S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-I INTRODUCTION		
1	Define symmetric and anti symmetric signals.	Remember	1
2	Explain about impulse response?	Understand	2
3	Describe an LTI system?	Understand	1
4	List the basic steps involved in convolution?	Remember	2
5	Discuss the condition for causality and stability?	Understand	1
6	State the Sampling Theorem	Remember	1
7	Express and sketch the graphical representations of a unit impulse, step	Understand	1
8	Model the Applications of DSP?	Apply	2
9	Develop the relationship between system function and the frequencyResponse	Apply	1
10	Discuss the advantages of DSP?	Understand	1
11	Explain about energy and power signals?	Understand	1
12	State the condition for BIBO stable?	Remember	2
13	Define Time invariant system.	Remember	2
14	Define the Parseval's Theorem	Remember	2
15	List out the operations performed on the signals.	Remember	1
16	Discuss about memory and memory less system?	Understand	2
17	Define commutative and associative law of convolutions.	Remember	1
18	Sketch the discrete time signal $x(n) = 4\,\delta(n+4) + \delta(n) + 2\,\delta(n-1) + \delta(n-2)$	Apply	2

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
19	Identify the energy and power of $x(n) = Ae^{j\omega n} u(n)$.	Apply	1
20	Illustrate the aliasing effect? How can it be avoided?	Apply	1
21	Identify linear system in the following: a) $y(n) = e^{x(n)}$ b) $y(n) = x^2(n)$ c) $y(n) = ax(n) + b$ d) $y(n) = x(n^2)$	Understand	1
22	Identify a time-variant system. a) $y(n) = e^{x(n)}$ b) $y(n) = x(n^2)$ c) $y(n) = x(n) - x(n-1)$ d) $y(n) = nx(n)$	Apply	2
23	Identify a causal system. a) $y(n) = x(2n)$ b) $y(n) = x(n) - x(n-1)$ c) $y(n) = nx(n)$ d) $y(n) = x(n) + x(n+1)$	Evaluate	1
	REALIZATION OF DIGITAL FILTERS		
24	Define Z-transform and region of converges.	Understand	2
25	What are the properties of ROC	Remember	2
26	Write properties of Z-transform	Understand	2
27	Find z-transform of a impulse and step signals	Remember	2
28	What are the different methods of evaluating inverse Z-transform	Evaluate	2
29	Define system function	Understand	2
30	Find The Z-transform of the finite-duration signal x(n)={1,2,5,7,0,1}	Understand	2
31	What is the difference between bilateral and unilateral Z-transform	Evaluate	2
32	What is the Z-transform of the signal $x(n)=Cos(w_o n)\ u(n)$.	Evaluate	2
33	With reference to Z-transform, state the initial and final value theorems?	Analyze	2
34	What are the basic building blocks of realization structures?	Understand	4
35	Define canonic and non-canonic structures.	Remember	4
36	Draw the direct-form I realization of 3rd order system	Understand	4
37	What is the main advantage of direct-form II realization when compared to Direct-form I realization?	Remember	4
38	What is advantage of cascade realization	Evaluate	4
39	Draw the parallel form structure of IIR filter	Understand	4
40	Draw the cascade form structure of IIR filter	Understand	4
41	Transfer function for IIR Filters	Understand	4
42	Transfer function for FIR Filters	Remember	4

UNIT-I (LONG ANSWER QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-I INTRODUCTION		
1	Determine the impulse response and step response of the causal system given below and discuss on stability: $y(n) + y(n-1) - 2y(n-2) = x(n-1)+2x(n-2)$	Evaluate	1

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
2	Test the following systems for linearity, time invariance, causality and stability. i. $y(n) = a^{\lvert x(n)\rvert}$ ii. $y(n) = \sin(2nfn/F)\, x(n)$	Evaluate	2
3	A causal LTI system is defined by the difference equation $2y(n) - y(n-2) = x(n-1)+3x(n-2)+2x(n-3)$. Find the frequency response $H(e^{jw})$, magnitude response and phase response.	Apply	2
4	Find the impulse response for the causal system $y(n)-y(n-1) = x(n)+x(n-1)$	Apply	2
5	Define stable and unstable system test the condition for stability of the first- order system governed by the equation $y(n)=x(n)+bx(n-1)$.	Evaluate	1
6	A system is described by the difference equation $y(n)-y(n-1)-y(n-2) = x(n-1)$. Assuming that the system is initially relaxed, determine it s unit sample response h(n).	Apply	2
7	A discrete time LTI system has impulse response given by $h(n)=\{1, 3, 2, -1, 1\}$ for $-1 \leq n \leq 3$. Using linearity and time invariance property, determine the system output y(n) if the input x(n) is given by $x(n) = 2\delta(n)-\delta(n-1)$.	Evaluate	1
8	Determine whether the following system is i. Linear ii. Causal iii. Stable iv. Time invariant $y(n) = \log_{10} \lvert x(n)\rvert$ Justify your answer.	Evaluate	2
9	Determine the impulse response and the unit step response of the systems described by the difference equation $y(n) = 0.6y(n-1)-0.08\, y(n-2) + x(n)$.	Apply	2
10	The impulse response of LTI system is h(n)={1 2 1-1} Determine the response of the system if input is x(n)={1 2 31}	Evaluate	1
11	Determine the output y(n) of LTI system with impulse response $h(n)= a^n u(n)$. $\lvert a\rvert<1$ When the input is unit input sequence that is $x(n)=u(n)$	Remember	1
12	Determine impulse response for cascade of two LTI systems havimg Impulse responses of $H_1(n)=(1/2)^n u(n)$ $H_2(n)=(1/4)^n u(n)$	Apply	1
13	For each impulse response listed below determine whether the corresponding system is (i) causal (ii) stable a) $h(n)=2^n u(-n)$ b) $\sin \frac{n\pi}{2}$ c) $h(n)=\delta(n)+\sin\pi n$ d) $h(n)=e^{2n} u(n-1)$	Understand	1

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
14	Find the Discrete convolution for the following sequence u(n)*u(n-3)	Apply	1
15	Calculate the frequency response for the LTI systems representation i) $H_1(n)=(1/2)^n u(n)$ ii) $h(n)=\delta(n)-\delta(n-1)$	Remember	1
16	Determine the stability of the system Y(n)-(5/2)y(n-1)+y(n-2)=x(n)-x(n-1)	Evaluate	2
17.	Find the response of the following difference equation y(n)-5y(n-1)+6y(n-2)=x(n) for x(n)=n	Apply	2
	REALIZATION OF DIGITAL FILTERS		
18.	A causal LTI system is described by the difference equation y(n)=y(n-1)+y(n- 2)+x(n-1), where x(n) is the input and y(n) is the output. Find i. The system function H(Z)=Y(Z)/X(Z) for the system, plot the poles and zeroes of H(Z) and indicate the region of convergence. ii. The unit sample response of the system. iii. Is this system stable or not?	Understand	2
19.	Find the input x(n) of the system if the impulse response h(n) and output y(n) are shown below h(n)={ 1 2 3 2} y(n)={ 1 3 7 10 10 7 2}	Remember	2
20.	Determine the convolution of the pairs of signals by means of z-transform $X_1(n)=(1/2)^n$ u(n) $X_2(n)=\cos\pi n$ u(n)	Remember	2
22	Find the inverse a-transform of $X(z)=\frac{z(z+1)}{(z-2)(z-1)^3}$ roc |z|>2 using partial fraction method.	Remember	2
23	Determine the transfer function and impulse response of the system $y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + \frac{1}{3}x(n-1)$.	Evaluate	2
24	Obtain the cascade and parallel form realizations for the following systems Y (n) = -0.1(n-1) + 0.2 y (n-2) + 3x (n) +3.6 x (n-1) +0.6 x (n-2)	Apply	2
25	Obtain the Direct form II y (n) = -0.1(n-1) + 0.72 y(n-2) + 0.7x(n) -0.252 x(n-2)	Understand	4
26	Find the direct form- II realization of H (z) =8z-2+5z-1+1 / 7z-3+8z-2+1	Remember	4
27	Obtain the i) Direct forms ii) cascade iii) parallel form realizations for the following systems y (n) = 3/4(n-1) – 1/8 y(n-2) + x(n) +1/3 x(n-1)	Remember	4
28	Obtain the i) Direct forms ii) parallel form realizations for the following systems y (n) = x(n) +1/3 x(n-1)-1/5 x(n-2)	Understand	4

UNIT-I (ANALYTICAL THINKING QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-I		

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	INTRODUCTION		
1	Consider the simple signal processing system shown in below figure. The sampling periods of the A/D and D/A converters are T=5ms and T`= 1ms respectively. Determine the output $y_a(t)$ of the system. If the input is $x_a(t) = 3\cos 100\pi t + 2\sin 250\pi t$ (t in seconds)	Apply	1
2	Given the impulse response of a system as $h(k)=a^k u(k)$ determine the range of 'a' for which the system is stable	Remember	2
3	Determine the range of 'a' and 'b'for which the system is stable with impulse response $H(n)=\begin{cases} a^n & n\geq 0 \\ b^n & n<0 \end{cases}$	Apply	1
	REALIZATION OF DIGITAL FILTERS		
4	Use the one-sided Z-transform to determine y(n) $n \geq 0$ in the following cases. (a) $y(n) + y(n-1) - 0.25y(n-2) = 0;\ y(-1) = y(-2) = 1$ (b) $y(n) - 1.5y(n-1) + 0.5y(n-2) = 0;\ y(-1) = 1;\ y(-2) = 0$	Apply	2
5	Prove that the fibonacci series can be thought of as the impulse response of the system described by the difference equation $y(n) = y(n-1) + y(n-2) + x(n)$ Then determine h(n) using Z-transform techniques	Remember	2
	Obtain the i) Direct forms ii) cascade iii) parallel form realizations for the following systems $y(n) = 3/4(n-1) - 1/8\, y(n-2) + x(n) + 1/3\, x(n-1)$	Apply	4
6	Find the direct form –I cascade and parallel form for $H(Z) = z^{-1} -1 / 1 - 0.5 z^{-1} + 0.06 z^{-2}$	Evaluate	4

UNIT-II (SHORT ANSWER QUESTIONS)

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-II DISCRETE FORUIER SERIES		
1	Define discrete fourier series?	Remember	3
2	Distinguish DFT and DTFT	Understand	3
3	Define N-pint DFT of a sequence x(n)	Remember	3
4	Define N-pint IDFT of a sequence x(n)	Remember	3
5	State and prove time shifting property of DFT.	Remember	3
6	Examine the relation between DFT & Z-transform.	Analyze	3
7	Outline the DFT X(k) of a sequence x(n) is imaginary	Understand	3
8	Outline the DFT X(k) of a sequence x(n) is real	Understand	3
9	Explain the zero padding ?What are its uses	Understand	3
10	Analyze about periodic convolution	Analyze	3
11	Define circular convolution.	Remember	3
12	Distinguish between linear and circular convolution of two sequences	Understand	3
13	Demonstrate the overlap-save method	Apply	3
14	Illustrate the sectioned convolution	Apply	3
15	Demonstrate the overlap-add method	Apply	3
16	State the difference between i)overlap-save ii)overlap-add method	Remember	3

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
17	Compute the values of $W_N k$,When N=8, k=2 and also for k=3.	Apply	2
18	Discuss about power density spectrum of the periodic signal	Understand	3
19	Compute the DTFT of the sequence $x(n)=a^n\ u(n)$ for a<1	Apply	2
20	Show the circular convolution is obtained using concentric circle method?	Apply	3
	FAST FOURIER TRANSFORM		
21	Why FFT is needed?	Remember	6
22	What is the speed improvement factor in calculation 64-point DFT of sequence using direct computation and FFT algorithm	Understand	6
23	What is the main advantages of FFT?	Understand	6
24	Determine N=2048, the number of multiplications required using DFT is	Evaluate	6
25	Determine N=2048, the number of multiplications required using FFT is	Evaluate	6
26	Determine, the number of additions required using DFT is	Evaluate	6
27	Determine N=2048, the number of additions required using FFT is	Evaluate	6
28	What is FFT	Remember	6
29	What is radix-2 FFT	Remember	6
30	What is decimation –in-time algorithm	Remember	6
31	What is decimation –in frequency algorithm	Remember	6
32	What are the diffences and similarities between DIF and DIT algorithms	Remember	6
33	What is the basic operation of DIT algorithm	Remember	6
34	What is the basic operation of DIF algorithm	Remember	6
35	Draw the butterfly diagram of DIT algorithm	Remember	6
36	How can we calculate IDFT using FFT algorithm	Understand	6
37	Draw the 4-point radix-2 DIT-FFT butterfly structure for DFT	Remember	6
38	Draw the 4-point radix-2 DIF-FFT butterfly structure for DFT	Apply	6
39	What are the Applys of FFT algorithms	Remember	6
40	Draw the Radix-N FFT diagram for N=6	Apply	6

UNIT-II (LONG ANSWER QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-II **DISCRETE FORUIER SERIES**		
1	State and prove the circular time shifting and frequency shifting properties of the DFT.	Apply	3
2	Prove the following properties. i. $W^n_N x(n) \longleftrightarrow X((K+1))_N R_N(K)$ ii. $x^*(n) \longleftrightarrow X^*((-K))_N R_N(K)$	Understand	3
3	If x(n) denotes a finite length sequence of length N, show that $x((-n))_N = x((N-n))_N$.	Apply	3
4	Define DFT of a sequence. Compute the N - point DFT of the sequence.	Apply	3

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	$X(n) = Cos(2\pi rn/N)$, $0 \le n \le N-1$ and $0 \le r \le N-1$		
5	Determine the fourier series spectrum of signals i)x(n)=cos√2πn ii)cosπn/3	Remember	3
7	Derive relation between fourier transform and z-transform	Remember	3
8	Let X(k) be a 14-point DFT of a length 14 real sequence x(n).The first 8 samples of X(k) are given by X(0)=12 X(1)=-1+j3 X(2)=3+j4 X(3)=1-j5 X(4)=-2+2j X(5)=6+j3 X(6)=-2-j3 X(7)=10.Determine the remaining samples	Understand	3
9	compute DFT of a sequence $(-1)^n$ for N=4	Apply	3
10	Find 4-point DFT of the following sequences (a) x(n)={1 -1 0 0} (b) x(n)={1 1 -2 -2} (c) $x(n)=2^n$ (d) x(n)=sin(nΠ/2)	Remember	3
11	Determine the circular convolution of the two sequences x1(n)={1 2 3 4} x2(n)={1 1 1 1} and prove that it is equal to the linear convolution of the same	Apply	3
12	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 overlap save method	Understand	3
13	Find the output y(n) of a filter whose impulse response is h(n) = {1 11} and input signal x(n) = {3 -1 0 1 3 2 0 1 2 1}. Using Overlap add method	Apply	3
14	Determine the impulse response for the cascade of two LTI systems having impulse responses h1(n)=(1/2)^n* u(n) h2(n)=(1/4)^n*u(n)	Apply	3
15	Find the output sequence y(n)if h(n)={1 1 1 1} and x(n)={1 2 3 1} using circular convolution	Apply	3
16	Find the convolution sum of x(n) =1 n = -2 0 1 = 2 n= -1 = 0 elsewhere and h(n) = δ (n) – δ (n-1) + δ(n-2) - δ (n-3)	Analyze	3
	FAST FOURIER TRANSFORM		
17.	Explain the inverse FFT algorithm to compute inverse DFT of N=8 sequence. Draw the flow graph for the same.	Evaluate	6
18.	Draw the butterfly line diagram for 8 - point FFT calculation and briefly explain. Use decimation in-time algorithm.	Analyze	6
19.	Find the DFT of a sequence x(n)={1 2 3 4 4 3 2 1} using DIF algorithm.	Understand	6
20.	Find the 8-pont DFT of sequence x(n)={1 1 1 1 1 0 0 0}	Evaluate	6
21	Compute the eight-point DFT of the sequence X(n)= { 1 0≤n≤7 0 otherwise by using **DIF** algorithms	Evaluate	6
22	Evaluate the 8-point DFT for the following sequences using DIT-FFT algorithm. $x_1(n) = 1$ for $-3 \le n \le 3$ and 0 otherwise.	Apply	6
23	Compute 4-point DFT of a sequence x(n)={0 1 2 3} using DIT DIF algorithms	Evaluate	6
24	Compute IDFT of sequence X(K)={7 -.707-j.707 –j 0.707-j0.707 1 0.707+j0.707 j - .707+j.707}	Analyze	6
25	Compute the eight-point DFT of the sequence x(n)={0.5 0.5 0.5 0.5 0 0 0 0} using Radix **DIT** algorithm	Apply	6
26	Compute the eight-point DFT of the sequence x(n)={0.5 0.5 0.5 0.5 0 0 0 0} using radix **DIF** algorithm	Apply	6
27	Compute the DFT of a sequence x(n)={1 -1 1 -1} using DIT algorithm	Understand	6
28	Given $x(n)=2^n$ and N=8 find X(k) using DIT-FFT algorithm	Apply	6
29	Compute the DFT of the sequence $x(n) = \cos\frac{n\pi}{2}$ where N=4 using DIF FFT	Understand	6

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	algorithm.		
30	Find the IDFT of sequence X(k)={1 1+j 2 1-2j 0 1+2j 0 1-j} using DIF algorithm	Evaluate	6
31	Find the IDFT of sequence X(k)={8 1+j2 1-j 0 1 0 1+j 1-j2}	Evaluate	6
32	Draw the signal flow graph for 16-point DFT using a) DIT algorithm b) DIF algorithm	Evaluate	6
33	Find the IDFT of a sequence x(n)={0 1 2 3 4 5 6 7} using DIT-FFT algorithm.	Understand	6

UNIT-II (ANALYTICAL THINKING QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-II **DISCRETE FORUIER SERIES**		
1	The linear convolution of length-50 sequence with a length 800 sequence is to be computed using 64 point DFT and IDFT a) What is the smallest number of DFT and IDFT needed to compute the linear convolution using overlap-add method b) What is the smallest number of DFT and IDFT needed to compute the linear convolution using overlap-save method	Apply	3
2	Consider the sequences x1(n) = {0 1 2 3 4} x2(n) = {0 1 0 0 0} x3(n) = {1 0 0 0 0} and their 5 point DFT. (a) Determine a sequence y(n) so that Y(k) =X1(k) X2(k) (b) Is there a sequence x3(n) such that S(k) =X1(k) X3(k)	Analyze	3
	FAST FOURIER TRANSFORM		
3	Find the IDFT of sequence X(k)={4 1-j2.414 0 1-j.414 0 1+j.414 0 1+j2.414} using DIF algorithm	Remember	6
4	Explain how the DFT can be used to compute N equi-spaced samples of the z-transform of an N-point sequence on a circle of radius r.	Remember	6
5	Evaluate and compare the 8-point for the following sequences using DIT-FFT algorithm. a) $x_1(n)=\begin{cases} 1 & \text{for } -3\leq n\leq 3 \\ 0 & \text{otherwise} \end{cases}$ b) $x_2(n)=\begin{cases} 1 & \text{for } 0\leq n\leq 6 \\ 0 & \text{otherwise} \end{cases}$	Apply	6

UNIT-III (SHORT ANSWER QUESTIONS)

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-III **IIR DIGTAL FILTERS**		
1	Give the magnitude function of butter worth filter.What is the effect of varying order of N on magnitude and phase response?	Understand	5
2	Give any two properties of butter worth low pass filter	Remember	5
3	What are properties of chebyshev filter	Remember	5
4	Give the equation for the order of N and cutoff frequency of butter worth filter	Remember	5
5	What is an IIR filter?	Remember	5
6	What is meant by frequency warping? What is the cause of this effect?	Remember	5

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
7	Distinguish between butterworth and chebyshev filter	Understand	5
8	How can design digital filters from analog filters	Evaluate	5
9	What is bilinear transformation and properties of bilinear transform	Remember	5
10	What is impulse invariant method of designing IIR filter	Remember	5
11	Distinguish IIR and FIR filters	Analyze	5
12	Distinguish analog and digital filters	Analyze	5
13	Give the equation for the order N, major, minor axis of an ellipse in case of chebyshev filter?	Understand	5
14	List the Butterworth polynomial for various orders	Remember	5
15	Write the various frequency transformations in analog domain?	Evaluate	5
16	What are the advantages of Chebyshev filters over Butterworth filters	Understand	5
17	What do you understand by backward difference	Understand	5
18	Write a note on pre warping.	Evaluate	5
19	What are the specifications of a practical digital filter	Evaluate	5
20	Write the expression for the order of chebyshev filter and Butterworth filter	Analyze	5

UNIT-III (LONG ANSWER QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-III IIR DIGTAL FILTERS		
1	Design a Digital IIR low pass filter with pass band edge at 1000 Hz and stop band edge at 1500 Hz for a sampling frequency of 5000 Hz. The filter is to have a pass band ripple of 0.5 dB and stop band ripple below 30 dB. Design Butter worth filler using **impulse invariant transformation**.	Evaluate	5
2	Design a Digital IIR low pass filter with pass band edge at 1000 Hz and stop band edge at 1500 Hz for a sampling frequency of 5000 Hz. The filter is to have a pass band ripple of 0.5 dB and stop band ripple below 30 dB. Design Butter worth filler using **Bi-linear transformation.**	Understand	5
3	Given the specification α_p=1dB, α_s=30dB,Ω_p=200rad/sec, Ω_s=600rad/sec. Determine the order of the filter	Understand	5
4	Determine the order and the poles of lowpass butter worth filter that has a 3 dB attenuation at 500Hz and an attenuation of 40dB at 1000Hz	Remember	5
5	Design an analog Butterworth filter that as a -2dB pass band attenuation at a frequency of 20rad/sec and at least -10dB stop band attenuation at 30rad/sec	Understand	5
6	For the given specification design an analog Butterworth filter $0.9 \leq \lvert H(j\Omega) \rvert \leq 1$ for $0 \leq \Omega \leq 0.2\pi$ $\lvert H(j\Omega) \rvert \leq 0.2\pi$ for $0.4\pi \leq \Omega \leq \pi$	Remember	5
7	For the given specifications find the order of butter worth filter α_p=3dB, α_s=18dB, f_p=1KHz, f_s=2KHz.	Evaluate	5
8	Design an analog butter worth filter that has α_p=0.5dB, α_s=22dB, f_p=10KHz, f_s=25KHz Find the pole location of a 6^{th} order butter worth filter with Ω_c=1 rad/sec	Understand	5
9	Given the specification α_p=3dB, α_s=16dB, f_p=1KHz, f_s=2KHz. Determine the order of the	Understand	5

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	filter Using cheby shev approximation. find H(s).		
10	Obtain an analog cheby shev filter transfer function that satisfies the constraints $0\leq\|H(j\Omega)\|\leq 1$ for $0\leq\Omega\leq 2$	Evaluate	5
11	Determine the order and the poles of type 1 low pass cheby shev filter that has a 1 dB ripple in the passband and passband frequency $\Omega_p=1000\pi$ and a stopband of frequency of 2000π and an attenuation of 40dB or more.	Evaluate	5
12	For the given specifications find the order of chebyshev-I α_p=1.5dB, α_s=10dB, Ω_p =2rad/sec, Ω_s =30 rad/sec.	Analyze	5
13	For the analog transfer function H(s)= $\frac{2}{(s+1)(s+2)}$ Determine H(z) using impulse invariance method .Assume T=1sec	Understand	5
14	For the analog transfer function H(s)= $\frac{1}{s^2+\sqrt{2}s+1}$ Determine H(z) using impulse invariance method .Assume T=1sec	Remember	5
15	Design a third order butter worth digital filter using impulse invariant technique .Assume sampling period T=1sec	Understand	5
16	An analog filter has a transfer function H(s)= $\frac{5}{s^3+6s^2+11s+6}$ .Design a digital filter equivalent to this using impulse invariant method for T=1Sec	Remember	5
17	For the analog transfer function H(s)= $\frac{2}{(s+1)(s+2)}$ Determine H(z) using bilinear method Assume T=1sec	Evaluate	5

UNIT-III (ANALYTICAL THINKING QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-III **IIR DIGTAL FILTERS**		
1	For the analog transfer function H(s)= $\frac{1}{s^2+6s+9}$ Determine H(z) using bilinear method	Understand	5
2	Apply impulse invariant method and find H(z) for H(s)= $\frac{s+a}{(s+a)^2+b^2}$	Remember	5
3	Design a chebyshev filter with a maximum pass band attenuation of 2.5dB at Ω_p=20rad/sec and the stopband attenuation of 30dB at Ω_s=50rad/sec.	Remember	5
4	An ideal discrete-time lowpass filter with cutoff frequency $\omega_c=2\pi/5$ was designed using impulse invariance from an ideal continuous-time lowpass filter with cutoff frequency $\Omega_c=2\pi(4000)$ rad/s. What was the value of T? is this value unique? If not, find another value of T consistent with the	Evaluate	5

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	information given.		
5	The bilinear transformation is used todesign an ideal discrete-time lowpass filter with cutoff frequency $\omega_c = 3\pi/5$ from an ideal continuous-time lowpass filter with cutoff frequency $\Omega_c = 2\pi(300)$ rad/s. What was the value of T? is this value unique? If not, find another value of T consistent with the information given.	Understand	5

UNIT-IV (SHORT ANSWER QUESTIONS)

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-IV FIR DIGTAL FILTERS		
1	What is mean by FIR filter? and What are advantages of FIR filter?	Understand	8
2	What is the necessary and sufficient condition for the linear phase characteristic of a FIR filter?	Remember	8
3	List the well known design technique for linear phase FIR filter design?	Understand	8
4	For What kind of Apply, the symmetrical impulse response can be used?	Remember	8
5	Under What conditions a finite duration sequence h(n) will yield constant group delay in its frequency response characteristics and not the phase delay?	Evaluate	8
6	What is Gibbs phenomenon?	Understand	8
7	What are the desirable characteristics of the windows?	Understand	8
8	Compare Hamming window with Kaiser window.	Evaluate	8
9	Draw impulse response of an ideal lowpass filter.	Evaluate	8
10	What is the principle of designing FIR filter using frequency sampling method?	Analyze	8
11	For What type of filters frequency sampling method is suitable?	Understand	8
12	What is the effect of truncating an infinite Fourier series into a finite series	Remember	8
13	What is a Kaiser window? In What way is it superior to other window functions?	Understand	8
14	Explain the procedure for designing FIR filters using windows.	Remember	8
15	What are the disadvantage of Fourier series method ?	Evaluate	8
16	Draw the frequency response of N point Bartlett window	Understand	8
17	Draw the frequency response of N point Blackman window	Understand	8
18	Draw the frequency response of N point Hanning window	Evaluate	8
19	What is the necessary and sufficient condition for linear phase characteristics in FIR filter.	Evaluate	8
20	Give the equation specifying Kaiser window.	Analyze	8

UNIT-IV (LONG ANSWER QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-IV FIR DIGTAL FILTERS		
1	Design a high pass filter using hamming window with a cut-off frequency of 1.2radians/second and N=9	Evaluate	8
2	Determine the frequency response of FIR filter defined by y(n)=0.25x(n)+x(n-1)+.25x(n-2) Calculate the phase delay and group delay.	Understand	8
3	The frequency response of Linear phase FIR filter is given by	Remember	8

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	$H(e^{jw})=\cos\frac{w}{2}+\frac{1}{2}\cos\frac{3w}{2}$. Determine the impulse response(n).		
4	Design an ideal highpass filter with a frequency respose $H_d(e^{jw})=1$ for $\frac{\pi}{4}\leq\|\omega\|\leq\pi$ 0 for $\|\omega\|\leq\frac{\pi}{4}$ Find the values of h(n) for N=11.Find H(z).plot magnitude response.	Remember	8
5	Design an ideal bandpass filter with a frequency respose $H_d(e^{jw})=1$ for $\frac{\pi}{4}\leq\|\omega\|\leq\frac{3\pi}{4}$ 0 for $\|\omega\|\leq\frac{\pi}{4}$ Find the values of h(n) for N=11.Find H(z).plot magnitude response.	Evaluate	8
6	Design an ideal band reject filter with a frequency respose $H_d(e^{jw})=1$ for $\|\omega\|\leq\frac{\pi}{3}$ and $\|\omega\|\geq\frac{2\pi}{3}$ 0 for otherwise Find the values of h(n) for N=11.Find H(z).plot magnitude response.	Understand	8
7	Design an ideal differentiate $H(e^{jw})=j\omega$ $-\pi\leq\omega\leq\pi$ Using a)rectangular window b)Hamming window with N=8.plot frequency response in both cases.	Understand	8
8	Using frequency sampling method design a bandpass filter with following specifications Sampling frequency F=8000Hz Cut off frequency f_{c1}=1000Hz f_{c2}=3000Hz Determine the filter coefficients for N=7	Evaluate	8
9	Compare IIR and FIR filters	Analyze	8
10	Using a rectangular window technique design a low pass filter with pass band gain of unity, cutoff frequency of 100Hz and working at a sampling frequency of 5KHz.The length of the impulse response should be7.	Remember	8
11	Design a HPF of length 7 with cut off frequency of 2 rad/sec using Hamming window. Plot the magnitude and phase response.	Remember	8
12	Explain the principle and procedure for designing FIR filter using rectangular window	Evaluate	8

UNIT-IV (ANALYTICAL THINKING QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-IV FIR DIGTAL FILTERS		
1	Design a filter with $Hd(ej\omega) = e^{-3j\omega}$, $\pi/4 \leq \omega \leq \pi/4$ 0 for $\pi/4 \leq \omega \leq \pi$ using a Hamming window with N=7.	Understand	8
2	H (w) =1 for $\|\omega\| \leq \pi/3$ and $\|\omega\| \geq 2\pi/3$ otherwise for N=11. and find the response	Remember	8
3	a) Prove that an FIR filter has linear phase if the unit sample response satisfies the condition h(n)= ± h(M-1-n), n =0,1,….. M-Also discuss symmetric and anti symmetric cases of FIR filter. b) Explain the need for the use of window sequence in the design of FIR filter.	Understand	8

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	Describe the window sequence generally used and compare the properties.		
4	Design an ideal differentiator with frequency response H (e jώ) = jw $-\pi \le \omega \le \pi$ using hamming window for N=8 and find the frequency response.	Remember	8
5	Design an ideal Hilbert transformer having frequency response H (e jώ) = j $-\pi \le \omega \le 0$ -j $0 \le \omega \le \pi$ for N=11 using rectangular window	Evaluate	8

UNIT-V (SHORT ANSWER QUESTIONS)

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING		
1	What is decimation by factor D	Understand	7
2	What is interpolation by factor I	Remember	7
3	Find the spectrum of exponential signal	Understand	7
4	Find the spectrum of exponential signal decimated by factor 2.	Remember	7
5	Find the spectrum of exponential signal interpolated by factor 2	Evaluate	7
6	Explain the term up sampling and down sampling	Understand	7
7	What are the Applys of multi rate DSP	Understand	7
8	What does multirate mean?	Evaluate	7
9	Why should I do multirate DSP?	Evaluate	7
10	What are the categories of multirate?	Analyze	7
11	What are "decimation" and "downsampling"?	Understand	7
12	What is the "decimation factor"?	Remember	7
13	Why decimate?	Understand	7
14	Is there a restriction on decimation factors I can use?	Remember	7
15	Which signals can be down sampled?	Evaluate	7
16	What happens if I violate the Nyquist criteria in down sampling or decimating?	Understand	7
17	Can I decimate in multiple stages?	Understand	7
18	How do I implement decimation	Evaluate	7
	FINITE WORDLENGTH EFFECTS		
19	What are the effects of finite word length in digital filters?	Remember	7
20	List the errors which arise due to quantization process.	Understand	4
21	Discuss the truncation error in quantization process.	Understand	4
22	Write expression for variance of round-off quantization noise.	Evaluate	4
23	Define limit cycle Oscillations, and list out the types.	Evaluate	4
24	When zero limit cycle oscillation and Over flow limit cycle oscillation has occur?	Evaluate	4
25	Why? Scaling is important in Finite word length effect.	Understand	7
26	What are the differences between Fixed and Binary floating point number representation?	Evaluate	7
27	What is the error range for Truncation and round-off process?	Evaluate	4
28	What do you understand by a fixed-point number?	Analyze	7
29	What is meant by block floating point representation? What are its advantages?	Remember	7
30	What are the advantages of floating point arithmetic?	Understand	7
31	How the multiplication & addition are carried out in floating point arithmetic?	Understand	7

S.No	QUESTION	Blooms Taxonomy Level	Course Outcome
32	What do you understand by input quantization error?	Evaluate	4
33	What is the relationship between truncation error e and the bits b for representing a decimal into binary?	Evaluate	4
34	What is meant rounding? Discuss its effect on all types of number representation?	Evaluate	4
35	What is meant by A/D conversion noise?	Understand	4
36	What is the effect of quantization on pole location?	Evaluate	4
37	What is meant by quantization step size?	Evaluate	4
38	How would you relate the steady-state noise power due to quantization and the b bits representing the binary sequence?	Analyze	4

UNIT-V (LONG ANSWER QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING		
1	Discuss the applications of Multirate Digital Signal Processing		
2	Consider a signal x(n) = u(n) i. Obtain a signal with a decimation factor '3' ii. Obtain a signal with a interpolation factor '3'.		
3	Derive the expression for decimation by factor D	Understand	7
4	Derive the expression for interpolation by factor I	Analyze	7
5	With the help of block diagram explain the sampling rate conversion by a rational factor 'I/D'. Obtain necessary expressions.	Evaluate	7
6	Write notes on filter design and implementation for sampling rate conversion	Analyze	7
	FINITE WORDLENGTH EFFECTS		
7	Explain the output noise due to A/D conversion of the input x (n).	Evaluate	7
8	Write short note on (a) Truncation and rounding (b) Coefficient Quantization.	Evaluate	4
9	Explain the errors introduced by quantization with necessary expression	Understand	4
10	(i). Discuss the various common methods of quantization. (ii). Explain the finite word length effects in FIR digital filters.	Apply	4
11	Describe the quantization in floating point realization of IIR digital filters. (i). Explain the characteristics of limit cycle oscillation with respect to the system described by the difference equation: y(n) = 0.95y(n – 1) + x(n); x(n) = 0 and y(-1) = 13. Determine the dead band range of the system. (ii). Explain the effects of coefficient quantization in FIR filters	Understand	4
12	(i). Derive the signal to quantization noise ratio of A/D converter. (ii). Compare the truncation and rounding errors using fixed point and floating point representation.	Analyze	4
13	(i). What is quantization of analog signals? Derive the expression for the quantization error. (ii). Explain coefficient quantization in IIR filter.	Evaluate	7

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
14	(i). How to prevent limit cycle oscillations? Explain. (ii). What is meant by signal scaling? Explain.	Analyze	7
15	Discuss in detail the errors resulting from rounding and truncation.	Evaluate	4
16	Explain the limit cycle oscillations due to product round off and overflow errors.	Analyze	7
17.	Explain the characteristics of a limit cycle oscillation with respect to the system described by the equation y(n) = 0.45y(n – 1) + x(n) when the product is quantized to 5 – bits by rounding. The system is excited by an input x(n) = 0.75 for n = 0 and x(n) = 0 for n ≠ 0. Also determine the dead band of the filter.	Evaluate	7
18.	Consider the LTI system governed by the equation, y(n) + 0.8301y(n – 1) + 0.7348y(n – 2) = x(n – 2). Discuss the effect of co-efficient quantization on pole location , when the coefficients are quantized by 3-bits by truncation 4-bits by truncation	Evaluate	7

UNIT-V (ANALYTICAL THINKING QUESTIONS)

S. No	QUESTION	Blooms Taxonomy Level	Course Outcome
	UNIT-V MULTIRATE DIGITAL SIGNAL PROCESSING		
1	a)Describe the decimation process with a neat block diagram. b)Consider a signal x(n)=sin(∏n)U(n). Obtain a signal with an interpolation factor of '2'	Understand	7
2	a) What are the advantages and drawbacks of multiratedigital signal processing b) Design a decimator with the following specification D = 5, δp=,0.025 δs=0.0035, ωs= 0.2∏ Assume any other required data.	Evaluate	7
	FINITE WORDLENGTH EFFECTS		
3	The output of an A/D is fed through a digital system whose system function is $H(z)=1/(1-0.8z^{-1})$.Find the output noise power of the digital system.	Evaluate	7
4	The output of an A/D is fed through a digital system whose system function is H(Z)=0.6z/z-0.6. Find the output noise power of the digital system=8 bits	Evaluate	4
5	Discuss in detail about quantization effect in ADC of signals. Derive the expression for Pe(n) and SNR.	Understand	4
	A digital system is characterized by the difference equation y(n)=0.95y(n-1)+x(n).determine the dead band of the system when x(n)=0 and y(-1)=13.	Understand	4
6	Two first order filters are connected in cascaded whose system functions of the individual sections are $H1(z)=1/(1-0.8z^{-1})$ and $H2(z)=1/(1-0.9z^{1})$. Determine the overall output noise power.	Evaluate	4