

KATHMANDU UNIVERSITY
End Semester Examination
January/February, 2025

Level : B.E.
Year : IV
Time : 2 hrs. 30mins.

Course : COMP 407
Semester : I
F. M. : 40

25 FEB 2025

SECTION "B"

[5 Q. × 8 = 40 marks]

Attempt ANY FIVE questions. Symbols have their usual meanings. Urgent appropriate assumptions are permissible. Marks are indicated inside brackets.

1.

- a. A system known by the name "The Accumulator" has the input and output equation

$$y[n] = \sum_{m=-\infty}^n x[m]$$

Check for the linearity and time invariance of the system. [2+2]

- b. For a LTI system, find the linear convolution between two signal $x[n]$ and $h[n]$ using graphical method, [4]

where $x[n] = \{1, -2, 3, 1, 3\}$ & $h[n] = 2u[n+1] - u[n-2] - u[n-3]$

2.

- a. Explain the time reversal and time shifting operations performed on independent variables with neat figures. [2]
- b. Find the Fourier transform of $x[n] = 0.8^n u[n]$. [3]
- c. Consider samples of the analog signal $x_a(t) = 2\sin 2800\pi t - 5\sin 3500\pi t$ is sampled at 1500 Hz and each input sample is quantized into 2048 different voltage levels. [2+1]
- i. What are the different frequencies in the resulting discrete-time signals $x[n]$?
- ii. Find the period of $x[n]$ and resolution, Δ .

3.

- a. Using partial fraction expansion method, find the inverse z-transform of $X(z)$, if the signal represented by $X(z)$ is a causal signal. [3]

$$X(z) = \frac{1}{\left(1 - \frac{2}{3}z^{-1}\right)\left(1 - \frac{3}{4}z^{-1}\right)}$$

- b. Find the lattice ladder structure of the following system. Is this system stable? [3]

$$H(z) = \frac{1 + z^{-1} + 2z^{-2}}{1 - 0.92z^{-1} - 0.65z^{-2}}$$

- c. Draw the direct form II structure of the following system described by LCCD equation. [2]

$$y[n] = -0.6y[n-2] + 0.4y[n-2] - 0.1y[n-3] + 2x[n] + 3x[n-2]$$

P.T.O.

25 FEB 2025

4.

- a. The transfer function of analog filter is given below. Design the IIR filter by using Impulse invariance method. [4]

$$H_a(s) = \frac{3}{(s+2)(s+3)}, \text{ with } T = 0.01 \text{ sec.}$$

- b. Use the signal flow graph to compute 8-point DFT of the following sequence using radix-2 decimation in time FFT algorithm. [4]

$$x[n] = \{1, 2, 3, 4, 0, -4, -3, -2\}$$

5.

- a. How circular convolution is different from linear convolution? Find linear convolution of following sequences using circular convolution method. [1+3]

$$x[n] = \{1, 2, 1\} \text{ \& } h[n] = \{-2, 4, 3\}$$

- b. State time shifting property of z-transform. Find z-transform and mention ROC of [1+3]

$$x[n] = 0.4^n u[n-2] + 2\delta[n]$$

6.

- a. Design a low pass FIR filter using Hamming window to meet the following requirements

$$\text{Desired frequency response, } H_d(\omega) = \begin{cases} e^{-j4\omega}, & |\omega| \leq 0.45\pi \\ 0, & 0.6\pi < |\omega| \leq 2\pi \end{cases} \quad [4]$$

The Hamming window is defined as,

$$W[n] = \begin{cases} 0.54 - 0.46 \cos \frac{2\pi n}{M-1}, & 0 \leq n \leq M-1 \\ 0, & \text{elsewhere} \end{cases}$$

- b. Explain the following terms: [2+2]
- Linear phase filter
 - Butterworth filter