CBCS SCHEME

USN

15EC44

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Signals and Systems

Time: 3 hrs. Max. Marks : 80

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

Module-1

1 a. Find the odd part and even part of the signal given in Fig.Q1(a). **(08 Marks)**

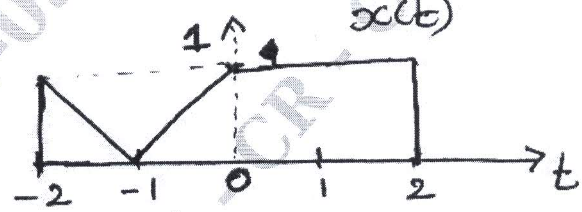

Fig.Q1(a)

b. Find $4x(-3n+4)$, if $x(n)$ is as shown in Fig.Q1(b). **(04 Marks)**

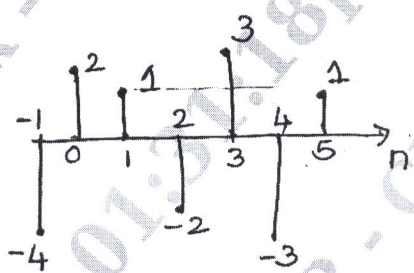

Fig.Q1(b)

c. Find whether the signal is causal, linear, time variant and static for all values of 'n'.
$y(n) = x(-3n)$. **(04 Marks)**

OR

2 a. Find whether the given signal is periodic and if periodic, determine the period :
$x(t) = a\cos(\sqrt{2}t) + b\sin\left(\frac{t}{4}\right)$. **(04 Marks)**

b. Sketch the following signal $x(t) = r(t+1) - r(t-1) + 2r(-3)$. **(05 Marks)**

c. Find $y(-t-2)\cdot x\left(\frac{t}{2}+1\right)$ if $y(t)$ and $x(t)$ are as shown in FigQ2(c). **(07 Marks)**

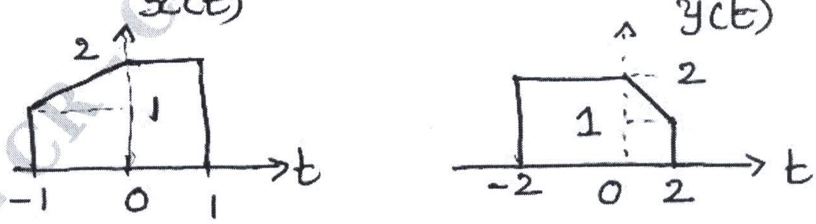

Fig.Q2(c)

Module-2

3 a. Derive the equation to determine the output of a linear time-invariant discrete-time system having impulse response h(n) and input x(n). Graphically illustrate with an example taking $x(n) = \{\underset{\uparrow}{1}, 2, 3\}$ and $h(n) = \{\underset{\uparrow}{3}, 2, 1\}$. **(08 Marks)**

b. A continuous-time LTI system has impulse response $h(t) = e^{-2t}\,u(t)$. Compute the output of the system for input signal $x(t) = u(t) - u(t-5)$. **(08 Marks)**

OR

4 a. Prove that output of a linear time-invariant continuous-time system can be determined by computing the convolution integral of input signal and impulse response. Illustrate with an example taking $x(t) = u(t)$ and $h(t) = u(t)$. **(08 Marks)**

b. A discrete-time LTI system has impulse response $h(n) = 0.5^n u(n)$. Determine the output of the system for the input $x(n) = u(n) - u(n-10)$. **(08 Marks)**

Module-3

5 a. Define the following properties of DTFS :
i) Convolution ii) Periodicity iii) Linearity **(06 Marks)**

b. Find the complex exponential Fourier series for the periodic rectangular pulse train shown in Fig.Q5(b). **(10 Marks)**

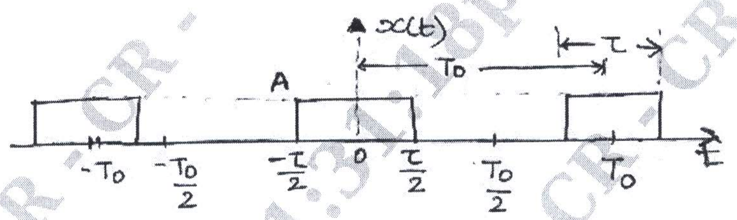

Fig.Q5(b)

OR

6 a. Find the DTFS coefficients of the signal shown in Fig.Q6(a). **(10 Marks)**

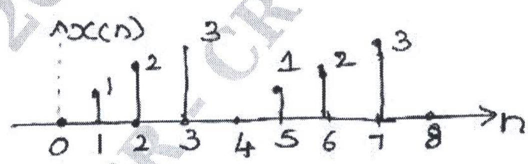

Fig.Q6(a)

b. Find an expression for impulse response of interconnection of LTI systems shown in Fig. Q6(b). **(06 Marks)**

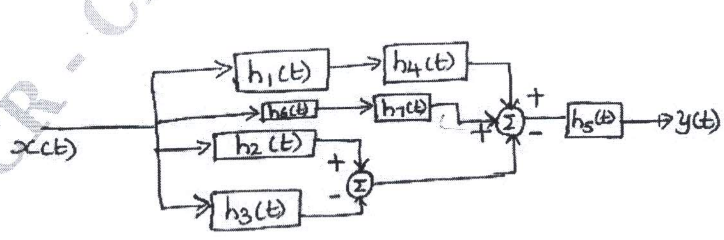

Fig.Q6(b)

Module-4

7 a. Obtain the Fourier transform of the signal $x(t) = e^{-at} u(t)$. Plot its magnitude and phase spectra, taking a = 1. **(08 Marks)**

b. State and prove the time-shift property of DTFT. **(04 Marks)**

c. Obtain the Fourier Transform of a rectangular pulse given by

$$x(t) = \begin{cases} 1, & -T < t < +T \\ 0, & \text{otherwise} \end{cases}$$

(04 Marks)

OR

8 a. Find the DTFT of $x(n) = -a^n u(-n-1)$, where 'a' is real. **(06 Marks)**

b. Find the DTFT of $x(n) = (1/2)^n u(n-4)$ using the properties of DTFT. **(06 Marks)**

c. State and prove frequency shift property of continuous time Fourier Transform. **(04 Marks)**

Module-5

9 a. Explain properties of ROC with example. **(06 Marks)**

b. Determine the z-transform of the following signals

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

ii) $x(n) = n\left(\frac{1}{2}\right)^n u(n)$ **(10 Marks)**

OR

10 a. Find the time domain signals corresponding to the following z-transforms.

$$x(z) = \frac{\left(\frac{1}{4}\right)z^{-1}}{\left(1-\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{4}z^{-1}\right)} \text{ with ROC } \frac{1}{4} < |z| < \frac{1}{2}.$$

(06 Marks)

b. Determine the transfer function and the impulse response for the causal LTI system described by the difference equation :

$$y(n) - \frac{1}{4}y(n-1) - \frac{3}{8}y(n-2) = -x(n) + 2x(n-1)$$

(10 Marks)

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