CBCS SCHEME

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

15EC44

Fourth Semester B.E. Degree Examination, Jan./Feb. 2023
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. Explain the classification signal with examples. **(08 Marks)**

b. Sketch even and odd part of the signal shown in Fig. Q1 (b).

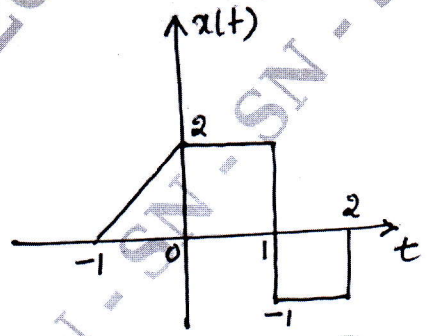

Fig. Q1 (b) **(04 Marks)**

c. Determine whether the following signals are periodic or non-periodic. If periodic find the fundamental period.

(i) $x(t) = 10\cos\sqrt{2}t$.

(ii) $x(n) = (-1)^{n^2}$ **(04 Marks)**

OR

2 a. Explain the operations on signals with example. **(06 Marks)**

b. Let x(t) and y(t) are continuous time signal given in Fig.Q2 (b), draw the following signals :

(i) $x(t)y(t-1)$

(ii) $x(t)y(-t-1)$

(iii) $x(t-1)y(-t)$

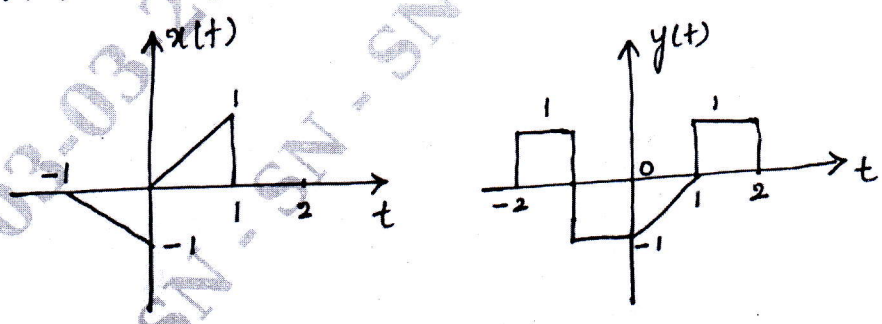

Fig. Q2 (b) **(06 Marks)**

c. Check whether following system $y(t) = x(t^2)$:

(i) Linear or non-linear

(ii) Causal or non-causal

(iii) Time invariant or time variant.

(iv) Static or dynamic **(04 Marks)**

Module-2

3 a. Derive an expression for convolution sum. **(04 Marks)**

b. A LTI system has the impulse response given by $h(n) = u(n) - u(n-3)$. Determine the output of the given system input $x(n) = 2 - n$, $0 \le n \le 3$. Using convolution sum. Show the details of your computation. Sketch all the sequence. **(07 Marks)**

c. 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. **(05 Marks)**

OR

4 a. Consider a LTI system with input $x[n] = 2^n x(-n)$ and unit impulse response $h(n) = u(n)$. Compute convolution sum and plot $y(n)$. **(07 Marks)**

b. Prove convolution properties. **(09 Marks)**

Module-3

5 a. Consider the interconnection of four LTI systems as depicted in Fig. Q5 (a). The impulse response of the systems are $h_1(n) = u(n)$, $h_2(n) = u(n+2) - u(n)$, $h_3(n) = \delta(n-2)$ and $h_4(n) = \alpha^n u(n)$. Find the impulse response $h(n)$ of the overall system.

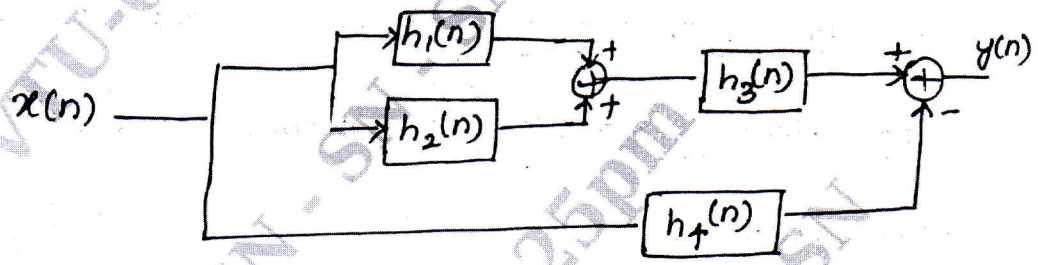

Fig. Q5 (a) **(07 Marks)**

b. For each of the following impulse responses determine whether the corresponding system is memory less, causal and stable. Justify your answers.

(i) $h(t) = u(t+1) - u(t-1)$

(ii) $h(t) = e^{-2(t)}$

(iii) $h(n) = \left(\frac{1}{2}\right)^n u(n)$ **(09 Marks)**

OR

6 a. Define the following properties of DTFS :

(i) Linearity (ii) Time shift (iii) Time scaling (iv) Convolution **(04 Marks)**

b. Evaluate the DTFS representation for the signal x(n) shown in Fig.Q6 (b) and sketch the magnitude and phase spectra.

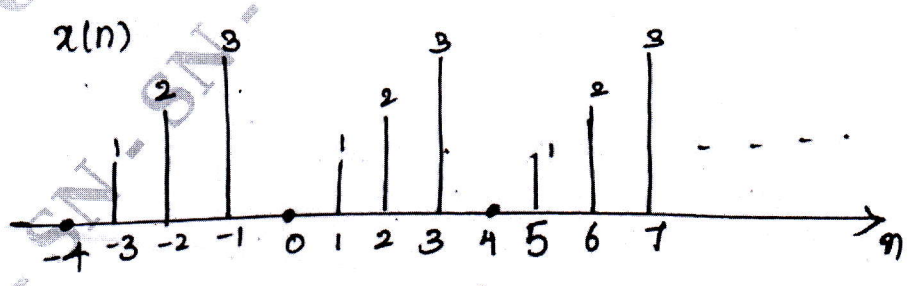

Fig. Q6 (b) **(12 Marks)**

Module-4

7 a. Find the FT of the Rectangular pulse. **(04 Marks)**

b. State and prove the time scaling property and Frequency shift property. **(08 Marks)**

c. Find the Fourier transtransform of $x(t) = e^{-0.5t}u(t)$ **(04 Marks)**

OR

8 a. State and prove (i) Time shift property (ii) Differentiation property **(07 Marks)**

b. Find DTFT of signal x(n) given by $x(n) = u(n) - u(n-N)$ where N is any integer. Determine magnitude and phase component. **(09 Marks)**

Module-5

9 a. Explain the properties of the ROC. **(08 Marks)**

b. Find the z-transform of the following signal using properties:

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

(ii) $x(n) = \left(\frac{1}{2}\right)^n u(n) - \left(\frac{1}{3}\right)^n u(-n-1)$ **(08 Marks)**

OR

10 a. Find the inverse z-transform of following x(z) :

(i) $x(z) = \frac{z(z^2 - 4z + 5)}{(z-3)(z-1)(z-2)}$ with ROC : $|z| > 3$, $|z| < 1$ using partial fraction method.

(ii) $x(z) = \frac{z}{z-\alpha}$ with ROC : $|z| > |\alpha|$, $|z| < |\alpha|$ using power series method. **(10 Marks)**

b. A LTI discrete time system is given by the system $H(z) = \frac{3 - 4z^{-1}}{1 - 3.5z^{-1} + 1.5z^{-2}}$. Specify the ROC of H(z) and determine impulse response h(n) for the following conditions :

(i) The system is stable.

(ii) The system is causal. **(06 Marks)**

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