CBCS SCHEME

USN

15EE54

Fifth Semester B.E. Degree Examination, July/August 2022
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 signals and systems with the help of examples. **(04 Marks)**

b. For the trapezoidal pulse x(t) shown in Fig.Q1(b), find the total energy.

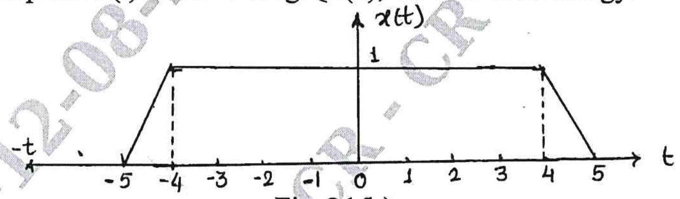

Fig.Q1(b) **(06 Marks)**

c. Obtain the even and odd arts of the discrete signal x(n) shown in Fig.Q1(c).

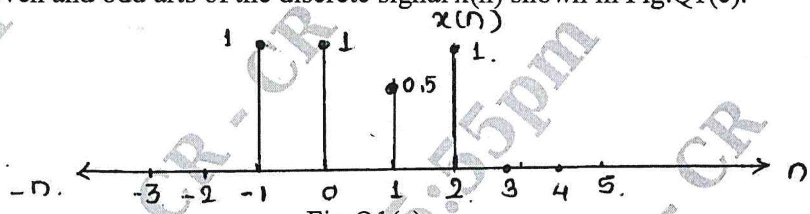

Fig.Q1(c) **(06 Marks)**

OR

2 a. Explain the classification of the signal. **(04 Marks)**

b. For the following system, determine whether the system is linear, time-invariant, memoryless, causal or stable.

(i) $y(t) = x(t/2)$ (ii) $y(n) = 2\,x(n)\,.\,u(n)$ **(06 Marks)**

c. Sketch the signal $x(t) = r(t+1) - r(t) + r(t-1)$, $x(t) = 2U(t+1) - 2U(t-2)$ **(06 Marks)**

Module-2

3 a. Consider a continuous time LTI system with unit impulse response h(t) = u(t) and input $x(t) = e^{-at}.u(t)$. Find the output y(t) of the system. **(06 Marks)**

b. For the impulse response given below, determine whether the corresponding system is (i) memoryless (ii) causal (iii) stable, $h(n) = 2u(n) - 2u(n-1)$ **(05 Marks)**

c. Draw the direct form I and II for the system described below:

$y(n) + 2y(n-1) + 3y(n-2) = x(n) + x(n-1) + 2x(n-2)$ **(05 Marks)**

OR

4 a. Determine the forced response for the system given by $5\frac{dy(t)}{dt} + 10y(t) = 2x(t)$ with input $x(t) = 2u(t)$. **(08 Marks)**

b. Find the convolution sum given below $y(n) = x(n) * h(n)$ where x(n) = [1, 2, 3, 4, 5] and h(n) = [1, 1, 1]. **(05 Marks)**

c. List the different properties of convolution sum or integral (impulse response representation). **(03 Marks)**

Module-3

5 a. State and prove the following properties of CTFT:
(i) Frequency shift (ii) convolution in time **(09 Marks)**

b. Obtain the Fourier transform of the signal $x(t) = e^{-at}.ut$, $x(t) = \delta(t)$. **(07 Marks)**

OR

6 a. Determine the time domain signal corresponding the following Fourier transform:

(i) $X(j\omega) = e^{-2\omega}.u(\omega)$ (ii) $X(j\omega) = \dfrac{5j\omega + 12}{(j\omega)^2 + 5j\omega + 6}$ **(09 Marks)**

b. Find the frequency response and the impulse response of the system described by the differential equation:

$$\frac{d^2y(t)}{dt^2} + 5.\frac{dy(t)}{dt} + 6y(t) = -\frac{dx(t)}{dt}$$ **(07 Marks)**

Module-4

7 a. State and prove the following properties of Discrete Time Fourier transform.
(i) Time shift property (ii) Parseval's theorem **(08 Marks)**

b. Find the DTFT for the following signals:
(i) $x(n) = a^n u(n)$ (ii) $x(n) = u(n)$ (iii) $x(n) = \delta(n + n_o)$ **(08 Marks)**

OR

8 a. Find the time domain signal corresponding to the following DTFT shown in Fig.Q8(a).

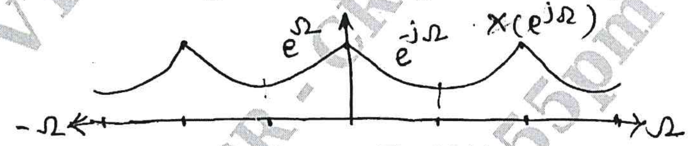

Fig.Q8(a) **(05 Marks)**

b. Obtain the frequency response of a discrete time LTI represented by the impulse response:

$$h(n) = \left(\frac{1}{2}\right)^n u(n)$$ **(04 Marks)**

c. Obtain frequency response and the impulse response of the system described by the difference equation $y(n) + \frac{1}{2}y(n-1) = x(n) - 2x(n-1)$. **(07 Marks)**

Module-5

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

b. Find the Z-transform of the following signal:

(i) $x(n) = \left(\frac{1}{3}\right)^n.u(n)$ (ii) $x(n) = \sin\left(\frac{\pi}{4}n\right).U(n)$ **(06 Marks)**

c. State and prove the following Z-transform property:
(i) Differentiation in the Z-domain (ii) Initial value theorem **(06 Marks)**

OR

10 a. A system has impulse response $h(n) = \left(\frac{1}{2}\right)^n.u(n)$. Determine the input to the system if the output is given by $y(n) = \frac{1}{3}u(n) + \frac{2}{3}\left(-\frac{1}{2}\right)^n.u(n)$ **(08 Marks)**

b. Solve the following difference equation for the given initial conditions and input $y(n) - \frac{1}{9}y(n-2) = x(n-1)$ with $y(-1) = 0$, $y(-2) = 1$ and $x(n) = 3.u(n)$. **(08 Marks)**