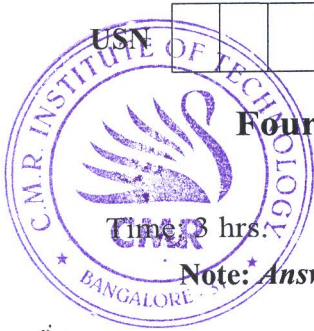


CBCS SCHEME

18EC45



USN

--	--	--	--	--	--	--	--

Fourth Semester B.E. Degree Examination, June/July 2023 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. Define signals and systems, briefly explain the classifications of signals. (08 Marks)
- b. Determine whether the discrete time signal $x(n) = \cos\left(\frac{\pi n}{5}\right) \sin\left(\frac{\pi n}{3}\right)$ is periodic, of periodic find the fundamental period. (06 Marks)
- c. Find and sketch the following signals and their derivatives. (06 Marks)
 - i) $x(t) = u(t) - u(t - a)$; $a > 0$
 - ii) $y(t) = t[u(t) - u(t - a)]$; $a > 0$.

OR

- 2 a. Let $x_1(t)$ and $x_2(t)$ be the two periodic signals with fundamental periods T_1 and T_2 respectively. Under what conditions the sum $x(t) = x_1(t) + x_2(t)$ is periodic and what is the fundamental period of $x(t)$, if it is periodic? (06 Marks)
- b. Calculate the average power of the signal $x(t) = A \cos(\omega_0 t + \theta)$, $-\infty < t < \infty$. Also classify whether signal is power or energy. (06 Marks)
- c. A continuous time m signal $x(t)$ is shown in Fig.Q2(c). Sketch and label each of the following : i) $x(t - 2)$ ii) $x(2t)$ iii) $x(t/2)$ iv) $x(-t)$.

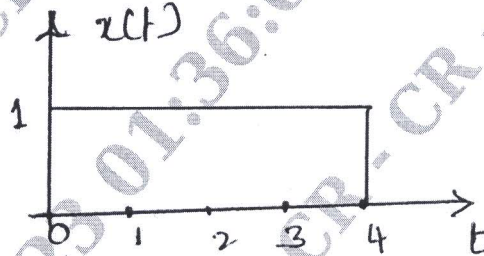


Fig.Q2(c)

(08 Marks)

Module-2

- 3 a. For a system describe by $T\{x(n)\} = ax + b$, check for the following properties :
i) Stability ii) Causality iii) Linearity iv) Time - Invariance. (06 Marks)
- b. Given : $x(t) = u(t) - u(t - 3)$, and $h(t) = u(t) - u(t - 2)$ evaluate and sketch $y(t) = x(t) * h(t)$. (10 Marks)
- c. Find the convolution sum of $x(n)$ and $h(n)$ where $x(n) = [0, 1, 2, 3]$ and $h(n) = [1, 2, 1]$. (04 Marks)

OR

- 4 a. Find the integral convolution of the following two continuous time signals $h(t) = e^{-2t}u(t)$ and $x(t) = u(t + 2)$. Also sketch the output. (08 Marks)
- b. Find the convolution sum of the following signals, where $x(n) = u(n)$ and $h(n) = (1/2)^n u(n)$. (06 Marks)
- c. State and prove the following properties of convolution sum :
i) Commutative ii) Associative iii) Distributive. (06 Marks)

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-3

- 5 a. Find the overall impulse response of the system shown in the Fig.Q5(a).

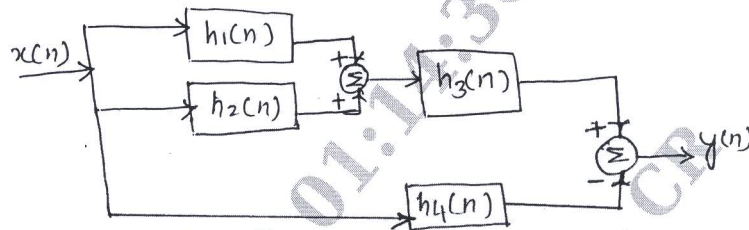


Fig.Q5(a)

Where $h_1(n) = u(n)$, $h_2(n) = u(n+2) - u(n)$
 $h_3(n) = \delta(n-2)$ and $h_4(n) = a^n u(n)$.

(04 Marks)

- b. Check for memory, causal and stability of the following systems :

$h(n) = (0.5)^n u(n)$ ii) $h(n) = 3^n u(n+2)$ iii) $h(t) = e^{-t} u(t)$.

(09 Marks)

- c. Find the Fourier series coefficient $x(k)$ for $x(t)$ shown in the Fig.Q5(c).

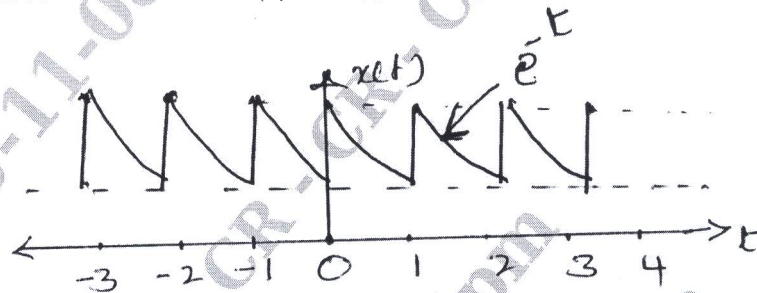


Fig.Q5(c)

(07 Marks)

OR

- 6 a. Find the step response of a system whose impulse response is given by $h(n) = (1/2)^n u(n-3)$. (08 Marks)

- b. Find the complex Fourier coefficients for $x(t)$ given below :

$$x(t) = \cos\left(\frac{2\pi t}{3}\right) + 2 \cos\left(\frac{5\pi t}{3}\right).$$

(06 Marks)

- c. Find the step response of the system whose impulse response is given by $h(t) = e^{-3t} u(t)$. (06 Marks)

(06 Marks)

Module-4

- 7 a. Find the DTFT of a signal $x(n) = a^n u(n)$. Also find the magnitude and phase angle. (08 Marks)
 b. Find the Fourier transform of a rectangular pulse described below :

$$x(t) = \begin{cases} 1, & |t| < a \\ 0, & |t| > a \end{cases}$$

Also find magnitude and phase spectrum.

CMRIT LIBRARY
 BANGALORE - 560 037

(12 Marks)

OR

- 8 a. Find the Fourier transform of a signal $x(t) = e^{-at} u(t)$. Also calculate its magnitude and phase angle. (06 Marks)

- b. State and prove the following properties of DTFT

i) Linearity ii) Time - shift iii) Frequency differentiation. (09 Marks)

- c. Using the properties of Fourier transforms find the Fourier transform of the signal :

$$x(t) = \sin(\pi t) e^{-2t} u(t).$$

(05 Marks)

Module-5

- 9 a. Find the z – transform of a signal $x(n) = 3^n u(n)$. Also plot RoC with poles and zeros. (08 Marks)
- b. Give the significance of the properties of RoC. (06 Marks)
- c. Using the properties of Z – transform find the Z – transform of the signal $x(n) = n a^{n-1} u(n)$. (06 Marks)

OR

- 10 a. State and prove the following properties of Z – transform
- Linearity
 - Time – shift
 - Time – reversal.
- (06 Marks)
- b. Find the inverse Z – transform of $x(z)$ using partial fraction expansion approach,
 $x(z) = \frac{z+1}{3z^2 - 4z + 1}$; RoC $|z| > 1$. (06 Marks)
- c. Using power series expansion technique find the inverse Z – transform of the following $x(z)$:

i) $x(z) = \frac{z}{2z^2 - 3z + 1}$; RoC $|z| < \frac{1}{2}$

ii) $x(z) = \frac{z}{2z^2 - 3z + 1}$; RoC $|z| > 1$.

CMRIT LIBRARY
BANGALORE - 560 037

(08 Marks)
