POKHARA UNIVERSITY

Level: Bachelor	Semester: Fall	Year	2024
Programme: BE		Full Marks	100
Course: Digital Signal Analysis and Processing (New)		Pass Marks	45
		Time	3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

1. a) Define elementary signals. Discuss different types of basic elementary signals with neat figures. 7

   b) Define discrete-time system. Classify the following system in terms of memory, causality, time invariance, linearity and stability. $y[n] = 2x[3 - n^2]$ 8

OR

Verify using commutative property of convolution for the signal x[n] = {**1**,2,1,2} and h[n] = {2,2, **-1**,1}. Here bold number represents value at origin. Also sketch the given signals and output response graphically.

2. a) A causal LTI system is described by the difference equation y(n)=y(n-1)+y(n-2)+x(n)+2x(n-1) Find the system function and frequency response of the system. Plot the poles and zeros and indicate the ROC. 7

OR

Find the difference equation satisfying the input and output of an LTI system with transfer function:

$H(z) = (1+z^{-1})^2 / [(1-0.5z^{-1})(1+0.75z^{-1})]$. Also, comment on causality of given transfer function.

   b) Find the Z transform and ROC of 8

$$x(n) = 2\left(\frac{5}{6}\right)^n u(n-1) + 3\left(\frac{1}{2}\right)^{2n} u(n)$$

3. a) Obtain the direct form I & II and cascade form realization for the following system: 8

$y(n) = -0.1\, y(n-1) + 0.2\, y(n-2) + 3\, x(n) + 3.6\, x(n-1) + 0.6\, x(n-2)$

   b) Determine the lattice coefficients corresponding to the FIR system with the system function $H(z) = 1 + (7/9)z^{-1} + (3/5)\, z^{-2}$. 7

4. a) The transfer function of analog filter is $H_a(s) = \frac{2}{(s+2)(s+4)}$ with T = 0.1 sec. Design the IIR digital filter by using impulse invariance method. 7

b) Design a digital lowpass Butterworth filter to meet the following specifications using Bilinear transformation method. 8

$$|H(e^{j\omega})| = \begin{cases} 0.8, & |\omega| \leq 0.25\pi \\ 0.25, & 0.45\pi < \omega < \pi \end{cases}$$

5. a) Design a linear FIR filter using Kaiser window to meet the following specifications: 7

$$0.99 \leq |He^{jw}| \leq 1.01 \qquad 0 \leq |w| \leq 0.19\pi$$

$$|He^{jw}| \leq 0.01 \qquad 0.21\pi \leq |w| \leq \pi$$

b) Design a filter with 8

$$H_d(e^{jw}) = \begin{cases} 1 & -\frac{\pi}{6} \leq w \leq \frac{\pi}{6} \\ 0 & otherwise \end{cases}$$

Using a Hanning window with M=9

6. a) Mathematically, perform the circular convolution of the following two sequences $x_1[n] = \{1,2,3,4\}$ and $x_2[n] = \{1,3,5,7\}$ 7

b) Use the 8-point radix-2 DIT-FFT algorithm to find the DFT of the sequence $x(n)=\{0.707,1,0.707,0,-0.707, -1,-0.707,0\}$ 8

7. Write short notes on: (**Any two**) 2×5

a) LTI system & convolution summation of discrete systems.

b) Properties of Z transform

c) Frequency response of LTI system