

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

Max. Marks: 100

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

Module-1

- 1 a. Determine even and odd components of a signals shown in Fig Q1(a)

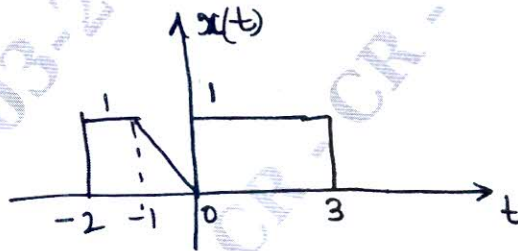


Fig Q1(a)

(06 Marks)

- b. Sketch the signals $x(n)$, $y_1(n)$ and $y_2(n)$, where $x(n) = (n - 6) [u(n) - u(n - 6)]$, $y_1(n) = x(2n)$
 $y_2(n) = x(2n - 3)$. (08 Marks)

- c. Determine the energy of the signals $y(t) = \frac{d}{dt} x(t)$, where $x(t) = \text{Sin } 10\pi t [u(t) - u(t - 0.2)]$. (06 Marks)

OR

- 2 a. Verify the following signals are periodic or non-periodic, if periodic find the fundamental period of a signals

i) $x(t) = \cos 20\pi t \cdot \text{Sin } \sqrt{2} \pi t$ ii) $x(n) = \text{Cos } 100\pi n + \text{Sin } 5\pi n$. (06 Marks)

- b. Sketch the signals $y_1(t) = x(2t - 5)$ and $y_2(t) = x(2t + 5)$. Where $x(t)$ shown in Fig Q2(b)

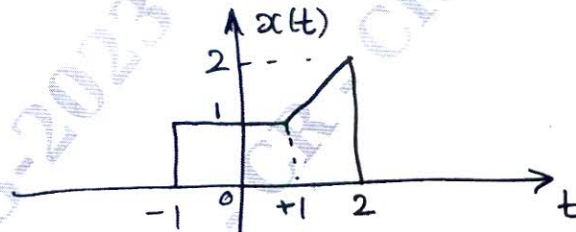


Fig Q2(b)

(08 Marks)

- c. Explain $x(t)$ interms and elementary signals as shown in Fig Q2(c)

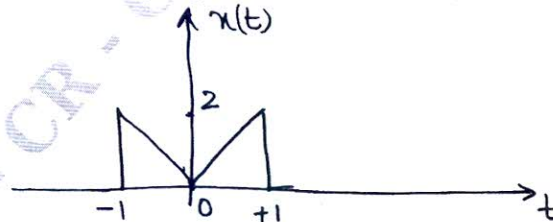


Fig Q2(c)

(06 Marks)

Module-2

- 3 a. Verify the following systems are Linear, time invariant causal stable.
 i) $y(t) = tx(t)$ ii) $y(n) = x(-n)$ (08 Marks)
 b. Determine the convolution integral of $e^{-2t}u(t) * e^{-t}u(t)$. (06 Marks)
 c. Find response of a system whose input and impulse response given by

$$x(t) = \begin{cases} 1, & 0 \leq t \leq 4 \\ 0 & \text{otherwise} \end{cases} \text{ and } y(t) = \begin{cases} 1 & -2 \leq t \leq 1 \\ 0 & \text{otherwise} \end{cases}$$
 (06 Marks)

OR

- 4 a. Evaluate the convolution sum of $(2)^n u(-n) * \left(\frac{1}{3}\right)^n u(n)$ (08 Marks)
 b. Verify the following systems are linear, time invariant and stable
 i) $y(n) = e^{x(n)}$ ii) $y(t) = e^{tx(t)}$ (06 Marks)
 c. Determine the convolution sum using graphical method where
 $x(n) = [1, 1, 1, 1]$ $h(n) = [2, 2, -2, -2]$ (06 Marks)

Module-3

- 5 a. State and prove associate property and convolution integral. (06 Marks)
 b. Verify the following LTI systems are stable, causal and memory less.
 i) $h(t) = e^{-t}u(t)$ ii) $h(n) = (n-2)[u(n+1) - u(n-2)]$ (06 Marks)
 c. Determine the Fourier series coefficient of the signal $x(t) = \cos(10\pi t) \sin(20\pi t)$; sketch magnitude and phase spectrum. (08 Marks)

OR

- 6 a. Determine the step response of the following signals
 i) $h(n) = \left(\frac{1}{2}\right)^{|n|}$ ii) $h(t) = t[u(t) - u(t-1)]$ (08 Marks)
 b. Determine the Fourier series coefficient of the signals $x(t) = 10\cos 10\pi t + 2 \sin 100\pi t$, Sketch magnitude and phase spectrum. (06 Marks)
 c. Determine the impulse response of the system given by the input and output relationship below. Also determine whether the system is stable or unstable. Assume $h(n)$ is causal

$$y(n) = x(n) + \frac{1}{2}y(n-1)$$
 (06 Marks)

Module-4

- 7 a. Determine the Fourier transform of the signal

$$x(t) = \begin{cases} 1, & 0 \leq t \leq 4 \\ 0 & \text{otherwise} \end{cases}$$
 Sketch magnitude and phase spectrum. (08 Marks)
 b. State and prove Time scaling property of Fourier transform. (05 Marks)
 c. Determine the DTFT of the signal $x(n) = \left(\frac{1}{2}\right)^n u(n)$. sketch magnitude and phase spectrum. (07 Marks)

OR

- 8 a. State and prove Parseval's property and Fourier transform. (05 Marks)
- b. Determine the DTFT and the signal $x(n) = [1, 1, 1, 1, 1]$ sketch magnitude and phase spectrum. (08 Marks)
- c. Determine the Fourier transform of the signal $x(t) = e^{-|t|}$. Sketch magnitude and phase spectrum. (07 Marks)

Module-5

- 9 a. Determine the z-transform of the signal $x(n) = -2^n u(-n-1) + \left(\frac{1}{3}\right)^n u(n)$. also sketch RoC. (08 Marks)
- b. Find the inverse z-transform of $X(z) = \frac{1}{z^2 - 5z + 6}$ for all possible RoC. (08 Marks)
- c. State any four properties of RoC. (04 Marks)

OR

- 10 a. Determine the impulse response of the system given below
 $y(n) - \frac{5}{6}y(n-1) + \frac{1}{6}y(n-2) = x(n) - 2x(n-1)$. Determine $h(n)$ for the following condition
 i) Stable ii) Causal. (12 Marks)
- b. Determine inverse z-transform using long division method or power series.
 $X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}} \quad (z) > \frac{1}{2}$ ii) $X(z) = \frac{1}{1 - \frac{1}{2}z^{-1}} \quad (z) < \frac{1}{2}$. (08 Marks)
