Printed Page:- 04 **Subject Code**:- **AEC0601**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI - THEORY EXAMINATION (2023 - 2024)

Subject: Digital Signal Processing

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of* **three Sections -A, B, & C.** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION A **20**

1. Attempt all parts:-

1-a. Which of the following should be done in order to convert a continuous-time signal to a discrete-time signal? (CO1) 1

(a) Sampling

(b) Differentiating

(c) Encoding

(d) Quantization

1-b. If x(n) and X(k) are an N-point DFT pair, then X(k+N)=? (CO1) 1

(a) X(-k)

(b) -X(k)

(c) X(k)

(d) None of above

1-c. The poles of butterworth filter lie on a... (CO2) 1

(a) circle

(b) parabola

(c) ellipse

(d) helix

1-d. Relationship between s and z for bilinear transformation method...(CO2) 1

(a) z= (2-sT)/(2+sT)

(b) s=e^(zT)

(c) z=e^(-sT)

(d) z= (2+sT)/(2-sT)

1-e. Out of all the windows available the one which has the narrowest main lobe for a given length is...(CO3) 1

(a) Rectangular

(b) Hanning

(c) Hamming

(d) Blackman

1-f. If a linear phase filter has a phase response of 40 degree at 200 Hz, what will be its phase response at a frequency of 400 Hz. (CO3) 1

(a) 35 degree

(b) 45 degree

(c) 40 degree

(d) 80 degree

1-g. When the no of delays is equal to order of the system, the structure is called... (CO4) 1

(a) Canonic

(b) Noncanonic

(c) Cascade

(d) None of these

1-h. For linear phase realization of FIR filter, the impulse response should be.. (CO4) 1

(a) Symmetric

(b) antisymmetric

(c) cascade

(d) parallel

1-i. In multirate signal processing, interpolation method is used to....(CO5) 1

(a) decrease the sampling rate

(b) Increase the sampling rate

(c) no change

(d) None of thses

1-j. Recursive Least Square Algorithm is used to overcome the problem of.....of LMS algorithm. (CO5) 1

(a) slow convergence

(b) fast convergence

(c) nonlinear property

(d) None of these

2. Attempt all parts:-

2.a. Draw the basic block diagram of digital signal processing. (CO1) 2

2.b. Differentiate between analog and digital filter.(CO2) 2

2.c. What is Gibbs phenomenon explain with diagram? (CO3) 2

2.d. Difference between system analysis and system realization. (CO4) 2

2.e. Enlist the applications of multirate signal processing. (CO5) 2

SECTION B **30**

3. Answer any <u>five</u> of the following:-

3-a. Compute the 4-point DFT of a given sequence x(n)={0,1,2,1}. Also sketch the magnitude and phase spectrum. (CO1) 6

3-b. What are the basic differences between linear and circular convolutional? (CO1) 6

3-c. Draw the frequency mapping in bilinear transformation method. Write down the advantages and disadvantages of bilinear transformation method. (CO2) 6

3-d. Transform the analog filter transfer function H(s)=0.5(s+4)/(s+1)(s+2), into a digital filter H(z) using the impulse invariant method.(CO2) 6

3.e. Derive the expression for linear phase and symmetric impulse response for an FIR filter. (CO3) 6

3.f. Briefly explain the advantages in representing digital filter in block diagram form. (CO4) 6

3.g. Compute the up sampled version of signals for up sampling factor (a) I=2 (b) I=3 (c) I=4 for discrete time signal x(n)={1,2,3,4,5,6} , (CO5) 6

SECTION C **50**

4. Answer any <u>one</u> of the following:-

4-a. State and prove circular convolution property of DFT. What is zero padding? What are its uses? (CO1) 10

4-b. Define bit reversal and in place computation. Also compute the 8-point DFT of the given sequence x(n) ={1,2,1,2,1,2,1,2} using DIF-FFT algorithm. (CO1) 10

5. Answer any <u>one</u> of the following:-

5-a. Briefly explain the Chebyshev type-1 and type-2 filter with suitable frequency response. Also explain the design process of digital Chebyshev filter with suitable example. (CO2) 10

5-b. Convert a single pole low pass Butterworth filter with system function: 10

$$H(z) = \frac{0.245(1 + z^{-1})}{(1 - 0.509z^{-1})}$$

into a BPF with upper and lower cut off frequencies are 0.6π and 0.4π respectively. The LPF has 3 dB bandwidth =0.2 π.(CO2)

6. Answer any <u>one</u> of the following:-

6-a. Explain the characteristic of kaiser window. Briefly explain the design steps for designing of finite impulse response filter using kaiser window with suitable diagram. (CO3) 10

6-b. Explain the phenomenon of finite word length effect in digital system with the help of Limit cycle oscillation and coefficient quantization error. (CO3) 10

7. Answer any <u>one</u> of the following:-

7-a. Obtain the direct form-I and direct form-II structure of the system described by difference equation. (CO4) 10

$y(n) = 2r \cos(\omega_0) y(n - 1) - r^2 y(n - 2) + x(n) - r \cos(\omega_o) x(n - 1)$

7-b. Define transpose structure. Also obtain direct form and cascade form realization for the transfer function of an FIR system given by (CO4) 10

$$H(z) = 1 + \frac{3}{8}z^{-1} - \frac{3}{32}z^{-2} + \frac{5}{64}z^{-3} - \frac{3}{16}z^{-4}$$

8. Answer any <u>one</u> of the following:-

8-a. Explain the process of Two channel Quadrature Mirror Filter bank with suitable block diagram. Also write down the main applications of QMF bank. (CO5) 10

8-b. Derive the expression for LMS algorithm in detail. Also explain convergence and stability of this algorithm. (CO5) 10