CBCS SCHEME

USN | | | | | | | | | | |

18EE54

Fifth Semester B.E. Degree Examination, June/July 2025
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Prove the following:
i) Power of the energy signal is zero
ii) Energy of the power signal is Infinite
iii) Is signal shown in fig. (1.a) power or energy signal?
Hence, compute energy or power as applicable.

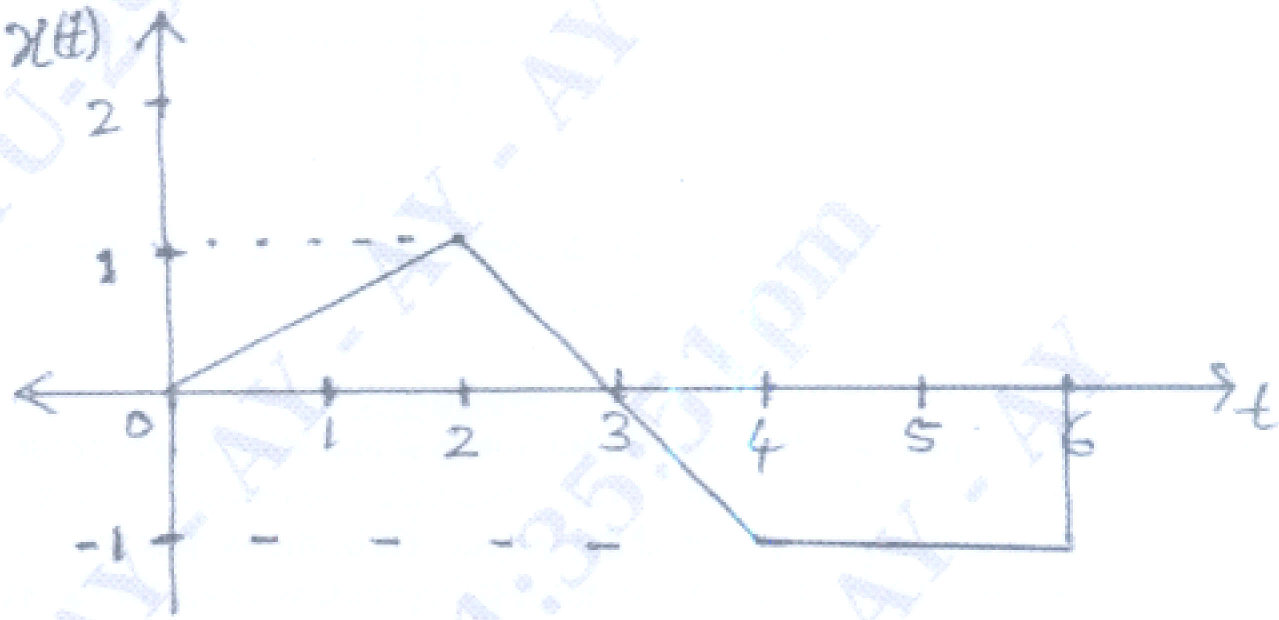

Fig. Q. 1(a) **(10 Marks)**

b. Express x(t) internals of g(t). Refer fig. (1.b)

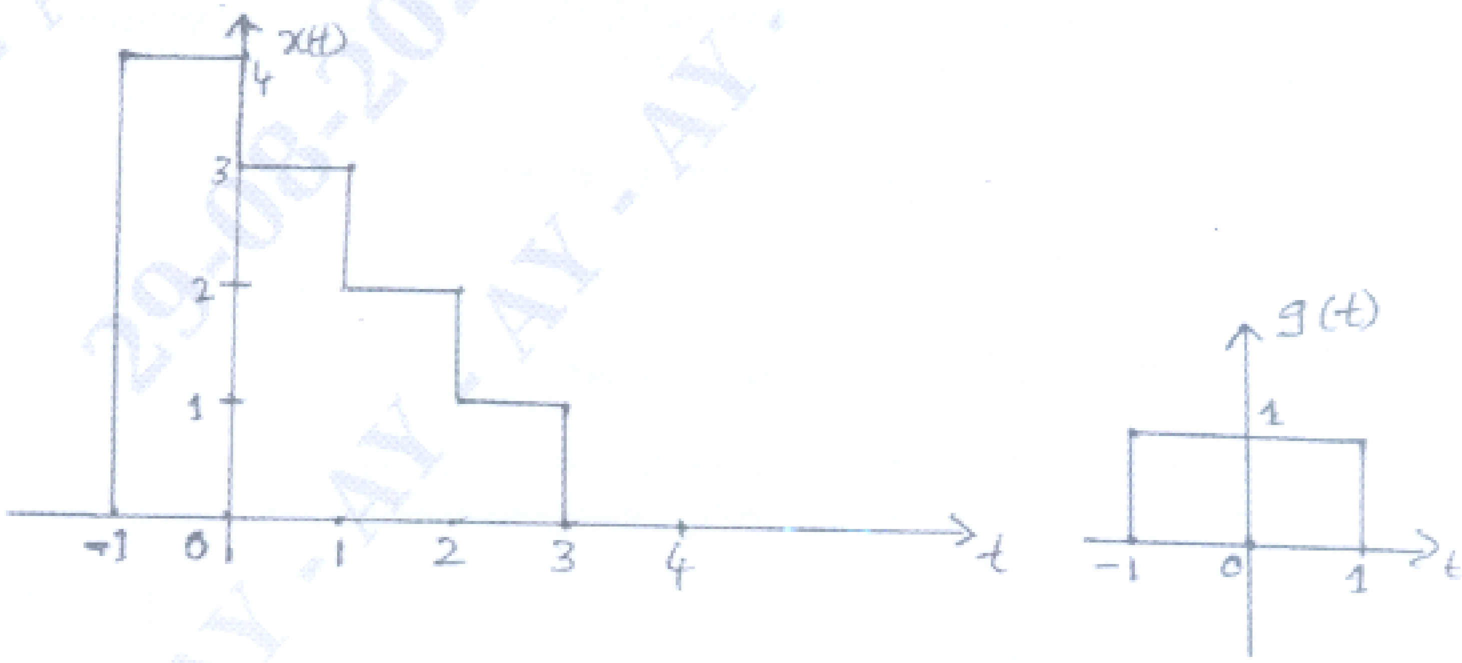

Fig. Q. 1 (b) **(05 Marks)**

c. Find whether the following signals are periodic or not. If yes, find the periodicity.

i) $x(t) = 2\cos t + 3\cos\frac{t}{3}$

ii) $x[n] = \cos\left(\frac{\pi n}{5}\right)\sin\left(\frac{\pi n}{3}\right)$ **(05 Marks)**

OR

2 a. Briefly explain the properties of the discrete time LTI system. **(06 Marks)**

b. For the signal shown in fig. 2(b), sketch the following :

i) $x(0.5t)$ ii) $x(3t + 2)$ iii) $x(-3(t - 1))$

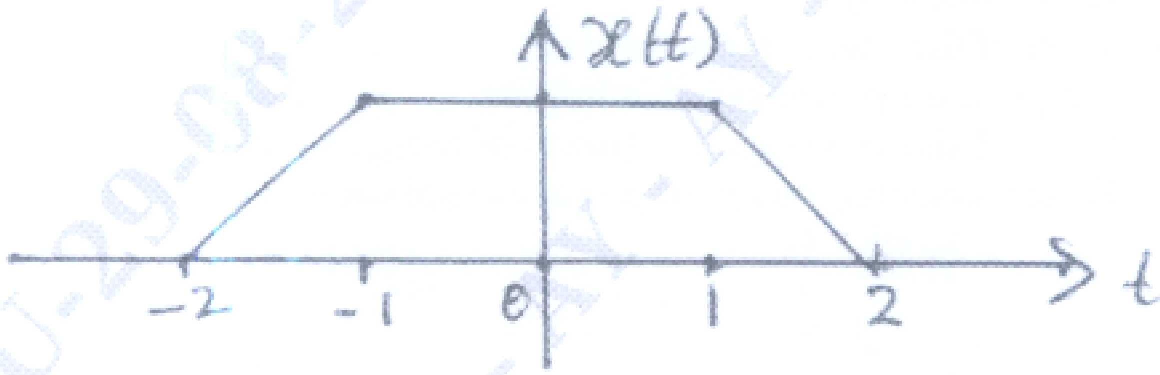

Fig. Q.2.b **(06 Marks)**

c. Sketch the following signal and determine its odd and even components.

$r(t + 2) - r(t + 1) - r(t - 2) + r(t - 3)$ **(08 Marks)**

Module-2

3 a. Derive an expression for convolution integral and state its properties. **(08 Marks)**

b. Consider a LTI system with impulse response $h(t) = e^{-t}u(t)$ and input $x(t) = e^{-3t}\{u(t) - u(t - 2)\}$. Find the output y(t) of the system. **(08 Marks)**

c. Draw the direct form I and direct form II implementations for the system.

$$\frac{d^3y(t)}{dt^2} + \frac{2dy(t)}{dt} + 3y(t) = x(t) + \frac{3dx(t)}{dt}$$ **(04 Marks)**

OR

4 a. Impulse response of LTI system is $h[n] = \{1, -\underset{\uparrow}{1}, 1, -1\}$. Determine the response of the system to the input $x(n) = \{1, \underset{\uparrow}{2}, 3, 1\}$ **(06 Marks)**

b. Find the total response of the system given by

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

With $y(0) = -1$; $\left.\frac{dy}{dt}\right|_{t=0} = 1$; $x(t) = \cos t\, u(t)$ **(08 Marks)**

c. The impulse response of a system is $h(t) = e^{2t}u(t - 1)$.

Check whether the system is stable, causal and memory less. **(06 Marks)**

Module-3

5 a. State and prove the following properties of Fourier Transform.
i) Time differentiation
ii) Convolution **(08 Marks)**

b. Find Fourier Transform of $x(t) = e^{-a|t|}$; $a > 0$
Draw its spectrum. **(06 Marks)**

c. Find the inverse Fourier Transform of the following using appropriate properties. **(06 Marks)**

OR

6 a. Find the FT of the signal $x[t] = \cos w_0 t$ and draw its spectrum. **(06 Marks)**

b. Find the frequency response and impulse response of the system described by the differential equation

$$\frac{d^2y(t)}{dt^2} + \frac{5dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$$ **(06 Marks)**

c. Find the FT of the following.
i) $x(t) = \dfrac{2}{t^2+1}$
ii) $x(t) = te^{-2t}u(t)$ **(08 Marks)**

Module-4

7 a. State and Prove the following properties of DTFT.
i) Frequency differentiation
ii) Paraseval's Therem **(08 Marks)**

b. Find DTFT of the following signal
i) $x[n] = a^{|n|}$; $|a| < 1$
ii) $x[n\} = (\left(\frac{1}{2}\right)^n \{u(n+3) - u(n-2)\}$ **(08 Marks)**

c. Obtain frequency response and impulse response of the system described by the difference equation.

$$y[n] + \frac{1}{2}y(n-1) = x[n] - 2x[n-1]$$ **(04 Marks)**

OR

8 a. State and prove the following properties of DTFT
i) Time shift
ii) Frequency shift **(08 Marks)**

b. A signal x [n] has DTFT, $x(e^{j\Omega}) = 1/1\text{-}ae^{-j\Omega}$.
Determine the DTFT of the following
i) $x_1[n] = x(2n+1)$
ii) $x_3(n) = x(-2n)$ **(06 Marks)**

c. $x(n) = \{3, 0, 1, \underset{\uparrow}{-2}, -3, 4, 1, 0, -1\}$ with DTFT $x(e^{j\Omega})$.

Evaluate the following without computing $X(e^{j\Omega})$

i) $\int_{-\pi}^{\pi} |x(e^{j\Omega})|^2 d\Omega$

ii) $\int_{-\pi}^{\pi} |\frac{dx(e^{j\Omega})}{d\Omega}|^2 d\Omega$ **(06 Marks)**

Module-5

9 a. List the properties of RoC **(06 Marks)**

b. Using appropriate properties, find the z – transform of

$x[n] = n^2\left(\frac{1}{2}\right)^n u(n-3)$ **(08 Marks)**

c. A causal system has input x(n) and output y(n). Find the impulse response h(n) of

$X(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$

$Y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$ **(06 Marks)**

OR

10 a. State and prove initial and final value theorem. **(08 Marks)**

b. Solve the following difference equation using unilateral z – transform.

$y[n] - \frac{3}{2}y[n-1] + \frac{1}{2}y(n-2) = x[n]$ for $n \geq 0$ **(06 Marks)**

With $y[-1] = 4$, $y(-2) = 10$, and $x(n) = \left(\frac{1}{4}\right)^n x[n]$

c. Find the inverse z – transform of the following :

i) $X(z) = \dfrac{1 - \frac{1}{2}z^{-1}}{1 + \frac{3}{4}z^{-1} + \frac{1}{8}z^{-2}}$

ii) $X(z) = \cos(2z)$; $|z| < \infty$ **(06 Marks)**

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