SRM VALLIAMMAI ENGINEERING COLLEGE

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

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

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Class	:	**II Year, IV Semester ECE**
Subject Code	:	**EC3465**
Subject Name	:	**DIGITAL SIGNAL PROCESSING**

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UNIT I – DISCRETE FOURIER TRANSFORM

Definition of Discrete Fourier Transform (DFT) -properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast Fourier transform (FFT)- Radix-2 Decimation-in-time (DIT), Decimation-in-frequency (DIF)

	PART – A			
Q.No	Questions	CO	BT Level	Competence
1	Define DFT and IDFT.	CO 1	BTL1	Remembering
2	List any four properties of DFT.	CO 1	BTL2	Understanding
3	Find the 4-point DFT of the sequence x(n) = {1,1,-1,-1}.	CO 1	BTL2	Understanding
4	State and prove periodicity property of DFT.	CO 1	BTL2	Understanding
5	Write the time shifting property of DFT?	CO 1	BTL2	Understanding
6	Express the Parseval's relation of DFT.	CO 1	BTL1	Remembering
7	Describe about relation between Discrete Fourier Transform and Discrete time Fourier Transform.	CO 1	BTL1	Remembering
8	Find the IDFT of the sequence x(n) = {1,0,1,0}.	CO 1	BTL2	Understanding
9	Compute the DFT of $x(n) = \delta(n-n_o)$.	CO 1	BTL2	Understanding
10	Find the DFT of the sequence x(n) = {1,2,3,0} using DIF algorithm.	CO 1	BTL1	Remembering
11	Distinguish between linear convolution and circular convolution?	CO 1	BTL2	Remembering
12	Obtain the circular convolution of $x(n) = \{1,2,3,1\}$; $h(n) = \{4,3,2,1\}$	CO 1	BTL2	Understanding
13	What is zero padding? What are its uses?	CO 1	BTL2	Understanding
14	State about overlap save method.	CO 1	BTL2	Understanding
15	Why FFT is needed?	CO 1	BTL2	Understanding
16	How many multiplications and additions are required to compute N point DFT using radix-2 FFT algorithm?	CO 1	BTL2	Understanding

17	What is meant by in-place computation?	CO 1	BTL2	Understanding
18	Outline the concept of bit reversal in FFT?	CO 1	BTL2	Understanding
19	What are the applications of FFT algorithms?	CO 1	BTL2	Understanding
20	Find the values of W_N^K when N = 8 and K = 2 and for K = 3.	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	BTL1	Remembering
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

<div align="center">PART – B</div>

1	Summarize the following properties of DFT:
	  a. Periodicity (3)
	  b. Time Reversal (4)
	  c. Circular frequency shifting (4)
	  d. Multiplication (4)
		CO 1	BTL3	Applying

2	Illustrate the 8-point DFT of a sequence $x(n) = \left\{\frac{1}{2},\frac{1}{2},\frac{1}{2},\frac{1}{2},0,0,0,0\right\}$ (15)	CO 1	BTL3	Applying
3	Solve the 8-point of a given sequence x$(n) = n + 1$ using DIT FFT algorithm. (15)	CO 1	BTL3	Applying
4	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? (15)	CO 1	BTL3	Applying
5	Apply DIT algorithm to compute DFT of the given sequence x(n) = {1, 1, 1, 1, 0, 0, 0, 0}. (15)	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. (15)	CO 1	BTL3	Applying
7	Construct the circular convolution of two finite duration sequences $x_1(n) = \{1, -1, -2,3, -1\}$; $x_2(n) = \{1,2,3\}$. (15)	CO 1	BTL3	Applying
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. (7)	CO 1	BTL3	Applying
9	Find the 8-point DFT of a given sequence $(n) = \{1,2,2,1,1,2,2,1\}$ using DIF-FFT algorithm. (15)	CO 1	BTL3	Applying
10	Using linear convolution construct $y(n) = x(n) * h(n)$ for the sequence $h(n) = \{1,1,1\}$ and input signal $x(n) =$	CO 1	BTL3	Applying

	{3,−1,0,1,3,2,0,1,2,1} using overlap save method and overlap add method. (15)			
11	Calculate IDFT of the sequence X(K) = {7, −0.707− j0.707, −j ,0.707− 0.707, 1, 0.707+ j0.707, j, −0.707+ j0.707 using DIT algorithm. (15)	CO 1	BTL4	Analyzing
12	Formulate the 8-point DFT using FFT $$x[n] = \begin{cases} 1 & for \quad 0 \le n \le 6 \\ 0 & otherwise \end{cases}$$ (15)	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. (15)	CO 1	BTL3	Applying
14	Compute 8 – point DFT of the sequence x(n) = {0, 1, 2, 3, 4,5, 6, 7} using radix – 2 DIT algorithm. (15)	CO 1	BTL4	Analyzing
15	Examine the 8-point DFT of the sequence $x(n)$ = {2,2,2,2,1,1,1,1} using decimation in time FFT algorithm. (15)	CO 1	BTL3	Applying
16	Find the DFT for the sequence {1,2,3,4,4,3,2,1} using Radix-2 decimation in frequency algorithm. (15)	CO 1	BTL3	Applying
17	(i) State and analyse convolution property of DFT? (7) (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
Butterworth filters, Chebyshev filters. Design of IIR filters from Analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

PART – A			
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
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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	BTL1	Remembering
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	Compare Butterworth with Chebyshev filters.	CO 2	BTL 2	Understanding
16	Justify why the Butterworth response is called a maximally flat response.	CO 2	BTL 2	Understanding
17	List the parameters that can be obtained from Chebyshev filter specification?	CO 2	BTL 1	Remembering
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	Sketch the frequency response of an odd and even order Chebyshev low pass filters.	CO 2	BTL 1	Remembering
22	Compare digital and analog filters.	CO 2	BTL 2	Understanding
23	Determine 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
	PART – B			
1	Enumerate the steps for IIR filter design by impulse invariance with example. (15)	CO 2	BTL2	Remembering
2	i. Convert the analog filter with system function $H_a = \frac{s+0.1}{(s+0.1)^2+9}$ into a digital IIR filter by means of the impulsive invariance method. (7) ii. Convert the analog filter into a digital filter whose system function is $H(s) = \frac{s+0.1}{(s+0.1)^2+9}$ using bilinear transformation technique. The digital filter should have a resonant frequency of $\omega_r = \pi /4$. (8)	CO 2	BTL3	Applying
3	Summarize the steps in the design of IIR filter using bilinear transformation for any one type of filter? (15)	CO 2	BTL3	Applying
4	Obtain a digital Butterworth filter with the following specifications $0.707 \leq \left\|H\left(e^{j\omega}\right)\right\| \leq 1 \quad 0 \leq \omega \leq 0.5\pi$ $\left\|H\left(e^{j\omega}\right)\right\| \leq 0.2 \quad 0.75\pi \leq \omega \leq \pi$	CO 2	BTL4	Analyzing

	using bilinear transformation determine system function $H(Z)$ assuming $T = 1sec$. (15)			
5	Given the specification $\propto_p= 3dB$; $\propto_s= 16dB$; $f_p = 1KHz$; $f_s = 2KHz$. Solve for H(s) using Chebyshev approximation. (15)	CO 2	BTL3	Applying
6	For the given specifications, design an analog Butterworth filter $$0.9 \le |H(j\Omega)| \le 1 \quad for \quad 0 \le \Omega \le 0.2\pi$$ $$|H(j\Omega)| \le 0.2 \quad for \quad 0.4\pi \le \Omega \le \pi \quad (15)$$	CO 2	BTL4	Analyzing
7	Find the system function H(z) of the Chebyshevs low pass digital filter with the specifications $$\propto p= 1dB \; ripple \; in \; the \; pass \; band \; 0 \le \omega \le 0.2\pi;$$ $$\propto s= 15dB \; ripple \; in \; the \; stop \; band \; 0.3\pi \le \omega \le \pi;$$ using bilinear transformation assume $T = 1sec$. (15)	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. (15)	CO 2	BTL4	Analyzing
9	Analyze a digital Chebyshev filter to satisfy the constraints $$0.707 \le |H(e^{j\omega})| \le 1 \quad 0 \le \omega \le 0.2\pi$$ $$|H(e^{j\omega})| \le 0.1 \quad 0.5\pi \le \omega \le \pi$$ using Bilinear transformation and assuming $T = 1sec$. (15)	CO 2	BTL4	Analyzing
10	Design a butterworth digital filter using bilinear transformation to satisfy the constraints $$0.89 \le |H(e^{j\omega})| \le 1 \quad 0 \le \omega \le 0.2\pi$$ $$|H(e^{j\omega})| \le 0.18 \quad 0.3\pi \le \omega \le \pi$$ using Bilinear transformation and assuming $T = 1sec$. (15)	CO 2	BTL3	Applying
11	Explain the conversion of analog BPF into digital IIR filter using backward difference for the derivative $H_a(s) = \frac{1}{(s+0.2)^2+8}$ (15)	CO 2	BTL3	Applying
12	(i) For the given specifications Ap = 3dB, As=15 dB, Ωp =500rad/sec and Ωs=1000rad/sec. Design a high pass filter. (7) (ii) Convert the following analog transfer function into digital using impulse invariant technique with sampling period T=1sec. H(s)=[s+1]/[(s+3)(s+5)] (8)	CO 2	BTL3	Applying
13	For the given specifications, design an digital Butterworth filter using impulse invariance method satisfying the constraints. Assume T=1sec $$0.8 \le |H(e^{j\omega})| \le 1 \quad 0 \le \omega \le 0.2\pi$$ $$|H(e^{j\omega})| \le 0.2 \quad 0.6\pi \le \omega \le \pi \quad (15)$$	CO 2	BTL3	Applying
14	An Analog filter has a transfer function	CO 2	BTL3	Applying

	$$H(s) = \frac{10}{s^2 + 7s + 10}$$ Design a digital filter equivalent to this using impulse invariant method for $T = 0.2sec$. (15)				
15	Summarize the design steps followed by discrete time IIR filter from analog filter. (15)	CO 2	BTL3	Applying
16	Obtain the direct form I, direct form II realization of the following system functions $y[n] = -0.1\,y[n-1] + 0.2\,y[n-2] + 3\,x[n] + 3.6\,x[n-1] + 0.6\,x[n-2]$ (15)	CO 2	BTL2	Understanding
17	Realize the direct form I, direct form II, cascade and parallel form realization of LTI system governed by the equation: $y(n) = -\frac{3}{8} + y(n-1) + \frac{3}{32}\,y(n-2) + \frac{1}{64}\,y(n-3) + x(n) + 3\,x(n-1) + 2\,x(n-2)$ (15)	CO 2	BTL3	Applying

UNIT III - FINITE IMPULSE RESPONSE FILTERS

Design of 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 2	Understanding
7	What is the impulse response condition for a FIR filter to have linear phase characteristics?	CO 3	BTL 2	Understanding
8	Infer the advantages and disadvantages of window.	CO 3	BTL 2	Understanding
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	Points out the desirable characteristics of FIR filter using windows.	CO 3	BTL 2	Understanding

13	Write the general expression of hanning, hamming and rectangular window.	CO 3	BTL 1	Remembering
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 2	Understanding
17	Justify that 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 2	Understanding
22	Illustrate 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
	PART – B			
1	Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n) = h(N - 1 - n)$. (15)	CO 3	BTL 3	Applying
2	Determine the frequency response of linear phase FIR filter when impulse response is symmetrical and N is even. (15)	CO 3	BTL 2	Understanding
3	Obtain the frequency response of linear phase FIR filter when impulse response is antisymmetrical and N is odd. (15)	CO 3	BTL 2	Understanding
4	Find the FIR LPF with cut-off frequency of 1KHz and sampling frequency of 4KHz with 11 samples using Fourier series method. (15)	CO 3	BTL 3	Applying
5	Obtain an ideal low pass filter with a frequency response $$Hd(e^{j\omega}) = \begin{cases} 1 & for & -\frac{\pi}{2} \leq \omega \leq \frac{\pi}{2} \\ 0 & for & \frac{\pi}{2} \leq |\omega| \leq \pi \end{cases}$$ Find the values of $h(n)$ for $N = 11$. Find $H(z)$. Plot the magnitude response. (15)	CO 3	BTL 4	Analyzing
6	Solve and design a FIR filter with the following desired specifications using hanning window with N=5. $$H_d(e^{j\omega}) = \begin{cases} 0 & for & -\frac{\pi}{4} \leq |\omega| \leq \frac{\pi}{4} \\ e^{-j2\omega} & for & \frac{\pi}{4} \leq |\omega| \leq \pi \end{cases}$$ (15)	CO 3	BTL3	Applying
7	Using a rectangular window technique, Illustrate a low pass filter with pass band gain of unity, cut-off frequency of 1000 Hz and	CO 3	BTL 3	Applying

	working at a sampling frequency of 5 KHz. The length of the impulse response should be 7. (15)			
8	By Choosing N = 7, Examine a filter with $$H_d(\omega) = \begin{cases} e^{-j3\omega} \ ; for |\omega| \le \dfrac{\pi}{4} \\ 0 \qquad ; \dfrac{\pi}{4} \le |\omega| \le \pi \end{cases}$$ Using Hamming window. (15)	CO 3	BTL 3	Applying
9	Design a length 5 FIR Band reject filter with a lower cutoff frequency of 2KHz and upper cutoff frequency 2.4KHz and the sampling rate of 8000Hz using Hamming window. (15)	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 $N = 6$. (15)	CO 3	BTL 3	Applying
11	Determine the filter coefficients for an FIR filter approximating the ideal frequency response having N=7 using Hamming window. $$H_d(\omega) = \begin{cases} e^{-j3\omega} \ ; for -\dfrac{3\pi}{4} |\omega| \le \dfrac{3\pi}{4} \\ 0 \qquad ; for \ \dfrac{3\pi}{4} \le |\omega| \le \pi \end{cases}$$ (15)	CO 3	BTL 3	Applying
12	Describe the procedure of designing FIR filters by windows. (15)	CO 3	BTL 2	Understanding
13	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. $$H_r\left(\dfrac{2\pi k}{15}\right) = \begin{cases} 1 & k = 0,1,2,3 \\ 0 & k = 4,5,6,7 \end{cases}$$ (15)	CO 3	BTL3	Applying
14	Obtain the direct form and cascade form realizations of the following system equation $y(n) = \dfrac{3}{4}y(n\text{-}1) \ \text{-} \dfrac{1}{8}y(n\text{-}2) + x(n) + \dfrac{1}{3}x(n\text{-}1)$ (15)	CO 3	BTL4	Analyzing
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. (15)	CO 3	BTL4	Analyzing
16	Illustrate the direct form I & II structure of the system function $H(z) = 1 + 2z^{-1} - 3z^{-2} + 4z^{-3} + 5z^{-4}$ (15)	CO 3	BTL3	Applying
17	Examine 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. $$H_r\left(\dfrac{2\pi k}{15}\right) = \begin{cases} 1 & k = 0,1,2,3 \\ 0.4 & k = 4 \\ 0 & k = 5,6,7 \end{cases}$$ (15)	CO 3	BTL4	Analyzing

UNIT - IV FINITE WORD LENGTH EFFECTS				
Fixed point and floating point number representation - quantization - truncation and rounding - input / output quantization - coefficient quantization error – product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.				
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	BTL2	Understanding
4	Mention the different formats of fixed point representation.	CO 4	BTL2	Understanding
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	BTL1	Remembering
10	Why rounding is preferred over truncation in relating digital filter?	CO 4	BTL2	Understanding
11	What is quantization?	CO 4	BTL1	Remembering
12	What is quantization error?	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	BTL2	Understanding
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	BTL1	Remembering
20	Classify the two kinds of limit cycle behavior in DSP?	CO 4	BTL2	Understanding
21	Infer the dead band of the filter.	CO 4	BTL2	Understanding
22	How overflow limit cycles can be eliminated?	CO 4	BTL2	Understanding
23	Summarize zero input limit cycle oscillations.	CO 4	BTL1	Remembering

24	Which realization is less sensitive to the process of quantization?	CO 4	BTL1	Remembering

<div align="center">PART – B</div>

1	Explain in detail about finite word length effects in digital filters. (15)	CO 4	BTL2	Understanding
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. (15)	CO 4	BTL4	Analyzing
3	For the given transfer function $H(z) = H_1(z).H_2(z)$, 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. (15)	CO 4	BTL3	Applying
4	Consider the transfer function $H(z) = H_1(z).H_2(z)$, 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. (15)	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. (15)	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. (15)	CO 4	BTL4	Analyzing
7	(i) Write a note on Limit Cycle oscillation. (5) (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	BTL2	Understanding
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. (15)	CO 4	BTL2	Understanding
9	(i) Explain in detail the input quantization error and coefficient quantization error and its effect on digital filter design, with an example. (7) (ii) Illustrate quantization noise. Summarize the expression for quantization noise power at the output ADC. (8)	CO 4	BTL2	Understanding
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 from and cascade form. (15)	CO 4	BTL3	Applying
11	Explain the detail the 3 types of quantization error that occur due to the finite word length of register. (15)	CO 4	BTL2	Understanding

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? (15)	CO 4	BTL3	Applying
13	A cascaded realization of the two first order digital filter is shown below. The system functions of the individual sections are $H_1(z) = \frac{1}{1-0.5z^{-1}}$ and $H_2(z) = \frac{1}{1-0.4z^{-1}}$. Draw the product quantization noise model of the system and determine the overall output noise power if b=3 bits (excluding sign bit). (15)	CO 4	BTL3	Applying
14	In the IIR system given below the products are rounded to 4 bits (including sign bits). The system function is $$H(Z) = \frac{1}{(1 - 0.35z^{-1})(1 - 0.62z^{-1})}$$ Find the output round off noise power in (a) direct form realization and (b) cascade form realization. (15)	CO 4	BTL3	Applying
15	The input to the system $y(n) = 0.999y(n-1) + x(n)$ is applied to an ADC. Calculate the power produced by the quantization noise at the output of the filter if the input is quantized to 8 & 16 bits. (15)	CO 4	BTL4	Analyzing
16	(i) Express decimal fraction 4.5, 6.5 and 1.5 in binary floating point format. (9) (ii) Compare fixed and floating point representation. (6)	CO 4	BTL3	Applying
17	(i) What are the errors occurred during resulting from truncation and rounding? Explain. (10) (ii) Describe the various formats of the fixed point representation of binary numbers. (5)	CO 4	BTL2	Understanding

PART –C

	UNIT V - INTRODUCTION TO DIGITAL SIGNAL PROCESSORS			
	DSP functionalities - DSP architecture – Fixed and Floating point architecture (TMS320C5X and TMS320C6X) principles – Programming – Application examples			
	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 2	Understanding
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	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	Choose the features to select digital signal processor.	CO 5	BTL 2	Understanding
14	Illustrate the need of accumulator.	CO 5	BTL 2	Understanding
15	Identify any two logical instruction of DS processor.	CO 5	BTL 1	Remembering
16	Specify the features of a Digital Signal Processor over Microcontroller?	CO 5	BTL 2	Understanding
17	List out the major functional units present in TMS32050.	CO 5	BTL 1	Remembering
18	Classify the types of special purpose DSP processors.	CO 5	BTL 2	Understanding
19	Write a program to add to numbers in DSP Processor.	CO 5	BTL 2	Understanding
20	Distinguish between fixed and floating point arithmetic?	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 1	Remembering
PART – B				
1	List and explain the various types of addressing modes of digital signal processor with suitable example. (15)	CO 5	BTL 3	Applying
2	(i) What are the factors used to select a Digital Signal processor? (5) (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. (15)	CO 5	BTL 2	Understanding
4	(i) Name the different types of MAC functions in Digital Signal processor. (5) (ii) Describe about VLIW architecture and its advantages and disadvantages. (10)	CO 5	BTL 2	Understanding
5	Explain the classification of instructions of TMS320C5X. (15)	CO 5	BTL 3	Applying
6	(i) Outline about different stages of pipelining and specify its importance. (8) (ii) Mention the features of Von Neumann and Harvard architectures. (7)	CO 5	BTL 3	Applying

7	With neat sketch explain the architecture of TMS320C54x processor. (15)	CO 5	BTL 3	Applying
8	(i) Specify the role of accumulator in TMS320C54x processor. (5) (ii) Explain the functionality of barrel shifter in TMS320C54x processor with neat sketch. (10)	CO 5	BTL 2	Understanding
9	Draw and explain the basic architecture of fixed point processors TMS320C5X. (15)	CO 5	BTL 2	Understanding
10	(i) Identify the need of MAC and its application in PDSP's. (10) (ii) List the instruction set of Digital Signal processor. (5)	CO 5	BTL 2	Understanding
11	(i) Examine the applications of PDSP's. (5) (ii) Write a simple program to generate square and saw tooth wave form. (10)	CO 5	BTL 2	Understanding
12	Illustrate in detail about Arithmetic Logic Unit with neat functional diagram of TMS320C54x. (15)	CO 5	BTL 3	Applying
13	Discuss about the principle of operation of floating point architecture with necessary diagram. (15)	CO 5	BTL 3	Applying
14	Draw and explain the bus structure and CPU of TMS320C50x. (15)	CO 5	BTL 2	Understanding
15	Enumerate the various on chip peripherals in TMS320C54x processor. (15)	CO 5	BTL 3	Applying
16	Examine about CSSU and Exponent encoder of TMS320C54x. (15)	CO 5	BTL 3	Applying
17	Write an assembly language program to generate a triangular and saw tooth waveform in TMS320C5X. (15)	CO 5	BTL 3	Applying