CBCS SCHEME

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

18EC45

# Fourth Semester B.E. Degree Examination, June/July 2024
## 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. Sketch the even and odd parts of the signal shown in Fig Q1(a)-i), ii).

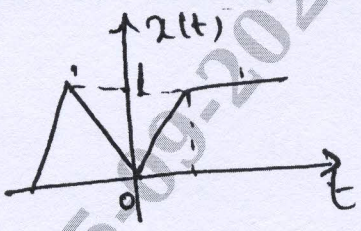


Fig Q1(a)-i)

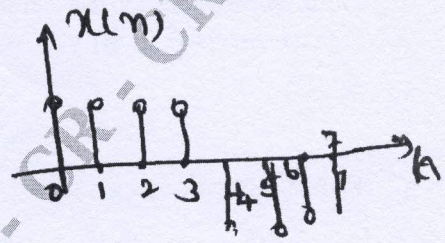


Fig Q1(a)- ii) **(08 Marks)**

b. Find the even components and odd components of the following equation
i) $x(t) = 1 + \cos t + t^2 \sin t + t^3 \sin t \cos t$ ii) $x(n) = \{-3, \underset{\uparrow}{1}, 2, -4, 2\}$ **(06 Marks)**

c. Determine whether the following signal is periodic or not if periodic find the fundamental period. i) $x(n) = \cos\frac{n\pi}{5}\sin\frac{n\pi}{3}$ ii) $x(t) = (\cos(2\pi t))^2$. **(06 Marks)**

**OR**

2 a. Explain with an example i) even and odd signal ii) energy and power signal iii) Time shifting iv) Time scaling v) Precedence rule. **(10 Marks)**

b. A continuous time signal x(t) is shown in Fig Q2(b) plot the following signal
i) $x\left(\frac{t}{2}+1\right)$ ii) $x[-2(t+1)]$ iii) $x(-2t-1)$.

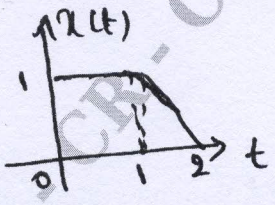


Fig Q2(b) **(06 Marks)**

c. If x(n) is as shown is Fig Q2(c) find the energy of the signal x(2n – 1)

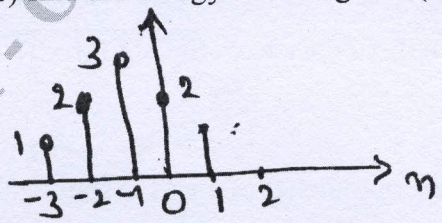


Fig Q2(c) **(04 Marks)**

## Module-2

3 a. For the signal x(t) and y(t) shown in Fig Q3(a). Sketch the following signals
i) $x(t+1)\,y(t-2)$ ii) $x(t)\cdot y(t-1)$

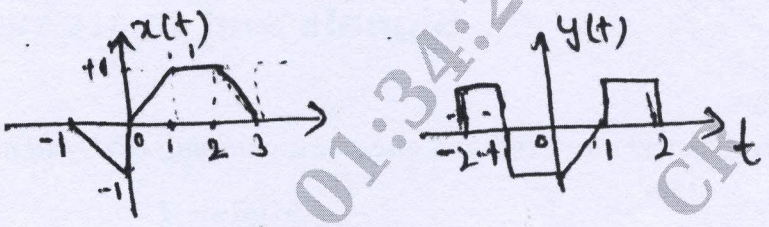


Fig Q3(a) **(10 Marks)**

b. Determine whether the following systems are memory less, causal, time invariant, stable
i) $y(n) = nx(n)$ ii) $y(t) = x(t/2)$ **(10 Marks)**

**OR**

4 a. Prove the following :

i) $x(n)*[h_1(n)*h_2(n)] = [x(n)*h_1(n)*x(n)*h_2(n)]$ ii) $x(n)*u(n) = \sum_{k=-\infty}^{\infty} x(k)$ **(08 Marks)**

b. The impulse response of the discrete LTI system is given by, $h(n) = u(n+1) - u(n-4)$. The system is excited by the input signal $x(n) = u(n) - 2u(n-2) + u(n-4)$. Obtain the response of the system $y(n) = x(n) * h(n)$ and plot the same. **(08 Marks)**

c. A system consists of several subsystems connected as shown in Fig Q4(c). Find the operator H relating x(t) to y(t) for the following sub systems operators.

$H_1 = y_1(t) = x_1(t)\,x_1(t-1)$
$H_2 : y_2(t) = |x_2(t)|$
$H_3 : y_3(t) = 1 + 2x_3(t)$
$H_4 : y_4(t) = \cos(x_4(t))$

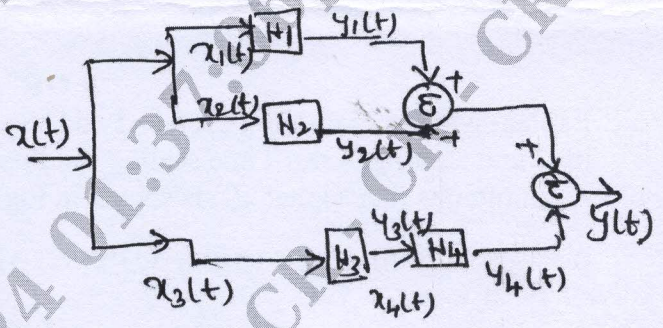


Fig Q4(c) **(04 Marks)**



## Module-3

5 a. Check whether the following systems are stable and causal
i) $h(t) = e^{-2t}u(t-1)$ ii) $h(t) = e^{-4t}u(t-10)$ iii) $h(t) = te^{-t}u(t)$ **(09 Marks)**

b. Find the step response of a LTI system if impulse response $h(t) = t^2\,u(t)$. **(04 Marks)**

c. Find the complex Fourier coefficient for $x(t) = \cos\left(\frac{2\pi}{3}t\right) + 2\cos\left(\frac{5\pi}{3}t\right)$. **(07 Marks)**

**OR**

6 a. Determine the output y(t) of a LTI system with impulse response
$h(t) = u(t+1) - 2u(t) + u(t-1)$ and input $x(t) = \begin{cases} 1 \text{ for } & |t| \le 2 \\ 0 \text{ for } & |t| > 2 \end{cases}$

Sketch the signals h(t), x(t) and y(t). **(12 Marks)**

b. Determine the FS representation for the signal x(t) of fundamental period T given by $x(t) = 3\cos\left[\frac{\pi}{2}t + \frac{\pi}{4}\right]$. Sketch the magnitude and phase of x(k). **(08 Marks)**

## Module-4

7 a. State and prove the following properties

i) $y(t) = h(t)*x(t) \xleftrightarrow{FT} y(j\omega) = x(j\omega)H(j\omega)$

ii) $\frac{d}{dt}x(t) \xleftrightarrow{FT} j\omega X(\omega)$

iii) $y(t) = x(t - t_0) \xleftrightarrow{FT} y(\omega) = e^{-j\omega t_0} X(\omega)$ **(10 Marks)**

b. Find DTFT of the following signals

i) $x(n) = \{1, 2, \underset{\uparrow}{3}, 2, 1$ ii) $x(n) = (3/4)^n u(n)$ **(10 Marks)**

**OR**

8 a. Determine the Fourier transform of unit step sequence x(n) = u(n). **(04 Marks)**

b. A discrete signal is defined by $x(n) = \sin\left(\frac{\pi n}{8}\right)$ sketch the magnitude and phase of DTFT of x(n – 2). **(08 Marks)**

c. Define Nyquist rate (aliasing), and specific the Nyuist rate and Nyquist intervals for the following signals :

i) $g_1(t) = \text{sinc}(200t)$ ii) $g_2(t) = \text{sinc}^2(200t)$ iii) $g_3(t) = \text{sinc } 200t + \text{sinc}^2(200t)$ **(08 Marks)**

## Module-5

9 a. List the properties of ROC. **(04 Marks)**

b. Using the properties of a transform, find the z-transform of these signals.

i) $x_1(n) = n(5/8)^n u(n)$ ii) $x_2(n) = (0.9)^n u(n) * (0.6)^n u(n)$ iii) $x_3(n) = (2/3)^n u(n + 2)$. **(06 Marks)**

c. Determine the Z-transform of the following signals

i) $x(n) = \left(\frac{1}{4}\right)^n u(n) - (1/2)^n(-n-1)$

ii) $x(n) = n(1/2)^n u(n)$ **(10 Marks)**



**OR**

10 a. What is Z-transform? Determine Z-transform and its ROC of the following signals

i) x(n) = u(n) ii) x(n) = cos (w n) u(n) **(08 Marks)**

b. Determine inverse Z-transform of the following signal

$x(z) = \frac{1}{1 - \frac{3}{2}z^{-1} - 1 + \frac{1}{2}z^{-2}}$ for i) $|z| > 1$ ii) $|z| < \frac{1}{2}$ iii) $\frac{1}{2} < |z| < 1$ **(08 Marks)**

c. Step response of a LTI system is found to be $y(n) = 2(1/3)^n u(n)$. Find out impulse of the system. **(04 Marks)**

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