\frac{\omega}{10}\right) = 1$ for $-5 \leq \omega \leq 5$

$\frac{1}{2\pi}\int_{-\infty}^{\infty} x^2(t)dt = \left(\frac{1}{2\pi}\right)^2 \frac{4\pi^2}{100}\int_{-5}^{5} 1 d\omega = 0.1$

The correct answer is: 0.1

Question 23

Correct

Mark 2.00 out of 2.00

Consider a continuous-time real signal $x(t)$ with Fourier Transform $X(\omega)$

Which of the following is/ are true

Select one or more:

- [ ] a. $X(\omega) = -X^*(-\omega)$
- [x] b. $X(\omega) = X^*(-\omega)$ ✓
- [x] c. $Re\{X(\omega)\} = Re\{X(-\omega)\}$ ✓
- [ ] d. $Im\{X(\omega)\} = Im\{X(-\omega)\}$

Your answer is correct.

The correct answers are: $X(\omega) = X^*(-\omega)$

, $Re\{X(\omega)\} = Re\{X(-\omega)\}$

Question 24

Correct

Mark 2.00 out of 2.00

Let $x(t) = sgn(t)$, the signum function. Which of the following is/ are true regarding its Fourier Transform $X(\omega)$

Select one or more:

- [ ] a. $X(\omega)$ is even
- [ ] b. $X(\omega) = \frac{-1}{\pi\omega}$
- [x] c. $X(\omega) = \frac{-2}{\omega} j$
- [ ] d. $Im\{X(\omega)\} = 0$
- [x] e. $Re\{X(\omega)\} = 0$

Your answer is correct.

The correct answers are: $X(\omega) = \frac{-2}{\omega} j$

, $Re\{X(\omega)\} = 0$

Question 25

Partially correct

Mark 0.67 out of 2.00

Consider an imaginary signal $x(t)$ such that $x(t) = -x(-t)$. Out of the following options, which are true regarding its Fourier Transform $X(\omega)$

Select one or more:

- [x] a. $X(\omega) = -X(-\omega)$
- [ ] b. $X(\omega) = X^*(\omega)$
- [ ] c. $X(\omega) = -X^*(-\omega)$
- [x] d. $X(\omega) = -X^*(\omega)$
- [x] e. $X(\omega) = X^*(-\omega)$
- [ ] f. $X(\omega) = X(-\omega)$

Your answer is partially correct.

You have correctly selected one option.

The correct answers are: $X(\omega) = -X(-\omega)$

, $X(\omega) = X^*(\omega)$

, $X(\omega) = -X^*(-\omega)$

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