BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – B.Tech.(RA)-2022
Course Name – Signal Processing and Implementation to Automation
Course Code - PEC-ECR501A
(Semester V)

Full Marks : 60   **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question)   1 x 15=15

1. Choose the correct alternative from the following :

(i) The discrete time function defined as u(n)=n for n≥0 and u(n)=0 for n<0 is represented as
    a) Unit sample signal
    b) Unit step signal
    c) Unit ramp signal
    d) None of the mentioned

(ii) Identify the average power for an energy signal
    a) infinite
    b) finite
    c) zero
    d) cannot be defined

(iii) Determine energy and power of the signal $x(n) = [1 + e^{(-5n)}]u(n)$
    a) $E= \infty$, P=1/2W
    b) E=1/2W , $P=\infty$
    c) E=0 , $P=\infty$
    d) cannot be defined

(iv) Identify the period of the function cos[(pi/4)(n-1)]
    a) 1/8 sec
    b) 8sec
    c) 4sec
    d) 1/4sec

(v) The function given by the equation x(n)=1, for n=0; x(n)=0, for n≠0 is represented as
    a) Step function
    b) Ramp function
    c) Triangular function
    d) Impulse function

(vi) The system y(n)= x(n) + 2x(n+3) is described as
    a) non causal
    b) causal
    c) anti-causal
    d) None of these

(vii) The system y(n)= x(-n-3) is expressed as
    a) BIBO stable
    b) stable
    c) unstable
    d) cannot be defined

(viii) The system y(n) = x(n) - 2x(n-1) is expressed as

a) linear

b) time variant

c) nonlinear

d) none of these

(ix) Identify the algorithm where the phase factors are multiplied before the add and subtract operations

a) DIT radix-2 FFT

b) DIF radix-2 FFT

c) inverse DFT

d) DIT radix-2 FFT and inverse DFT

(x) Identify why Z-transform used for signal processing

a) To convert digital signals into analog form

b) To analyze signals in the frequency domain

c) To quantize signals for transmission

d) To perform convolution operations

(xi) Identify Z transform of unit step signal

a) $1/(z-1)$

b) $z/(1-z)$

c) $z/(z-1)$

d) none of these

(xii) The width of the main-lobe in rectangular window spectrum is chosen as ,

a) $4*pi/N$

b) $16*pi/N$

c) $8*pi/N$

d) $2*pi/N$

(xiii) Choose the correct alternative that IIR stand for in the context of filter design

a) Infinite Impulse Response

b) Irregular Impulse Rejection

c) Integrated Input Resonance

d) Iterative Input Reconstruction

(xiv) Choose a type of filter that is known for its equi ripple behavior in the frequency domain

a) Butterworth

b) Chebyshev Type I

c) Chebyshev Type II

d) Elliptic

(xv) Choose the purpose of windowing in signal processing

a) To reduce the amplitude of a signal

b) To remove high-frequency components

c) To smooth the signal and reduce spectral leakage

d) To increase the sampling rate

Group-B
(Short Answer Type Questions)

3 x 5=15

2. Describe unit step and unit ramp relating to discrete time signal. (3)

3. Describe linear and non-linear system. (3)

4. Determine whether the following signal is periodic or aperiodic? If periodic signal, then calculate fundamental period. (3)

$$x(n) = \cos\left(\frac{n}{9} - \pi\right)$$

5. Explain Hamming window. (3)

6. Evaluate z-transform and ROC of the sequence. (3)

$$x(n) = \left\{-3, -2, -1, 0, \underset{\uparrow}{1}, 0, 3, -1, 2\right\}$$

OR

Evaluate z-transform and ROC of the sequence. (3)

$$x(n) = \left\{ \underset{\uparrow}{1}, 0, 3, -1, 2 \right\}$$

Group-C
(Long Answer Type Questions)

5 x 6=30

7.

Calculate the z transform and ROC of the given signal: (5)

$$x(n) = a^n u(n) + b^n u(-n-1)$$

8. Identify the transfer function and impulse response of the system described by the difference (5) equation through z-transform
y(n)-3y(n-1)-4y(n-2)=x(n) 2x(n-1).

9.

Determine whether the following signal is periodic or aperiodic? If (5) periodic signal, then calculate fundamental period.

$$x(n) = \cos\left(\frac{8\pi}{5}n - 1\right)$$

10. Determine the discrete Fourier transform of the following sequence for N=4 (5)
x(n) = { 1,1,1,1}.

11.

Explain whether or not the following system is linear or non-linear: (5)

$$y(n) = \cos[x(n)]$$

12. Write the procedure for design of low pass digital butterworth filter. (5)

OR

Write the bilinear transformation method to design IIR filter. (5)