SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

QUESTION BANK

Regulation	:	**2019**
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Class	:	**III Year, V Semester ECE**
Subject Code	:	**1906002**
Subject Name	:	**Discrete Time Signal Processing**

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UNIT I – DISCRETE FOURIER TRANSFORM

Review of signals and systems, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

PART – A

Q. No	Questions	BT Level	Competence
1	How will you perform linear convolution using circular convolution?	BTL1	Remembering
2	What is the relation between Discrete Fourier Transform and Discrete time Fourier Transform	BTL2	Understanding
3	Test the causality and stability of $x(n) = \sin(n)$.	BTL4	Analyzing
4	Compare energy and power signal of Discrete time signal	BTL4	Analyzing
5	Write short notes on overlap save method.	BTL1	Remembering
6	Distinguish between linear convolution and circular convolution?	BTL4	Analyzing
7	Write the time shifting property of DFT?	BTL1	Remembering
8	Define the Parseval's relation of DTFT.	BTL1	Remembering
9	State and prove periodicity property of DFT.	BTL5	Evaluating
10	Obtain the circular convolution of $x(n) = \{1,2,3,4\}$; $h(n) = \{1,1,2,2\}$	BTL3	Applying
11	Define zero padding? What are its uses?	BTL2	Understanding
12	Compute the DFT of $x(n)= \delta(n-n0)$.	BTL3	Applying
13	Write down the usage of in-place computation in FFT?	BTL1	Remembering

14	Mention the advantages of FFT over DFT.	BTL3	Applying
15	How many stages of decimations are required in the case of a 64point radix-2 DIT FFT algorithm?	BTL6	Creating
16	Define the term bit reversal as applied to FFT?	BTL2	Understanding
17	Draw the basic butterfly diagram of radix-2 DIT FFT.	BTL6	Creating
18	Write are the differences and similarities between DIT and DIF.	BTL2	Understanding
19	What is twiddle factor?	BTL1	Remembering
20	Calculate the number of multiplications required in the computation of 8-point DFT using FFT.	BTL5	Evaluating
	PART – B		
1	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? (13)	BTL2	Understanding
2	Illustrate the 8-point DFT of a sequence $x(n) = \left\{\frac{1}{2}, \frac{1}{2}, \frac{1}{2}, \frac{1}{2}, 0,0,0,0\right\}$ (13)	BTL1	Remembering
3	Explain the following properties of DFT: Periodicity, Time Reversal, Circular frequency shifting & Multiplication. (13)	BTL2	Understanding
4	Find 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. (13)	BTL4	Analyzing
5	Obtain 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 add method. (13)	BTL6	Creating
6	Compute the circular convolution of two finite duration sequences using concentric circle method $x_1(n) = \{1, -1, -2, 3, -1\}$; $x_2(n) = \{1,2,3\}$. (13)	BTL5	Evaluating
7	(i) Show that FFT algorithm helps in reducing the number of computations involved in DFT computation. (7) (ii) Discuss about overlap add method for convolution. (6)	BTL4	Analyzing
8	Find the 8-point DFT of a given sequence $(n) = \{1,2,2,1,1,2,2,1\}$ using DIF-FFT algorithm. (13)	BTL1	Remembering
9	(i) Derive the steps for radix-2 DIT FFT algorithm. (7) (ii) Solve the 8-point of a given sequence $x(n) = n + 1$ using DITFFT algorithm. (6)	BTL2	Understanding
10	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. (13)	BTL3	Applying
11	Compute the DFT of the sequence $x(n) = cos\frac{n\pi}{2}$ where $N = 4$ using DIF FFT algorithm. (13)	BTL3	Applying

12	Compute 8 – point DFT of the sequence x(n) = {0, 1, 2, 3, 4,5, 6, 7} using radix – 2 DIT algorithm? (9)	BTL1	Remembering
13	Solve the DFT for the sequence {1,2,3,4,4,3,2,1} using Radix-2 Decimation in Frequency algorithm. (13)	BTL3	Applying
14	(i)Derive decimation-in-frequency, radix-2, FFT algorithm for evaluating DFT. (9) (ii) Find circular convolution of the sequences x_1={1,1,2,1} and x_2={1,2,3,4}. (4)	BTL1	Remembering
	PART – C		
1	(i) Apply DIT algorithm to compute DFT of the given sequence. x(n) = {1, 1, 1, 1, 0, 0, 0, 0}. (12) (ii) The first five points of the 8-point DFT of a real valued sequence are {0.25,0.125-j0.3018,0,0.12-j0.0518,0}. Determine the remaining three points (3)	BTL5	Evaluating
2	Determine the DFT of the sequence $x[n] = \{1,2,3,2,1,0\}$ (15)	BTL5	Evaluating
3	Find the 8-point DFT using FFT $x[n] = \begin{cases} 1 & for \quad 0 \le n \le 6 \\ 0 & otherwise \end{cases}$ (15)	BTL6	Creating
4	Solve the 8 point DFT for the given sequence using DIT FFT algorithm $x[n] = \begin{cases} 1 & for \quad -3 \le n \le 3 \\ 0 & otherwise \end{cases}$ (15)	BTL6	Creating

UNIT II – INFINITE IMPULSE RESPONSE FILTERS

Characteristics of practical frequency selective filters. Characteristics of commonly used analog filters - Butterworth filters, Chebyshev 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	BT Level	Competence
1	Compare bilinear transformation and Impulse invariant method of IIR filter design	BTL 2	Understanding
2	Distinguish between recursive realization and non-recursive realization?	BTL 2	Understanding
3	Convert the given analog transfer function $H(s) = \frac{1}{s+a}$ into digital by impulse invariant method?	BTL 3	Applying
4	List the different types of filters based on frequency response.	BTL 1	Remembering
5	Write the properties of Butterworth filter.	BTL 1	Remembering

6	Justify why impulse invariant method is not preferred in the design of IIR filter other than LPF?	BTL 4	Analyzing
7	Give the expression for location of poles of normalized Butterworth filter.	BTL 1	Remembering
8	Why do we go for analog approximation to design a digital filter?	BTL 3	Applying
9	List the steps in design of a digital filter from analog filters.	BTL 2	Understanding
10	State the conditions for a digital filter to be causal and stable?	BTL 1	Remembering
11	What is the need for prewarping.	BTL 2	Understanding
12	What are the properties of bilinear transformation.	BTL 1	Remembering
13	Use the backward difference for the derivative to convert analog LPF with system function $\mathrm{H}(s) = \frac{1}{s+3}$	BTL 3	Applying
14	Compare Butterworth with Chebyshev filters.	BTL 4	Analyzing
15	Justify why the Butterworth response is called a maximally flat response.	BTL 4	Analyzing
16	What are the parameters that can be obtained from Chebyshev filter specification?	BTL 6	Creating
17	What is the advantage of direct form II realization when compared to direct form I realization?	BTL 1	Remembering
18	How to represent the frequency warping in IIR filter?	BTL 5	Evaluating
19	Compute the expression for location of poles of normalized Butterworth filter?	BTL 6	Creating
20	Sketch the frequency response of an odd and even order Chebyshev low pass filters.	BTL 5	Evaluating
	PART – B		
1	(i) Explain the impulse invariant method of designing IIR filter. (ii) Obtain a second order digital low pass Butterworth filter with a cut-off frequency 3.4 KHz at a sampling rate of 8 KHz using bilinear transformation.	BTL1	Remembering
2	Realize the direct form I ,direct form II and cascade form of the following system functions $y[n] = 0.1\, y[n-1] + 0.2\, y[n-2] = 3\, x[n] + 3.6\, x[n-1] + 0.6\, x[n-2]$ (13)	BTL 5	Evaluating
3	Explain the bilinear transform method of IIR filter design. What is wrapping effect? Explain the poles and zeros mapping procedure clearly. (13)	BTL1	Remembering
4	Find the system function H(z) of the Chebyshev 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 Impulse Invariant transformation assume $T = 1sec$. (13)	BTL3	Applying

5	Determine and realise a Chebyshev filter using Bilinear Transformation for the following specifications. Monotonic pass band and stop band -3.01 dB cut off at 0.5π rad magnitude down atleast 15dB at ω=0.75 π rad.	BTL1	Remembering
6	Design a digital Butterworth filter with the following specifications : $$0.707 \le \left\|H\left(e^{j\omega}\right)\right\| \le 1 \qquad 0 \le \omega \le 0.5\pi$$ $$\left\|H\left(e^{j\omega}\right)\right\| \le 0.2 \qquad 0.75\pi \le \omega \le \pi$$ using Bilinear Transformation determine system function $H(Z)$ assuming $T = 1sec.$ (15)	BTL6	Creating
7	Convert the analog filter into a digital filter whose system function is $H(s) = \frac{s+0.2}{(s+0.2)^2+9}$ Use impulse invariance technique. Assume $T = 1sec.$ (13)	BTL3	Applying
8	Realize a cascade and parallel realization for the system having difference equation y(n)+0.1y(n-1)-0.2y(n-2)=3x(n)+3.6x(n-1)+0.6x(n-2) (15)	BTL 5	Evaluating
9	Design a digital Chebyshev filter to satisfy the constraints $$0.707 \le \left\|H\left(e^{j\omega}\right)\right\| \le 1 \qquad 0 \le \omega \le 0.2\pi$$ $$\left\|H\left(e^{j\omega}\right)\right\| \le 0.1 \quad 0.5\pi \le \omega \le \pi$$ using Bilinear transformation and assuming $T = 1sec$. (13)	BTL6	Creating
10	Explain the conversion of analog BPF into digital IIR filter using backward difference for the derivative $H_a(s) = \frac{1}{(s+0.2)^2+8}$ (13)	BTL 2	Understanding
11	Using Bilinear transformation to determine H(z) for Butterworth filter satisfying the following specifications. $$0.8 \le \left\|H\left(e^{j\omega}\right)\right\| \le 1 \qquad 0 \le \omega \le \pi/4$$ $$\left\|H\left(e^{j\omega}\right)\right\| \le 0.2 \qquad \pi/2 \le \omega \le \pi$$ (13)	BTL4	Analyzing
12	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 $T = 1sec.$ (13)	BTL3	Applying
13	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 $T = 0.2sec.$ (13)	BTL3	Applying
14	Obtain a third order Butterworth digital filter using impulse invariant technique. Assume the sampling period $T = 1sec$	BTL4	Analyzing
	Part C		
1	Obtain the direct form I, direct form II, cascade and parallel form structure of LTI system governed by the equation:	BTL 5	Evaluating

	$y(n) = -\frac{3}{8} + y(n-1) + \frac{3}{32}\, y(n-2) + \frac{1}{64}\, y(n-3) + x(n) + 3\, x(n-1) + 2\, x(n-2)$ (15)		
2	Design a digital Butterworth filter with the following specifications : $0.707 \le \lvert H(e^{j\omega}) \rvert \le 1 \quad 0 \le \omega \le 0.5\pi$; $\lvert H(e^{j\omega}) \rvert \le 0.2 \quad 0.75\pi \le \omega \le \pi$ using Impulse Invariant Transformation determine system function $H(Z)$ assuming $T = 1sec$. (15)	BTL6	Creating
3	Determine the system function H(z) of the Chebshev filter that meets following specifications using Bilinear Transformation $0.8 \le \lvert H(e^{j\omega}) \rvert \le 1 \quad 0 \le \omega \le 0.2\pi$; $\lvert H(e^{j\omega}) \rvert \le 0.2 \quad 0.6\pi \le \omega \le \pi$ (15)	BTL 5	Evaluating
4	Design a Chebshev filter for the following specifications using Impulse Invariant method $0.8 \le \lvert H(e^{j\omega}) \rvert \le 1 \quad 0 \le \omega \le 0.2\pi$; $\lvert H(e^{j\omega}) \rvert \le 0.2 \quad 0.6\pi \le \omega \le \pi$ (15)	BTL 6	Creating

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	BT Level	Competence
1.	Name the different types of filters based on frequency response.	BTL 1	Remembering
2.	List the advantages of FIR filters.	BTL 2	Understanding
3.	What are the necessary and sufficient condition for the linear phase characteristic of an FIR filter.	BTL 2	Understanding
4.	Draw the frequency response of linear phase LTI system with constant phase delay and constant group delay.	BTL 6	Creating
5.	How are phase distortions and delay distortion introduced?	BTL 3	Applying
6.	Mention the significance of linear phase response.	BTL 1	Remembering
7.	State the conditions for a digital filter to be causal and stable.	BTL 1	Remembering
8.	Write the two concepts that lead to the Fourier series method for designing FIR filters.	BTL 3	Applying
9.	Write the Hanning window sequence for the design of FIR filter.	BTL 3	Applying

10.	Define Gibbs phenomenon.	BTL 1	Remembering
11.	State the need for employing window technique for FIR filter design?	BTL 2	Understanding
12.	What are the desirable characteristics of FIR filter using windows?	BTL 1	Remembering
13.	Sketch the frequency response of N-point rectangular windows.	BTL 5	Evaluating
14.	Compare Hamming and Hanning window.	BTL 4	Analyzing
15.	List the features of FIR filter using rectangular window.	BTL 2	Understanding
16.	Distinguish between IIR and FIR filter.	BTL 4	Analyzing
17.	Justify that frequency-sampling method is suitable for narrow band filters.	BTL 4	Analyzing
18.	Draw the direct form realization of FIR filter.	BTL 6	Creating
19.	What is the reason that FIR filter is always stable?.	BTL 1	Remembering
20.	Realize the following causal linear phase FIR system function $H(z)=2/3 + z^{-1}+(2/3)z^{-2}$	BTL 5	Evaluating
	PART – B		
1.	Prove that an FIR filter has linear phase if the unit sample response satisfies the condition $h(n) = h(N-1-n)$. Also discuss symmetric and antisymmetric case of FIR filter when N is even. (13)	BTL 4	Analyzing
2.	Design an ideal low pass filter with a frequency response $$Hd(e^{j\omega}) = \begin{cases} 1 & for \quad -\frac{\pi}{2} \le \omega \le \frac{\pi}{2} \\ 0 & for \quad \frac{\pi}{2} \le \lvert\omega\rvert \le \pi \end{cases}$$ Find the values of $h(n)$ for $N = 11$. Find $H(z)$. (13)	BTL 6	Creating
3.	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. (13)	BTL 2	Understanding
4.	By Choosing N = 7,design a filter with $$Hd(\omega) = \begin{cases} e^{-j3\omega} & ; for \lvert\omega\rvert \le \frac{\pi}{4} \\ 0 & ; \frac{\pi}{4} \le \lvert\omega\rvert \le \pi \end{cases}$$ Using Hamming window. (13)	BTL 3	Applying
5.	(i) A band reject filter of length 7 is required it is to have lower and upper cut off frequencies of 3kHz and 5 kHz respectively. The sampling frequency is 20 kHz. Derive the filter coefficient using hanning window. (11) (ii) Illustrate the frequency domain characteristics for Rectangular and Hanning Window. (2)	BTL 4	Analyzing

6.	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 $N = 6$. (13)	BTL 2	Understanding
7.	Design an FIR filter approximating the ideal frequency response $H_d(\omega) = \begin{cases} e^{-j\alpha\omega} ; for \lvert\omega\rvert \le \frac{\pi}{6} \\ 0 \quad ; \frac{\pi}{6} \le \lvert\omega\rvert \le \pi \end{cases}$ Determine the filter coefficients for N=7 using Hamming window. (13)	BTL 2	Understanding
8.	Illustrate the procedure of designing FIR filters by windows. (13)	BTL 1	Remembering
9.	Design a low pass filter using frequency sampling method with the following specifications; cut off frequency $\omega_C = \pi/4$ and N=15 and plot the magnitude response. (13)	BTL 6	Creating
10.	A low pass filter is to be designed with the following desired frequency response. $H_d(e^{j\omega}) = e^{-j2\omega}, \lvert\omega\rvert \le \pi/4$ $0 , \quad \pi/4 < \lvert\omega\rvert \le \pi$ Determine the filter coefficients $h_d(n)$ if the window function is defined as $\omega(n) = 1, 0 \le n \le 4$ 0, otherwise	BTL 1	Remembering
11.	Explain the design procedures of FIR filter using frequency-sampling method. (13)	BTL 1	Remembering
12.	Realize the direct form I & II structure of the system function $H(z) = 1 + 2z^{-1} - 3z^{-2} + 4z^{-3} + 5z^{-4}$ (13)	BTL 5	Evaluating
13.	What is the need for realization of FIR filters?. Explain about the different types of linear phase FIR structures. (13)	BTL 1	Remembering
14.	Obtain a direct form and linear phase FIR structures with the following impulse response. Which is the best realization and why? $h(n) = \delta(n) + \frac{1}{3}\delta(n-1) - \frac{1}{4}\delta(n-2) + \frac{1}{3}\delta(n-3) + \delta(n-4)$. (13)	BTL 3	Applying
	PART - C		
1.	Design a filter using Hamming window with the specification N=7 of the system $H_d(e^{jw}) = e^{-j3w}, \lvert w\rvert \le (\pi/4);$ $0 \quad (\pi/4) \le \lvert w\rvert \le \pi$ otherwise zero	BTL 6	Creating

2.	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. (15)	BTL 5	Evaluating
3.	Design an ideal high pass filter using Hanning window with the specification N=11 of the system $$H_d(e^{j\omega}) = \begin{cases} 1 & for\ \frac{\pi}{4} \le \lvert\omega\rvert \le \pi \\ 0 & for\ \ \ \ \lvert\omega\rvert \le \frac{\pi}{4} \end{cases}$$ (15)	BTL 6	Creating
4.	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. $$H_r\left(\frac{2\pi k}{15}\right) = \begin{Bmatrix} 1 & k = 0,1,2,3 \\ 0 & k = 4,5,6,7 \end{Bmatrix}$$ (15)	BTL 5	Evaluating

UNIT - IV FINITE WORD LENGTH EFFECTS

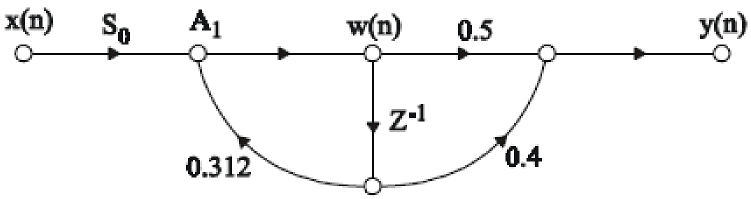
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation -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

PART – A

Q.No	Questions	BT Level	Competence
1.	List the different types of fixed point arithmetic.	BTL1	Remembering
2.	Define truncation.	BTL1	Remembering
3.	What are the causes of round off noise error.	BTL1	Remembering
4.	Write about the over flow oscillations.	BTL 1	Remembering
5.	What is meant by dead band of a filter?	BTL1	Remembering
6.	State the saturation arithmetic.	BTL1	Remembering
7.	Define product quantization error.	BTL2	Understanding
8.	How the digital filter is affected by quantization of filter coefficients?	BTL2	Understanding
9.	What are the causes of limit cycle oscillations?	BTL2	Understanding
10.	How the sensitivity of frequency response to quantization of filter coefficients is minimized?	BTL2	Understanding
11.	Write down the differences between fixed point and floating point number representations.	BTL3	Applying

12.	Define zero input limit cycle oscillation.	BTL3	Applying
13.	List the methods to eliminate overflow limit cycles.	BTL3	Applying
14.	Differentiate truncation with rounding errors.	BTL4	Analyzing
15.	What are the effects of finite word length in digital filters.	BTL4	Analyzing
16.	List the different quantization methods.	BTL4	Analyzing
17.	Why is rounding preferred over truncation in realizing digital filter.	BTL5	Evaluating
18.	What are the advantages of floating point arithmetic.	BTL5	Evaluating
19.	Mention the types of quantization errors occur in digital system.	BTL6	Creating
20.	Express truncation error for sign magnitude representation and for 2's complement representation.	BTL6	Creating
	PART – B		
1.	(i) Explain in detail about finite word length effects in digital filters. (6) (ii) Determine the variance of the round of noise power at the output of cascade realization of the filter is as described by the transfer function $H(z) = H_1(z)H_2(z)$.Where $H_1(z) = \frac{1}{1-0.5z^{-1}}$ *and* $H_2(z) = \frac{1}{1-0.25z^{-1}}$. (7)	BTL1	Remembering
2.	Describe the quantization process and errors introduced due to quantization. (13)	BTL1	Remembering
3.	For the second order IIR filter, the system function is, $$H(Z) = \frac{1}{(1-0.5z^{-1})(1-0.45z^{-1})}$$ Explain the effect of shift in pole location with 3 bit coefficient representation in direct and cascade forms. (13)	BTL1	Remembering
4.	(i) Write a note on Limit Cycle oscillation. (3) (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)	BTL1	Remembering
5.	(i) Explain the characteristics of a limit cycle oscillation with respect to the system described by the equation $y(n) = 0.95y(n-1) + x(n)$. Calculate the dead band of the filter. (Assume sign magnitude is 4 bit). (7) (ii) Illustrate the Zero input limit cycle oscillation. (6)	BTL2	Understanding

6.	(i)Explain in detail the input quantization error and coefficient quantization error and its effect on digital filter design, with an example. (6) (ii) Define quantization noise and derive the expression for quantization noise power at the output ADC. (7)	BTL2	Understanding
7.	Explain the need for scaling and derive the scaling factor for a second order IIR filter. (13)	BTL2	Understanding
8.	Consider the recursive filter y(n)= 0.8y(n-1)+x(n). The input x(n) has a range of values $\pm 100V$ represented by 8 bits. Compute the variance of the output due to Analog to Digital conversion system. (13)	BTL3	Applying
9.	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. Prove that under those stated conditions, the filter output exhibits dead band effect. What is the dead band range? (13)	BTL3	Applying
10.	An LTII system is characterized by the difference equation, $y(n) = 0.87\, y(n-1) + x(n)$. Determine the limit cycle behavior and dead band of the system when $x(n) = 0$ and $y(-1) = 0.61$. Assume that the product is quantized to 4 bits by rounding. (13)	BTL4	Analyzing
11.	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. (13)	BTL4	Analyzing
12.	(i) Represent the following numbers in floating point format with five bits for mantissa and three bits for exponent. (a) 7_{10} (4) (b)0.25_{10} (3) (ii) Compare fixed and floating point representation. (6)	BTL4	Analyzing
13.	(i)Determine the errors during resulting from truncation and rounding. (10) (ii)Explain the various formats of the fixed point representation of binary numbers. (3)	BTL5	Evaluating
14.	Derive the steady state output noise power and find the steady state variance of the noise in the output due to quantization of input for the first order filter $y(n) = a\, y(n-1) + x(n)$. (13)	BTL6	Creating
	PART –C		

1.	The output of an A/D converter is applied to a digital filter with the system function; $H(z) = \frac{0.5z}{z-0.5}$. Compute the output noise power from the digital filter when the input signal is quantized to have 8 bits. (15)	BTL6	Creating
2.	i) For the digital network shown find H(Z) and scale factor S_0 to avoid overflow in register A_1 (10)  (ii)Explain the need for signal scaling with necessary derivations (5)	BTL5	Evaluating
3.	Discuss the effect of coefficient quantization on pole locations of the second order IIR system realised in Direct Form I and in Cascade. Assume word length of 4 bits through truncation. The transfer function of the realization is given as follows. $H(z) = \frac{1}{1-0.9z^{-1}+0.2z^{-2}}$ (15)	BTL5	Evaluating
4.	Consider the transfer function where $H(z) = H_1(z)H_2(z)$ Let $H(z) = H_1(z)H_2(z)$ i.e., $H_1(z) = \frac{1}{1-0.5z^{-1}}$ and $H_2(z) = \frac{1}{1-0.4z^{-1}}$ Find the output round off noise power. Assume b = 3. (excluding Sign Bit) (15)	BTL6	Creating

UNIT V - INTRODUCTION TO DIGITAL SIGNAL PROCESSORS			
DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.			
PART – A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	List the applications of DSP.	BTL 1	Remembering
2.	What is the role of the pipeline operation in a Digital Signal Processor?	BTL 1	Remembering
3.	Mention the buses used in digital signal processors?	BTL 1	Remembering
4.	Define circular buffering.	BTL 1	Remembering
5.	List the features of MAC unit.	BTL 1	Remembering
6.	Classify the instruction sets in Digital Signal Processor?	BTL 1	Remembering
7.	What are the different phases used in pipelining process?	BTL 2	Understanding

8.	Compare the difference between Von Neumann architecture & Harvard architecture.	BTL 2	Understanding
9.	Mention the advantages and disadvantages of VLIW architecture.	BTL 2	Understanding
10.	Classify the any four addressing modes of TMS320C54XX	BTL 4	Analyzing
11.	What is the need of accumulator?	BTL 3	Applying
12.	List any two logical instruction of DS processor.	BTL 3	Applying
13.	Specify the features of a Digital Signal Processor over Microcontroller?	BTL 3	Applying
14.	Write a program to add to numbers in DSP Processor.	BTL 6	Creating
15.	Distinguish between fixed and floating point arithmetic?	BTL 4	Analyzing
16.	How the DS Processor pipeline differs from micro controller.	BTL 5	Evaluating
17.	List out any four features to select digital signal processor.	BTL 5	Applying
18.	Classify the any four addressing modes of TMS32050.	BTL 4	Analyzing
19.	What are the arithmetic instructions of C5x processor.	BTL 1	Remembering
20.	List the major functional units present in TMS32050.	BTL 2	Understanding
	PART – B		
1.	List and explain the various types of addressing modes of digital signal processor with suitable example. (13)	BTL 1	Remembering
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. (8)	BTL 1	Remembering
3.	Give a detailed note about arithmetic instructions with necessary syntax (13)	BTL 1	Remembering
4.	(i) Name the different types of MAC functions in Digital Signal processor. (3) (ii) Describe about VLIW architecture and its advantages and disadvantages. (10)	BTL 1	Remembering
5.	(i) Explain about different stages of pipelining and specify its importance. (6) (ii) Discuss about the features of Von Neumann and Harvard architectures. (7)	BTL 2	Understanding
6.	With neat sketch and explain the architecture of TMS320C54x processor. (13)	BTL 2	Understanding
7.	(i) Discuss about the role of accumulator in TMS320C54x processor. (5) (ii) Explain the functionality of barrel shifter in TMS320C54x processor with neat sketch. (8)	BTL 2	Understanding
8.	(i) Explain the need of MAC and its application in PDSP's. (8) (ii) Classify the instruction set of Digital Signal processor and Explain (5)	BTL 3	Applying
9.	(i) Write down the applications of PDSP's. (5) (ii) Write a simple program to generate square and saw tooth wave form. (8)	BTL 3	Applying

10.	Draw and explain the bus structure and CPU of TMS320C50x .(13)	BTL 4	Analyzing
11.	Illustrate about on chip peripherals used in TMS320C54x processor. (13)	BTL 4	Analyzing
12.	Explain about CSSU and Exponent encoder of TMS320C54x. (13)	BTL 4	Analyzing
13.	Discuss about Arithmetic Logic Unit with neat functional diagram of TMS320C54x (13)	BTL 5	Evaluating
14.	Describe about the principle of operation of floating point architecture with necessary diagram. (13)	BTL 6	Creating
	PART C		
1.	Explain in detail about the architecture of TMS 320C5416 Digital Signal Processor with neat sketches. (15)	BTL 6	Creating
2.	Discuss in detail with syntax for any six instructions used in TMS320C50X processors. (15)	BTL 5	Evaluating
3.	Write a suitable algorithm and illustrate the memory access used to calculate the value of the function $Y= A*X_1+B*X_2+C*X_3$. and also write the necessary assembly code in TMS320C50 processor. (15)	BTL 6	Creating
4.	With neat functional diagram elaborate the following features of TMS320C54X : (i) Multiplier / Adder Unit (8) (ii) Barrel Shifter (7)	BTL 5	Evaluating