Code No: 157BG **R18**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, January/February - 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) Obtain the frequency response of the system given by $h(n) = b^n u(n)$. [2]
b) Find whether the signal defined by $x[n] = [5\ (1/2)^n + 4\ (1/3)^n\ ]\ u(n)$ is causal. [3]
c) What are the differences between Overlap Save method and Overlap Add method?[2]
d) How many multiplications are required to compute N point DFT using Radix-2 FFT?[3]
e) What is the advantage of designing IIR Filters using pole-zero plots? [2]
f) Obtain the transfer function of Butterworth filter for order N=4. [3]
g) What is the reason for FIR filter to be always stable? [2]
h) Show that the filter with h (n) = [-1, 0, 1] is a linear phase filter. [3]
i) What is zero padding? Does zero padding improve the frequency resolution in the spectral estimate? [2]
j) What is Overflow Noise? [3]

PART – B

(50 Marks)

2.a) An LTI system is described by the differential equation $y(t) + 3y(t) = x(t)$. The initial conditions of $y(0) = 2$. Find the output $y(t)$ for a unit step input.
b) Explain how Continuous time signals are converted into discrete time signals graphically. [5+5]

OR

3.a) Obtain the frequency response of $y(n) - 2y(n-1) + \frac{2}{9}y(n-2) = x(n) - \frac{3}{5}x(n-1)$. Also discuss the properties of frequency response of discrete time system.
b) Explain with block diagrams how sampling rate can be converted by a rational factor M/L in frequency domain. [5+5]

4.a) State and Prove i) Circular Shift of a Sequence ii) Complex Conjugate property of DFT.
b) Find the output y[n] of a filter whose impulse response is h[n] = {1,1,1} and input signal x[n]={3,-1,0,1,3,2,0,1,2,1} using overlap save method. [4+6]

OR

5.a) Two finite duration sequence are given by $x(n) = \sin\left(\frac{n\pi}{2}\right)$ $for\ n = 0,1,2,3$ and $h(n) = 2n$ *for n = 0,1,2,3*. Determine circular convolution using DFT & IDFT method.
b) Determine IDFT of X(K)={6,-2,-2j,2,-2+2j} using DIT algorithm. [5+5]

6.a) The specifications of desired low pass filter is

$$0.7 \le |H(\omega)| \le 1.0 \; ; \; 0 \le \omega \le 0.2\pi$$
$$|H(\omega)| \le 0.3 \; ; \; 0.6\pi \le \omega \le \pi$$

Design a Chebyshev digital filter using impulse invariant Transformation

b) Describe any one procedure for digitizing the transfer function of an analog filter. [6+4]

OR

7.a) Design a Butterworth high pass filter satisfying $f_p = 0.32\,Hz$; $\alpha_p = 0.5dB$ and $f_s = 0.16\,Hz$; $\alpha_s = 30dB$; F=1Hz using Bilinear transformation method.

b) Explain the design procedure of Chebyshev filter with necessary equations. [6+4]

8.a) Design an Ideal Low pass filter using Hanning Window with N=11

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

b) Explain Frequency sampling method of designing FIR filters. [6+4]

OR

9.a) Design an ideal band reject filter using Hamming window for the given frequency response. Assume N=11

$H_d(e^{j\omega}) = 1$; $\omega < \pi/3$ and $\omega > 2\pi/3$
$= 0$; otherwise

b) Describe the procedure for designing FIR filter using Windowing technique. Also elaborate about the different windows used for the design. [6+4]

10.a) Realize the first order transfer function $H(z) = 1 / (1 - az^{-1})$ and draw its quantization model. Find the steady state noise power due to product round off.

b) Evaluate the frequency response of the system described by the system function. [5+5]

$$H(z) = \frac{1}{1-0.5z^{-1}}$$

OR

11. Obtain the realization of the following with minimum number of multipliers and Direct form I and also parallel form. $H(z) = \frac{1}{3} + \frac{1}{4}z^{-1} + \frac{3}{2}z^{-2} + \frac{5}{6}z^{-3} + \frac{6}{4}z^{-4} + \frac{1}{3}z^{-5}$ [10]

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