VIT®
Vellore Institute of Technology

Final Assessment Test – November/December 2023

Course: BECE202L - Signals and Systems
Slot: B2+TB2
Class NBR(s): 2252 / 2254 / 2256 / 2258 / 2260 / 2262
Max. Marks: 100
Time: Three Hours

KEEPING MOBILE PHONE/SMART WATCH, EVEN IN "OFF" POSITION, IS TREATED AS EXAM MALPRACTICE

General Instructions: If any of the values are missing, assume suitable value and clearly specify your assumption.

Answer ALL Questions
(10 X 10 = 100 Marks)

1. a) Two continuous time signals $x_1(t)$ and $x_2(t)$ are shown in figure 1. Perform graphical addition and multiplication between those two signals. [5]

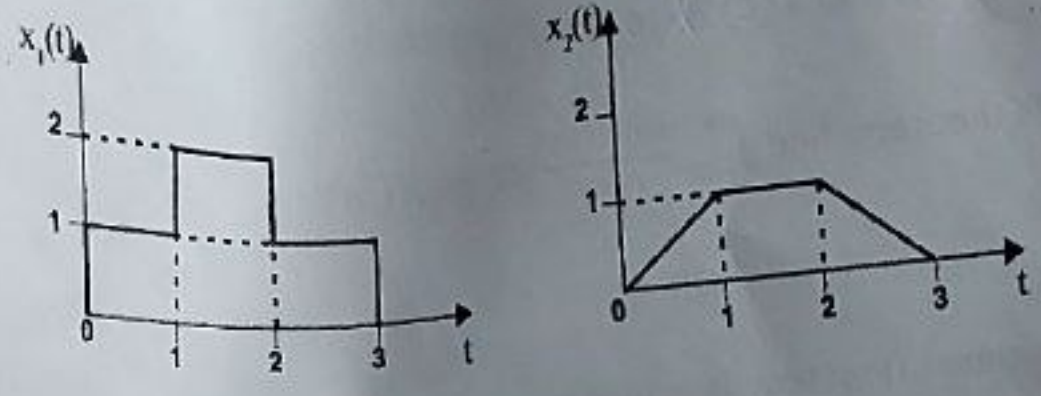

Fig.1

b) Find whether the given signal x(t) is energy signal or power signal. [5]

$$x(t) = \begin{cases} t-2, & -2 \le t \le 0 \\ 2-t, & 0 \le t \le 2 \\ 0, & otherwise \end{cases}$$

Also find the energy/power of the signal.

2. a) Find the even and odd component of the signal [5]

$$x(t) = \sin 2t + \sin 2t \cos 2t + \cos 2t.$$

b) Check whether the following system is dynamic, linear, causal, time invariant and stable. [5]

$$y[n] = \log_{10}[x(n)]$$

3. Find the response for the input $x(t) = u(t)$ given to a low pass filter whose impulse response is given as $h(t) = \frac{1}{RC} e^{-\frac{t}{RC}} u(t)$.

4. Consider a causal discrete-time LTI system whose input x[n] and output y[n] are related by the following difference equation:

$$y[n] - \frac{1}{4} y[n-1] = x[n]$$

Find the Fourier series representation of the output y[n] for the input

$$x[n] = \sin\left(\frac{3\pi}{4} n\right)$$

5. Find the Fourier transform of a signal x(t) given in figure.2 using appropriate property.

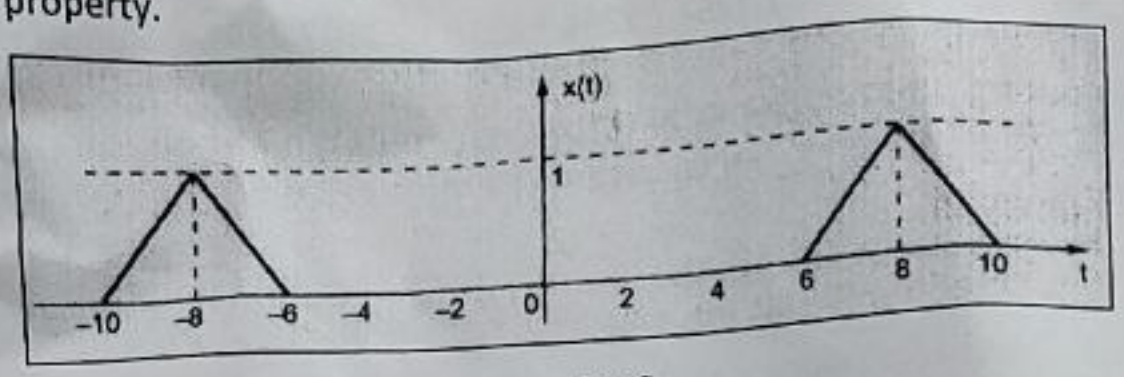

Fig.2

6.(a) Evaluate the following:

(i) Using duality property, find $x(t) \leftrightarrow e^{-2\omega}u(\omega)$.

(ii) Using Parseval's theorem, find $\int_{-\infty}^{\infty} \frac{sin^2(\pi t)}{(\pi t)^2} dt \leftrightarrow X(\omega)$.

OR

6.(b) Consider a discrete-time LTI system described by,

$$y[n] - \frac{1}{2}y[n-1] = x[n] + \frac{1}{2}x[n-1]$$

(i) Determine the frequency response $H(j\Omega)$ of the system.

(ii) Find the impulse response $h[n]$ of the system.

7. a) If $H(.)$ denotes the Hilbert transform, justify that $H[H(x(t)] = -x(t)$ through argument (do not use any mathematical formula). [4]

b) Determine the Hilbert transform of $x(t) = \sin(2\omega_0 t)$. [6]

8. a) The sequence $x[n] = \cos(\frac{\pi}{4}n)$ was obtained by sampling a continuous – time signal $x_c(t) = \cos(\Omega_0 t)$ at a sampling rate of 1000 samples/second. What are two possible values of Ω_o that could have resulted in the sequence $x[n]$? [5]

b) The continuous time signal $x_c(t) = \cos(4000\pi t)$ is sampled with a sampling period T_s to obtain a discrete-time signal $x[n] = \cos(\frac{\pi n}{3})$. [5]

(i) Determine a choice for T_s consistent with this information.

(ii) Is your choice for T_s in part (i) unique? If so explain why. If not, specify another choice of T_s consistent with the information given.

9. Determine output $y(t)$ for the system characterized by the transfer function $H(s) = \frac{s+5}{s^2+4s+3}$, when an input of $x(t) = e^{-2t}u(t)$ is applied. Also, determine the differential equation governing the input-output relation of the above LTI system.

10.(a) A Causal LTI system is described by a difference equation;

$y[n] = y[n-1] + y[n-2] + x[n-1]$

(i) Find the system function and plot poles and zeros of H (z). Also specify the ROC.

(ii) Find the impulse function of the system.

OR

10.(b) Find Inverse Z Transform to the following signal.

$X(Z) = log(1 + aZ^{-1}); |Z| > |a|$