Code No: 157BG **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech IV Year I Semester Examinations, July/August - 2023

DIGITAL SIGNAL PROCESSING

(Electrical and Electronics Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) What is an LSI system? [2]

b) What is meant by Interpolation? [3]

c) Distinguish between DFT and DTFT. [2]

d) What is the relation between Z-transform and DFT? [3]

e) What is the drawback of Impulse Invariance Technique? [2]

f) Distinguish between Chebyshev and Butterworth filters. [3]

g) What is the necessary and sufficient condition for linear phase characteristics of FIR filters? [2]

h) What are the advantages of Kaiser Window over other Windows? [3]

i) State the stability criterion of system using Z-transform. [2]

j) What is meant by finite word length effects in digital filters? [3]

PART – B

(50 Marks)

2.a) Determine the frequency response $H(e^{j\omega})$ for the system $y(n) + y(n-1) + 2y(n-2) = x(n) + x(n-1)$. Also plot magnitude response as well as phase response.

b) With necessary equations, describe the Frequency Domain Representation of Systems. [5+5]

OR

3.a) Check whether the system $y(n) = 3x(n-2) + 4x(n-2) + x(n-1)$ is a causal linear System.

b) Explain the concept of Multirate signal processing with spectral interpretation of decimation of a signal from 6 KHz to 2 KHz. [5+5]

4.a) Determine the DTFT of the given sequence $x[n]=a^n(u(n)-u(n-8))$, $|a|<1$.

b) The first five points of the eight point DFT of a real valued sequence are {0.25, 0.125 – j0.3018, 0, 0.125 - j0.0518, 0}. Determine the remaining three points. [5+5]

OR

5.a) Determine the response of LTI system when the input sequence is x(n)={-1,1,2,1,-1} using radix 2 DIF FFT. The impulse response is h(n)={-1,1,-1,1}.

b) Derive the decimation-in time radix-2 DIT FFT algorithm and draw signal flow graph for 8- point sequence. [5+5]

6.a) Design a Chebyshev low pass filter with the specifications $\alpha_p = 1dB$ ripple in the pass band $0 \leq \omega \leq 0.2\pi$, $\alpha_s = 15dB$ ripple in the stop band $0.3\pi \leq \omega \leq \pi$ using Impulse Invariance technique.

b) Describe the frequency transformations from Analog to Digital Domain with necessary equations. [6+4]

OR

7.a) Using Bilinear transformation design a Band pass Butterworth filter with sampling frequency F=8KHz, $\alpha_p = 2dB$ in the passband 800Hz ≤ f ≤ 1000 Hz, $\alpha_s = 20dB$ in the stopband 2000Hz ≤ f ≤ ∞.

b) Discuss the transformations relating Low pass filter to HPF, BPF and BRF with necessary equations. [5+5]

8.a) Design an Ideal Low pass filter using Hamming Window with N=7

$$H(e^{j\omega}) = \begin{cases} 1 & for\ \frac{\pi}{6} \leq |\omega| \leq \frac{\pi}{3} \\ 0 & otherwise \end{cases}$$

b) Obtain the frequency response of Linear Phase FIR filter with N odd and having antisymmetrical response. [6+4]

OR

9.a) Design an ideal differentiator with frequency response.

$$H(e^{j\omega}) = j\omega;\ - -\pi \leq \omega \leq \pi$$

using hamming window with N=7

b) Describe the Fourier series method of designing FIR fitler. [6+4]

10.a) A causal system is represented by the differential equations

$$y(n) + \frac{1}{4}y(n-1) + \frac{7}{8}y(n-2) = x(n) + \frac{3}{4}x(n-1).$$

Find the system function H(Z) and its corresponding Region of Convergence(ROC).

b) Find the one sided z-transform of discrete sequences generated by mathematically sampling of the continuous time function $x(t) = \sin \omega t$. [6+4]

OR

11.a) Determine the characteristics of a limit cycle oscillation with respect to the system described by the difference equation y(n) = 0.7y(n-2) + x(n). Determine the dead band of the filter.

b) Given $H(z) = 0.5+0.25z^{-1} + 0.75z^{-2} + z^{-3}+ 0.75z^{-4} + 0.25z^{-5} + 0.5z^{-6}$. Draw the direct form realization. [5+5]

---ooOoo---