ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY
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ANGUCHETTYPALAYAM, PANRUTI – 607 106.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

QUESTION BANK

V SEMESTER

DIGITAL SIGNAL PROCESSING

Regulation – 2017 & 2019

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DEPARTMENT OF ELECRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

SUBJECT : 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		CO	BT Level	Competence
1.	Define the term Nyquist rate.		CO1	K1	Remember
2.	Discuss about the Shannon's sampling Theorem		CO 1	K 2	Understand
3.	Define aliasing effect.		CO1	K 1	Remember
4.	Distinguish even and odd signals with an example for each.		CO1	K 2	Understand
5.	Given a continuous time signal x(t)=2cos500πt. Evaluate the Nyquist rate and fundamental frequency of the signal?		CO1	K5	Evaluate
6.	Express the sampling techniques.		CO1	K 5	Evaluate
7.	Check whether the given system y(n)=cos x(n) is linear or not.		CO1	K 6	Create
8.	List any few applications of Digital Signal Processing.		CO1	K 1	Remember
9.	Sketch spectral density and write expression for it.		CO1	K 3	Apply
10.	Define energy and power signals. Given an example for		CO1	K1	Remember
11.	Point out the different types of system.		CO 1	K 4	Analyse
12.	Classify the types of signals.		CO 1	K 4	Analyse
13.	Define recursive systems.		CO 1	K1	Remember
14.	Analyze the system described by the equation y(n) = nx(n) is linear or not.		CO 1	K4	Analyse
15.	Define the term BIBO stable?		CO 1	K 1	Remember
16.	Define static and dynamic systems with an example.		CO 1	K1	Remember
17.	Is the system y(n)=|x(n)| linear and time invariant? Justify your answer.		CO 1	K 5	Evaluate
18.	Distinguish between Linear and Nonlinear systems.		CO 1	K 4	Analyse
19.	Check the stability (i) $y(n)=a^n u(n)$ (ii) $y(n)=(1/2)^n u(n)$		CO 1	K 1	Remember
20.	Discuss the term quantization and quantization error?		CO 1	K 2	Understand
21.	Distinguish between power and energy signal with an		CO 1	K 4	Analyse
22.	Write the necessary and sufficient conditions for BIBO.		CO 1	K 1	Remember

23.	Find the Nyquist rate for the following signal $x(t)=20\cos400\pi t+10\sin200\pi t$		CO 1	K 3	Apply
24.	Compute the total energy of the signal $x(n)=(1/2)^n u(n)$.		CO 1	K6	Create
PART – B					
1.	(i) Define energy and power signal? Also examine whether the following signals are energy or power or neither energy nor power signals. (1) $x(n)=(1/4)^n u(n)$ (2) $x(n)=\sin(\pi n/3)$ (3) $x(n)=u(n)$ (ii) Describe the concept of quantization and quantization error .	(8) (5)	CO 1 CO 1	BTL 1 BTL 2	Remember Understand
2.	A discrete system is characterized by the difference equation $y(n)=x(n)-0.5y(n-1)+0.25x(n-1)$ Evaluate the system for (1) Linearity (2) Causality (3) Time Invariant (4) Static and (5) Stability.	(13)	CO 1	K 5	Evaluate
3.	(i) Demonstrate which of the following systems are stable (1) $y(n)=\cos x(n)$ (2) $y(n)=ax(n)$ (3) $y(n)=x(n)\, e^n$ (4) $y(n)=a^{x(n)}$ (ii) Demonstrate which of the following systems are causal or non causal. (1) $y(n)=x(\|n\|)$ (2) $y(n) = \sum_{k=n}^{\infty} x(n-k)$	(8) (5)	CO 1 CO 1	K 3 K 3	Apply Apply
4.	(i) What is meant by Nyquist rate? Point out of its significance. (ii) Explain the classification of discrete signal with an suitable example.	(5) (8)	CO 1 CO 1	K 4 K 2	Analyze Understanding
5.	(i) Given $y[n]=x[n^2]$, Test whether the system is linear, time invariant, memoryless and causal. (ii) Test whether the following is an energy signal or power signal.(1) $x(n)=(1/4)^n u(n)$ (2) $x(n)=u(n)$ (3) $x(n)=\sin(\pi n/3)$	(8) (5)	CO 1 CO 1	K 5 K 5	Evaluate Evaluate
6.	Illustrate the following system is time invariant or not. (i) $y(n)=\cos(x(n))$ (ii) $y(n)= \|x(n)\|$ (iii) $y(n)=x(-n)$ (iv) $y(n)=x(n)+nx(n+1)$	(13)	CO 1	K 3	Apply

7.	A discrete time systems can be: (1)Static or dynamic (2)Linear or non Linear (3)Time invariant or time varying (4) Stable or unstable (5)Causal or noncausal. Analyse the following systems (1) $y(n)=x(n^2)$ (2) $y(n)= \cos(x(n))$.	(13)	CO 1	BTL 4	Analyse
8.	(i) Test the causality and stability of the systems $y(n)=x(-n)+x(n-2)+x(2n-1)$. (ii) Test the system for linearity and time invariance $y(n)=(n-1)x^2(n)+c$.	(6) (7)	CO 1 CO 1	BTL 5 BTL 5	Evaluate Evaluate
9.	Demonstrate the response of the following systems to the input signal $x(n) = \begin{cases} \lvert n \rvert, & -3 \leq n \leq 3 \\ 0, & \text{otherwise} \end{cases}$ (1) $y(n)=x(n)$ (2) $y(n)=x(n+1)$ (3)$y(n)=x(n+1)$ (4) $y(n) = \frac{1}{3}[x(n+1) + x(n) + x(n-1)]$	(13)	CO 1	BTL 4	Analyse
10.	With neat figure explain block diagram of a Digital Signal Processing System and give its merits and demerits.	(13)	CO 1	K 1	Remember
11.	(i) Determine if the signals, $x_1(n)$ and $x_2(n)$ are power, energy or neither energy nor power signals. (1) $x_1(n)=(1/3)^n u(n)$ (2) $x_2(n)=e4^n u(n)$ (ii) Discuss about quantization effects while digitizing analog signals for processing.	(6) (7)	CO 1 CO 1	BTL 2 BTL 2	Understand Understand
12.	Analyze whether the given discrete time system whether or not the system is Linear, Time Invarient, causal and Stable. (1) $y(n)=x(n+7)$ (2) $y(n)=n\,x(n)$ (3)$y(n)=x^3(n)$.	(13)	CO 1	K 4	Analyse
13.	(i)Consider the analog signal $x(t)=3\cos(200\pi t)$ (i) Determine the maximum sampling rate required to avoid alising (ii) Let the signal sampled rate Fs=400 Hz. Find the discrete time after sampling (iii) Fs=150 Hz. Find the discrete sampling. Find the discrete time after sampling and also obtain sinusoidal yield frequency 0<F<Fs/2.For each of these cases, explain if you can recover the signal x(t) from the samples signal. ii) State and prove the sampling theorem.	(9) (4)	CO 1 CO 1	BTL 6 BTL 1	Create Remember

14.	(i) Explain the following with respect to discrete-time system : (1) Stability (2) Static. (ii) Check for following systems are static and stability (1) y(n)=n x(n) (2) $y(n)=x(n^2)$ (3) y(n)=x(n)+3u(n+1)	(4) (9)	CO 1 CO 1	BTL 2 BTL 4	Understanding Analyse
15.	Draw and explain the following sequences : (i) Unit sample sequence (ii) Unit step sequence (iii) Unit ramp sequences (iv) Sinusoidal sequences (v)Exponential sequences.	(13)	CO 1	BTL 4	Analyse
16.	Find the following systems are (i) static or dynamic (ii) stable or unstable. (i) y(n)=nx(n) (ii)y(n)=a.x(n) (iii) y(n)=x(n2) (iv) y(n)=x(n)+3.u(n+1)	(13)	CO 1	K 3	Apply
17.	Illustrate whether the following systems are Causal or not. (i) y(n)=x(-n) (ii) y(n)=x(n-1)+K x(n-2) (iii) y(n)=2x(n-2)+ x(n-2) (iv) h(n)=u(n-2)-u(n-3) (v) y(n)=x(n+7) (vi) y(n)=nx(n)	(13)	CO 1	BTL 3	Apply
	PART-C				
1.	(i) Illustrate the condition of the system to be causal and linearity. Check the same for the given system y(n)=x(n)+[1/{x(n-1)}] . (ii) Analyze the time invariant and stability of the given system y(n)=cos x(n).	(8) (7)	CO 1 CO 1	BTL 3 BTL 4	Apply Analyze
2.	(i) Distinguish the following with examples and formulae. (1) Energy vs power signal (2) Time variant vs time invariant signal. (ii) What is system? Explain the classification of systems with an examples.	(15)	CO 1	K2	understanding
3.	Explain the following Discrete time systems with suitable example : (1) Static and Dynamic (2) Time variant and invariant (3)Linear and Nonlinear (4) Causal and Noncausal (5) Stable and unstable (6) FIR and IIR System.	(15)	CO 1	K 5	Evaluate

4.	(i) Determine the function is stable or not. (1) y(n)= sin x(n) (2) y(n)=ax(n) (3) y(n)= cos x(n) (ii) Analyze the types of signals with its mathematical expression and with neat diagram.	(9) (6)	CO 1 CO 1	BTL 4 BTL 4	Analyse Analyse
5.	(i) Check whether the following system y(n)=x(n)+nx(n+1) is linear, time invariant, causal and stable. (ii) Evaluate whether the following signal is Energy or Power Signal (1) $x(n)=(3/2)^n u(n)$ (2) $x(n)=(1/4)^n u(n)$	(7) (8)	CO 1 CO 1	BTL 5 BTL 5	Evaluate Evaluate

UNIT II - DISCRETE TIME SYSTEM ANALYSIS

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.	Define the term ROC of Z- transform? List the properties of Z-transform.		CO 2	BTL 1	Remember
2.	Calculate the inverse z transform of H(Z)=2Z/(Z-[1/2])?		CO 2	BTL 3	Apply
3.	Calculate the z-transform and ROC for the signal x(n)= δ(n-k)+ δ(n+k).		CO 2	BTL 3	Apply
4.	List the methods to find inverse Z transform.		CO 2	BTL 1	Remember
5.	Evaluate the Z-transform of the sequence x(n)= {2,1,-1,0, 3}		CO 2	BTL 5	Evaluate
6.	Solve the following z- transform of a digital impulse signal and digital step signal.		CO 2	BTL 3	Apply
7.	Analyze the condition for stability in Z-domain?		CO 2	BTL 4	Analyse
8.	Calculate the inverse Z – transform of $X(Z) = \log(1-0.5z^{-1})$ for $\lvert Z \rvert > ½$ using differentiation property		CO 2	BTL 3	Apply
9.	Analyze the value of Z- transform $x(n) = a^n u(n)$ and its ROC.		CO 2	BTL 4	Analyse
10.	Solve and find the Z transform and its ROC of the discrete time signals $x(n)=-a^n u(-n-1)$, a > 0.		CO 2	BTL 3	Apply
11.	Find the stability of the system whose impulse response $h(n)=2^n u(n)$		CO 2	BTL 3	Apply
12.	Consider the signal x(n)=|1| for -1≤n≤1 and 0 for all other values of n, Formulate, the magnitude and phase spectrum.		CO 2	BTL 6	Create
13.	Develop the linear convolution for x(n)={1,2,3,4} and h(n)={1,1,1,1}.		CO 2	BTL 6	Create

14.	What is the relation between Z transform and DTFT.		CO 2	K 1	Remember
15.	Find the convolution of the input signal {1,2,1} and its impulse response {1,1,1} using Z transform.		CO 2	BTL 3	Apply
16.	Determine the Z-transform of a signal x(n)={1,2,5,7,0,1}		CO 2	BTL 5	Evaluate
17.	Discuss and prove the time reversal property of Fourier transform.		CO 2	BTL 2	Understand
18.	Define the term convolution.		CO 2	BTL 1	Remember
19.	Solve and obtain the DTFT of the sequence x(n)={1,1,0.0}.		CO 2	BTL 3	Apply
20.	Given a difference equation y[n]=x[n]+3x[n-1]+2y[n-1]. Evaluate the system function H(z).		CO 2	BTL 5	Evaluate
21.	State Parseval's relation of DFT.		CO 2	BTL 1	Remember
22.	Find the Z-Transform of x(n)={1,2, **4**,-1}and also find ROC. ↑		CO 2	BTL 3	Apply
23.	Evaluate the circular convolution for the following sequences x(n)={1,2,1} and h(n)={1,-2,2}		CO 2	BTL 5	Evaluate
24.	State the initial and final value theorem for Z-transform.		CO 2	BTL 1	Remember
	PART – B				
1.	(i) Find the Z-transform for the following functions : (1) x(n)= nu(n) (2) x(n)=u(n) (3) x(n)= sinωn (4) x(n)=cosωn . (ii) Explain the properties of Z-transform.	(8) (5)	CO 2 CO 2	BTL 3 BTL 2	Apply Understand
2.	(i) Determine the pole-zero plot for the system described by the difference equation y(n)-(3/4)y(n-1)+(1/8)y(n-2) = x(n)-x(n-1) (ii) State and prove convolution and Parseval's theorem using Z transform.	(8) (5)	CO 2 CO 2	BTL 5 BTL 1	Evaluate Remember
3.	(i) Find the Z transform and its ROC of $x(n) = (1/2)^{\|n\|} + (-1/2)^{\|n\|}$. (ii) Find x(n) if $X(Z)=(1+[1/2]z^{-1})/(1-[1/2]z^{-1})$	(8) (5)	CO 2 CO 2	BTL 3 BTL 3	Apply Apply
4.	(i) Find the inverse z-transform of $X(z) = \frac{4z}{(z+1)^2(z+3)}$ for all possible ROCs. (ii) Find the z-transform and ROC of the sequence $x(n) = \left[\frac{1}{3}\right]^{n-1} u(n-1)$	(8) (5)	CO 2 CO 2	BTL 3 BTL 3	Apply Apply

5.	Evaluate the following: (i) Inverse Z-Transform for $X(z)=1/(z-1.5)^4$; ROC : |z| > ¼. (ii) The ROC of a finite duration signal $x(n)=\{2, -1, -2, -3, 0, -1\}$ (iii) The ROC of a infinite duration signal $x(n)=2^n u(n)$	(7) (3) (3)	CO 2	BTL 5	Evaluate
6.	(i) A Linear time-invariant system is characterized by the system function $H(z)=\frac{3-4z^{-1}}{1-3.5z^{-1}+1.5z^{-2}}$ Specify the ROC of H(z) and Illustrate the value of h(n) for the following conditions (1) The system is stable (2) The system is causal (3) The system is anticausal (ii) Examine the value of x(n) for the given x(Z) with ROC (1) |z|>2 (2) |z| <2 $X(z) = \frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$	(7) (6)	CO 2 CO 2	BTL 3 BTL 4	Apply Analyze
7.	(i) Evaluate the z-transform and ROC of $x(n)=r^n\cos(n\theta)u(n)$ (ii) Evaluate the Inverse z-transform of $X(z) = z/[3z^2-4z+1]$, ROC |z|>1, |z|<1/3, 1/3<|z|<1.	(5) (8)	CO 2	BTL 5	Evaluate
8.	(i) Calculate the causal signal x(n) whose z-transform is given by $(z) = \frac{1}{1-z^{-1}+0.5z^{-2}}$ (ii) Solve and obtain the z-transform of the signal $x(n)= r^n (\cos n\Theta)u(n)$.	(8) (5)	CO 2	BTL 3	Apply
9.	Find the Z-transform of the following signals: (i)$\delta(n)$ (ii)$u(n)$ (iii) $a^n u(n)$ (iv) $n\,u(n)$	(13)	CO 2	BTL 3	Apply
10.	Find the impulse response, frequency response, magnitude response and phase response of the second order system $y(n) - y(n-1) + \frac{3}{16} y(n-2) = x(n) - \frac{1}{2} x(n-1)$	(13)	CO 2	BTL 3	Apply

11.	(i) What is the need for frequency response analysis? (ii) Determine the frequency response and plot the magnitude response and phase response for the system. Y(n)=2x(n)+x(n-1)+y(n-2).	(3) (10)	CO 2 CO 2	BTL 1 BTL 5	Remember Evaluate
12.	(i) Compute the plot for the convolution x(n)*h(n) for the following signal : x(n)={1,1, 1, 1} with h(n)={6, 5, 4, 3,2,1}. (ii) Find the circular convolution of x(n)={1,2, 3, 4} with h(n)={4, 3, 2,1} by Matrix Method.	(13)	CO 2	BTL3	Apply
13.	(i) Analyse the impulse response of the system described by the difference equation $y(n) = y(n-1) - \left[\frac{1}{2}\right] y(n-2) + x(n) + x(n-1)$ using Z transform and discuss its stability. (ii) Find the (i) linear convolution (ii) Circular Convolution of x(n)={2,1, 1, 2} with h(n)={1, -1, -1, 1}.	(8) (5)	CO 2 CO 2	BTL 4 BTL 3	Analyse Apply
14.	(i) 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. (ii) Illustrate that a system having system function H(z) is stable, if and only if all poles of H(z) are inside the unit circle.	(8) (5)	CO 2 CO 2	BTL 4 BTL 3	Analyse Apply
15.	Find the Z-transform of : (i) x(n)=n(n-1)u(n) (ii) y(n)=an sin nø u(n)	(13)	CO 2	BTL3	Apply
16.	(i) Find the inverse transform by division $X(z)=2/3z^2-4z+1$ Where the ROC is : |z| >1 and |z| >1/3. (ii) Evaluate the circular convolution for the following sequences $x_1(n)$={2,1,2,1} and $x_2(n)$={1,2,3,4}	(6) (7)	CO 2 CO 2	BTL3 BTL5	Apply Evaluate
17.	(i) Illustate the Z-transform of (i) $x(n)=a^n$ Cosωn u(n) (ii) $x(n)=3^n$ x(n). (ii) Evaluate the system function and impulse response of the following system y(n)-5y(n-1)=x(n)-x(n-1).	(6) (7)	CO 2 CO 2	BTL3 BTL5	Apply Evaluate
	PART-C				
1.	Find the inverse Z transform of X(z)= $\{z^3+z^2\}/\{(z-1)(z-3)\}$ ROC |z|>3.	(15)	CO 3	BTL 3	Apply

2.	(i) Analyse x(n) by convolution for $$X(z) = \frac{1}{(1-0.5z^{-1})(1+0.25z^{-1})}$$ (ii) Using scaling property, determine the z-transform of the sequence $x(n)=\alpha^n \cos w_0 n$	(10) (5)	CO 3	BTL 4	Analyse
3.	Find the Inverse Z-transform of $X(Z)=1/(1+Z^{-1})(1-Z^{-1})^2$	(15)	CO 3	BTL 3	Apply
4.	(i) Find the circular convolution of the two sequences $x_1(n)=\{1,3,5,7\}$ and $x_2(n)=\{2,4,6,8\}$ (ii) Find the value of y(n) using linear convolution of the two sequences $x_1(n)=\{1,2,2,1\}$ and $x_2(n)=\{1,2,2,2,1\}$	(7) (8)	CO 3 CO 3	BTL 3 BTL 3	Apply Apply
5.	(i) Evaluate x(n) for the following transfer function $X(Z)=1/(1-1.5Z^{-1}+0.5Z^{-2})$ for ROC : (i) $\|z\|>1$ (ii) $\|z\|<0.5$, (iii) $0.5 < \|z\|<1$.	(15)	CO 2	BTL 5	Evaluate

UNIT III - DISCRETE FOURIER TRANSFORM & COMPUTATION

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.	Develop the 4-point DFT of the sequence x(n)={1,1}.		CO 3	BTL 5	Evaluate
2.	Define the term FFT? List the advantages of it.		CO 3	BTL 1	Remember
3.	Sketch and express the basic butterfly flow graph for the computation in the DIT FFT.		CO 3	BTL 3	Apply
4.	Calculate DFT for the sequence x(n)={1,1, 0,0}.		CO 3	BTL 3	Apply
5.	Draw and explain the basic butterfly diagram for Radix 2 DIFFFT.		CO 3	BTL 3	Apply
6.	Point out the expression of the discrete Fourier Transform for δ(n).		CO 3	BTL 4	Analyse
7.	Define the term circular frequency shift property of DFT.		CO 3	BTL 1	Remember
8.	Differentiate DIT radix-2 FFT and DIF radix-2 FFT.		CO 3	BTL 4	Analyse
9.	Define the term Twiddle factor and Write its magnitude and phase angle.		CO 3	BTL 1	Remember
10.	List the properties of DFT.		CO 3	BTL 1	Remember
11.	Define zero padding? And also mention its uses.		CO 3	BTL 1	Remember
12.	Compute the number of multiplications and additions for 32 point DFT and FFT.		CO 3	BTL 4	Analyse
13.	State and prove the circular frequency shifting property of DFT.		CO 3	BTL 1	Remember

14.	Illustrate the term bit reversal as applied to FFT?		CO 3	BTL 3	Apply
15.	Distinguish between linear and circular convolution of two sequences.		CO3	BTL 4	Analyse
16.	Compare the terms of DFT with DTFT.		CO 3	BTL 4	Analyse
17.	Compare the two methods used for the sectioned convolution		CO 3	BTL 4	Analyse
18.	Solve and compute the DFT of $x(n)= \delta(n-n_0)$.		CO 3	BTL 3	Apply
19.	Express the term radix-4 FFT?		CO 3	BTL 5	Evaluate
20.	Develop DFT of the sequence x(n)={0,1,2,3} using DIF algorithm.		CO 3	BTL 5	Evaluate
21.	Draw a 2 point DIT-FFT Butterfly structure. Mention some of the applications of FFT Algorithm.		CO 3	BTL 3	Apply
22.	Write the circular time shift and frequency shift property of DFT.		CO 3	BTL 1	Remember
23.	Sketch the basic butterfly diagram for DIT radix-2 FFT.		CO 3	BTL 3	Apply
24.	Find the 4-point DFT of the sequence $x(n)=Cos(n\pi/4)$		CO 3	BTL 3	Apply
	PART – B				
1.	(i)Compute 4-point DFT of a sequence x(n) = {0, 1, 2,3} using DIT,DIF Algorithm. (ii)Draw the flow graph of an 8-point DIF FFT algorithm and explain.	(6) (7)	CO 3 CO 3	BTL 3 BTL 3	Apply Apply
2.	(i)Given x(n) = n+1, and N=8, Evaluate X(K) using DIF FFT algorithm. (ii)Use 4-point inverse FFT for the DFT result {6,-2+2j,-2,-2-2j} and Evaluate the input sequence.	(6) (7)	CO 3 CO 3	BTL 4 BTL 5	Analyse Evaluate
3.	Calculate the value of the inverse DFT of $X(K) = \{7, -\sqrt{2}-j\sqrt{2}, -j, \sqrt{2}-j\sqrt{2}, 1, \sqrt{2}+j\sqrt{2}, j, -\sqrt{2}+j\sqrt{2}\}$	(13)	CO 3	BTL 3	Apply
4.	(i)Obtain 8 point DFT of the input sequence x(n)={1,1,1,1,1,1,1,1} using decimation in frequency fast Fourier transform algorithm. (ii) How is the FFT algorithm applied to determine inverse discrete Fourier transform?	(8) (5)	CO 3 CO 3	BTL 2 BTL 1	Understand Remember
5.	An 8-Point sequence is given by x(n)={2,2,2,2,1,1,1,1} Compute DFT of x(n) using radix 2 DIT FFT.	(13)	CO 3	BTL 3	Apply

6.	(i)Derive decimation-in-frequency, radix-2, FFT algorithm for evaluating DFT. (ii) Find circular convolution of the sequences using concentric circle method x_1={2,1,2,1} and x_2={1,2,3,4}.	(9) (4)	CO 3	BTL 5 BTL 3	Evaluate Apply
7.	(i)State and analyse convolution property of DFT? (ii) Find the 4-point inverse DFT of X(k)={10,-2+2j,-2,-2-2j} using DIT-FFT algorithm	(7) (6)	CO 3	BTL 4 BTL 3	Analyse Apply
8.	Evaluate the output y(n) of a filter whose impulse response is h(n)={1,1,1} and input signal x(n)={3,-1,0,1,3,2,0,1,2,1} using overlap save method.	(13)	CO 3	BTL 5	Evaluate
9.	Evaluate the DFT of a sequence x(n)={1,2,3,4,4,3,2,1}, using decimation in time(DIT) algorithm.	(13)	CO 3	BTL 5	Evaluate
10.	(i) Derive the computational equation for the 8-point FFT DIT. (ii) Given that x(n)={0,1,2,3,4,5,6,7}. Find X(k) using DIT FFT Algorithm.	(4) (9)	CO 3 CO 3	BTL 4 BTL 5	Analyse Evaluate
11.	Find the output y(n) of a filter whose impulse response is h(n)={1,1,1} and input signal x(n)={3,-1,0,1,3,2,0,1,2,1} using overlap add method.	(13)	CO 3	BTL 3	Apply
12.	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 DIT algorithm.	(13)	CO 3	BTL 3	Apply
13.	Formulate the X(K) for the given sequence x(n)={1,2,3,4,1,2,3,4}.	(13)	CO 3	BTL 6	Create
14.	Find the DFT of the sequence (i) x(n)={1,0,0,1} (ii) x(n)={1,-1,1,-1} using DIF Algorithm (ii) Indicate how inverse DFT can be computed by using FFT algorithm.	(13)	CO 3	BTL 3	Apply
15.	A 8-point sequence is given by x(n)={2,2,2,2,1,1,1,1}. Compute 8-point DFT of x(n) using radix-2 DIT FFT.	(13)	CO 3	BTL 3	Apply

16.	Explain the Decimation in frequency radix-2 FFT algorithm for evaluating N-Point DFT of the given sequence. Draw the signal flow graph for N=8.	(13)	CO 3	BTL 4	Analyze
17.	(i) Formulate the 8-point DFT of the sequence x(n)={0.5,0.5,0.5,0.5,0,0,0,0} using the radix-2 decimation-in-time algorithm.	(13)	CO 3	BTL 6	Create
	PART-C				
1.	(i) State and analyse the properties of DFT. (ii) Find the DFT of a sequence x(n)={1/4,1/4,1/4,0}, using decimation in time(DIT) algorithm.	(10) (5)	CO 3 CO 3	BTL 4 BTL 3	Analyse Apply
2.	Determine the DFT of the sequence x(n)={1,1,1,1,1,1,1,0} using DIT algorithm.	(15)	CO 3	BTL 5	Evaluate
3.	Determine the DFT of the given sequence x(n)={1,2,3,4,4,3,2,1}, using DIF FFT algorithm.	(15)	CO 3	BTL 5	Evaluate
4.	Compute IDFT of the sequence x(n)={7,-0.707-j0.707,-j,0.707-j0.707,1,0.707+j0.707,j,-0.707+j0.707} using DIT Algorithm.	(15)	CO 3	BTL 4	Analyse
5.	(i) Compute the value of X(k) using DIF FFT Algorithm for N=8 and n≥0. (ii) Calculate the DFT of the sequence x(n)={1,1,-2,-2}	(10) (5)	CO 3 CO 3	BTL 4 BTL 3	Analyse Apply

UNIT IV - DESIGN OF DIGITAL FILTERS

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.	Express the need for employing window for designing FIR filter?		CO 4	BTL 2	Understand
2.	Point out the warping effect? Explain its effect on frequency response?		CO 4	BTL 4	Analyse
3.	Define warping effect.		CO 4	BTL 1	Remember
4.	Formulate the equation specifying Hamming window.		CO 4	BTL 6	Create
5.	Explain the advantages and disadvantages of FIR filter?		CO 4	BTL 2	Understand
6.	Define linear phase response of a filter?		CO 4	BTL 1	Remember
7.	Compare bilinear transformation and Impulse invariant method of IIR filter design.		CO 4	BTL 4	Analyse

8.	Point out any two methods for digitizing the transfer function of an analog filter.		CO 4	BTL 4	Analyse
9.	Obtain the transfer function for a normalized butterworth filter of order 2.		CO 4	BTL 2	Understand
10.	Define the term bilinear transformation? List the advantages of it.		CO 4	BTL 1	Remember
11.	Show the diagram of causal FIR filter structure for length M= 5.		CO 4	BTL 3	Apply
12.	Draw the direct form–II structure of IIR filter.		CO 4	BTL 3	Apply
13.	Realize and explain the following causal linear phase FIR system function $H(z)=2/3 + z^{-1}+(2/3)z^{-2}$		CO 4	BTL 5	Evaluate
14.	Generalize the comment on the passband and stopband characteristics of butter worth filter.		CO 4	BTL 4	Analyse
15.	Distinguish between Butterworth and Chebyshev (Type-I) filter.		CO 4	BTL 4	Understand
16.	Draw the direct form - I realization for the given system $y(n)=-0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2)$.		CO 4	BTL 3	Apply
17.	Express the advantages and disadvantages of digital filters?		CO 4	BTL 4	Analyse
18.	Distinguish between IIR and FIR filter.		CO 4	BTL 4	Analyse
19.	The most straight forward approach to FIR filter design is to truncate the impulse response of an ideal IIR filter. Why this is usually an undesirable approach?		CO 4	BTL 2	Understand
20.	Evaluate the direct form-I realization for the given difference equation $y(n)=0.5y(n-1)-0.25y(n-2)+x(n)+0.4x(n-$		CO 4	BTL 5	Evaluate
21.	Compare bilinear transformation and impulse invariant method.		CO 4	BTL 4	Analyse
22.	Using backward difference for the derivative and convert the analog filter into digital filter given $H(S)=1/(S^2+16)$		CO 4	BTL 5	Evaluate
23.	Compare FIR and IIR Filters		CO 4	BTL 4	Analyse
24.	State relationship between the analog and digital filter using Bilinear transform.		CO 4	BTL 1	Remember
	PART – B				
1.	A low pass filter is to be designed with the following desired frequency response. $H_d(e^{j\omega}) = e^{-j2\omega}, -\pi/4 \le \lvert\omega\rvert \le \pi/4$ $0 , \quad \pi/4 < \lvert \omega\rvert \le \pi$ Calculate the filter coefficients $h_d(n)$ if the window function is defined as $\omega(n)= 1, 0 \le n \le 4$ 0, otherwise	(13)	CO 4	BTL3	Apply
2.	Design a butterworth filter method using Bilinear transformation for the following specifications. $0.8 \le \lvert He^{jw}\rvert \le 1 \qquad 0 \le w \le 0.2\pi$ $\lvert He^{jw}\rvert \le 0.2 \qquad 0.6 \pi \le w \le \pi$	(13)	CO 4	BTL 6	Create

3.	(i)Determine the cascade and parallel realization for the system transfer function $H(z)=[3(2z^2+5z+4)]/[(2z+1)(z+2)]$. (ii) What is Hamming Window Function? Obtain its frequency domain characteristics.	(8) (5)	CO 4 CO 4	BTL 5 BTL 1	Evaluate Remember
4.	Design a Chebyshev filter using impulse invariance method for the following specification $0.9 \leq \lvert He^{jw}\rvert \leq 1 \qquad 0 \leq w \leq 0.25\pi$ $\lvert He^{jw}\rvert \leq 0.24 \qquad 0.5\pi \leq w \leq \pi$	(13)	CO 4	BTL 6	Create
5.	(i) Convert the analog filter with system function H(s) into digital IIR Filter by means of impulse invariant method : $H(S)=1/(S+0.2)(S+0.6)$. (ii) Realize the following using cascade and parallel form : $H(Z)=(3+3.6Z^{-1}+0.6Z^{-2})/(1+0.1Z^{-1}-0.2Z^{-2})$	(13)	CO 4	BTL 3	Apply
6.	Design a low pass FIR filter for the following specifications using rectangular window function. Cut-off frequency=500Hz; Sampling frequency=2000Hz; Order of the filter=10.	(13)	CO 4	BTL 5	Evaluate
7.	(i) Implement the following system function using cascade structure: $H(Z)= 1/[(1+2z^{-1})(1- z^{-2})]$ (ii) Convert the following analog transfer function into digital using impulse invariant technique with sampling period T=1sec. $H(s)=[s+1]/[(s+3)(s+5)]$	(6) (7)	CO 4	BTL 4	Analyse
8.	(i) Realize a cascade and parallel realization for the system having difference equation $y(n)+0.1y(n-1)-0.2y(n-2)=3x(n)+3.6x(n-1)+0.6x(n-2)$ (ii) For the analog transfer function $H(s) = \frac{2}{(s+1)(s+3)}$ Determine H(z) using bilinear transformation with T=1 sec.	(6) (7)	CO 4	BTL 3 BTL 4	Apply Analyze

9.	Design a Chebyshev filter for the following specification using bilinear transformation. $0.8 \le \lvert He^{jw}\rvert \le 1 \quad 0 \le w \le 0.2\pi$ $\lvert He^{jw}\rvert \le 0.2 \quad 0.6\pi \le w \le \pi$	(13)	CO 4	BTL 6	Create
10.	(i) Explain the impulse invariant method of designing IIR filter. (ii) Design 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.	(5) (8)	CO 4 CO 4	BTL 1 BTL 6	Remember Create
11.	(i) Explain the bilinear transformation method of designing IIR filter. (ii) Design a length-5 FIR band reject filter with a lower cut-off frequency of 2KHz, an upper cut-off frequency of 2.4KHz, and a sampling rate of 8000Hz using Hamming window.	(5) (8)	CO 4 CO 4	BTL 2 BTL 4	Understanding Analyze
12.	Design a filter using Hamming window with the specification N=7 of the system $H_d e^{jw}=e^{-j3w}, \; -(\pi/4)\le w \le (\pi/4);$ $-(\pi/4)\le w \le \pi$ otherwise zero	(13)	CO 4	BTL 6	Create
13.	Design and realise a Butterworth filter using impulse invariance method for the following specifications. Monotonic pass band and stop band -3.01 dB cut off at 0.5π rad magnitude down atleast 15dB at $\omega=0.75\pi$ rad.	(13)	CO 4	BTL 6	Create
14.	(i)Convert the analog filter with system function $H_a(s)=[s+0.1]/[(s+0.1)^2+9]$ into a digital IIR filter by means of the impulsive invariance method. (ii) Illustrate the direct form I and direct form ii structures for the given difference equation $y(n)=y(n-1)-0.5y(n-2)+x(n)+x(n-1)+x(n+2).$	(7) (6)	CO 4 CO 4	BTL 6 BTL 3	Create Apply
15.	Design an IIR Filter using impulse invariant method technique for the given $Ha(S)=1/(S^2+17S+12)$.Assume T=1 sec. Realize this filter using Direct Form I and Direct Form II.	(13)	CO 4	BTL 6	Create

16.	Evaluate the Direct Form I, Direct Form II, Cascade and Parallel Realization for the following system: y(n)=-0.1y(n-1)+0.2y(n-2)+3x(n)+3.6x(n-1)+0.6x(n-2)	(13)	CO 4	BTL 5	Evaluate
17.	(i)If H(S)=1/(S+1)(S+2), Find H(z) using Impulse Invariant Method for sampling frequency of 5 samples/sec. (ii)Realize the given transfer function $H(Z)=(4Z^2+11Z-2)/(Z+1)(Z-3)$ using Direct Form-II and Parallel structure.	(7)	CO 4 CO 4	BTL 3 BLT6	Evaluate Create
	PART-C				
1.	Design an ideal high pass filter using Hanning window with the specification N=11 of the system $H_d(e^{jw}) = \begin{cases} 1 & \frac{\pi}{4} \leq \lvert w \rvert < \pi \\ 0 & \lvert w \rvert \leq \frac{\pi}{4} \end{cases}$	(15)	CO 4	BTL 6	Create
2.	Determine the order of the filter using Chebyshev approximation fot the given specification a_p=3dB, a_s=16dB, f_p=1KHz and f_s=2 KHz. Find H(s).	(15)	CO 4	BTL 6	Create
3.	(i) Design a High pass filter using Hamming window with a cut-off frequency of 1.2 radians/sec and N=9. (ii) Summarize the factors that decide the choice of window in FIR filter design using window techniques. Also compare the merits and demerits of windowing techniques.	(8) (7)	CO 4 CO 4	BTL 6 BTL 2	Create Understanding
4.	Design a Butterworth filter using the Impulse invariance method for the following specifications. $0.8 \leq \lvert He^{jw} \rvert \leq 1 \quad 0 \leq w \leq 0.2\pi$ $\lvert He^{jw} \rvert \leq 0.2 \quad 0.6\pi \leq w \leq \pi$ Realize the designed filter using direct form II structure.	(15)	CO 4	BTL 6	Create
5.	Obtain the Direct form I, Direct form II, Cascade form structure for the system $H(Z)=(8Z^3-4Z^2+11Z-2)/(Z-0.25)(Z^2-Z+0.5)$	(15)	CO 4	BTL 6	Create
	UNIT V - DIGITAL SIGNAL PROCESSORS				
	Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.				

	PART – A				
Q.No	Questions			BT Level	Competence
1.	Analyze how does a digital signal processor differ from other processor?		CO 5	BTL 4	Analyse
2.	State any four applications of DSP.		CO 5	BTL 1	Remember
3.	List any two special feature of DSP architecture.		CO 5	BTL 1	Remember
4.	Give examples for fixed point processor and floating point processor.		CO 5	BTL 1	Remember
5.	List the various registers used with ARAU.		CO 5	BTL 1	Remember
6.	What are the different buses of TMS 320C54X Processor and list their functions?		CO 5	BTL 1	Remember
7.	What are the different stages in pipelining?		CO 5	BTL 1	Remember
8.	Express the different registers used with ARAU of DSP processor?		CO 5	BTL 2	Understand
9.	Mention one important feature of Harvard architecture.		CO 5	BTL 1	Remember
10.	What is the advantage of pipelining?		CO 6	BTL 1	Remember
11.	What is meant by bit reversed addressing mode? What is the application for which this addressing mode is preferred?		CO 6	BTL 1	Remember
12.	Compare the RISC and CISC processors.		CO 6	BTL 4	Analyse
13.	What are the buses used in DSP processor ?		CO 6	BTL 1	Remember
14.	List some example of commercial digital signal processor		CO 5	BTL 1	Remember
15.	Mention the features of DSP processor		CO 6	BTL 1	Remember
16.	Write the applications of commercial digital signal processors.		CO 5	BTL 1	Remember
17.	Express the special features of DSP processors.		CO 5	BTL 2	Understand
18.	What is pipelining?		CO 5		
19.	Define the term warping.		CO 5	BTL 1	Remember
20.	What is BSAR instruction? Give an example.		CO 6	BTL 1	Remember
21.	Distinguish between TMS320C5X and TMS320C54X.		CO 6	BTL 1	Remember
22.	What are the special features of digital signal processors?		CO 6	BTL 1	Remember
23.	Mention some addressing modes of DSP Processor.		CO 6	BTL 1	Remember
24.	List the applications of DSP Processor.		CO 6	BTL 1	Remember
	PART – B				
1.	Draw the architecture of a DSP processor for implementing a DSP algorithm. Explain its features.	(13)	CO 1	BTL 3	Apply

2.	(i)Name the different addressing modes of a DSP processor. Explain them with an example. (ii) Highlight the features of a commercial digital signal processor.	(8) (5)	CO 1	BTL 2	Understand
3.	(i)With a flow diagram explain the multiply and accumulated (MAC) unit in a digital signal processor. (ii) Write a note on commercial processors.	(7) (6)	CO 1	BTL 2	Understand
4.	With examples evaluate the different addressing formats supported by DSP processors, for various signal processing applications.	(13)	CO 6	BTL 4	Analyse
5.	Draw and Explain the architecture of TMS 320C54X processor.	(13)	CO 1	BTL 2	Understand
6.	Explain in detail about MAC unit and Pipelining.	(13)	CO 1	BTL 4	Analyse
7.	Explain the architecture of TMS320C50 with a neat diagram.	(13)	CO 1	BTL 4	Analyse
8.	(i)Explain the types of operations performed by L functional mode. (ii) Explain what is meant by bit reversed addressing mode.	(7) (6)	CO 5	BTL 4	Analyse
9.	Draw the functional block diagram of a digital signal processor and explain.	(13)	CO 5	BTL 3	Apply
10.	Explain Von Neumann, Harvard architecture and modified Harvard architecture for the computer.	(13)	CO 5	BTL 2	Understand
11.	(i)Explain how convolution is performed using a single MAC unit. (ii) Explain the functional modes present in the DSP processor.	(7) (6)	CO 5	BTL 2	Understand
12.	(i)With neat diagram explain Von-Neumann architecture. (ii) What is MAC unit? Explain its functions.	(7) (6)	CO 6	BTL 2	Understand
13.	Discuss the advantages and disadvantages of VLIW architecture.	(13)	CO 5	BTL 2	Understand
14.	Describe the following things a. Memory mapped register addressing b. Circular addressing mode c. Auxiliary registers	(5) (5) (3)	CO 5	BTL 2	Understand

15.	Explain the addressing formats and functional modes of a DSP Processor.	(13)	CO 5	BTL 4	Analyse
16.	Explain the architecture of TMS320C50 with neat functional block diagram.	(13)	CO 6	BTL 4	Analyse
17.	Explain about any one applications of DSP Processor.	(13)	CO 6	BTL 4	Analyse
	PART-C `				
1.	Explain how digital signal processors can be used to implement Biomedical Signal Processing Algorithms with a case study of your choice.	(15)	CO 5	BTL 4	Analyse
2	Explain the various types of addressing modes of digital signal processor with suitable example.	(15)	CO 6	BTL 4	Analyse
3	Formulate the DSP architecture required for a DSP device to implement each of the following (i) FIR filter (ii) 8 point DIT-FFT	(15)	CO 6	BTL 6	Create
4	Illustrate the structure of central processing unit and explain each unit with its function.	(15)	CO 5	BTL 3	Apply
5.	Explain in detail the architectural features of a TMS320C5X DSP Processor.	(15)	CO 5	BTL 5	Evaluate

COURSE OUTCOMES:

CO 1	Ability to understand the importance of Fourier transform, digital filters and DSP Processors.
CO 2	Ability to acquire knowledge on Signals and systems & their mathematical representation.
CO 3	Ability to understand and analyze the discrete time systems.
CO 4	Ability to analyze the transformation techniques & their computation.
CO 5	Ability to understand the types of filters and their design for digital implementation.
CO 6	Ability to acquire knowledge on programmability digital signal processor & quantization effects.