

B.Tech. DEGREE EXAMINATION, NOVEMBER 2023

Third Semester

18AIS201T – LINEAR SYSTEMS AND SIGNAL PROCESSING*(For the candidates admitted during the academic year 2020-2021 & 2021-2022)***Note:**

- (i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- (ii) **Part - B & Part - C** should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

Marks BL CO

PART – A (20 × 1 = 20 Marks)Answer **ALL** Questions

- | | | | |
|--|---|---|---|
| 1. $\int_{-\infty}^{\infty} \delta(t-2) \sin \pi t \, dt = ?$ | 1 | 2 | 1 |
| (A) 0 | | | |
| (B) 3 | | | |
| (C) -3 | | | |
| (D) 1 | | | |
| | | | |
| 2. Differentiation of ramp function is _____. | 1 | 1 | 1 |
| (A) Impulse | | | |
| (B) Ramp function | | | |
| (C) Step function | | | |
| (D) Exponential function | | | |
| | | | |
| 3. A Signal is said to be an energy signal only if the total energy of the signal is _____. | 1 | 1 | 1 |
| (A) Finite | | | |
| (B) Infinite | | | |
| (C) Only 0 | | | |
| (D) Only 1 | | | |
| | | | |
| 4. Find the fundamental period of the given signal $x(t) = \cos(60\pi t) - \sin(50\pi t)$ | 1 | 2 | 1 |
| (A) 1/5 sec | | | |
| (B) 1 sec | | | |
| (C) 0 Sec | | | |
| (D) 5 sec | | | |
| | | | |
| 5. Convolution of $x(t+5)$ with impulse function $\delta(t-7)$ is equal to _____. | 1 | 2 | 2 |
| (A) $x(t-12)$ | | | |
| (B) $x(t+12)$ | | | |
| (C) $x(t-2)$ | | | |
| (D) $x(t+2)$ | | | |
| | | | |
| 6. The system with impulse response $h(t) = e^{-6 t }$ is | 1 | 3 | 2 |
| (A) Non-causal, stable | | | |
| (B) Non-causal, unstable | | | |
| (C) Causal, unstable | | | |
| (D) Causal, stable | | | |
| | | | |
| 7. If two system with impulse responses are $h_1(t)$ and $h_2(t)$ connected in parallel then the overall impulse response is | 1 | 3 | 2 |
| (A) $h_1(t) * h_2(t)$ | | | |
| (B) $h_1(t) + h_2(t)$ | | | |
| (C) $h_1(t) - h_2(t)$ | | | |
| (D) $\sqrt{h_1(t) h_2(t)}$ | | | |
| | | | |
| 8. Consider a discrete time system with impulse response $h[n] = \left(\frac{1}{3}\right)^n u[n]$. The response of system to input $x[n] = (-1)^n$ for all 'n' is | 1 | 2 | 2 |
| (A) $\frac{1}{4}(-1)^n$ | | | |
| (B) $\frac{3}{4}(-1)^n$ | | | |
| (C) $\frac{2}{3}(-1)^n$ | | | |
| (D) $\frac{1}{3}(-1)^n$ | | | |

9. The trigonometric Fourier series of an even function of time doesn't have the 1 1 3
- (A) DC Term (B) Cosine Terms
(C) Sine Terms (D) Odd harmonic terms
10. If $x(t)$ is even, then its Fourier series coefficient must be 1 2 3
- (A) Real and Odd (B) Real and Even
(C) Imaginary and Odd (D) Imaginary and Even
11. The Fourier Transform of a real-valued time signal has 1 3 3
- (A) Odd Symmetry (B) Even Symmetry
(C) Conjugate Symmetry (D) No Symmetry
12. If $x(t)$ is odd then $x(j\omega)$ is 1 2 3
- (A) Imaginary and Odd (B) Imaginary and Even
(C) Real and Odd (D) Real and Even
13. If $\delta(t)$ denotes a unit impulse, then Laplace transform of $\frac{d^2\delta(t)}{dt^2}$ will be 1 2 4
- (A) 1 (B) S^2
(C) S (D) S^{-2}
14. The inverse Laplace transform of $X(S) = \frac{s}{s^2 + 5s + 6}$ is 1 3 4
- (A) $x(t) = -2e^{-2t}u(t) + 3e^{-3t}u(t)$ (B) $x(t) = e^{-t} \sin 2t$
(C) $x(t) = e^{-2t} \cos 5t$ (D) $x(t) = -2e^{-2t}u(t)$
15. The final value of $L^{-1}\left[\frac{2s+1}{s^4 + 8s^3 + 16s^2 + s}\right]$ is 1 3 4
- (A) 0 (B) 1
(C) 2 (D) 5
16. Find the z-transform and ROC of $x(n) = \delta(n)$ 1 2 4
- (A) 0, ROC: entire z-plane (B) 1, ROC: entire z-plane
(C) 0, ROC: doesn't exist (D) 1, ROC: doesn't exist
17. Find the Nyquist frequency and Nyquist interval of the speech signal containing frequencies upto 4 kHz 1 2 5
- (A) 8 kHz 0.125 ms (B) 4 kHz 0.125 ms
(C) 8 kHz 0.225 ms (D) 4 kHz 0.425 ms
18. Find the z-transform and ROC of the given sequence $x(n) = \{3, 2, -1, -4, \underset{\uparrow}{1}\}$ 1 2 5
- (A) $3z^4 + 2z^3 - z^2 - 4z + 1$ (B) $z^4 + 2z^3 - z^2 - 4z + 1$
(C) $3 - 2z^3 + z^4$ (D) $z^{-4} + 2z^{-3} + 3$
19. Determine the z-transform and ROC for the given signal $x(n) = a^n u(n)$ 1 2 5
- (A) $\frac{1}{1-az^{-1}}, ROC: |z| > |a|$ (B) $\frac{1}{1-az^{-1}}, ROC: |z| > \frac{1}{a}$
(C) $\frac{1}{a-z^{-1}}, ROC: |z| > \frac{1}{a}$ (D) $\frac{1}{a-z^{-1}}, ROC: |z| > |a|$

20. The Z transform of $u(n)$ is

(A) $\delta(n)$

(B) 0

(C) 1

(D) $\frac{Z}{Z-1}$

1 3 5

PART – B ($5 \times 4 = 20$ Marks)

Answer ANY FIVE Questions

Marks BL CO

21. Check whether the given signal is energy or power signal $x(t) = e^{j\left(2t + \frac{\pi}{4}\right)}$.

4 2 1

22. Find whether the following signals are periodic or not

4 2 1

(i) $\sin^2 t$

(ii) $\cos\left(\frac{1}{4}n\right)$

23. Find the convolution of $x_1(t)$ and $x_2(t)$ of the given signal

4 2 2

$x_1(t) = tu(t)$ & $x_2(t) = u(t)$.

24. Explain the conditions under which any periodic wave form can be expressed using Fourier series.

4 1 2

25. Find the Fourier transform of the given signal $x(t) = \delta(t)$.

4 2 3

26. Find the Laplace transform and ROC of the signal $x(t) = e^{-at}u(t)$.

4 3 4

27. Find the z-transform and ROC of the signal $x(t) = a^n u(n)$.

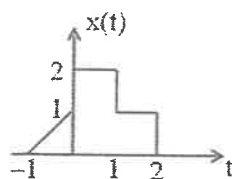
4 3 5

PART – C ($5 \times 12 = 60$ Marks)

Answer ALL Questions

Marks BL CO

28. a.



12 2 1

(i) For the above given signal $x(t)$ draw the following

I. $x(t-2)$

II. $x(2t+3)$

III. $x(-t+1)$

(ii) Check whether the given signal is energy or power signal

$x(t) = e^{j\left(2t + \frac{\pi}{4}\right)}$

(OR)

b.i. Check whether the given signal is periodic or not and also find the fundamental time period $x(t) = 2\cos(10t + 1) - \sin(4t - 1)$.

4 2 1

ii. For the given system $y(t) = x(t) \cos \omega t$, check the system is:

4 2 1

- Linear or non-linear
- Time invariant or time variant
- Static or dynamic

iii. Find $x\left[\frac{x}{2}\right]$ for the given signal $x(n) = \{1, 2, 3, 4, 5\}$.

4 2 1

29. a. Find the convolution of $x_1(t)$ and $x_2(t)$

12 3 2

$$x_1(t) = e^{-at}u(t)$$

$$x_2(t) = e^{-bt}u(t)$$

(OR)

b.i. Find whether the following system with impulse response $h(t)$ is stable or not

6 3 2

$$h(t) = \frac{1}{RC} e^{-t/RC} u(t)$$

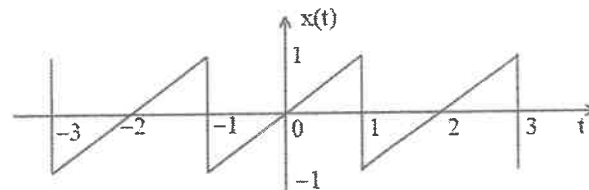
ii. Find the convolution of $x_1(t)$ and $x_2(t)$ of the given signal

6 3 2

$$x_1(t) = \sin t u(t) \text{ \& } x_2(t) = u(t)$$

30. a. Find the trigonometric Fourier series for the periodic signal $x(t)$ shown below.

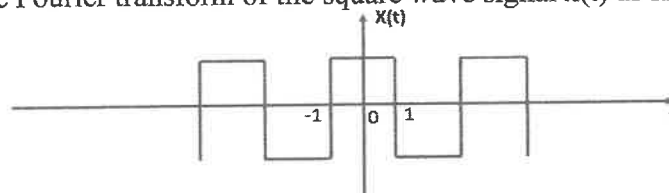
12 2 3



(OR)

b. Determine the Fourier transform of the square wave signal $x(t)$ as shown below.

12 2 3



31. a. Find the inverse Laplace transform of the given function,

12 2 4

$$X(s) = \frac{3s^2 + 8s + 6}{(s+2)(s^2 + 2s + 1)}$$

(OR)

b.i. Find the laplace transform and RoC of the function

6 2 4

$$x(t) = e^{-at}u(t) + e^{-bt}u(-t)$$

ii. Define Nyquist sampling theorem and explain analog to digital conversion process using suitable block diagram.

6 2 4

32. a. Find the inverse of z-transform of the following

12 2 5

$$X(z) = \frac{z^2}{(1-az)(z-a)} \text{ ROC : } a < |z| < \frac{1}{a}$$

(OR)

b. Using long division, determine the inverse z-transform of

12 2 5

$$X(z) = \frac{1+2z^{-1}}{1-2z^{-1}+z^{-2}} \text{ If (a) } x(n) \text{ is causal and (b) is anticausal.}$$
