

# SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)  
SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

## QUESTION BANK



Regulation : 2023  
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Class : III Year, V Semester MDE  
Subject Code : MD3562

Subject Name : Discrete Time Signal Processing

Institution

*Prepared by*

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## UNIT I – DISCRETE FOURIER TRANSFORM

Review of signals and systems, concept of frequency in discrete-time signals - Frequency Domain Sampling DFT and its properties, magnitude and phase representation - Linear Convolution – Correlation - Circular Convolution, Overlap-add and overlap-save methods. FFT- Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering.

### PART – A

Q.No	Questions	CO	BT Level	Competence
1	List the classifications of signals?	CO 1	BTL1	Remembering
2	What is an LTI system?	CO 1	BTL1	Remembering
3	Compare energy and power signal of Discrete time signal.	CO 1	BTL2	Understanding
4	Check the causality of $y(n) = x(n^2)$ .	CO 1	BTL2	Understanding
5	Check and explain whether the system $y(n) = e^{x(n)}$ is linear or not?	CO 1	BTL2	Understanding
6	Define sampling theorem.	CO 1	BTL1	Remembering
7	Write the condition for system stability.	CO 1	BTL1	Remembering
8	Distinguish between linear convolution and circular convolution?	CO 1	BTL2	Understanding
9	Obtain the circular convolution of $x(n) = \{1,2,3,1\}$ ; $h(n) = \{4,3,2,1\}$	CO 1	BTL2	Understanding
10	What is zero padding? What are its uses?	CO 1	BTL1	Remembering
11	State about overlap save method.	CO 1	BTL1	Remembering
12	State and prove periodicity property of DFT.	CO 1	BTL1	Remembering
13	What is the time shifting property of DFT?	CO 1	BTL2	Understanding
14	Write the expression for Parseval's relation of DTFT.	CO 1	BTL1	Remembering
15	Describe about relation between Discrete Fourier Transform and Discrete time Fourier Transform	CO 1	BTL2	Understanding
16	Find the 4-point DFT of the sequence $x(n) = \{1,1,-1,-1\}$ .	CO 1	BTL2	Understanding
17	Find the DFT of the sequence $x(n) = \{1,2,3,0\}$ using DIF algorithm.	CO 1	BTL1	Remembering
18	How many multiplications and additions are required to compute N point DFT using radix-2 FFT algorithm?	CO 1	BTL2	Understanding
19	What is meant by in-place computation?	CO 1	BTL1	Remembering
20	Outline the concept of bit reversal in FFT?	CO 1	BTL2	Understanding
21	Draw the basic butterfly diagram of radix-2 DIT FFT.	CO 1	BTL2	Understanding
22	List the differences and similarities between DIT and DIF.	CO 1	BTL2	Understanding
23	Define twiddle factor and write the properties of twiddle factor.	CO 1	BTL1	Remembering
24	What are the advantages of FFT algorithm over direct computation of DFT?	CO 1	BTL1	Remembering

### PART – B

1	Determine whether the following signals are energy signals or power signals a. $x(n) = \left(\frac{1}{3}\right)^n u[n]$ (8) b. $x[n] = \begin{cases} n & \text{for } 0 \leq n \leq 5 \\ 10 - n & \text{for } 5 \leq n \leq 10 \\ 0 & \text{otherwise} \end{cases}$ (8)	CO 1	BTL3	Applying
2	(i) Consider an analog signal $x(t) = 5\cos 200\pi t$ . a. Examine the minimum sampling rate to avoid sampling. (5) b. If sampling rate $F_s = 400\text{Hz}$ . What is the Discrete time signal after sampling? (5) (ii) Write short notes on aliasing effects. (6)	CO 1	BTL3	Applying
3	How will you determine the circular convolution of the following sequence $x(n) = \{1,1,2,1\}$ , $h(n) = \{1,2,3,4\}$ using DFT and IDFT method? (16)	CO 1	BTL3	Applying
4	Illustrate the 8-point DFT of a sequence $x(n) = \left\{\frac{1}{2}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 0, 0, 0, 0\right\}$ (16)	CO 1	BTL3	Applying
5	Summarize the following properties of DFT: a. Periodicity (4) b. Time Reversal (4) c. Circular frequency shifting (4) d. Multiplication. (4)	CO 1	BTL4	Analyzing
6	Determine the output $y(n)$ of a filter whose impulse response $h(n) = \{1,2\}$ and input signal $x(n) = \{1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1\}$ using overlap save method and overlap add method. (16)	CO 1	BTL4	Analyzing
7	Construct the circular convolution of two finite duration sequences $x_1(n) = \{1, -1, -2, 3, -1\}$ ; $x_2(n) = \{1, 2, 3\}$ . (16)	CO 1	BTL4	Analyzing
8	(i) Prove that FFT algorithm helps in reducing the number of computations involved in DFT computation. (8) (ii) Discuss about overlap add method for convolution. (8)	CO 1	BTL3	Applying
9	Find the 8-point DFT of a given sequence $x(n) = \{1, 2, 2, 1, 1, 2, 2, 1\}$ using DIF-FFT algorithm. (16)	CO 1	BTL4	Analyzing
10	(i) Write the steps for radix-2 DIT FFT algorithm. (8) (ii) Solve the 8-point of a given sequence $x(n) = n + 1$ using DIT FFT algorithm. (8)	CO 1	BTL3	Applying
11	Calculate IDFT of the sequence $X(K) = \{7, -0.707 - j0.707, -j0.707 - 0.707, 1, 0.707 + j0.707, j, -0.707 + j0.707\}$ using DIT algorithm. (16)	CO 1	BTL4	Analyzing
12	Apply DIT algorithm to compute DFT of the given sequence $x(n) = \{1, 1, 1, 1, 0, 0, 0, 0\}$ . (16)	CO 1	BTL3	Applying
13	Compute the DFT of the sequence $x(n) = \cos \frac{n\pi}{2}$ where $N = 4$ using DIF FFT algorithm. (16)	CO 1	BTL3	Applying
14	(i) Analyze the $N$ - point DFT of the sequence $x(n) = \delta(n)$ (4) (ii) Compute 8 - point DFT of the sequence $x(n) = \{0, 1, 2, 3, 4, 5, 6, 7\}$ using radix - 2 DIT algorithm. (12)	CO 1	BTL4	Analyzing

15	Using linear convolution construct $y(n) = x(n) * h(n)$ for the sequence $h(n) = \{1,1,1\}$ and input signal $x(n) = \{3,-1,0,1,3,2,0,1,2,1\}$ using overlap save method and overlap add method. (16)	CO 1	BTL4	Analyzing
16	Calculate the 8 point for the given sequence using DIT FFT algorithm and also find the magnitude and phase spectrum $x[n] = \begin{cases} 1 & \text{for } -3 \leq n \leq 3 \\ 0 & \text{otherwise} \end{cases} \quad (16)$	CO 1	BTL3	Applying
17	(i) State and analyse convolution property of DFT? (8) (ii) Find the 4-point inverse DFT of $X(k) = \{10, -2+2j, -2, -2-2j\}$ using DIT-FFT algorithm. (8)	CO 1	BTL3	Applying

### UNIT II – INFINITE IMPULSE RESPONSE FILTERS

Characteristics of practical frequency selective filters. Characteristics of commonly used Analog filters - Butterworth filters. Design of IIR filters from Analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the Analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

#### PART – A

Q.No	Questions	CO	BT Level	Competence
1	What are the different types of structures for realization of IIR systems?	CO 2	BTL 2	Understanding
2	Distinguish between recursive realization and non-recursive realization?	CO 2	BTL 2	Understanding
3	Convert the given analog transfer function $H(s) = \frac{1}{s+a}$ into digital by impulse invariant method?	CO 2	BTL 2	Understanding
4	List the different types of filters based on frequency response.	CO 2	BTL 1	Remembering
5	Write the properties of Butterworth filter.	CO 2	BTL 1	Remembering
6	Justify why impulse invariant method is not preferred in the design of IIR filter other than LPF?	CO 2	BTL 2	Understanding
7	Identify the expression for location of poles of normalized Butterworth filter.	CO 2	BTL 2	Understanding
8	What is the relation between digital and analog frequency in bilinear transformation?	CO 2	BTL 1	Remembering
9	Why do we go for analog approximation to design a digital filter?	CO 2	BTL 2	Understanding
10	Outline the steps in design of a digital filter from analog filters.	CO 2	BTL 2	Understanding
11	Mention the requirements for the digital filter to be stable and causal.	CO 2	BTL 1	Remembering
12	Write the need for prewarping.	CO 2	BTL 1	Remembering
13	Give the properties of bilinear transformation.	CO 2	BTL 1	Remembering
14	Use the backward difference for the derivative to convert analog LPF with system function $H(s) = \frac{1}{s+3}$	CO 2	BTL 2	Understanding
15	What is the bilinear transformation method?	CO 2	BTL 2	Understanding

16	Justify why the Butterworth response is called a maximally flat response.	CO 2	BTL 2	Understanding
17	State the limitations of impulse invariance method.	CO 2	BTL 2	Understanding
18	What is the advantage of direct form II realization when compared to direct form I realization?	CO 2	BTL 1	Remembering
19	How to represent the frequency warping in IIR filter?	CO 2	BTL 2	Understanding
20	Write the expression for location of poles of normalized Butterworth filter.	CO 2	BTL 1	Remembering
21	List any two characteristics of IIR filters.	CO 2	BTL 1	Remembering
22	Compare digital and analog filters.	CO 2	BTL 2	Understanding
23	Find the order of the analog butterworth filter that has a -2db pass band attenuation at a frequency of 20rad/sec and at least -10db stop band attenuation at 30 rad/sec.	CO 2	BTL 2	Understanding
24	Write the various frequency translations in analog domain.	CO 2	BTL 2	Understanding
<b>PART – B</b>				
1	Enumerate the steps for IIR filter design by impulse invariance with example. (16)	CO 2	BTL3	Applying
2	Obtain the direct form I ,direct form II and cascade form realization of the following system functions $y[n] = 0.1 y[n - 1] + 0.2 y[n - 2] = 3 x[n] + 3.6 x[n - 1] + 0.6 x[n - 2]$ (16)	CO 2	BTL3	Applying
3	Explain the bilinear transform method of IIR filter design. What is wrapping effect? Explain the poles and zeros mapping procedure clearly. (16)	CO 2	BTL 4	Analyzing
4	Summarize the steps in the design of IIR filter using bilinear transformation for any one type of filter? (16)	CO 2	BTL3	Applying
5	Given the specification $\alpha_p = 3dB$ ; $\alpha_s = 16dB$ ; $f_p = 1KHz$ ; $f_s = 2KHz$ . Solve for H(s) using Butterworth approximation. (16)	CO 2	BTL3	Applying
6	For the given specifications, design an analog Butterworth filter $0.9 \leq  H(j\Omega)  \leq 1$ for $0 \leq \Omega \leq 0.2\pi$ $ H(j\Omega)  \leq 0.2$ for $0.4\pi \leq \Omega \leq \pi$ (16)	CO 2	BTL4	Analyzing
7	Convert the analog filter into a digital filter whose system function is $H(s) = \frac{s+0.2}{(s+0.2)^2+9}$ using bilinear transformation technique. The digital filter should have a resonant frequency of $\omega_r = \pi/4$ . (16)	CO 2	BTL3	Applying
8	Using the bilinear transformation design a high pass filter 3 dB monotonic in pass band with cut off frequency of 1000Hz and down 10 dB at 350Hz. The sampling frequency is 5000Hz. (16)	CO 2	BTL4	Analyzing
9	Compare impulse invariance and bilinear transformation methods for IIR filter design.	CO 2	BTL4	Analyzing
10	Design a butterworth digital filter using bilinear transformation to satisfy the constraints $0.89 \leq  H(e^{j\omega})  \leq 1$ $0 \leq \omega \leq 0.2\pi$ $ H(e^{j\omega})  \leq 0.18$ $0.3\pi \leq \omega \leq \pi$ using Bilinear transformation and assuming $T = 1sec$ . (16)	CO 2	BTL3	Applying

11	Explain the conversion of analog BPF into digital IIR filter using backward difference for the derivative $H_a(s) = \frac{1}{(s+0.2)^2+8}$ (16)	CO 2	BTL3	Applying
12	(i) For the given specifications $A_p = 3\text{dB}$ , $A_s = 15\text{ dB}$ , $\Omega_p = 500\text{rad/sec}$ and $\Omega_s = 1000\text{rad/sec}$ . Design a high pass filter. (8) (ii) Convert the following analog transfer function into digital using impulse invariant technique with sampling period $T=1\text{sec}$ . $H(s) = \frac{s+1}{(s+3)(s+5)}$ (8)	CO 2	BTL3	Applying
13	Apply Bilinear transformation to determine (z) for Butterworth filter satisfying the following specifications. $0.8 \leq  H(e^{j\omega})  \leq 1 \quad 0 \leq \omega \leq \pi/4$ $ H(e^{j\omega})  \leq 0.2 \quad \pi/2 \leq \omega \leq \pi$ (16)	CO 2	BTL3	Applying
14	Analyze the frequency warping effect in bilinear transformation. How can pre-warping compensate for this effect? (16)	CO 2	BTL4	Analyzing
15	An Analog filter has a transfer function $H(s) = \frac{10}{s^2 + 7s + 10}$ Design a digital filter equivalent to this using impulse invariant method for $T = 0.2\text{sec}$ . (16)	CO 2	BTL3	Applying
16	Realize the direct form I, direct form II, cascade and parallel form realization of LTI system governed by the equation: $y(n) = -\frac{3}{8}y(n-1) + \frac{3}{32}y(n-2) + \frac{1}{64}y(n-3) + x(n) + 3x(n-1) + 2x(n-2)$ (16)	CO 2	BTL4	Analyzing
17	(i) Convert the analog filter with system function $H_a(s) = \frac{s+0.1}{(s+0.1)^2+9}$ into a digital IIR filter by means of the impulsive invariance method. (10) (ii) Draw the direct form I structures for the given difference equation $y(n) = 2y(n-1) + 3y(n-2) + x(n) + 2x(n-1) + 4x(n-2)$ . (6)	CO 2	BTL4	Analyzing

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### UNIT III - FINITE IMPULSE RESPONSE FILTERS

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures – linear phase structure, direct form realizations.

#### PART – A

Q.No	Questions	CO	BT Level	Competence
1	Name the different types of filters based on frequency response.	CO 3	BTL 1	Remembering
2	Summarize the advantages of FIR filters.	CO 3	BTL 2	Understanding
3	Mention the necessary and sufficient condition for the linear phase characteristic of an FIR filter.	CO 3	BTL 2	Understanding
4	Illustrate the condition for the impulse response of FIR filter to satisfy for constant phase delay and for only constant group delay.	CO 3	BTL 2	Understanding
5	What is Window? Why it is necessary?	CO 3	BTL 1	Remembering
6	Classify the properties of FIR filter.	CO 3	BTL 1	Remembering
7	What is the impulse response condition for a FIR filter to have linear phase characteristics?	CO 3	BTL 2	Understanding
8	List the advantages and disadvantages of window technique.	CO 3	BTL 1	Remembering
9	Write about phase delay and group delay	CO 3	BTL 2	Understanding
10	Define Gibbs phenomenon.	CO 3	BTL 1	Remembering
11	Write the need for employing window technique for FIR filter design.	CO 3	BTL 2	Understanding
12	Point out the desirable characteristics of FIR filter using windows.	CO 3	BTL 1	Remembering
13	Write the general expression of hanning, hamming and rectangular window.	CO 3	BTL 2	Understanding
14	Compare Hamming and Hanning window.	CO 3	BTL 2	Understanding
15	List the characteristics features of Rectangular window.	CO 3	BTL 1	Remembering
16	What are the desirable characteristics of window?	CO 3	BTL 1	Remembering
17	Why is the frequency-sampling method is suitable for narrow band filters.	CO 3	BTL 2	Understanding
18	Draw the direct form realization of FIR filter.	CO 3	BTL 1	Remembering
19	Why FIR filters are always stable?	CO 3	BTL 1	Remembering
20	Express why cascade realization is preferred in FIR filters.	CO 3	BTL 2	Understanding
21	Write the definition for linear phase response of a filter.	CO 3	BTL 1	Remembering
22	Point out the various methods of designing FIR filters.	CO 3	BTL 2	Understanding
23	Differentiate symmetric FIR filters and antisymmetric FIR filters.	CO 3	BTL 2	Understanding

24	What are the Antisymmetric FIR filters? What are its applications?	CO 3	BTL 1	Remembering
<b>PART – B</b>				
1	Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n) = h(N - 1 - n)$ . (16)	CO 3	BTL3	Applying
2	Determine the frequency response of linear phase FIR filter when impulse response is symmetrical and $N$ is even. (16)	CO 3	BTL3	Applying
3	Obtain the frequency response of linear phase FIR filter when impulse response is antisymmetrical and $N$ is odd. (16)	CO 3	BTL3	Applying
4	Find the FIR LPF with cut-off frequency of 1KHz and sampling frequency of 4KHz with 11 samples using Fourier series method. (16)	CO 3	BTL 4	Analyzing
5	Solve and design a FIR filter with the following desired specifications using hanning window with $N=5$ . $H_d(e^{j\omega}) = \begin{cases} 0 & \text{for } -\frac{\pi}{4} \leq  \omega  \leq \frac{\pi}{4} \\ e^{-j2\omega} & \text{for } \frac{\pi}{4} \leq  \omega  \leq \pi \end{cases}$ (16)	CO 3	BTL3	Applying
6	Obtain an ideal low pass filter with a frequency response $H_d(e^{j\omega}) = \begin{cases} 1 & \text{for } -\frac{\pi}{2} \leq \omega \leq \frac{\pi}{2} \\ 0 & \text{for } \frac{\pi}{2} \leq  \omega  \leq \pi \end{cases}$ Find the values of $h(n)$ for $N = 11$ . Find $H(z)$ . (16)	CO 3	BTL 4	Analyzing
7	Using a rectangular window technique, Illustrate a low pass filter with pass band gain of unity, cut-off frequency of 1000 Hz and working at a sampling frequency of 5 KHz. The length of the impulse response should be 7. (16)	CO 3	BTL3	Applying
8	By Choosing $N = 7$ , Examine a filter with $H_d(\omega) = \begin{cases} e^{-j3\omega} & ; \text{for }  \omega  \leq \frac{\pi}{4} \\ 0 & ; \frac{\pi}{4} \leq  \omega  \leq \pi \end{cases}$ Using Hamming window. (16)	CO 3	BTL3	Applying
9	Design a length 5 FIR Band reject filter with a lower cutoff frequency of 2 kHz and upper cutoff frequency 2.4 kHz and the sampling rate of 8000 Hz using Hamming window. (16)	CO 3	BTL 4	Analyzing
10	How to design a FIR band stop filter to reject frequencies in the range 1.2 to 1.8 rad/sec using hamming window, with length $N = 6$ . (16)	CO 3	BTL 4	Analyzing
11	Determine the filter coefficients for an FIR filter approximating the ideal frequency response having $N=7$ using Hamming window. $H_d(\omega) = \begin{cases} e^{-j3\omega} & ; \text{for } -\frac{3\pi}{4} \leq  \omega  \leq \frac{3\pi}{4} \\ 0 & ; \text{for } \frac{3\pi}{4} \leq  \omega  \leq \pi \end{cases}$ (16)	CO 3	BTL3	Applying
12	Describe the procedure of designing FIR filters by windows. (16)	CO 3	BTL3	Applying

13	Determine the Lowpass FIR filter using frequency sampling technique having cutoff frequency of $\pi/2$ rad/sample. The filter should have linear phase and length of 7. $H_d(e^{j\omega}) = e^{-j3\omega} \quad \text{for } 0 \leq \omega \leq \frac{\pi}{2} \quad (16)$	CO 3	BTL3	Applying
14	Determine the coefficients of a linear phase FIR filter of length $M = 15$ which has a symmetric unit sample response and a frequency response that satisfies the conditions. $H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1 & k = 0,1,2,3 \\ 0 & k = 4,5,6,7 \end{cases} \quad (16)$	CO 3	BTL3	Applying
15	Briefly explain the procedure for design of linear phase FIR filter using frequency sampling technique or discuss the design procedure of FIR filter using frequency sampling method. (16)	CO 3	BTL 4	Analyzing
16	Illustrate the direct form I & II structure of the system function $H(z) = 1 + 2z^{-1} - 3z^{-2} + 4z^{-3} + 5z^{-4} \quad (16)$	CO 3	BTL3	Applying
17	What is the need for realization of FIR filters? Mention the various types of linear phase FIR structures. Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n) = h(N - 1 - n)$ . Also discuss symmetric and antisymmetric case of FIR filter when N is odd. (16)	CO 3	BTL 4	Analyzing


  
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**UNIT - IV FINITE WORD LENGTH EFFECTS AND MULTIRATE SIGNAL PROCESSING**

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error – product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow. Multi-rate Signal Processing - Decimation and Interpolation.

**PART – A**

Q.No	Questions	CO	BT Level	Competence
1	List the different types of number representations in digital systems.	CO 4	BTL1	Remembering
2	Define Finite word length effect.	CO 4	BTL1	Remembering
3	Point out the some of the finite word length effects in digital filters.	CO 4	BTL1	Remembering
4	Mention the different formats of fixed point representation.	CO 4	BTL1	Remembering
5	State the advantages of floating-point representation.	CO 4	BTL1	Remembering
6	Express the fraction 7/8 and -7/8 in sign magnitude, 1's complement and 2's complement.	CO 4	BTL2	Understanding
7	Compare the fixed and floating point number representation.	CO 4	BTL2	Understanding
8	Illustrate what are the errors occurred due to finite word length registers in digital filter.	CO 4	BTL2	Understanding
9	List the two types of quantization employed in digital system.	CO 4	BTL2	Understanding
10	Why rounding is preferred over truncation in relating digital filter?	CO 4	BTL2	Understanding
11	What is quantization?	CO 4	BTL1	Remembering
12	Define dead band of a filter.	CO 4	BTL1	Remembering
13	What is the effect of quantization on pole location?	CO 4	BTL1	Remembering
14	How would you relate the steady state noise power due to quantization to the b bits representing the binary sequence?	CO 4	BTL2	Understanding
15	What do you understand by input quantization error?	CO 4	BTL1	Remembering
16	Interpret the meaning of coefficient quantization error.	CO 4	BTL2	Understanding
17	Define product quantization error.	CO 4	BTL2	Understanding
18	Write about the product round-off noise.	CO 4	BTL2	Understanding
19	Summarize about limit cycles.	CO 4	BTL2	Understanding
20	Classify the two kinds of limit cycle behavior in DSP?	CO 4	BTL2	Understanding
21	Define decimation. Give its basic equation.	CO 4	BTL2	Understanding
22	What is interpolation in DSP?	CO 4	BTL2	Understanding
23	Mention any two differences between decimation and interpolation.	CO 4	BTL2	Understanding
24	Why is anti-aliasing filtering necessary before decimation?	CO 4	BTL1	Remembering

**PART – B**

1	Explain in detail about finite word length effects in digital filters. (16)	CO 4	BTL3	Applying
2	Realize the first order transfer $H(z) = \frac{1}{1-az^{-1}}$ and draw its quantization noise model. Find the steady state noise power due to product round off. (16)	CO 4	BTL4	Analyzing

3	For the given transfer function $H(z) = H_1(z) \cdot H_2(z)$ , Where $H_1(z) = \frac{1}{1-0.9z^{-1}}$ and $H_2(z) = \frac{1}{1-0.8z^{-1}}$ . Solve the output round off noise power. Identify the value if B=3bits. (16)	CO 4	BTL3	Applying
4	Consider the transfer function $H(z) = H_1(z) \cdot H_2(z)$ , Where $H_1(z) = \frac{1}{1-0.5z^{-1}}$ and $H_2(z) = \frac{1}{1-0.6z^{-1}}$ . Estimate the output round off noise power. (16)	CO 4	BTL3	Applying
5	The output signal of an ADC is passed through a first order lowpass filter with transfer function given by $H(z) = \frac{(1-a)z}{(z-a)}$ for $0 < a < 1$ . Calculate the steady state output noise power due to quantization at the output of the digital filter. (16)	CO 4	BTL3	Applying
6	For the second order IIR filter, the system function is, $H(Z) = \frac{1}{(1 - 0.5z^{-1})(1 - 0.45z^{-1})}$ Examine the effect of shift in pole location with 3 bits coefficient representation in direct and cascade forms. (16)	CO 4	BTL4	Analyzing
7	(i) Write a note on Limit Cycle oscillation. (6) (ii) Explain the characteristics of limit cycle oscillations to the system described by the difference equation $y(n) = 0.95y(n-10) + x(n)$ ; $x(n)=0$ and $y(n-1)=13$ . Determine the dead band of the system. (10)	CO 4	BTL4	Analyzing
8	Find the characteristics of a limit cycle oscillation with respect to the system described by the equation $y(n) = 0.95y(n - 1) + x(n)$ . Estimate the dead band of the filter. (16)	CO 4	BTL3	Applying
9	(i) Explain in detail the input quantization error and coefficient quantization error and its effect on digital filter design, with an example. (8) (ii) Illustrate quantization noise. Summarize the expression for quantization noise power at the output ADC. (8)	CO 4	BTL4	Analyzing
10	For a second order IIR filter $H(z) = \frac{1}{(1-0.9z^{-1})(1-0.8z^{-1})}$ find the effect of shift in pole location with 3-bit coefficient presentation in direct form and cascade form. (16)	CO 4	BTL4	Analyzing
11	Explain the detail the 3 types of quantization error that occur due to the finite word length of register. (16)	CO 4	BTL3	Applying
12	An IIR causal filter has the system function $H(z) = \frac{z}{z-0.97}$ . Assume that the input signal is zero valued and the computed output signal values are rounded to one decimal place. Show that under those stated conditions, the filter output exhibits dead band effect. What is the dead band range? (16)	CO 4	BTL3	Applying
13	A digital system characterized by difference equation $y(n) = 0.8 y(n-1) + x(n)$ with $x(n)=0$ and initial condition $y(-1) = 10$ . Determine the dead band of the system. (16)	CO 4	BTL4	Analyzing

14	<p>In the IIR system given below the products are rounded to 4 bits (including sign bits). The system function is</p> $H(Z) = \frac{1}{(1 - 0.35z^{-1})(1 - 0.62z^{-1})}$ <p>Find the output round off noise power in (a) direct form realization and (b) cascade form realization. (16)</p>	CO 4	BTL4	Analyzing
15	<p>Derive the expression for the decimated signal and explain each block involved in a decimator structure. (16)</p>	CO 4	BTL4	Analyzing
16	<p>(i) Express decimal fraction 4.5, 6.5 and 1.5 in binary floating point format. (8)</p> <p>(ii) Compare fixed and floating point representation. (8)</p>	CO 4	BTL4	Analyzing
17	<p>Explain the step-by-step process of designing an interpolator with a factor of L. Include diagrams and mathematical expressions. (16)</p>	CO 4	BTL4	Analyzing



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## UNIT V - INTRODUCTION TO DIGITAL SIGNAL PROCESSORS

Introduction to DSP Processors – Fixed & Floating point processor, Architecture of DSP processor, Addressing Modes, Instruction Set.

### PART – A

Q.No	Questions	CO	BT Level	Competence
1	List the applications of DSP.	CO 5	BTL 1	Remembering
2	What is the role of the pipeline operation in a Digital Signal Processor?	CO 5	BTL 1	Remembering
3	Mention the buses used in digital signal processors?	CO 5	BTL 1	Remembering
4	Define circular buffering.	CO 5	BTL 1	Remembering
5	Brief the features of MAC unit.	CO 5	BTL 1	Remembering
6	Point out the classification of instruction set in Digital Signal Processor?	CO 5	BTL 1	Remembering
7	Summarize the on-chip peripherals in 'C5x'.	CO 5	BTL 2	Understanding
8	Outline the different phases in pipelining process.	CO 5	BTL 2	Understanding
9	Compare the difference between Von Neumann architecture & Harvard architecture.	CO 5	BTL 2	Understanding
10	Enumerate the advantages and disadvantages of VLIW architecture.	CO 5	BTL 2	Understanding
11	Categorize the addressing modes of TMS320C54XX processor.	CO 5	BTL 2	Understanding
12	Identify the important elements of program controller?	CO 5	BTL 2	Understanding
13	List out the major functional units present in TMS32050.	CO 5	BTL 1	Remembering
14	Classify the types of special purpose DSP processors.	CO 5	BTL 1	Remembering
15	Write a program to add to numbers in DSP Processor.	CO 5	BTL 1	Remembering
16	Distinguish between fixed- and floating-point arithmetic?	CO 5	BTL 1	Remembering
17	How the DS Processor pipeline differs from micro controller.	CO 5	BTL 1	Remembering
18	Analyze the various addressing modes of TMS32050.	CO 5	BTL 1	Remembering
19	Examine the arithmetic instructions of C5x processor.	CO 5	BTL 2	Understanding
20	Point out some examples for floating point DSPs.	CO 5	BTL 2	Understanding
21	How the DS Processor pipeline differs from micro controller.	CO 5	BTL 2	Understanding
22	Analyze the various addressing modes of TMS32050.	CO 5	BTL 2	Understanding
23	Examine the arithmetic instructions of C5x processor.	CO 5	BTL 2	Understanding
24	Point out some example for floating point DSPs.	CO 5	BTL 2	Understanding
<b>PART – B</b>				
1	List and explain the various types of addressing modes of digital signal processor with suitable example. (16)	CO 5	BTL 3	Applying

2	(i) What are the factors used to select a Digital Signal processor? (6) (ii) Write in detail about few applications of programmable digital signal processor. (10)	CO 5	BTL 3	Applying
3	Summarize a detailed note about arithmetic instructions with necessary syntax. (16)	CO 5	BTL 3	Applying
4	(i) Name the different types of MAC functions in Digital Signal processor. (6) (ii) Describe about VLIW architecture and its advantages and disadvantages. (10)	CO 5	BTL 3	Applying
5	Explain the classification of instructions of TMS320C5X. (16)	CO 5	BTL 4	Analyzing
6	(i) Outline about different stages of pipelining and specify its importance. (8) (ii) Mention the features of Von Neumann and Harvard architectures. (8)	CO 5	BTL 4	Analyzing
7	With neat sketch explain the architecture of TMS320C54x processor. (16)	CO 5	BTL 4	Analyzing
8	(i) Specify the role of accumulator in TMS320C54x processor. (6) (ii) Explain the functionality of barrel shifter in TMS320C54x processor with neat sketch. (10)	CO 5	BTL 4	Analyzing
9	Draw and explain the basic architecture of fixed point processors TMS320C5X. (16)	CO 5	BTL 3	Applying
10	(i) Identify the need of MAC and its application in PDSP's. (8) (ii) List the instruction set of Digital Signal processor. (8)	CO 5	BTL 3	Applying
11	(i) Examine the applications of PDSP's. (8) (ii) Write a simple program to generate square and saw tooth wave form. (8)	CO 5	BTL 3	Applying
12	Illustrate in detail about Arithmetic Logic Unit with neat functional diagram of TMS320C54x. (16)	CO 5	BTL 3	Applying
13	Discuss about the principle of operation of floating point architecture with necessary diagram. (16)	CO 5	BTL 3	Applying
14	Draw and explain the bus structure and CPU of TMS320C50x. (16)	CO 5	BTL 4	Analyzing
15	Explain in detail about the architecture of TMS320C5416 Digital Signal Processor with neat sketches. (16)	CO 5	BTL 4	Analyzing
16	Discuss in detail with syntax for any six instructions used in TMS320C50X processors. (16)	CO 5	BTL 4	Analyzing
17	Write an assembly language program to perform linear and circular convolution through MAC operation in TMS320C5x. (16)	CO 5	BTL 4	Analyzing