

# 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
- $$0.99 \leq |He^{jw}| \leq 1.01 \quad 0 \leq |w| \leq 0.19\pi$$
- $$|He^{jw}| \leq 0.01 \quad 0.21\pi \leq |w| \leq \pi$$
- b) Design a filter with 8
- $$H_d(e^{jw}) = \begin{cases} 1 & -\frac{\pi}{6} \leq w \leq \frac{\pi}{6} \\ 0 & \text{otherwise} \end{cases}$$
- 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