# CBCS SCHEME



USN

18EC45

## Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
## Signals and Systems

Time: 3 hrs.  Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

### Module-1

1 a. Determine even and odd components of a signals shown in Fig Q1(a)

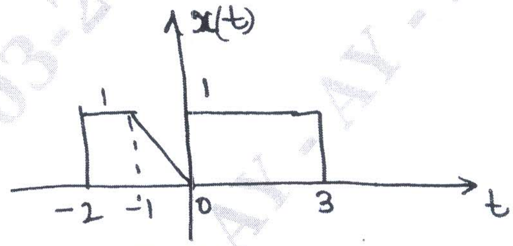


Fig Q1(a) **(06 Marks)**

b. Sketch the signals x(n), $y_1(n)$ and $y_2(n)$, where $x(n) = (n-6)[u(n) - u(n-6)]$, $y_1(n) = x(2n)$ $y_2(n) = x(2n-3)$. **(08 Marks)**

c. Determine the energy of the signals $y(t) = \frac{d}{dt}x(t)$, where $x(t) = \text{Sin } 10\pi t\,[u(t) - u(t-0.2)]$. **(06 Marks)**

**OR**

2 a. Verify the following signals are periodic or non-periodic, if periodic find the fundamental period of a signals

i) $x(t) = \cos 20\pi t \cdot \text{Sin } \sqrt{2}\,\pi t$  ii) $x(n) = \text{Cos } 100\pi n + \text{Sin } 5\pi n$. **(06 Marks)**

b. Sketch the signals $y_1(t) = x(2t-5)$ and $y_2(t) = x(2t+5)$. Where x(t) shown in Fig Q2(b)

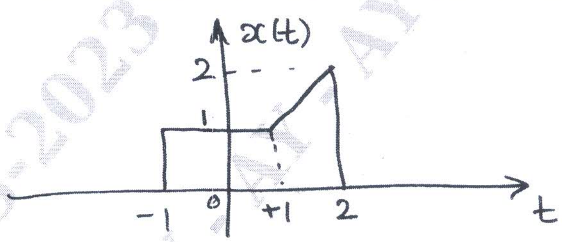


Fig Q2(b) **(08 Marks)**

c. Explain x(t) interms and elementary signals as shown in Fig Q2(c)

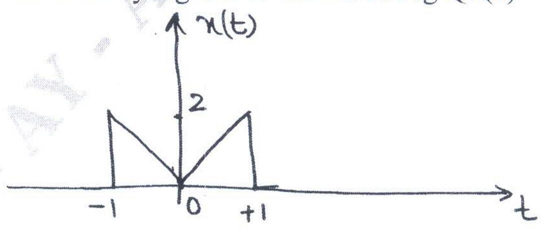


Fig Q2(c) **(06 Marks)**

## Module-2

3 a. Verify the following systems are Linear, time invariant causal stable.
i) $y(t) = tx(t)$ ii) $y(n) = x(-n)$ **(08 Marks)**

b. Determine the convolution integral of $e^{-2t}u(t) * e^{-t}u(t)$. **(06 Marks)**

c. Find response of a system whose input and impulse response given by
$x(t) = \begin{cases} 1, & 0 \le t \le 4 \\ 0 & \text{otherwise} \end{cases}$ and $y(t) = \begin{cases} 1 & -2 \le t \le 1 \\ 0 & \text{otherwise} \end{cases}$. **(06 Marks)**

**OR**

4 a. Evaluate the convolution sum of $(2)^n u(-n) * \left(\frac{1}{3}\right)^n u(n)$ **(08 Marks)**

b. Verify the following systems are linear, time invariant and stable
i) $y(n) = e^{x(n)}$ ii) $y(t) = e^{tx(t)}$ **(06 Marks)**

c. Determine the convolution sum using graphical method where
$x(n) = [\underset{\uparrow}{1}, 1, 1, 1]$ $h(n) = [\underset{\uparrow}{2}, 2, -2, -2]$ **(06 Marks)**

## Module-3

5 a. State and prove associate property and convolution integral. **(06 Marks)**

b. Verify the following LTI systems are stable, causal and memory less.
i) $h(t) = e^{-t}u(t)$ ii) $h(n) = (n-2)[u(n+1) - u(n-2)]$ **(06 Marks)**

c. Determine the Fourier series coefficient of the signal x(t) = Cos(10πt) Sin (20π(t) ; sketch magnitude and phase spectrum. **(08 Marks)**

**OR**

6 a. Determine the step response of the following signals
i) $h(n) = \left(\frac{1}{2}\right)^{|n|}$ ii) $h(t) = t[u(t) - u(t-1)]$ **(08 Marks)**

b. Determine the Fourier series coefficient of the signals x(t) = 10Cos10πt + 2 Sin 100πt, Sketch magnitude and phase spectrum. **(06 Marks)**

c. Determine the impulse response of the system given by the input and output relationship below. Also determine whether the system is stable or unstable. Assume h(n) is causal
$y(n) = x(n) + \frac{1}{2}y(n-1)$ **(06 Marks)**

## Module-4

7 a. Determine the Fourier transform of the signal
$x(t) = \begin{cases} 1, & 0 \le t \le 4 \\ 0 & \text{otherwise} \end{cases}$ Sketch magnitude and phase spectrum. **(08 Marks)**

b. State and prove Time scaling property of Fourier transform. **(05 Marks)**

c. Determine the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$. sketch magnitude and phase spectrum. **(07 Marks)**

**OR**

8 a. State and prove Parsevals property and Fourier transform. **(05 Marks)**

b. Determine the DTFT and the signal $x(n) = [\underset{\uparrow}{1}, 1, 1, 1, 1]$ sketch magnitude and phase spectrum. **(08 Marks)**

c. Determine the Fourier transform of the signal $x(t) = e^{-|t|}$. Sketch magnitude and phase spectrum. **(07 Marks)**

## Module-5

9 a. Determine the z-transform of the signal $x(n) = -2^n u(-n-1) + \left(\frac{1}{3}\right)^n u(n)$. also sketch RoC. **(08 Marks)**

b. Find the inverse z-transform of $X(z) = \frac{1}{z^2 - 5z + 6}$ for all possible RoC. **(08 Marks)**

c. State any four properties of RoC. **(04 Marks)**

**OR**

10 a. Determine the impulse response of the system given below

$y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n) - 2x(n-1)$. Determine h(n) for the following condition

i) Stable ii) Causal. **(12 Marks)**

b. Determine inverse z-transform using long division method or power series.

$X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}}$ $(z) > \frac{1}{2}$ ii) $X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}}$ $(z) < \frac{1}{2}$. **(08 Marks)**

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