Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, DEC 2024

Biomedical Engineering
V Semester
BM5502 DISCRETE TIME SIGNAL PROCESSING
(Regulation 2019)

Time: 3 hrs | Max.Marks: 100

CO1	Describe the continuous time and discrete time signals and systems.
CO2	Analyze the signals in both continuous time and discrete time
CO3	Compute the spectrum of any signal
CO4	Design IIR filter to process real world signals
CO5	Design FIR filter to process real world signals

BL – Bloom's Taxonomy Levels
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

Q.No	Questions	Marks	CO	BL
1	Determine the odd component of the signal $x[n]=\{1,\ 2,-3,4,-1\}$	2	1	3
2	Determine whether the signal is periodic or not. If periodic find the fundamental period. $x[n]=3e^{j\frac{\pi}{4}n}$	2	1	3
3	State and prove Parseval's theorem using DTFT.	2	2	2
4	State the relation between DTFT and Z transform.	2	2	2
5	Compare the computational complexity of DFT and FFT for N=16.	2	3	2
6	How is IDFT calculated using FFT algorithm?	2	3	3
7	What is prewarping?	2	4	2
8	Obtain the Direct Form II realization of the system $H(z)=\frac{3+2z^{-1}}{1+4z^{-2}+0.5z^{-3}}$	2	4	3
9	What are Gibb's oscillations?	2	5	2
10	Determine the downsampled signal of x[n] with downsampling factor of 3 $x[n]=\{1,-3,4,2,-3,-1,5,4,6,-3,-2\}$	2	5	3

PART- B (5 x 13= 65 Marks)

Q.No	Questions	Marks	CO	BL
11 (a) (i)	A discrete time signal $x[n]$ is applied to a discrete LTI system with impulse response $h[n]$ and input $x[n]$. Find the output response of the system. $x[n]=a^n u[n]$ $h[n]=b^n u[n]$	8	1	3

(ii)	Test the causality and stability of the system $h[n]=4^n u[-n]$	**5**	1	3
	OR			
11 (b) (i)	Compute autocorrelation of the sequence $x[n]=\{1,3,-2,4\}$	**8**	1	3
(ii)	Determine the energy and power of the signal $x[n]=2e^{j3n}$	**5**	1	3
12 (a) (i)	Find the time domain signal x[n] given the spectrum $X(e^{jw})=1, \quad \frac{\pi}{4}\le\|w\|\le\frac{\pi}{2}$ 0 otherwise	**8**	2	3
(ii)	A discrete time LTI system is described by $y[n]=\frac{1}{3}\{x[n]+x[n-1]+x[n-2]\}$. Determine the frequency response, plot the magnitude and phase response.	**5**	2	3
	OR			
12 (b) (i)	The transfer function of a discrete time LTI system is given by $H(z)=\frac{z}{z-\frac{1}{2}} \quad \|z\|>\frac{1}{2}$ Determine the output y[n] to the input $x[n]=nu[n]$	**8**	2	3
(ii)	Find the z transform of a) $x[n]=u[n]-u[n-3]$ b) $x[n]=n\{u[n]-u[n-3]\}$	**5**	2	3
13 (a)	Compute 8 point DFT of $x[n]=(-2)^n$ using DIF FFT algorithm.	**13**	3	3
	OR			
13 (b)	Find the output y[n] of a linear time invariant system given $x[n]=\{1,2,-3,0.5,-1,-2,3,4\}$ and $h[n]=\{1,-1\}$ using Overlap add method.	**13**	3	3
14 (a)	Design a Butterworth digital highpass filter using bilinear transformation with the following specifications, T=0.1s $0.6\le\|H(e^{jw})\|\le 1.0$ for $0.7\pi\le w\le\pi$ $\|H(e^{jw})\|\le 0.1$ for $0\le w\le 0.35\pi$	**13**	4	3
	OR			
14 (b) (i)	Explain the method to design an analog Chebyshev filter.	**8**	4	2
(ii)	Realize the filter $y[n]-\frac{5}{6}y[n-1]+\frac{1}{6}y[n-2]=x[n]+2x[n-1]$ in parallel form.	**5**	4	3
15 (a)	Design a linear phase FIR highpass filter with cutoff frequency of $\frac{\pi}{2}$ radian using hanning window with N=7.	**13**	5	3
	OR			
15 (b) (i)	Determine the coefficients of linear phase FIR filter of length N=15 which has the frequency response of $H(k)=1, \quad k=0,1,2,3$ $=0.4, \quad k=4$ $=0, \quad k=5,6,7$	**8**	5	3

(ii)	Compare Von Neumann and Modified Harvard architecture of DSP processor and explain the pipelining process	**5**	5	2

PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

Q.No	Questions	Marks	CO	BL
16a.	Design a linear phase FIR filter to eliminate high frequency noise in EEG signal with sampling frequency 256Hz.	**10**	5	4
b.	What are the noises that corrupt ECG signals? State the methods to eliminate them.	**5**	5	4