CBCS SCHEME

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18EC45

# 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.
i) $x(t) = u(t) - u(t-a)$ ; $a > 0$
ii) $y(t) = t[u(t) - u(t-a)]$ ; $a > 0$. **(06 Marks)**

**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) $x(-t)$.

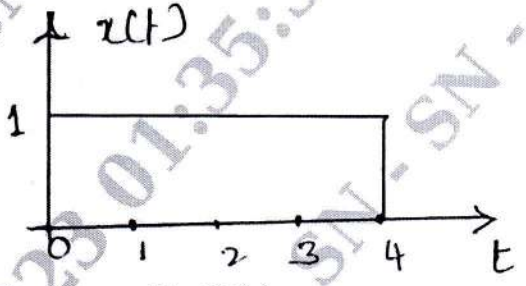


Fig.Q2(c) **(08 Marks)**

### 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 $x(n) = [\underset{\uparrow}{0}, 1, 2, 3]$ and $h(n) = [1, \underset{\uparrow}{2}, 1]$. **(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)**

## Module-3

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

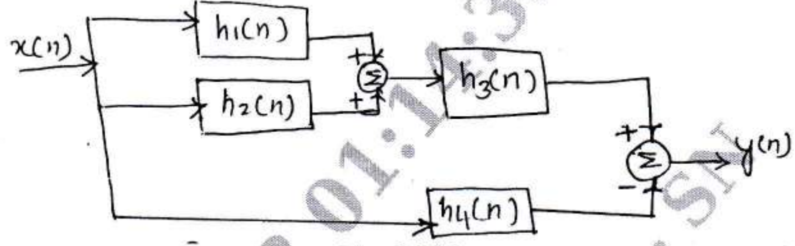


Fig.Q5(a)

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).

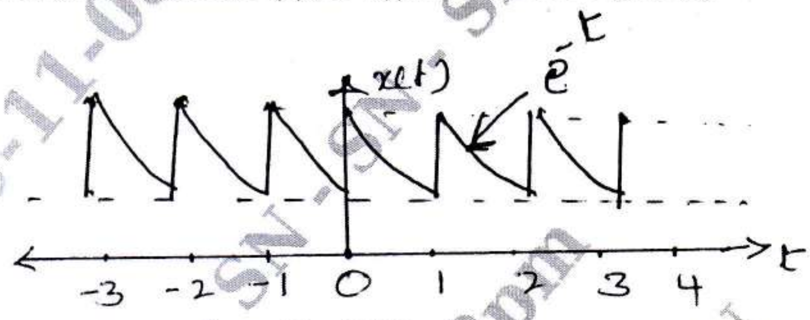


Fig.Q5(c) **(07 Marks)**

**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)**

## 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. **(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 or 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
   i) Linearity
   ii) Time – shift
   iii) Time – reversal. **(06 Marks)**

b. Find the inverse Z – transform of x(z) using partial fraction expansion approach,

$$x(z) = \frac{z+1}{3z^2 - 4z + 1};\ \text{RoC} |z| > 1.$$ **(06 Marks)**

c. Using power series expansion technique find the inverse Z – transform of the following x(z):

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

ii) $x(z) = \dfrac{z}{2z^2 - 3z + 1};\quad \text{RoC} |z| > 1.$ **(08 Marks)**

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