CBCS SCHEME

USN

17EE54

Fifth 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. For the continuous time signal x(t) shown in Fig.Q1(a), draw $y(t) = x(-2t-1)$.

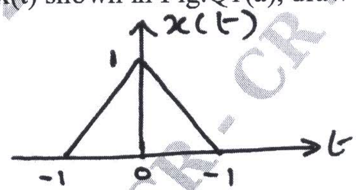

Fig.Q1(a) **(05 Marks)**

b. A discrete-time signal x(n) is shown in Fig.Q1(b), sketch the signal $y(n) = x(n)u(2-n)$.

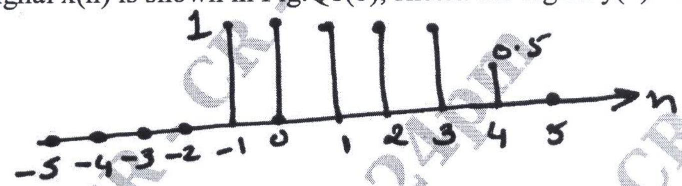

Fig.Q1(b) **(05 Marks)**

c. Sketch the even and odd component of the signal shown in Fig.Q1(c).

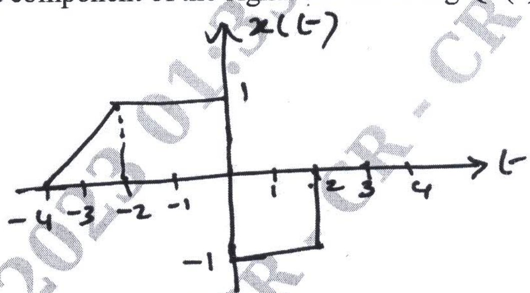

Fig.Q1(c) **(10 Marks)**

OR

2 a. Determine whether the given discrete-time signal is periodic or not. If periodic, find its fundamental period $x(n) = (-1)^n$. **(05 Marks)**

b. Find the average power of the triangular wave shown in Fig.Q2(b).

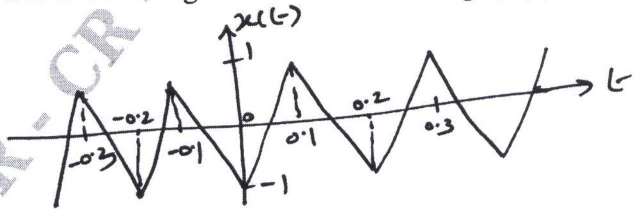

Fig.Q2(b) **(05 Marks)**

c. For the following discrete-time system, determine whether the system is :
(i) Linear (ii) Time-invariant (iii) Memoryless (iv) Causal (v) Stable **(10 Marks)**

Module-2

3 a. Consider a continuous-time LTI system with unit impulse response $h(t) = u(t)$ and input $x(t) = e^{-at}u(t);\ a > 0$. Find the output y(t) of the system. **(10 Marks)**

b. Find the natural response of the system described by difference equation $y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + x(n-1)$ with $y(-1) = 0$ and $y(-2) = 1$. **(10 Marks)**

OR

4 a. The output and the input of an LTI system is related by $y(n) = 0.8x(n+1) + 0.8x(n) - 0.4x(n-1)$

(i) Find the impulse response of the system
(ii) Is the system memoryless?
(iii) Is the system causal?
(iv) Is the system stable?
(v) Find the output if $x(n) = u(n+1) - u(n-3)$. **(12 Marks)**

b. Draw direct form I and direct form II implementation of the system

$$\frac{d^2}{dt^2}y(t) + 5\frac{d}{dt}y(t) + 4y(t) = \frac{d}{dt}x(t)$$ **(08 Marks)**

Module-3

5 a. Find the frequency response of a continuous-time LTI system represented by the impulse response $h(t) = e^{-|t|}$. **(06 Marks)**

b. Evaluate the Fourier transform for the signal, $x(t) = e^{-3t}u(t-1)$, find the expression for magnitude and phase spectra. **(08 Marks)**

c. What are the properties of CTFT? Briefly explain. **(06 Marks)**

OR

6 a. Find the frequency response and the impulse response of the system described by the differential equation $\frac{d^2}{dt^2}y(t) + 5\frac{d}{dt}y(t) + 6y(t) = -\frac{d}{dt}x(t)$. **(10 Marks)**

b. Obtain the difference equation for the system with the frequency response

$$H(e^{j\Omega}) = 1 + \frac{e^{-j\Omega}}{\left(1 + \frac{1}{2}e^{-j\Omega}\right)\left(1 + \frac{1}{4}e^{-j\Omega}\right)}$$ **(10 Marks)**

Module-4

7 a. Determine the time-domain signal corresponding to the spectra shown in Fig.Q7(a)(i) and (ii) respectively.

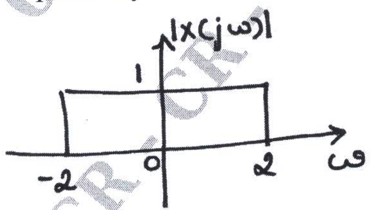

Fig.Q7(a)(i)

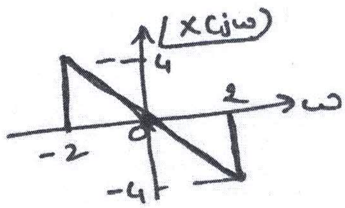

Fig.Q7(a)(ii) **(10 Marks)**

b. Compute the DTFT of the signal $x(n) = 2^n u(-n)$. **(10 Marks)**

OR

8 a. Obtain the frequency response and impulse response of the system having the output y(n) for the input x(n) as given below $x(n)=\left(\frac{1}{2}\right)^n u(n)$; $y(n)=\frac{1}{4}\left(\frac{1}{2}\right)^n u(n)+\left(\frac{1}{4}\right)^n u(n)$. **(10 Marks)**

b. Find the differential equation that represents the system with the frequency response

$$H(j\omega)=\frac{2+3j\omega-3(j\omega)^2}{1+2j\omega}$$ **(10 Marks)**

Module-5

9 a. Find the Z-transform of the sequence $x(n)=7\left(\frac{1}{3}\right)^n \cos\left[\frac{2\pi n}{6}+\frac{\pi}{4}\right]u(n)$. Plot the ROC. **(10 Marks)**

b. Find the convolution of the signals $x_1(n)=\{\underset{\uparrow}{1},-2,1\}$, $x_2(n)=u(n)-u(n-6)$. Use convolution property of Z-transform. **(10 Marks)**

OR

10 a. Find the inverse Z-transform of

$$x(z)=\frac{z^3+z^2+\frac{3}{2}z+\frac{1}{2}}{z^3+\frac{3}{2}z^2+\frac{1}{2}z};\ ROC: |z|<\frac{1}{2}$$

by partial fraction expansion method. **(10 Marks)**

b. Determine the step response of the system $(n)=\alpha y(n-1)+x(n)$; $-1<\alpha<1$ with the initial condition $y(-1)=1$. **(10 Marks)**

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