# POKHARA UNIVERSITY

Semester: Spring

Level: Bachelor
Programme: BE
Course: Digital Signal Analysis and Processing

Year : 2024
Full Marks: 100
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) What are the advantages of digital signal processing over analog signal processing? Briefly explain the basic elements of digital signal processing with the help of block diagram. 8

   b) Obtain a linear convolution of the following two discrete-time signals: 7

   $x(n) = \sum_{k=0}^{3} \delta(n-k)$ and $h(n) = 2^n[u(n)-u(n-3)]$

2. a) Define the term causality, stability, time-invariance and linearity of discrete time system. And state their significance in case of LTI system. 7

   b) Define Z transform. Find the inverse z transform of 8

   $X(z) = \log(1 + az^{-1})$.

3. a) Find the 8-point DIFFFT of $x(n) = sin\frac{\pi}{3}n$. 8

   b) Show that the multiplication of two DFT sequences results in circular convolution. 7

4. a) Find the direct form-I and direct form-II realizations of a discrete-time system represented by the transfer function 8

   $$H(z) = \frac{3z^3-5z^2+9z-3}{[z-\left(\frac{1}{2}\right)][z^2-z+\left(\frac{1}{3}\right)]}$$

   b) How are FIR digital filters designed using different approaches? How would you use a rectangular window to design a FIR filter? Explain. 7

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

   $$0.99 \leq |H(e^{j\omega})| \leq 1.01, for 0 \leq |\omega| \leq 0.19\pi$$
   $$\leq |H(e^{j\omega})| \leq 0.01, for 0.21\pi \leq |\omega| \leq \pi$$

   b) Design a digital lowpass filter using Bilinear Transformation to satisfy the following requirements 8

- Monotonic stopband and passband
- −3dB cut off frequency at $0.6\pi$ radians, and
- Magnitude down at 15 dB at $0.75\pi$ radians

6. a) Convert the analog filter with system function 8

$$H_a(S) = \frac{S + 0.2}{(S + 0.2)^2 + 9}$$

into a digital filter by means of the bilinear transformation. The digital filter is to have a resonant frequency of $\omega_r = \pi/2$.

b) Differentiate between FIR and IIR digital filters with examples. 7

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

a) Linear convolution vs. circular convolution

b) Causal System

c) Remez Exchange Algorithm