

**R13**

Code No: 126EK

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, July - 2023

**DIGITAL SIGNAL PROCESSING**  
(Electronics and Communication 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) Find the period of  $x(n) = \cos [8\pi n/7 + 2]$ . [2]
- b) Given  $x[n] = (0.5)^n u[n]$ , find the signals z-transform  $X(z)$  and the corresponding ROC. [3]
- c) Compare Over-Lap add method and Over-Lap save method. [2]
- d) Find the DTFT of the sequence  $x(n) = a^n u(n)$ . [3]
- e) Explain warping effect. [2]
- f) Draw the direct form structure of IIR. [3]
- g) Compare IIR and FIR filter. [2]
- h) Show that the  $h(n) = [-1, 0, 1]$  is a linear phase filter. [3]
- i) What are the quantization error due to finite word length register in digital filter? [2]
- j) Draw a labelled block diagram of a unity-gain multirate signal processing system that converts an input signal with sampling frequency 8 kHz to an output signal with sampling frequency 12 kHz. [3]

**PART - B**

**(50 Marks)**

2. A discrete time system can be a) Static or Dynamic b) Linear or nonlinear c) Time invariant or time varying d) Causal or Non-Causal e) Stable or unstable. Examine the system  $y(n) = x(-n+2)$  with respect to the properties mentioned in the question. [10]

**OR**

3. Realize the system  $y(n) = 3/4 y(n-1) - 1/8 y(n-2) + x(n) + 1/3 x(n-1)$ , using cascade form and parallel form. [10]

- 4.a) What do you mean by Radix-2 FFT? Draw the basic butterfly diagram of radix -2 FFT.
- b) Compute an 8-point DFT using DIF FFT radix -2 algorithm.  $x(n) = \{1, 2, 3, 4, 5, 6, 7, 8\}$ . [4+6]

**OR**

5.  $x(n) = \{0.5, 0.5, 0.5, 0.5, 0, 0, 0, 0\}$ . Compute the DFT of the sequence using the in-place radix 2 DIF-FFT algorithm. [10]

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6. Determine  $H(Z)$  using impulse invariant technique for the analog transfer function  $(s) = H(S) = 1/ (S+1)(S+2)$ . Assume  $T=1$  sec. [10]

OR

7. Design an analog Butterworth filter that satisfies the following constraints: [10]  
 $0.9 \leq |H(j\Omega)| \leq 1, 0 \leq \Omega \leq 0.2\pi$   
 $|H(j\Omega)| \leq 0.2, 0.4\pi \leq \Omega \leq \pi$

8. Describe the design of FIR filter using frequency sampling technique. [10]

OR

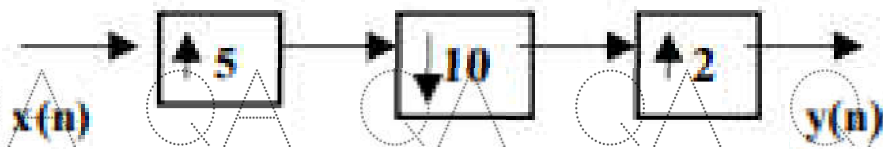
9. Design an ideal High Pass Filter the frequency of  
 $H_d(e^{j\omega}) = 1$  for,  $\pi/4 \leq |\omega| \leq \pi$   
 $= 0$  for  $|\omega| \leq \pi/4$   
Using Hanning window with  $N=11$ . [10]

10. Discuss the steps involved in converting sampling rate by a factor of  $I/D$ . [10]

OR

11.a) Determine the characteristics of a limit cycle oscillation with respect to the system described by the difference equation  $y(n) = 0.95y(n-1) + x(n)$ . Determine the dead band of the filter, when  $x(n) = +0.875$  for  $n=0$  and  $y(-1)=0$ . Assume 4 bit sign magnitude representation.

b) Develop an expression for  $y(n)$  as a function of  $x(n)$  for the given multirate system: [5+5]



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