Code No: R2032043 **R20** SET -1

III B. Tech II Semester Regular Examinations, July -2023
DIGITAL SIGNAL PROCESSING
(Electronics and Communication Engineering)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks
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UNIT-I

1. a) Find the linear, invariance and casuality property of given system represented by : $y(n) = x(n) – ax(n - 1)$. [7M]
   b) Find the convolution of the signals x(n) = i) $(a)^n u(n)$ and $h(n) = (b)^n u(n)$. [7M]

(OR)

2. a) Write the properties of ROC of X(z). [7M]
   b) Find the magnitude and phase response for the system characterized by the difference equation $y(n) = \frac{1}{2}x(n) + x(n-1) + \frac{1}{2}x(n-2)$. [7M]

UNIT-II

3. a) State and prove the following properties of DFT [7M]
   i) circular frequency shift ii)Parseval's Theorem.
   b) Develop a DIF FFT algorithm and draw its flow diagram. [7M]

(OR)

4. a) Find the DFT of i) x*(n) ii) x*(-n) iii) Re{x(n)} iv) Im {x(n)} [7M]
   b) Find the IDFT of the sequence using DIF algorithm Y (k) = {10, -2-j2, -2, -2+j2} [7M]

UNIT-III

5. a) Determine the digital filter Transformation from the following analog T.F $Ha(s)= 1 / (s+0.5)(s^2+0.5s+2)$ using Impulse Invariant Method .Assume Ts= 1 sec. [7M]
   b) With an example explain the design procedure for Butterworth filter [7M]

(OR)

6. a) Design a digital Butterworth filter that satisfies the following specifications : [7M]
   $0.9< |H(jw)| \leq 1$, for $0 \leq w \leq \pi/2$
   $|(H(jw)|< 0.2$, for $¾ \pi \leq w \leq \pi$ using BLT .Assume Ts= 1 sec
   b) Explain basic structures and Transposed forms of IIR systems with suitable examples. [7M]

UNIT-IV

7. a) Design a 7-tap linear FIR Digital filter with a cut-off frequency of $\pm 3\pi/4$ rad using hamming window. [7M]
   b) Obtain the parallel realization of the system described by the difference equation [7M]
   $$y[n] - \frac{13}{12}y[n-1] + \frac{9}{24}y[n-2] - \frac{1}{24}y[n-3] = x[n] + 2x[n-1]$$

(OR)

8. a) Explain the need for the use of window sequence in the design of FIR filter. Describe the window sequence generally used and compare the properties. [7M]
   b) Determine the lattice filter representation for the following FIR filter: [7M]
   $H(z) = 1+ 7/8\, z^{-1} + 11/16\, z^{-2} + ¼\, z^{-3}$

UNIT-V

9. a) Discuss the salient features and special addressing modes of Digital signal processors. [7M]

   b) Explain briefly the following for TMS320C5X: i) Flags available in status register ii) Parallel Logic Unit. [7M]

(OR)

10. a) Explain in detail the architecture of TMS320C5X processor. [7M]

    b) With neat block diagram, explain about the pipelining in DSP processors. [7M]

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UNIT-I

1. a) Determine the Inverse Z-Transform of: $X(Z)=1/(1-Z^{-1})(1-Z^{-1})^2$. [7M]
   b) Defne Disrete time systems ,explain the classification with suitable exampls [7M]

(OR)

2. a) Find the frequency response $H(e^{jw})$ of the linear time-invariant system whose input and output satisfy the difference equation: [7M]
   $y[n]-\frac{1}{2}y[n-1]=x[n]+2x[n-1]+x[n-2]$.
   b) A causal LTI system is defined by the difference equation: [7M]
   2y(n)-y(n-2)=x(n1)+3x(n-2)+2x(n-3). Find the frequency response $H(e^{jw})$, magnitude response and phase response.

UNIT-II

3. a) Define DFT and then state and prove properties of DFT. [7M]
   b) Given X(K) = { 36,-4+j9.565, -4+j4,-4+j1.656,-4,-4-j1.656,-4-j4,-4-j9.656} find x(n) using FFT algorithm [7M]

(OR)

4. a) Show how the complexity of computing DFT can be reduced by Radix-2 DIF algorithm with suitable diagrams. [7M]
   b) Determine the 8 point DFT of the sequence $X(n)=\begin{cases}1 & ; -4\le n\le 4\\ 0 & ; \text{otherwise}\end{cases}$ [7M]

UNIT-III

5. a) For the analog transfer function H(s) = 2/ {(s+2) (s+3)}. Determine H (z) using impulse invariance method. Assume T = 1 sec [7M]
   b) Determine the order and poles of type-I chebyshev low pass filter for the given specifications: [7M]
   α_p = 1 dB, α_s = 40 dB, Ωp= 1000Π rad/sec Ωs = 2000 Π rad/ sec.

(OR)

6. a) Design a digital second order Low-Pass Butterworth filter with cut-off frequency 2.2KHz using Bilinear Transformation. Sampling rate 8 KHz [7M]
   b) Compare Impulse invariant and bilinear transformation methods. [7M]

UNIT-IV

7. a) Design an FIR low pass filter satisfying the following specifications [7M]
   $\alpha_p \le 1\ dB;\ \alpha_s \ge 44\ dB,\ w_p = 20\ rad/sec,\quad w_s = 30\ rad/sec,\ w_{sf} = 100\ rad/sec$
   b) Given a 3-stage lattice FIR filter with coefficients, k_1=(1/4); k_2=(1/2); k_3=(1/3); Determine the FIR filter coefficients for the direct form structure. [7M]

(OR)

8. a) Design a low pass filter using Hanning window with a cutoff frequency of 0.9 radians/sec and N=6. Draw the filter structure and plot its spectrum. [7M]
   b) Find the structural representation in direct and transposed form for system described by the difference equation. [7M]
   y(n) = x(n) – 0.3 x(n - 1) - 0.7 x(n - 2) + 0.6 y(n - 1) + 0.8 y(n - 2)

UNIT-V

9. a) Explain in brief memory access schemes in DSP processors. [7M]
   b) Draw the pipelined MAC configuration to perform convolution operation and Explain with neat timing diagrams. [7M]

(OR)

10. a) Explain how the VLIW architecture is improving the performance of DSP processor. [7M]
    b) What is meant by bit reversed addressing mode? What is the application for which this addressing mode is preferred? [7M]

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UNIT-I

1. a) Define an LTI System and show that the output of an LTI system is given by the convolution of Input sequence and impulse response. [7M]
   b) Check the following filter for time invariant, causal and linear [7M]
   i) y (n) = (n-1) (n+1) ii) y(n) = x (n-2)

(OR)

2. a) Explain the concept of stability and causality with examples. [7M]
   b) An LTI system is described by the equation y(n)=x(n)+0.81x(n-1)-0.81x(n2)-0.45y(n-2). Determine the transfer function of the system. Sketch the poles and zeroes on the Z-plane [7M]

UNIT-II

3. a) Perform i) Linear Convolution ii) Circular Convolution for the following sequence [7M]
   x(n)= 1, n=0 h(n) = 0.5, n= 0
   = 0.5, n=1 = 1, n= 1
   = 0, otherwise = 0, otherwise
   And Show when they are equal.
   b) Develop a radix-2 DIT FFT algorithm for evaluating the DFT for N = 8. [7M]

(OR)

4. a) Explain how DFT provides an alternative approach to time domain convolution through linear filtering. [7M]
   b) Find the DFT of the given sequence by using DIF FFT. [5+5] x(n) = {0.5, 1.5, -0.5, -0.5} [7M]

UNIT-III

5. a) Design an analog filter for the following specifications: [7M]

$$-1 < |H(j\Omega)|_{db} \leq 0, \ \text{for } 0 \leq \Omega \leq 1404\pi \text{ rad/s}$$
$$|(H(j\Omega)|_{db} < -60, \ \text{for } \Omega \geq 8268\pi \text{ rad/s}$$

   b) Discuss the impulse invariant method and also explain its limitations. [7M]

(OR)

6. a) Explain the procedure for designing Analog filters using the Chebyshev approximation. [7M]
   b) Using Bilinear transformation, design a high pass filter, monotonic in pass band with cutoff frequency of 1000 Hz and down 10dB at 350 Hz. The sampling frequency is 5000 Hz. [7M]

UNIT-IV

7. a) Explain the canonical form of digital filter realization with suitable examples. [7M]
   b) Design a FIR digital low-pass filter with a cutoff frequency of 1 kHz and a sampling rate of 4 kHz with 7 samples using Fourier series method. [7M]

(OR)

8. a) Using a Hanning window technique, design a low pass filter with pass band gain of unity, cut-off frequency of 1000Hz and working at a sampling frequency of 5 KHz. The length of the impulse response should be 7 [7M]

   b) Realize the system function $H(z)=\left(\frac{2}{3}\right)z+1+\left(\frac{2}{3}\right)z^{-1}$ by linear phase FIR structure. [7M]

UNIT-V

9. a) Write about the architectural features of TMS320C5X DSP processor. [7M]

   b) How much memory can be Interfaced to TMS320C5X? Explain in detail its Memory mapping. [7M]

(OR)

10. a) Explain the special addressing modes of DSP with suitable examples. [7M]

    b) Explain the i) Bus Structure ii) On-chip peripherals in a TMS320C5X DSP processor. [7M]

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UNIT-I

1. a) Determine the impulse response h(n) for the system described by the second order difference equation y (n) – 4 y (n-1) + 4 y (n-2) = x (n-1) [7M]
   b) Establish the relation between DFT and Z-transform. [7M]

(OR)

2. a) Determine the stability of the following systems using Z-transform: [7M]
   i) $h(n) = 2^n u(n)$ ii) $h(n) = 5^n u(3-n)$
   b) Determine the causal signal x(n) having the Z-transform [7M]
   $X(Z) = (Z^2+Z)/[(Z-\frac{1}{2})^2 (Z-\frac{1}{4})]$

UNIT-II

3. a) Find the DFT of a sequence y[n]= { 1,2,3,4,4,3,2,1} using: [7M]
   i) DIT algorithm ii) DIF algorithm.
   b) Let x(n) be a real valued sequence with N-points and Let X(K) represent its DFT , with real and imaginary parts denoted by $X_R(K)$ and $X_I(K)$ respectively. So that $X(K) = X_R(K) + JX_I(K)$. Now show that if x (n) is real, $X_R(K)$ is even and $X_I(K)$ is odd. [7M]

(OR)

4. a) Compute 4-point DFT of a sequence x (n) = { 0,1,2,3} using DIT algorithm. [7M]
   b) Draw the butterfly line diagram for 8 - point FFT calculation and briefly explain. Use decimation -in-time algorithm. [7M]

UNIT-III

5. a) Apply bilinear transformation to $H(s) = \frac{2}{(s+1)(s+2)}$ with T=1 Sec and find H (z). [7M]
   b) For the given specifications design an analog Butterworth filter. [7M]
   $0.9 \le |H(j\Omega)| \le 1 \; for \; 0 \le \Omega \le 0.2\pi$
   $|H(j\Omega)| \le 0.2 \; for \; 0.4\pi \le \Omega \le \pi$

(OR)

6. a) Using the bilinear transform, design a high pass filter, monotonic in password with cutoff frequency of 1000 Hz and down 10 dB at 350 Hz. The sampling frequency is 5000 Hz. [7M]
   b) What are the steps to design an analog Chebyshev High pass filter. [7M]

UNIT-IV

7. a) Explain the design procedure of linear phase FIR filter using Fourier series method. [7M]
   b) Consider a second order IIR filter with: [7M]
   $H(z) = \frac{1}{(1-0.5z^{-1})(1-0.45z^{-1})}$.
   Find the effect on quantization on pole locations of the given system function in direct form and in cascade form. Assume b=3 bits.

(OR)

8. a) Explain the type -1 FIR filter design procedure using frequency sampling method. [7M]
   b) Explain how reduction of product round-off error is achieved in digital filters? [7M]

UNIT-V

9.	a)	Discuss various interrupt types supported by TMS320C5X processor.	[7M]
	b)	Explain the memory access schemes in P-DSP's.	[7M]
		(OR)	
10.	a)	Explain the functioning of Multiplier and Multiplier Accumulator in DSP processor.	[7M]
	b)	Explain the functions of on-chip peripherals in a DSP processor.	[7M]