CBCS SCHEME

USN

17EC42

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

Time: 3 hrs. Max. Marks: 100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

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

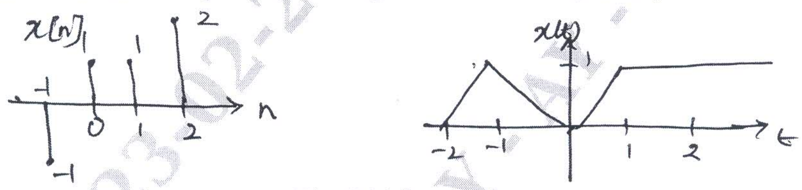

Fig.Q1(a) **(08 Marks)**

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

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

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

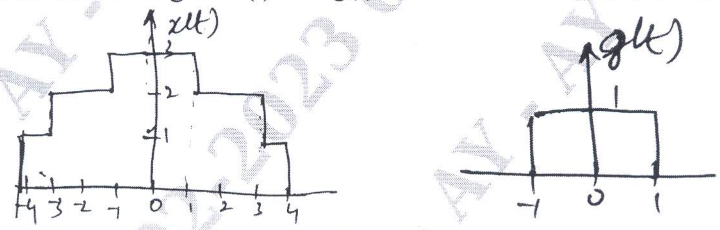

Fig.Q2(a) **(06 Marks)**

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 $z(t) = x(2t)\cdot y(2t + 1)$.

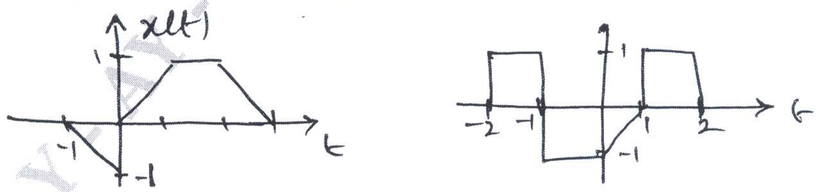

Fig.Q2(c) **(06 Marks)**

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 :

$$y[n] = \alpha^n u[n] * p^n u[n];$$
$$|\alpha| < 1, \quad |p| < 1$$
(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 $y(t) = v_c(t)$. Find the input – output relationship. Determine whether the system is :
i) Linear ii) Tine invariant iii) Memoryless iv) Casual v) Stable.

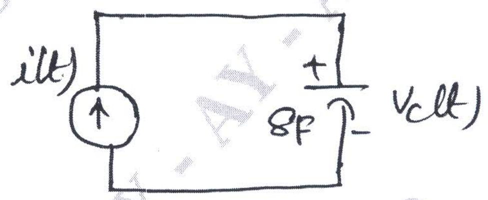

Fig.Q4(a) **(06 Marks)**

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) $h[n] = 2\delta[n] + \sin 2\pi$
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
$x[n] = 1 ; \ |n| \leq m$
$\quad = 0 ; \ |n| \geq m.$ **(08 Marks)**

c. Find the inverse DTFT of the following :
$x(e^{j\Omega}) = 1 + 2\cos\Omega + 3\cos\Omega.$ **(04 Marks)**

OR

8 a. Find the Fourier transform of $x(t) = e^{-a|t|}$; $a > 0$. Draw its spectrum. **(08 Marks)**

b. State and prove the following properties of FT :
i) Scaling
ii) Parseval's theorem. **(08 Marks)**

c. Find the Fourier transform of $x(t) = 1$. **(04 Marks)**

Module-5

9 a. State and prove the properties of z–transform :
i) Time shifting
ii) Time scaling. **(08 Marks)**

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

$$X(z) = \frac{-1 + 5z^{-1}}{1 - \frac{3}{2}z^{-1} + \frac{1}{2}z^{-2}}.$$ **(06 Marks)**

OR

10 a. State and prove the following properties of z–transform
i) Time reversal
ii) Convolution on. **(08 Marks)**

b. Determine the z–transform of
$x(n) = \alpha^{|n|}$ where $|\alpha| < 1$. **(06 Marks)**

c. Find the transfer function and impulse response if the system given by :
$y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = -\ x[n] + 2[x(n) - 1].$ **(06 Marks)**

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