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)**
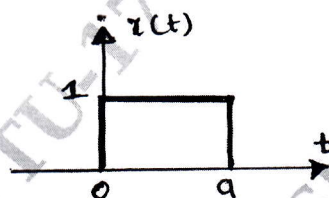
   i)

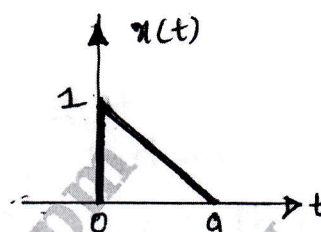   ii)

   Fig. Q1(c) (i)

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

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

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

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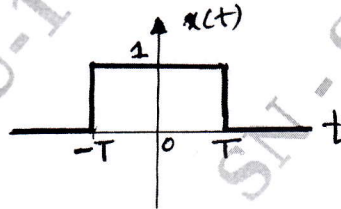

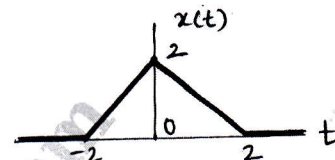Fig. Q6(a) (i)   Fig. Q6(a) (ii)

  b. Determine the Fourier transform of the following signals using appropriate properties :
   i) $x(t) = \dfrac{2}{t^2 + 1}$ ii) $x(t) = \dfrac{d}{dt}[t\, e^{-2t} \sin(t)\, u(t)]$.   **(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) $x(n) = (\tfrac{1}{2})^n u(n-2)$ ii) $x(n) = \sin\left(\dfrac{\pi}{4}n\right)\left(\dfrac{1}{4}\right)^n u(n-1)$.   **(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

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

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

* * * * *