SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

V SEMESTER

1907502- DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING

Regulation – 2019

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SUBJECT: 1907502- DISCRETE TIME SYSTEMS AND SIGNAL PROCESSING

SEM / YEAR: V / III

UNIT-I CLASSIFICATION AND ANALYSIS OF SIGNALS			
Classification of signals: continuous and discrete- continuous and discrete: Energy and power, Deterministic and Random, Periodic and Aperiodic; Mathematical representation of signals; Fourier series and Fourier transform of continuous time signal, 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 are the different types of operations performed on discrete time signals?	**BTL3**	Apply
3.	Determine whether the signal $x(n) = e^{j(\frac{\pi}{2}n + \pi/4)}$ is an energy signal or a power signal.	**BTL5**	Evaluate
4.	Determine $x(n) = u(n)$ is a power signal or an energy signal.	**BTL5**	Evaluate
5.	Differentiate between Energy and Power signals.	**BTL2**	Understand
6.	Find the energy and power of the given signal $x(t) = e^{-2t}\, u(t)$	**BTL5**	Evaluate
7.	Define periodic and non-periodic signal.	**BTL1**	Remember
8.	What is a Deterministic signal?	**BTL1**	Remember
9.	Give any two differences between deterministic signal and random signal with an example.	**BTL2**	Understand
10.	If the finite duration sequence is $x(n) = \{2, 4, -1, -2\}$, What is its representation as a weighted sum of impulse?	**BTL6**	Create
11.	What are the Dirichlet's conditions of Fourier series?	**BTL4**	Analyze
12.	What is meant by self-reciprocal with respect to FT?	**BTL3**	Apply
13.	State Parseval's relation for continuous time fourier transform.	**BTL2**	Understand
14.	Write the equations for trigonometric & exponential Fourier series.	**BTL4**	Analyze
15.	Show the Fourier transform of $x(t) = e^{-at}u(t)$.	**BTL4**	Analyze
16.	Find the Fourier transform of $x(t) = \delta(t)$.	**BTL4**	Analyze
17.	What is meant by spectral density?	**BTL2**	Understand
18.	State sampling theorem.	**BTL1**	Remember
19.	What is Quantization error?	**BTL1**	Remember

20.	List the sampling techniques.	**BTL2**	Understand
21.	State Nyquist rate.	**BTL1**	Remember
22.	Given a continuous signal $x(t) = 2cos300\pi t$. Identify the Nyquist rate and fundamental frequency of the signal.	**BTL6**	Create
23.	What is meant by sampling?	**BTL1**	Remember
24.	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 and discrete time signals with its mathematical representation. **(13)**	**BTL1**	Remember
2.	Define energy and power signal. Also examine whether the following signals are energy or power or neither energy nor power signals. **(6+7)** **(i)** $x_1(n) = \left(\frac{3}{2}\right)^n u(n)$ **(ii)** $x_2(n) = \cos(\left(\frac{\pi}{6}n\right) + \frac{\pi}{3}n\,))$	**BTL2**	Understand
3.	Determine whether the following signals are energy or power or neither energy nor power signals. **(6+7)** **(i)** $x_1(n) = \left(\frac{1}{3}\right)^n u(n)$ **(ii)** $x_2(n) = \sin(\frac{\pi}{4}n)$	**BTL2**	Understand
4.	Determine whether each of the following signals is periodic. If the signal is periodic, specify its fundamental period. **(i)** $x(n) = e^{j6\pi n}$ **(ii)** $x(n) = cos\frac{\pi}{3}n + cos\frac{3\pi}{4}n.$ **(6+7)**	**BTL5**	Evaluate
5.	**(i)** Determine the values of power and energy of the given signal: **(6)** $x(n) = (-0.5)^n u(n)$ **(ii)** Explain the types of signals with its mathematical expression and neat diagram. **(7)**	**BTL1**	Remember
6.	Illustrate about the properties of discrete time sinusoidal signals and continuous time sinusoidal signal. **(13)**	**BTL3**	Apply
7.	**(i)** What are the basic operations of signals? Illustrate with an example. **(10)** **(ii)** Distinguish between continuous-time and discrete –time signals. **(3)**	**BTL4**	Analyze
8.	Distinguish the following with examples. **(5+4+4)** **(i)** Energy vs. power signal **(ii)** Deterministic and Random **(iii)** Periodic and Aperiodic	**BTL2**	Understand
9.	State and prove any five properties of discrete-time Fourier series. **(13)**	**BTL3**	Apply
10.	Find the Fourier transform of following signal. **(7+6)** **(i)** $x(t) = cos\omega_0 t\, u(t)$ **(ii)** $x(t) = e^{-\|t\|}u(t)$	**BTL5**	Evaluate

11.	State and prove following properties of Fourier transform. **(5+4+4)** **(i)** Convolution in time domain **(ii)** Differentiation in time domain **(iii)** Time shifting	**BTL4**	Analyze
12.	Describe about spectral density and aliasing effect. **(13)**	**BTL1**	Remember
13.	Discuss about the process of quantization and describe how quantization error can be minimized? **(13)**	**BTL2**	Understand
14.	Starting from the first principles, state and explain sampling theorem both in time domain and in frequency domain. **(13)**	**BTL1**	Remember
15.	A signal $x(t) = \sin c(50\pi t)$ is sampled at a rate of 20 Hz, 50 Hz and 75 Hz. For each of these cases, explain if you can recover the signal $x(t)$ from the samples signal. **(13)**	**BTL4**	Analyze
16.	Find the Fourier transform of a rectangular pulse of duration T and amplitude A. **(13)**	**BTL6**	Create
17.	Define Nyquist rate. Compare the merits and demerits of performing sampling using impulse, Natural and Flat-top sampling techniques. **(13)**	**BTL3**	Apply
	PART – C		
1.	Determine whether the following signals are energy or power or neither energy nor power signals. **(7+8)** **(i)** $x_1(n) = e^{j(\frac{\pi}{2}n+\frac{\pi}{4})}$ **(ii)** $x_2(n) = e^{2n}u(n)$	**BTL5**	Evaluate
2.	Determine whether each of the following signals is periodic. If the signal is periodic, specify its fundamental period. **(7+8)** **(i)** $x(n) = e^{j\frac{3}{5}(n+\frac{1}{2})}$ **(ii)** $x(n) = cos\frac{2\pi}{3}n$	**BTL6**	Create
3.	Find the exponential fourier series for half wave rectified sine wave. **(15)**	**BTL5**	Evaluate
4.	Find the trigonometric fourier series representation of a periodic signal, $x(t) = t$, for the interval of t = -1 to t = 1? **(15)**	**BTL6**	Create
5.	Consider the analog signal $x(t) = 3\cos 100\pi t$ **(15)** **(i)** Determine the minimum sampling rate required to avoid aliasing. **(ii)** If the signal is sampled at the rate Fs = 200 Hz, what is the discrete time signal obtained after sampling.	**BTL5**	Evaluate

UNIT-II CLASSIFICATION OF SYSTEMS AND DIGITAL SIGNAL PROCESSOR			
SYLLABUS Classification of systems: Continuous and discrete; Discrete- linear, causal, stability, dynamic, recursive, time variance; Introduction – DSP Architecture – Features.			
PART –A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	What are the classification of discrete time systems?	**BTL1**	Remember
2.	Check if the system $y(n) = x(n)x(n-1)$ is static.	**BTL4**	Analyze
3.	Test if the system is stable (or) not. $y(n) = x(n)u(n)$.	**BTL6**	Create
4.	What is an LTI system?	**BTL1**	Remember
5.	What is causality condition for LTI system?	**BTL3**	Apply
6.	If $y[n] = x[n^2]$, is the system causal?	**BTL5**	Evaluate
7.	What is the property of recursive and non-recursive systems?	**BTL3**	Apply
8.	Determine if the system is linear (or) not.$y(n) = x^2\ (n)$.	**BTL5**	Evaluate
9.	What is casual system?	**BTL1**	Remember
10.	Check if the system described by the difference equation $y(n) - ay(n-1) + x(n)$ with $y(0) = 1$ is stable.	**BTL2**	Understand
11.	If $x(n) = x(n+1) + x(n+2)$, is the system causal?	**BTL4**	Analyze
12.	Check if the system $y(n) = ax(n) + b$ is linear.	**BTL6**	Create
13.	What is time invariant system?	**BTL2**	Understand
14.	Find if the system is time invariant (or) not. $y(n) = x(-n)$.	**BTL4**	Analyze
15.	What is the condition for system stability?	**BTL2**	Understand
16.	Define linear system.	**BTL1**	Remember
17.	What are FIR and IIR system?	**BTL4**	Analyze
18.	Define stable system.	**BTL1**	Remember
19.	Analyze various factor influence selection of DSPs.	**BTL5**	Evaluate
20.	What are applications of DSPs?	**BTL3**	Apply
21.	What is pipelining?	**BTL1**	Remember
22.	What are different stages in pipelining?	**BTL2**	Understand
23.	What are the classification of digital signal processors?	**BTL2**	Understand
24.	Why Linear and Time Invariant(LTI) systems are widely used in digital signal processing applications	**BTL3**	Apply
PART –B			
1.	Describe the different types of system and write the condition to state the system with its types. **(13)**	**BTL2**	Understand
2.	Determine the stability for each of the following linear systems: **(13)** **(i)** $y(n) = x(2n)$ **(ii)** $y(n) = x(-n)$ **(iii)** $y(n) = e^{x(n)}$	**BTL3**	Apply

3.	Analyze whether the following system is linear, time varying, causal and stable $y(n) = nx^2\,(n)$. **(13)**	**BTL3**	Apply
4.	Given $y[n] = x[n^2]$. Determine whether the system is linear, time invariant, memory less and causal. **(13)**	**BTL3**	Apply
5.	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)**	**BTL6**	Create
6.	Test if the following systems are linear (or) not. **(7+6)** **(i)** $y(n) = ax(n) + bx(n-1)$ **(ii)** $y(n) = cosx(n)$	**BTL5**	Evaluate
7.	Test if the following systems are casual (or) not. **(7+6)** **(i)** $y(n) = x(n) + x^2(n-1)$ **(ii)** $y(n) = x(n+1) + 3x(n) + 5x(n-1)$	**BTL5**	Evaluate
8.	For each of the following systems, determine whether (or) not the system is time-invariant. **(7+6)** **(i)** $y(n) = nx(n)$ **(ii)** $y(n) = x(2n)$	**BTL 4**	Analyze
9.	For each impulse response listed below, determine whether the corresponding system is casual and stable. **(7+6)** **(i)** $h(n) = 2^n u(-n)$ **(ii)** $h(n) = \delta(n) + sin\,\pi n$	**BTL 4**	Analyze
10.	Find whether the following systems are static (or) dynamic. **(5+4+4)** **(i)** $y(n) = x^2(n) + x(n)$ **(ii)** $y(n) = x(2n)$ **(iii)** $y(n) = x^2(n)$	**BTL4**	Analyze
11.	Describe with a neat diagram the generic internal architecture of a DSP processor and explain the function of the main components. **(13)**	**BTL1**	Remember
12.	Draw and explain the architecture of TMS320C54x processor. **(13)**	**BTL1**	Remember
13.	**(i)** Explain the functional blocks of TMS320C50 CPU. **(7)** **(ii)** List any six major features of digital signal processors. **(6)**	**BTL2**	Understand
14.	**(i)** What is causality and stability of a system? Derive the necessary and sufficient condition on the impulse response of the system for causality and stability. **(7)** **(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)**	**BTL1**	Remember

15.	Distinguish the following with examples and formulae **(i)** Linear and Non-Linear system **(ii)** Time variant and time invariant system. **(iii)** Casual and Non-casual system **(5+4+4)**	**BTL2**	Understand
16.	**(i)** Check the causality and stability of the systems $y(n) = x(-n) + x(n-2) + x(2n-1)$. **(7)** **(ii)** Check the system for linearity and time variance $y(n) = (n-1)x^2(n) + C$. **(6)**	**BTL2**	Understand
17.	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)**	**BTL1**	Remember
	PART –C		
1.	Check for following systems are static, causality and time invariant. **(5+5+5)** **(i)** $y(n) = x(-n+5)$ **(ii)** $y(n) = x(n) + nx(n+2)$ **(iii)** $y(n) = x^2(n)$	**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 $y(n) = x(n) + nx(n+1)$. **(3+4+4+4)**	**BTL5**	**Evaluate**
3.	Design a DSP based system for the process of audio signals in an audio recorder system. **(15)**	**BTL6**	**Create**
4.	**(i)** What is an LTI system? Explain its properties. Derive an expression for the Transfer function of an LTI system. **(7)** **(ii)** Obtain the conditions for the distortion less transmission through a system. What do you understand by the term signal bandwidth? **(8)**	**BTL6**	**Create**
5.	Elaborate on Radar signal processing using a DSP Processor. **(15)**	**BTL5**	**Evaluate**

UNIT-III Z- TRANSFORMS AND 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 are the properties of Region of convergence?	BTL1	Remember
2.	Determine the Z-transform the following finite duration signal $x(n) = \{1,2,3,4\}$.	BTL1	Remember
3.	Explain the multiplication property of the z-transform.	BTL6	Create
4.	State initial value theorem of Z transform.	BTL3	Apply
5.	Calculate the Z-transform of $x(n) = a^n u(n)$.	BTL5	Evaluate
6.	Determine the z transform and its ROC of the discrete time signal $x(n) = -b^n u(-n-1), b > 0$.	BTL6	Create
7.	Illustrate the proof of the convolution property of z-transform.	BTL5	Evaluate
8.	State and proof the Parseval's theorem in Z-transform.	BTL4	Analyze
9.	List the methods of evaluating inverse Z-transform.	BTL2	Understand
10.	Define Fourier transform of a sequence and give its symmetry property.	BTL5	Evaluate
11.	Find the z-transform of digital impulse and digital ramp signal.	BTL3	Apply
12.	Define z-transform.	BTL4	Analyze
13.	Write the conditions to define stability in ROC.	BTL1	Remember
14.	If $x(n) = \{1,2,1\}$ *and* $h(n) = \{1,1,1\}$, analyze the response $y(n)$ of the system.	BTL2	Understand
15.	Define system function.	BTL1	Remember
16.	Find the Z-transform of the sequence $x(n) = \left(\frac{1}{3}\right)^{n-1} u(n-1)$.	BTL2	Understand
17.	Determine the Z-transform the following finite duration signal $x(n) = \{3,2,2,3,5,0,1\}$ and analyze the ROC.	BTL3	Apply
18.	Given a difference equation $y(n) = x(n) + 2x(n-1) - 4x(n-2) + x(n-3)$. Express the system function H(z).	BTL4	Analyze
19.	State the relation between DTFT and Z-transform.	BTL1	Remember
20.	State time reversal property of the Z-transform.	BTL1	Remember
21.	Define discrete-time Fourier transform pair for a discrete sequence.	BTL2	Understand
22.	Determine the DTFT of the sequence $x(n) = \{1,-1,1,-1\}$.	BTL4	Analyze
23.	What are the properties of Fourier transform of a discrete –time aperiodic sequence?	BTL3	Apply
24.	Express the relationship between s-plane and z-plane.	BTL2	Understand

PART – B

Q. No	Questions	BT Level	Competence
1.	State and prove any five properties of z transform. **(13)**	BTL1	Remember

2.	Find the Z transform of $x(n) = n^2 u(n)$. **(13)**	**BTL1**	Remember
3.	Determine the z transform and its ROC of the discrete time signal $x(n) = a^n \mathrm{u(n)} + b^n u(-n-1)$ **(13)**	**BTL3**	Apply
4.	Find Z-transform and ROC of the causal sequence. **(6+7)** **(i)** $x(n) = \{1,0,3,-1,2\}$ **(ii)** $x(n) = \{1,-2,1,3,4\}$	**BTL2**	Understand
5.	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. **(13)**	**BTL2**	Understand
6.	Find the Z-transform of the signals **(6+7)** **(i)** $x(n) = (sin\omega_0 n)u(n)$. **(ii)** $x(n) = (cos\omega_0 n)u(n)$.	**BTL4**	Analyze
7.	Find the inverse z transforms of **(13)** $X(z) = \frac{z+0.2}{(z+0.5)(z-1)}$ ROC $\|z\| > 1$ using long division method.	**BTL3**	Apply
8.	Determine the inverse z transform of **(13)** $X(z) = \frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}}$ ROC $\|z\| > 2$.	**BTL3**	Apply
9.	Using residue method find the inverse Z transform **(13)** $X(z) = \frac{z+1}{(z+0.2)(z-1)}$ ROC$\|z\| > 1$	**BTL4**	Analyze
10.	Find the inverse Z transform of $X(z) = \frac{1}{1-3z^{-1}+2z^{-2}}$ using convolution method. **(13)**	**BTL5**	Evaluate
11.	Find the impulse response of the system described by difference equation using z-transform. $y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x$ **(13)**	**BTL2**	Understand
12.	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)**	**BTL2**	Understand
13.	Convolute the following two sequences $x_1(n) = \{0, 1, 4, -2\}$ and $x_2(n) = \{1,2,2,2\}$. **(13)**	**BTL4**	Analyze
14.	Find the linear convolution of $x(n) = \{1,2,3,4,5,6,7\}$ with $h(n) = \{2,4,6,8\}$. **(13)**	**BTL5**	Evaluate
15.	State and Prove the linearity and frequency shifting property of DTFT. **(13)**	**BTL1**	Remember
16.	Find the impulse response, frequency response, magnitude response and phase response of the second order system. $y(n) - y(n-1) + 3/16\, y(n-2) = x(n) - 1/2\, x(n-1)$ **(13)**	**BTL1**	Remember

17.	Evaluate the frequency response of the system described by system function $H(z) = 1/(1 - 0.5z^{-1})$ **(13)**	**BTL6**	Create
	PART – C		
1.	Find the z-transform and its associated ROC for the following discrete time signal $x[n] = \left(\frac{-1}{5}\right)^n u[n] + 5\left(\frac{1}{2}\right)^{-n} u[-n-1]$. **(15)**	**BTL5**	Evaluate
2.	Determine the Z-transform $x(n) = n(-1)^n u(n)$. **(15)**	**BTL5**	Evaluate
3.	Determine the frequency response $H(e^{j\omega})$ 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)**	**BTL6**	Create
4.	Determine the impulse response, of the given difference equation $y(n) = y(n-1) + .25\, y(n-2) + x(n) + \ x(n-1)$ **(15)**	**BTL5**	Evaluate
5.	Determine DTFT of the given sequence $x(n) = \ a^n\big(u(n) - u(n-8)\big), \lvert a \rvert < 1$. **(15)**	**BTL6**	Create

UNIT-IV 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.	State circular frequency shift property of DFT.	**BTL1**	Remember
2.	What is zero padding?	**BTL4**	Analyze
3.	Find the discrete Fourier transform for δ[n].	**BTL4**	Analyze
4.	Estimate the DFT of the signal $x(n) = a^n$	**BTL5**	Evaluate
5.	Evaluate the 4-point DFT of the sequence $x(n) = \{1,1,-2,-2\}$.	**BTL5**	Evaluate
6.	Evaluate the 4-point DFT of the sequence $x(n) = \{1,1,0,0\}$.	**BTL5**	Evaluate
7.	State Parseval's relation for DFT.	**BTL3**	Apply
8.	Compute the number of multiplications and additions for 32-point DFT and FFT.	**BTL1**	Remember
9.	What is the main advantage of FFT?	**BTL1**	Remember
10.	State circular convolution.	**BTL3**	Apply
11.	Obtain the circular convolution of the following sequences $x(n) = \{1,2,1\}\ \ h(\ n) = \{1,-2,2\}$.	**BTL4**	Analyze
12.	What is FFT?	**BTL2**	Understand

13.	Draw the basic butterfly flow graph for the computation in the DIT FFT algorithm.	**BTL6**	Create
14.	What is meant by radix-2 FFT?	**BTL1**	Remember
15.	Draw the flow graph of a 4-point DFT by applying radix-2 DIF-FFT algorithm.	**BTL6**	Create
16.	Draw the flow graph of a 4-point DFT by applying radix-2 DIT-FFT algorithm.	**BTL1**	Remember
17.	What is the basic operation in DIT algorithm?	**BTL2**	Understand
18.	Draw the basic butterfly diagram for DIF algorithm.	**BTL1**	Remember
19.	Compare DIT radix-2 FFT and DIF radix-2 FFT.	**BTL3**	Apply
20.	What are the applications of FFT algorithm?	**BTL2**	Understand
21.	In eight point decimation in time (DIT), calculate the gain of the signal path that goes from $x(7)$ to $x(2)$.	**BTL3**	Apply
22.	Explain how butterfly structure is helpful in DFT computation?	**BTL4**	Analyze
23.	Summarize the information we get from magnitude and phase representation.	**BTL2**	Understand
24.	Discuss about "in-place computation" in FFT algorithm	**BTL2**	Understand
	PART –B		
1.	State and proof any four properties of DFT. **(13)**	**BTL1**	Remember
2.	Find the DFT of a sequence. **(13)** $x[n] = \begin{cases} 1 & for\ 0 \le n \le 2 \\ 0 & otherwise \end{cases}$ $for N = 4.$ Plot its magnitude response.	**BTL2**	Understand
3.	Determine the DFT of the sequence $x(n) = \begin{cases} \frac{1}{4}, & for\ 0 \le n \le 2 \\ 0, & otherwise \end{cases}$ **(13)**	**BTL6**	Create
4.	Find the circular convolution of two finite duration sequences. **(13)** $x_1(n) = \{1, -1, -2, 3, -1\}$, $x_2(n) = \{1, 2, 3\}$	**BTL2**	Understand
5.	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 $x_1(n) = \{1,2,3,4\}$, $x_2(n) = \{1,1,2,2\}$. **(13)**	**BTL1**	Remember
6.	Find the DFT of a sequence $x[n] = \{1,1,1,1,1,1,1,1\}\ using$ Decimation- in- Time (DIT) algorithm. **(13)**	**BTL3**	Apply
7.	Find the DFT of a sequence $x[n] = \{1,2,3,4,4,3,2,1\}\ using$ Decimation- in- Time (DIT) algorithm. **(13)**	**BTL3**	Apply
8.	Derive and draw the butterfly diagram for computing 8-point DFT of a sequence $x(n)$ using DIF FFT algorithm. **(13)**	**BTL1**	Remember
9.	Derive and draw the butterfly diagram for computing 8-point DFT of a sequence $x(n)$ using DIT FFT algorithm. **(13)**	**BTL1**	Remember

10.	Find the DFT of a sequence $x[n] = \{1,0,0,0,0,0,0,0\}$ using Decimation-in- Time (DIT) algorithm. **(13)**	**BTL3**	Apply
11.	Compute the 4-point DFT of the sequence $x(n) = \{0,1,2,3\}$ using DIT and DIF algorithm. **(13)**	**BTL4**	Analyze
12.	Find the DFT of a sequence $x[n] = \{1,2,3,4,4,3,2,1\}$ using Decimation- in- Frequency (DIF) algorithm. **(13)**	**BTL4**	Analyze
13.	Find the DFT of a sequence $x[n] = \{1,1,1,1,1,1,1,1\}$ using Decimation- in- Frequency (DIF) algorithm. **(13)**	**BTL2**	Understand
14.	An 8 point sequence is given by $x(n) = \{2,2,2,2,1,1,1,1\}$, compute 8 point DFT of $x(n)$ by radix 2 DIT FFT. Also analyze its response with respect to magnitude and space spectrum. **(13)**	**BTL4**	Analyze
15.	Consider the sequences: $x_1(n) = \{0,1,2,3,4\}$, $x_2(n) = \{0,1,0,0,0\}$ $and\ s(n) = \{1,0,0,0\}$ **(i)** Determine a sequence $y(n)$ $so\ that\ Y(k) = X_1(k)X_2(k)$ **(ii)** Is there a sequence $x_3(n)$ $such\ that\ S(k) = X_1(k)X_3(k)$. **(7+6)**	**BTL5**	Evaluate
16.	Describe the need for Bit reversal and the Butterfly structure. For a sequence $x(n) = \{4,3,2,1,-1,2,3,4\}$ obtain the 8 point FFT computation using DIT method. **(13)**	**BTL6**	Create
17.	Given $x(n) = n + 1, and\ N = 8$, find $X(k)$ using DIT FFT algorithm. **(13)**	**BTL2**	Understand
	PART – C		
1.	Determine 8-point DFT of the sequence $x(n) = \{1,1,1,1,1,1,0,0\}$. **(15)**	**BTL5**	Evaluate
2.	An 8-point sequence is given by $x(n) = \{2,2,2,2,1,1,1,1\}$, compute 8-point DFT of $x(n)$ by radix 2 DIT FFT. **(15)**	**BTL5**	Evaluate
3.	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. **(15)**	**BTL6**	Create
4.	Compute the eight-point DFT of the sequence $x(n) = \{0, 1, 2, 3, 4, 5, 6, 7\}$ using DIF FFT algorithm. **(15)**	**BTL6**	Create
5.	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. **(15)**	**BTL6**	Create

UNIT-V DESIGN OF ANALOG AND 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.	BTL4	Analyze
3.	What are the different types of structures for realization of IIR systems?	BTL5	Evaluate
4.	Write the advantages and disadvantages of FIR filters.	BTL2	Understand
5.	How one can design digital filters from analog filters?	BTL1	Remember
6.	Relate under what conditions an FIR filter will exhibit linear phase response.	BTL5	Evaluate
7.	What are the different types of structures for realization of FIR systems?	BTL1	Remember
8.	What is bilinear transformation?	BTL 1	Remember
9.	Point out the limitation of using rectangular window in FIR filter design.	BTL4	Analyze
10.	Give Hamming window function.	BTL1	Remember
11.	What is Gibb's phenomenon?	BTL3	Apply
12.	What is the main disadvantage of direct-form realization?	BTL1	Remember
13.	Discuss about the pass band and stop band characteristics of Butterworth filter.	BTL5	Evaluate
14.	List the properties of Chebyshev filter.	BTL3	Apply
15.	Write the advantages and disadvantages of digital filters.	BTL2	Understand
16.	Name the methods that convert the transfer function of analog filter into digital filter.	BTL2	Understand
17.	Give the mapping relation for mapping of s-plane to z-plane in bilinear transformation.	BTL6	Create
18.	What is warping effect? Examine its effect on frequency response?	BTL3	Apply
19.	What is pre-warping? Conclude what happens, if pre-warping is not employed?	BTL2	Understand
20.	What is impulse invariant transformation?	BTL1	Remember
21.	Is the given transfer function $H(z) = \frac{1+0.8Z^{-1}}{1-0.9Z^{-1}}$ represents low pass filter or high pass filter. Justify the answer	BTL6	Create
22.	Draw the frequency response of N-point rectangular window.	BTL3	Apply
23.	Analyze the need for employing window for designing FIR filter?	BTL 4	Analyze

24.	How do you analyze in selecting the type of filter (IIR/FIR) for an application?	**BTL4**	**Analyze**
	PART –B		
1.	Obtain the direct form I and direct form II realization for the system. $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$. **(13)**	**BTL2**	Understand
2.	Obtain the cascade form and parallel form realization for the system. $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$. **(13)**	**BTL4**	Analyze
3.	Show the realization for the following system using cascade form. **(13)** $$H(z) = \frac{\left(1+\frac{1}{3}z^{-1}\right)}{\left(1-\frac{3}{42}z^{-1}+\frac{1}{8}z^{-2}\right)}$$	**BTL5**	Evaluate
4.	Realize the system given by difference equation $y(n) = 0.1y(n-1) + 0.72y(n-2) - 0.252x(n-2)$ in parallel form. **(13)**	**BTL1**	Remember
5.	**(i)** Determine the direct form realization of system function. **(7)** $H(z) = 1 + 2z^{-1} - 3z^{-2} - 4z^{-3} + 5z^{-4}$ **(ii)** Determine the cascade form realization of system function. **(6)** $H(z) = (1 + 2z^{-1} - z^{-2})(1 + z^{-1} - z^{-2})$	**BTL 1**	Remember
6.	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)**	**BTL 1**	Remember
7.	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)**	**BTL2**	Understand
8.	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)**	**BTL2**	Understand
9.	Using rectangular window technique design a LPF with pass band gain of unity, cut-off frequency of 1000Hz and working sampling frequency of 5kHz. The length of impulse is 7. **(13)**	**BTL5**	Evaluate
10.	Given the specifications $\propto_p = 3dB$, $\propto_s = 10dB$ $f_p = 1kHz$ and $f_s = 2kHz$. Determine the order of the filter using Chebyshev approximation. Find $H(s)$. **(13)**	**BTL3**	Apply

11.	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. **(13)**	**BTL6**	Create
12.	**(i)** Illustrate the bilinear transformation method of obtaining digital filter from analog filter. **(7)** **(ii)** Illustrate impulse invariant method of designing IIR filter. **(6)**	**BTL2**	Understand
13.	Using impulse variance method with T =1 Sec. Compute $H(z)\ if H(s) = \frac{1}{s^2+\sqrt{2}s+1}$. **(13)**	**BTL4**	Analyze
14.	Apply bilinear transformation to $H(s) = \frac{2}{(s+1)(s+2)}$ with T=1sec and compute $H(z)$. **(13)**	**BTL3**	Apply
15.	Apply impulse variance method to $H(s) = \frac{2}{(s+1)(s+2)}$ with T=1sec and compute $H(z)$. **(13)**	**BTL3**	Apply
16.	Convert the following analog transfer function into digital by applying impulse invariant technique with sampling period T=1 sec $H(z) = s + \frac{1}{(s+3)(s+5)}$ **(13)**	**BTL4**	Analyze
17.	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. **(13)**	**BTL 1**	Remember
	PART –C		
1.	Design a Butterworth filter using the Impulse invariance method for the following specifications. $0.8 \le \lvert H(e^{j\omega})\rvert \le 1 \quad 0 \le \omega \le 0.2\pi$ $\lvert H(e^{j\omega})\rvert \le 0.2 \quad 0.6\pi \le \omega \le \pi$ **(15)**	**BTL5**	Evaluate
2.	A low pass filter is to be designed with the following desired frequency response. $H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega}, & -\frac{\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0, & \frac{\pi}{4} < \lvert\omega\rvert \le \pi \end{cases}$ 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)**	**BTL5**	Evaluate
3.	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 at least 15dB at ω=0.75 π rad. **(15)**	**BTL6**	Create

4.	Design a Chebyshev filter for the following specification using bilinear transformation. $$0.8 \le \lvert H(e^{j\omega})\rvert \le 1; 0 \le \omega \le 0.2\pi$$ $$\lvert H(e^{j\omega})\rvert \le 0.2; 0.6\pi \le \omega \le \pi$$ **(15)**	**BTL6**	Create
5.	Obtain the system function of the digital filter if the analog filter is $H_a(s) = 1/[(s+0.2)^2+2]$, using the impulse invariance method and the Bilinear Transformation method. **(15)**	**BTL5**	Evaluate