SRM VALLIAMMAI ENGINEERING COLLEGE

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEEING

QUESTION BANK

SUBJECT: EE8591–DIGITAL SIGNAL PROCESSING **SEM / YEAR: V / III**

UNIT I - INTRODUCTION

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

PART –A

Q.No	Questions	BT Level	Competence
1.	How do you relate discrete signal with digital signal representation?	BTL3	Apply
2.	What is an LTI system?	BTL1	Remember
3.	Why Linear and Time Invariant(LTI) systems are widely used in digital signal processing applications?	BTL2	Understand
4.	Test whether the system governed by the relation $y(n) = \sum_{k=-\infty}^{n} x(k)$ is linear time invariant or not?	BTL4	Analyze
5.	Define BIBO stable.	BTL1	Remember
6.	Check if the system described by the difference equation $y(n) - ay(n-1) + x(n)$with $y(0) = 1$ is stable.	BTL4	Analyze
7.	If$x(n) = x(n+1) + x(n+2)$, is the system causal?	BTL4	Analyze
8.	Check if the system $y(n) = ax(n) + b$ is linear.	BTL4	Analyze
9.	What is meant by spectral density?	BTL1	Remember
10.	Differentiate between Energy and Power signals.	BTL2	Understand
11.	Determine $x(n) = u(n)$ is a power signal or an energy signal.	BTL5	Evaluate
12.	Determine whether the signal $x(n) = e^{j(\frac{\pi}{2}n + \pi/4)}$ is an energy signal or a power signal.	BTL5	Evaluate
13.	Give any two differences between deterministic signal and random signal with an example.	BTL2	Understand
14.	If the finite duration sequence is, $x(n) = \{2, 4, -1, -2\}$, What is its representation as a weighted sum of impulse?	BTL6	Create
15.	State Shannon's sampling theorem and Nyquist rate.	BTL1	Remember
16.	What is Quantization error?	BTL1	Remember
17.	List the sampling techniques.	BTL2	Understand
18.	Given a continuous signal $x(t) = 2cos300\pi t$. Identify the Nyquist rate and fundamental frequency of the signal.	BTL3	Apply
19.	What is meant by aliasing effect and anti-aliasing effect?	BTL1	Remember
20.	Calculate the Nyquist rate for the following signal $x(t) = 1 + 2cos1000\pi t - \sin 500\pi t$.	BTL3	Apply

PART – B			
1.	Explain the classification of continuous time signals with its mathematical representation. **(13)**	**BTL1**	Remember
2.	**(i)** Describe the digital signal processing system with necessary sketches and give its merits and demerits. **(7)**	**BTL1**	Remember
	(ii) Determine the stability for each of the following linear systems: **a)** $y_1(n) = \sum_{k=0}^{\infty} \left(\frac{3}{4}\right)^k x(n-k)$ **b)** $y_2(n) = \sum_{k=0}^{\infty} 2^k x(n-k)$ **(3+3)**	**BTL5**	Evaluate
3.	Describe the different types of system and write the condition to state the system with its types. **(13)**	**BTL2**	Understand
4.	**(i)** Check the causality and stability of the systems $y(n) = x(-n) + x(n-2) + x(2n-1)$. **(7)**	**BTL4**	Analyze
	(ii) Check the system for linearity and time variance $y(n) = (n-1)x^2(n) + C$. **(6)**	**BTL4**	Analyze
5.	A discrete time system is represented by the following difference equation in which $x(n)$ is input and $y(n)$ is output $y(n) = 3y(n-1) - nx(n) + 4x(n-1) + 2x(n-1); and n \geq 0$.Is this system linear? Shift invariant? Causal? In each case, justify your answer. **(13)**	**BTL2**	Understand
6.	**(i)** Illustrate about the properties of discrete time sinusoidal signals and continuous time sinusoidal signal. **(5)**	**BTL3**	Apply
	(ii) Analyze whether the following system is linear, time varying, causal and stable $y(n) = nx^2(n)$. **(8)**	**BTL 4**	Analyze
7.	Distinguish the following with examples and formulae **(i)** Energy Vs power signal **(ii)** Time variant Vs time invariant system. **(6+7)**	**BTL2**	Understand
8.	**(i)** Find the impulse response of a discrete time invariant system whose difference equation is given by $y(n) = y(n-1) + 0.5y(n-2) + x(n) + x(n-1)$. **(7)**	**BTL5**	Evaluate
	(ii) Determine whether or not each of the following signals is periodic. If the signal is periodic, specify its fundamental period. **a)** $x(n) = e^{j6\pi n}$ **b)** $x(n) = cos\frac{\pi}{3}n + cos\frac{3\pi}{4}n$ **(3+3)**	**BTL5**	Evaluate
9.	Determine the power and energy of given signal. State the signal is power or energy $x(n) = sin\frac{\pi}{4}n$ **(13)**	**BTL5**	Evaluate
10.	Determine whether the following discrete time system is static, causal, linear, shift invariant and stable $y(n) = x\left(\frac{n}{2}+1\right) + x(n-1)$ **(13)**	**BTL5**	Evaluate
11.	**(i)** Describe about by spectral density. **(4)**	**BTL1**	Remember

	(ii) Describe about aliasing with necessary illustrations. **(9)**	**BTL5**	Evaluate
12.	**(i)** Given $y[n] = x[n^2]$. Determine whether the system is linear, time invariant, memory less and causal. **(9)**	**BTL5**	Evaluate
	(ii) Discuss about the process of quantization and describe how quantization error can be minimized? **(4)**	**BTL2**	Understand
13.	Starting from the first principles, state and explain sampling theorem both in time domain and in frequency domain. **(13)**	**BTL1**	Remember
14.	A signal $x(t) = \sin c(50\pi t)$ is sampled at a rate of 20Hz, 50Hz and 75Hz. For each of these cases, explain if you can recover the signal $x(t)$ from the samples signal. **(13)**	**BTL4**	Analyze
	PART – C		
1.	Determine the response of the following systems to the input signal $$x(n) = \begin{cases} \|n\|, -3 \le n \le 3 \\ 0, \quad otherwise \end{cases}$$ **(i)** $x_1(n) = x(n-2)\delta(n-3)$ **(ii)** $x_2(n) = x(n+1)$ **(iii)** $y(n) = 1/3[x(n+1) + x(n) + x(n-1)]$ **(iv)** $y(n) = \max[x(n+1), x(n), x(n-1)]$ **(v)** Find the even and odd components of given $x(n)$. **(15)**	**BTL5**	Evaluate
2.	A discrete time systems can be **(i)** Static or dynamic **(ii)** Linear or non linear **(iii)** Time invariant or time varying **(iv)** Stable or unstable Examine the following system with respect to the properties above $y(n) = x(n) + nx(n+1)$. **(15)**	**BTL4**	Analyze
3.	Determine whether the following signals are energy or power or neither energy nor power signals. **(i)** $x_1(n) = \left(\frac{1}{2}\right)^n u(n)$ **(ii)** $x_2(n) = \sin(\frac{\pi}{6}n)$ **(iii)** $x_3(n) = e^{j(\frac{\pi n}{3}+\frac{\pi}{6})}$ **(iv)** $x_4(n) = e^{2n}u(n)$. **(15)**	**BTL5**	Evaluate
4.	**(i)** State Nyquist rate. If the sampling rate is less than the Nyquist rate, what happens? Justify it with an example. **(8)**	**BTL5**	Evaluate
	(ii) Consider the analog signal $x(t) = 3\cos 100\pi t$ **a)** Determine the minimum sampling rate required to avoid aliasing **b)** If the signal is sampled at the rate Fs = 200Hz, what is the discrete time signal obtained after sampling? **(7)**	**BTL5**	Evaluate

UNIT II - DISCRETE TIME SYSTEM ANALYSIS			
SYLLABUS Z-transform and its properties, inverse z-transforms; difference equation – Solution by z transform, application to discrete systems - Stability analysis, frequency response – Convolution –Discrete Time Fourier transform, magnitude and phase representation.			
PART –A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	What is ROC of Z transform? State its properties.	**BTL1**	Remember
2.	Determine the Z-transform the following finite duration signal $x(n) = \{3,2,2,3,5,0,1\}$and analyze the ROC.	**BTL4**	Analyze
3.	Express the relationship between s-plane and z-plane.	**BTL2**	Remember
4.	State initial value theorem and final value theorem of Z transform.	**BTL1**	Remember
5.	Calculate the Z-transform of $x(n) = a^n$.	**BTL3**	Apply
6.	Determine the z transform and its ROC of the discrete time signal $x(n) = -a^n u(n-1), a > 0$.	**BTL5**	Evaluate
7.	Illustrate the proof of the convolution property of z-transform.	**BTL3**	Apply
8.	Determine the z-transform and ROC for the signal $x(n) = \delta(n-k) + \delta(n+k)$.	**BTL5**	Evaluate
9.	List the methods of evaluating inverse Z-transform.	**BTL1**	Remember
10.	Express the nth order difference equation.	**BTL2**	Understand
11.	If $x(n) = \{1,2,3,4\} and h(n) = \{1,-2\}$, analyzethe response y(n) of the system?.	**BTL4**	Analyze
12.	Given a difference equation $y(n) = x(n) + 3x(n-1) + 2y(n-1)$. Express the system function H(z).	**BTL2**	Understand
13.	What are the properties of frequency response?	**BTL1**	Remember
14.	Test the stability of the system whose impulse response $h(n) = \left(\frac{1}{2}\right)^n u(n)$.	**BTL4**	Analyze
15.	Write the conditions to define stability in ROC.	**BTL1**	Remember
16.	What is the inverse Z transform of $H(z) = \frac{2z}{z-.5}$?	**BTL5**	Evaluate
17.	How to relate Fourier transform with z-transform?	**BTL3**	Apply
18.	Define discrete-time Fourier transform pair for a discrete sequence.	**BTL1**	Remember
19.	Express the Fourier Transform of the signal$x(t) = sin\omega_0 t$.	**BTL2**	Understand
20.	What is zero padding?	**BTL6**	Create
PART –B			
1.	State and prove any five properties of z transform. **(13)**	**BTL1**	Remember
2.	**(i)** Find the Z transform of $x(n) = n^2 u(n)$. **(6)**	**BTL3**	
	(ii) Determine the one sided Z transform of $y(n) + \frac{1}{2}y(n-1) - \frac{1}{4}y(n-2) = 0; y(-1) = y(-2) = 1$. **(7)**	**BTL5**	Evaluate

3.	**(i)** An anti-causal signal x(n) is given by $x(n) = -a^n u(-n-1) = \begin{cases} 0 & n \geq 0 \\ -a^n & n < 0 \end{cases}$. Determine the z-transform and ROC. **(7)**	**BTL5**	Evaluate
	(ii) Consider the signal x(n) is given by $x(n) = \left(\frac{1}{2}\right)^n u(n) + \left(\frac{-1}{4}\right)^n u(n)$ Determine x(z) and ROC. **(6)**	**BTL5**	Evaluate
4.	Find the Z-transform of the signals **(i)** $x(n) = r^n con(n\theta)u(n)$. **(i)** $x(n) = (sin\omega_0 n)u(n)$. **(7+6)**	**BTL3**	Apply
5.	Determine the inverse z transform of the following z domain functions. **(i)** $x(z) = \frac{3z^2+2z+1}{z^2-3z+2}$ **(ii)** $x(z) = \frac{z-0.4}{z^2+z+2}$ **(7+6)**	**BTL5**	Evaluate
6.	**(i)** Find Inverse z-transform of $X(z) = z/[3z^2 - 4z + 1]$ROC$\|z\| > 1$. **(7)**	**BTL5**	Evaluate
	(ii) Determine the causal signal x(n) whose z-transform is given by $X(z) = 1 + z^{-1}/(1 - z^{-1} + 0.5z^{-2})$. **(6)**	**BTL5**	Evaluate
7.	Evaluate the following **(i)** The impulse response $h(n)\ for\ y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$ **(7)** **(ii)** The ROC of a finite duration signal $x(n) = \{2, -1, -2, -3, 0, -1\}$ **(6)**	**BTL5**	Evaluate
8.	**(i)** State and Prove the linearity and frequency shifting theorems of the Discrete Time Fourier Transform **(6)**	**BTL1**	Remember
	(ii) Determine the impulse response of the system described by the difference equation $y(n) = y(n-1) - \left(\frac{1}{2}\right)y(n-2) + x(n-1)$ using Z transform and examine its stability. **(7)**	**BTL5**	Evaluate
9.	Find the inverse z-transform of $X(z) = \frac{4Z}{(z+1)^2(z+3)}$ for all possible ROCs also analyze about the relationship between ROC and Z-transform. **(13)**	**BTL 4**	Analyze
10.	Find the response of the causal system $y(n) - y(n-1) = x(n) + x(n-1)$ to the input $x(n) = u(n)$ Test its stability. **(13)**	**BTL4**	Analyze
11.	**(i)** How do you obtain the magnitude and phase response of DTFT?. **(6)**	**BTL1**	Remember
	(ii) Convolute the following two sequences $x_1(n) = \{0,1,4,-2\}$ and $x_2(n) = \{1,2,2,2\}$. **(7)**	**BTL5**	Evaluate
12.	Find the linear convolution of $x(n) = \{1,2,3,4,5,6,7\}$with$h(n) = \{2,4,6,8\}$. **(13)**	**BTL5**	Evaluate
13.	Find the inverse Z transform of $X(z) = \frac{1}{1-3z^{-1}+2z^{-2}}$ using convolution method. **(13)**	**BTL 5**	Evaluate
14.	**(i)** State and proof the Parseval's theorem. **(6)**	**BTL1**	Remember
	(ii) Determine DTFT of the given sequence $x(n) = a^n\big(u(n) - u(n-8)\big), \|a\| < 1$. **(7)**	**BTL5**	Evaluate

PART –C			
1.	**(i)** Find the Z transform and its ROC of $x(n) = \left(\frac{1}{2}\right)^{\lvert n\rvert} + \left(-\frac{1}{2}\right)^{\lvert n\rvert}$. **(8)**	**BTL5**	Evaluate
	(ii) Find the z-transform and its associated ROC for the following discrete time signal $x[n] = \left(\frac{-1}{5}\right)^{n} u[n] + 5\left(\frac{1}{2}\right)^{-n} u[n-1]$. **(7)**	**BTL5**	Evaluate
2.	Determine the frequence response H(e^{jw}) for the given system and plot magnitude and phase response, $y(n) + \frac{1}{4}y(n-1) = x(n) + x(n\text{-}1)$ **(15)**	**BTL5**	Evaluate
3.	Using Z-transform determine the response $y(n)\ \ for\ \ n \geq 0\ if$ $y(n) = 1/2\, y(n-1) + x(n), x(n) = \left(\frac{1}{3}\right)^{n} u(n),\ y(-1) = 1.$ **15)**	**BTL5**	Evaluate
4.	Determine the impulse response, of the given difference equation $y(n) = y(n-1) + .25\, y(n-2) + x(n) +\ x(n-1)$. *Plot the pole zero pattern and check its stability.* **(15)**	**BTL5**	Evaluate

UNIT III - DISCRETE FOURIER TRANSFORM & COMPUTATION

SYLLABUS

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

PART –A

Q.No	Questions	BT Level	Competence
1.	List any two properties of DFT.	BTL1	Remember
2.	State circular frequency shift property of DFT.	BTL1	Remember
3.	Given $x(n) = \{1,2,3,4\}$. Formulate the circularly shifted sequence x(n-2).	BTL6	Create
4.	Find the discrete Fourier transform for δ[n].	BTL3	Apply
5.	Compute the number of multiplications and additions for 32 point DFT and FFT.	BTL5	Evaluate
6.	State Parsavel's relation for DFT.	BTL1	Remember
7.	Evaluate the 4-point DFT of the sequence $x(n) = \{1,1,0,0\}$.	BTL5	Evaluate
8.	Point out when the DFT X(k) of a sequence x(n) is imaginary.	BTL4	Analyze
9.	Summarize the information we get from magnitude and phase representation.	BTL2	Understand
10.	What is FFT? What is its advantage?	BTL1	Remember
11.	Draw the basic butterfly flow graph for the computation in the DIT FFT algorithm.	BTL2	Understand
12.	Estimate the DFT of the signal $x(n) = a^n$.	BTL6	Create
13.	Discuss about "in-place computation" in FFT algorithm.	BTL2	Understand
14.	What is meant by radix-4 FFT?	BTL3	Apply
15.	Explain how butterfly structure is helpful in DFT computation.	BTL4	Analyze
16.	Draw the flow graph of a 4 point DFT by applying radix-2 DIT-FFT algorithm.	BTL3	Apply
17.	What is the basic operation in DIT algorithm?	BTL1	Remember
18.	Draw the basic butterfly diagram for DIF algorithm.	BTL2	Understand
19.	Compare DIT radix-2 FFT and DIF radix-2 FFT.	BTL4	Analyze
20.	What are the applications of FFT algorithm?	BTL1	Remember

PART – B

Q.No	Questions	BT Level	Competence
1.	State and proof any four properties of DFT. **(13)**	BTL1	Remember
2.	**(i)** State and prove convolution property of DFT. **(4)**	BTL1	Remember
	(ii) Find circular convolution of the two sequences $x_2(n) = \{1, 2, 2, 1\}$ and $x_2(n) = \{1, 2, 3, 1\}$. **(9)**	BTL5	Evaluate
3.	**(i)**Find the circular convolution of two finite duration sequences $x_1(n) = \{1, -1, -2, 3, -1\}$, $x_2(n) = \{1, 2, 3\}$ **(9)** **(ii)** State and prove time shifting property of DFT **(4)**	BTL5	Evaluate
4.	An 8 point sequence is given by $x(n) = \{1, -1, -1, -1,1,1,1, -1\}$, compute 8 point DFT of x(n) by radix 2 DIT FFT. **(13)**	BTL4	Analyze
5.	Find the DFT of a sequence $x[n] = \{1,2,3,4,4,3,2,1\}$. using Decimation-in- Time (DIT) algorithm. **(13)**	BTL5	Evaluate

6.	Derive and draw the butterfly diagram for computing 8-point DFT of a sequence x(n) using DIF FFT algorithm. **(13)**	**BTL2**	Remember
7.	**(i)** Compute the eight point DFT of the sequence $x(n)$ =using DIF FFT algorithm. **(7)**	**BTL5**	Evaluate
	(ii) Compare the difference between DIT-FFT with DIF-FFT. **(6)**	**BTL4**	Analyze
8.	**(i)**Find the DFT of a sequence. $x[n] = \begin{cases} 1 & for\ 0 \leq n \leq 2 \\ 0 & otherwise \end{cases} forN = 4.$ Plot its magnitude response. **(9)** **(ii)**Determine the DFT of the sequence $x(n) = \begin{cases} \frac{1}{4}, & for\ 0 \leq n \leq 2 \\ 0, & otherwise \end{cases}$ **(4)**	**BTL5**	Evaluate
9.	Derive and draw the butterfly diagram for computing 8-point DFT of a sequence x(n) using DIT FFT algorithm. **(13)**	**BTL1**	Evaluate
10.	**(i)** The first five points of the eight point DFT of a real valued sequence are (0.25, 0, 125-j0.3018, 0, 0.125-j0.0518). Explain how do you infer the remaining three points. **(3)**	**BTL4**	Analyze
	(ii) Compute the eight point DFT of the sequence $x = \{0, 1, 2, 3, 4, 5, 6, 7\}$ using DIF FFT algorithm. **(10)**	**BTL5**	Evaluate
11.	**(i)** Compute the 4 point DFT of the sequence $x(n) = \{0,1,2,3\}$ using DIT and DIF algorithm. **(7)**	**BTL5**	Evaluate
	(ii) Find the 4-point inverse DFT of $X(k) = \{10, -2 + 2j, -2, -2 - 2j\}$. **(6)**	**BTL5**	Evaluate
12.	By means of DFT and IDFT, determine the sequence $x(n)$corresponding to the circular convolution of sequences $x_1(n) and x_2(n)$ given by$x_1(n) = \{2,1,2,1\}, x_2(n) = \{1,2,3,4\}$. **(13)**	**BTL5**	Evaluate
13.	Find the IDFT of the sequence $X(k) = \{4,1 - j2.414,0,1 - j0.414,0,1 + j0.414,0,1 + j2.414\}$ using DIF algorithm. **(13)**	**BTL5**	Evaluate
14.	Compute the N point DFT of the sequence x(n) = a^n, where n = 0,1,2,..., N-1 and N=8 using **(i)** DIT algorithm. **(7)** **(ii)** DIF algorithm. **(6)**	**BTL5**	Evaluate
	PART – C		
1.	What is the need for frequency response analysis? Determine the frequency response and plot the magnitude response and phase response for the system, $y(n) = 2x(n) + x(n-1) + 1y(n-2)$. **(15)**	**BTL5**	Evaluate
2.	Given $x(n) = n + 1, and\ N = 8$, find X(k) using DIT FFT algorithm. **(15)**	**BTL5**	Evaluate
3.	Derive the computational equation and draw the butterfly diagram for computing 8-point DFT using DIT FFT algorithm. **(15)**	**BTL6**	Create
4.	Find the inverse DFT of $X(K) = \{7, -\sqrt{2} - j\sqrt{2}, -j, \sqrt{2} - j\sqrt{2}, 1, \sqrt{2} + j\sqrt{2}, j, -\sqrt{2} + j\sqrt{2}\}$. **(15)**	**BTL5**	Evaluate

UNIT IV-DESIGN OF DIGITAL FILTERS

SYLLABUS

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

PART –A

Q.No	Questions	BT Level	Competence
1.	Summarize, why digital filters are more useful than analog filters?	BTL2	Understand
2.	Distinguish the IIR and FIR filter.	BTL1	Remember
3.	How do you analyze in selecting the type of filter (IIR/FIR) for an application?	BTL4	Analyze
4.	Develop the realization structure for the causal linear phase FIR system function, $H(z) = \frac{2}{3} + z^{-1} + \frac{2}{3}z^{-2}$	BTL6	Create
5.	Develop the cascade realization for the system function $H(z) = \frac{1+\frac{1}{4}z^{-1}}{\left(1+\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{a}z^{-1}+\frac{1}{4}z^{-2}\right)}$	BTL6	Create
6.	Relate under what conditions an FIR filter will exhibit linear phase response.	BTL3	Apply
7.	Analyze the need for employing window for designing FIR filter.	BTL 4	Analyze
8.	Draw the frequency response of N-point rectangular window.	BTL3	Apply
9.	Point out the limitation of using rectangular window in FIR filter design.	BTL4	Analyze
10.	Give Hamming window function.	BTL2	Understand
11.	What is Gibbs phenomenon?	BTL1	Remember
12.	Obtain the direct form –I realization for the given difference equation Y(n)=.5y(n-1)-.25y(n-2)+x(n)+.4x(n-1).	BTL5	Evaluate
13.	Discuss about the pass band and stop band characteristics of Butterworth filter.	BTL2	Understand
14.	List the properties of Chebyshev filter.	BTL1	Remember
15.	Write the advantages and disadvantages of digital filters.	BTL1	Remember
16.	Name the methods that convert the transfer function of a analog filter into digital filter	BTL1	Remember
17.	Give the mapping relation for mapping of s-plane to z-plane in bilinear transformation.	BTL2	Remember
18.	What is impulse invariant transformation?	BTL1	Remember
19.	What is warping effect? Examine its effect on frequency response?	BTL3	Apply
20.	What is pre-warping? Conclude what happens, if pre-warping is not employed?	BTL5	Evaluate

PART –B				
1.	(i) A difference equation describing a filter is given by $y(n) - 2y(n-1) + y(n-2) = x(n) + \frac{1}{2}x(n-1)$ .Show the realization of direct form II structure. (7)		BTL3	Apply
	(ii) Implement the following system function by applying cascade form. $H(z) = \frac{1}{(1+2z^{-1})(1-z^{-1})}$. (6)		BTL3	Apply
2.	Show the realization for the following system using cascade and parallel structures $H(z) = \frac{\left(1+\frac{1}{4}z^{-1}\right)}{\left(1+\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)}$ (13)		BTL3	Apply
3.	Design a filter with desired frequency response $H_d(e^{j\omega}) = e^{-j3\omega} for -\frac{\pi}{4} \le \omega \le \frac{\pi}{4}$ $= 0\ for -\frac{\pi}{4} \le \omega \le \pi$ Using a Hamming window for N=7. (13)		BTL6	Create
4.	Design an ideal low pass filter with a frequency response $H_d(e^{j\omega}) = \begin{cases} 1 & for -\frac{\pi}{2} \le \omega \le \frac{\pi}{2} \\ 0 & for \frac{\pi}{2} \le \lvert\omega\rvert \le \pi \end{cases}$ Find H(z) and the filter coefficients for N=11. (13)		BTL6	Create
5.	Using rectangular window technique design a LPF with pass band gain of unity, cutoff frequency of 1000Hz and working sampling frequency of 5kHz. The length of impulse is 7. (13)		BTL6	Create
6.	(i) Describe the characteristics of Butter worth filter. (4)		BTL1	Remember
	(ii) Discuss the design procedure for analog Chebyshev low pass filter. (9)		BTL2	Understand
7.	(i) Write briefly on comparison of Butterworth and Chebyshev Filter. (4)		BTL4	Analyze
	(ii) Given the specifications $\alpha_p = 3dB$, $\alpha_s = 10dB$ $f_p = 1kHz and$ $f_s = 2kH$. Determine the order of the filter using Chebyshev approximation. Find H(s). (9)		BTL5	Evaluate
8.	Design a length-5 FIR band reject filter with a lower cut off frequency of 2kHz, an upper cut-off frequency of 2.4 kHz, and a sampling rate of 8000Hz using Hamming window. (13)		BTL6	Create
9.	(i) Tabulate any three differences between Analog filter and Digital filter. (3)		BTL1	Remember
	(ii) Design an Analog Butter Worth filter that has -2dB pass band attenuation at a frequency of 20rad /sec and at least -10dB stop band attenuation at 30 rad/sec. (10)		BTL6	Create
10.	(i) Illustrate the bilinear transformation method of obtaining digital filter from analog filter. (7)		BTL3	Apply

	(ii) Apply bilinear transformation to $H(s) = \frac{2}{(s+1)(s+2)}$ with T=1sec and compute H(z). **(6)**	**BTL3**	Apply
11.	**(i)** Illustrate impulse invariant method of designing IIR filter. **(7)**	**BTL3**	Apply
	(ii) Using impulse variance method with T =1 Sec. Compute $H(z) if H(s) = \frac{1}{s^2+\sqrt{2}s+1}$. **(6)**	**BTL3**	Apply
12.	**(i)** Describe about warping and pre warping **(6)**	**BTL1**	Remember
	(ii) Convert the following analog transfer function into digital by applying impulse invariant technique with sampling period T=1 sec $H(z) = s + \frac{1}{(s+3)(s+5)}$ **(7)**	**BTL3**	Apply
13.	Design and realize a digital filter using bilinear transformation for the following specifications. Monotonic pass band and stop band -3.01dB cutoff at 0.5π rad. magnitude of at least 15dB at $\omega = 0.75\pi$rad. **(13)**	**BTL6**	Create
14.	Design a butterworth filter using the Impulse invariance method for the following specifications. $0.8 \le \left\|H(e^{j\omega})\right\| \le 1 \quad 0 \le \omega \le 0.2\pi$ $\left\|H(e^{j\omega})\right\| \le 0.2 \quad 0.6\pi \le \omega \le \pi$ **(13)**	**BTL6**	Create
	PART – C		
1.	Obtain 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)**	**BTL6**	Create
2.	A low pass filter is to be designed with the following desired frequency response $H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega}, & -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0, \frac{\pi}{4} < \|\omega\| \le \pi \end{cases}$ Determine the filter coefficients $h_d(n)$ if the window function is defined as $\omega(n) = \begin{cases} 1 & 0 \le n \le 4 \\ 0, & otherise \end{cases}$ **(15)**	**BTL6**	Create
3.	Design a second order digital low pass Butter worth filter with a cut-off frequency 3.4 kHz at a sampling frequency of 8 kHz using bilinear transformation. **(15)**	**BTL6**	Create
4.	Design a Chebyshev filter for the following specification using bilinear transformation.. $.8 = \le \left\|H(e^{j\omega})\right\| \le 1; 0 \le \omega \le .2\pi$ $\left\|H(e^{j\omega})\right\| \le 0.2; .6\pi \le \omega \le \pi$ **(15)**	**BTL6**	Create

UNIT V - DIGITAL SIGNAL PROCESSORS			
SYLLABUS Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to commercial DS Processors.			
PART –A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	How does a digital signal processor differ from other processors?	**BTL2**	Understand
2.	Analyze how, DSP processors more advantageous than microcontrollers?	**BTL4**	Analyze
3.	Summarize the factors that influence selection of DSP processor for an application.	**BTL 2**	Understand
4.	Mention one important feature of Harvard architecture and illustrate the advantage of this architecture in a DS processor.	**BTL3**	Apply
5.	List the features DSP processor.	**BTL1**	Remember
6.	Is DSP processor works faster than general purpose processor? Justify your answer.	**BTL5**	Evaluate
7.	What is pipelining? What are the different stages in pipelining?	**BTL1**	Remember
8.	What is the advantage of pipelining?	**BTL 1**	Remember
9.	Point out the advantage of instruction cache in a DSP processor?	**BTL4**	Analyze
10.	List the various registers used with ARAU of DSP processor.	**BTL1**	Remember
11.	What is meant by bit reversed addressing mode? Examine the application for which this addressing mode is preferred?	**BTL3**	Apply
12.	List the addressing modes of TMS320C50DSP processor.	**BTL1**	Remember
13.	Analyze about the function of parallel logic unit in DSP processor.	**BTL 4**	Analyze
14.	Show the different buses of TMS 320C54X processor and relate each with its functions.	**BTL3**	Apply
15.	Summarize the merits and demerits of VLIW architecture.	**BTL2**	Understand
16.	Compare the RISC and CISC processors.	**BTL5**	Evaluate
17.	List the advantages and applications of DSP.	**BTL1**	Remember
18.	Write the applications of commercial digital signal processor.	**BTL6**	Create
19.	Generalize how spectrum meter application can be designed with DS processor.	**BTL6**	Create
20.	Summarize the intended applications of Da Vinci Digital Media Processors.	**BTL2**	Understand
PART –B			
1.	Describe with a neat diagram the generic internal architecture of a DSP processor and explain the function of the main components. **(13)**	**BTL2**	Understand
2.	**(i)** Explain the functional blocks of TMS320C50 CPU. **(7)**	**BTL4**	Analyze
	(ii) List any six major features of digital signal processors. **(6)**	**BTL1**	Remember

3.	Draw and explain the architecture of TMS320C54x processor. **(13)**	**BTL1**	Remember
4.	**(i)** Describe the data path architecture and the bus structure in a DSP processor with suitable diagram. **(7)**	**BTL2**	Understand
	(ii) Describe how convolution is performed using a single MAC unit. **(6)**	**BTL2**	Understand
5.	Draw the architecture of ADSP2181 DSP processor and explain. **(13)**	**BTL 1**	Remember
6.	Describe in detail about Von Neuman, Harvard and modified Harvard architecture for the computer. **(13)**	**BTL1**	Remember
7.	Sketch and explain a SHARC DSP architecture. **(13)**	**BTL4**	Analyze
8.	**(i)** Identify the functional modes present in the DSP processor and explain. **(7)**	**BTL3**	Apply
	(ii) Describe about the Auxiliary Register Arithmetic Unit in DSP processors. **(6)**	**BTL2**	Understand
9.	Explain the various types of addressing modes of digital signal processor with suitable example. **(13)**	**BTL3**	Apply
10.	**(i)** Discuss about the special addressing modes of TMS320C54. **(8)**	**BTL2**	Understand
	(ii) Write short notes on auxiliary registers. **(5)**	**BTL1**	Remember
11.	**(i)** Describe about the common addressing format used in TMS 320C5X processor. **(7)**	**BTL2**	Understand
	(ii) Discuss the advantages and disadvantages of VLIW architecture. **(6)**	**BTL2**	Understand
12.	**(i)**Explain the classification of instructions in DSP processor with suitable examples. **(6)**	**BTL4**	Analyze
	(ii) Examine about commercial DSP processor. **(7)**	**BTL 4**	Apply
13.	Draw the structure of central processing unit and explain each unit with its function. **(13)**	**BTL3**	Analyze
14.	Describe briefly about the following: **(i)** The architecture of any one type of DS processor. **(7)** **(ii)** The addressing modes of any one type of DS processor. **(6)**	**BTL1**	Remember
	PART –C		
1.	**(i)** Explain how the memory address of the operand is obtained in MMR addressing mode? **(8)**	**BTL5**	Evaluate
	(ii) Explain what is meant by bit reversed addressing mode. **(7)**	**BTL4**	Analyze
2.	Determine the influence of quantization effects in DSP system design in detail. **(15)**	**BTL5**	Evaluate
3.	Elaborate on Radar signal processing using a DSP Processor. **(15)**	**BTL6**	Create
4.	Design a DSP based system for the process of audio signals in an audio recorder system. **(15)**	**BTL6**	Create