CBCS SCHEME

USN | | | | | | | | | | **18EE54**

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Signals and Systems

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define Signal and System. Explain with the help of suitable examples. **(05 Marks)**

b. Determine the periodicity of following continuous time signal.
$X(t) = 4\cos(3\pi t + \pi/4) + 2\cos 4\pi t$. **(05 Marks)**

c. Sketch the even and odd party of the following signals : **(10 Marks)**

i)

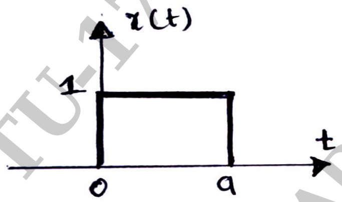

Fig. Q1(c) (i)

ii)

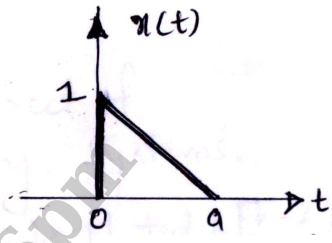

Fig. Q1(c) (ii)

OR

2 a. Explain the operation on signals for both dependent and independent variable. **(05 Marks)**

b. Determine whether following signal is energy or power signal, $x(n) = (\pi/4)^n U[n]$. **(05 Marks)**

c. State whether the following systems are linear , causal , time variant and dynamic.

i) $y(n) = x(n) + \dfrac{1}{x(n-1)}$ ii) $y(n) = x(n-1)$. **(10 Marks)**

Module-2

3 a. Consider an input x[n] and unit impulse response h[n] given by
$x[n] = \alpha^n u[n]$; $0 < \alpha < 1$.
$h[n] = u[n]$.
Evaluate and plot the o/p signal y[n]. **(10 Marks)**

b. Consider a continuous – time LTI system with unit impulse response ,
$h(t) = u(t)$ and input $x(t) = e^{-at} u(t)$; $a > 0$.
Determine the output y(t) of system. **(10 Marks)**

OR

4 a. Determine the total response of system given by

$$\frac{d^2y(t)}{dt^2} + 3.\frac{dy(t)}{dt} + 2y(t) = 2x(t) \quad \text{with } y(0) = -1, \ \left.\frac{dy(t)}{dt}\right/_{t=0} = 1 \ \& \ x(t) = \cos t\, u(t).$$

(10 Marks)

b. Sketch direct form I and direct form II implementations for following systems.

i) $y[n] + \frac{1}{2} y[n-1] - y[n-3] = 3x[n-1] + 2x[n-2]$.

ii) $\frac{dy(t)}{dt} + 5y(t) = 3x(t)$. **(10 Marks)**

Module-3

5 a. Prove the following properties of continuous time Fourier transform.
i) Linearity ii) Time shift iii) Frequency shift. **(10 Marks)**

b. Determine the Fourier transform of signals :
i) $x(t) = e^{-at} u(t)$; $a > 0$ ii) $x(t) = e^{-a|t|}$, $a > 0$.
Draw its magnitude spectrum. **(10 Marks)**

OR

6 a. Determine the Fourier transform of the following signals using time differentiation property. **(10 Marks)**

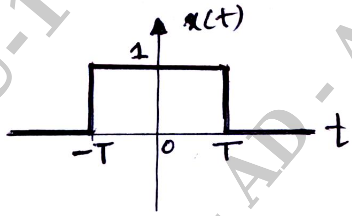

Fig. Q6(a) (i)

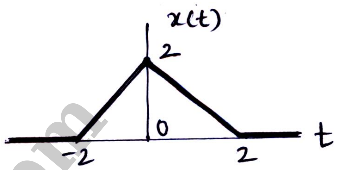

Fig. Q6(a) (ii)

b. Determine the Fourier transform of the following signals using appropriate properties :

i) $x(t) = \frac{2}{t^2+1}$ ii) $x(t) = \frac{d}{dt}[t\ e^{-2t} \sin(t)\ u(t)]$. **(10 Marks)**

Module-4

7 a. Prove the following properties of discrete time Fourier transform :
i) Scaling ii) Summation iii) Convolution. **(10 Marks)**

b. Determine the discrete time Fourier transform of following signals :
i) $x(n) = \alpha^n u(n)$; $|\alpha| < 1$ ii) $x(n) = \delta(n)$.
Draw its Magnitude spectrum of both signals. **(10 Marks)**

OR

8 a. Using appropriate properties, determine the DTFT of following signals :

i) $x(n) = (\frac{1}{2})^n\ u(n-2)$ ii) $x(n) = \sin\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n\ u(n-1)$. **(10 Marks)**

b. Determine the frequency response and the impulse response of the system having the output y(n) for the input x(n) as given below

$x(n) = (\frac{1}{2})^n\ u(n)$; $y(n) = \frac{1}{4}(\frac{1}{2})^n u(n) + \left(\frac{1}{4}\right)^n u(n)$. **(10 Marks)**

Module-5

9 a. Determine the Z transform of following signals :
i) $x(n) = \alpha^n u(n)$ ii) $x(n) = -\alpha^n u(-n-1)$. Find its ROC for both signals. **(10 Marks)**

b. Prove the following properties of Z – transform :
i) Initial value theorem ii) Final value theorem. **(10 Marks)**

OR

10 a. Determine the inverse Z transform of the following using partial fraction expansion method.

$$X(z) = \frac{1+2z^{-1}+z^{-2}}{1-\frac{3}{2}z^{-1}+\frac{1}{2}z^{-2}}$$, with ROC ; $|z| > 1$. **(10 Marks)**

b. Solve the following difference equation using unilateral Z transform :

$y(n) - \frac{3}{2}\, y(n-1) + \frac{1}{2}\, y(n-2) = x(n)$ for $n \geq 0$ with initial condition $y(-1) = 4$, $y(-2) = 10$ and $x(n) = \left(\frac{1}{4}\right)^n u(n)$. **(10 Marks)**

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