

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. Sketch the even and odd parts of the signal shown in Fig.Q1(a).



Fig.Q1(a)

(08 Marks)

- b. Check whether the following are energy or power signal and find corresponding value.

$$x[n] = \begin{cases} n; & 0 \leq n \leq 6 \\ 12 - n; & 6 \leq n \leq 12 \\ 0; & \text{else} \end{cases}$$

$$x(t) = \begin{cases} 5 \cos(\pi t); & -1 \leq t \leq 1 \\ 0; & \text{else} \end{cases}$$

(08 Marks)

- c. Given the signal $x[n] = (8 - n)\{u[n] - u[n - 8]\}$ determine and sketch $y[n] = x[2n - 3]$.

(04 Marks)

OR

- 2 a. A continuous time signal $x(t)$ and $g(t)$ are shown in Fig.Q2(a) express $x(t)$ in terms of $g(t)$.



Fig.Q2(a)

(06 Marks)

- b. Determine whether each of the following signals is periodic. If signal is periodic determine the fundamental period.

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

ii) $x(t) = \cos 2t + \sin 3t$.

(08 Marks)

- c. Given the signal $x(t)$ and $y(t)$ in Fig.Q2(c). Sketch $z(t) = x(2t) \cdot y(2t + 1)$.

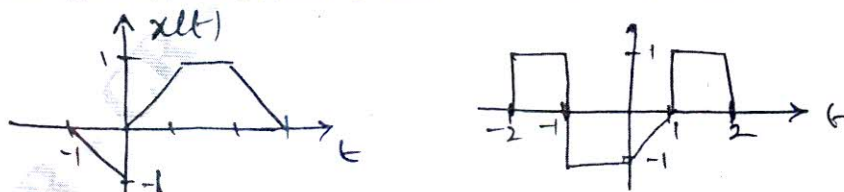


Fig.Q2(c)

(06 Marks)

Module-2

- 3 a. For the following system $y[n] = H\{x[n]\} = n x(n)$ determine whether the system is :
 i) Linear ii) Time invariant iii) Memoryless iv) Casual v) Stable. (06 Marks)
- b. Evaluate :
 $y[n] = \alpha^n u[n] * p^n u[n];$
 $\alpha < 1, |p| < 1$ (07 Marks)
- c. If $x(t) = u(t)$ and $h(t) = e^{-\alpha t} u(t); \alpha > 1$ find $y(t) = x(t) * h(t)$. (07 Marks)

OR

- 4 a. A system is shown let $x(t)$, $i(t)$ and output $y(t) = v_e(t)$. Find the input – output relationship. Determine whether the system is :
 i) Linear ii) Time invariant iii) Memoryless iv) Casual v) Stable.

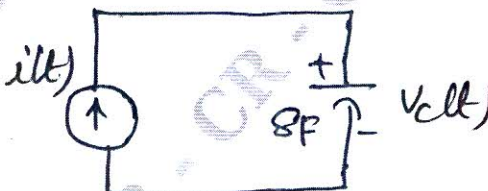


Fig.Q4(a)

- b. Consider an input $x[n]$ and unit impulse response $h[n]$ given by
 i) $x[n] = \alpha^n \mu[n] \quad 0 < \alpha < 1$
 ii) $h[n] = \mu[n]$
 Evaluate and plot the signal $y[n]$. (07 Marks)
- c. Evaluate the continuous time convolution integral $y(t) = e^{\alpha t} u(-t) * e^{-\alpha t} u(t)$. (07 Marks)

Module-3

- 5 a. Determine whether corresponding system is :
 i) Memoryless ii) Casual iii) Stable.
 i) $h[n] = 2^n u(n-1)$
 ii) $h(t) = e^{-t} u(t+50)$. (06 Marks)
- b. Evaluate the step response for the LTI system :
 i) $h[n] = \delta[n] + 2\delta[n-1]$
 ii) $h(t) = t^2 u(t)$. (06 Marks)
- c. Evaluate the DTFS coefficients for the signal $x[n] = \sin\left(\frac{4\pi}{21}n\right) + \cos\left(\frac{10\pi}{21}n\right) + 1$. Sketch magnitude and phase spectra. (08 Marks)

OR

- 6 a. Determine whether corresponding system is
 i) Memoryless ii) Casual iii) Stable
 i) $h[n] = 2\delta[n] + \sin 2\pi n$
 ii) $h(t) = e^{-t} u(-2-t)$. (06 Marks)
- b. Evaluate the step response for the LTI system :
 i) $h(t) = t u(t)$
 ii) $h[n] = \left(\frac{1}{2}\right)^n u[n]$. (06 Marks)
- c. Evaluate the FS representation for the signal
 $x(t) = \sin(2\pi t) + \cos(3\pi t)$. (08 Marks)

Module-4

- 7 a. State and prove the following properties of DTFT. (08 Marks)
 i) Time shifting
 ii) Convolution.
 b. Obtain the DTFT of a rectangular pulse which is defined as
 $x[n] = 1 ; |n| \leq m$
 $= 0 ; |n| \geq m.$ (08 Marks)
 c. Find the inverse DTFT of the following : (04 Marks)
 $x(e^{j\Omega}) = 1 + 2 \cos\Omega + 3 \cos 2\Omega.$

OR

- 8 a. Find the Fourier transform of $x(t) = e^{-at}$; $a > 0$. Draw its spectrum. (08 Marks)
 b. State and prove the following properties of FT : (08 Marks)
 i) Scaling
 ii) Parseval's theorem.
 c. Find the Fourier transform of $x(t) = 1$. (04 Marks)

Module-5

- 9 a. State and prove the properties of z-transform : (08 Marks)
 i) Time shifting
 ii) Time scaling.
 b. Determine the z-transform of $x(n)$
 $x(n) = A\rho^n \cos(\omega_0 n + \phi) u(n)$
 and sketch the ROC. (06 Marks)
 c. Find the discrete time sequence $x(n)$ which has the z-transform (06 Marks)

$$X(z) = \frac{-1 + 5z^{-1}}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}}.$$

OR

- 10 a. State and prove the following properties of z-transform (08 Marks)
 i) Time reversal
 ii) Convolution on.
 b. Determine the z-transform of (06 Marks)
 $x(n) = \alpha^{|n|}$ where $|\alpha| < 1$.
 c. Find the transfer function and impulse response if the system given by : (06 Marks)
 $y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = -x[n] + 2[x(n) - 1].$
