24.11.25 FN

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

CONTROLLER OF EXAMINATIONS AU CHENNAI 600 025

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, NOV / DEC 2025

IV Semester

BM23402 DISCRETE TIME SIGNAL PROCESSING (Regulation2023)

Time:3hrs Max.Marks: 100

CO1	Describe the discrete time signals and systems
CO2	Analyze the signals in discrete time and compute the spectrum
CO3	Implement linear, circular convolution and FFT using MATLAB
CO4	Design IIR and FIR filter to process real world signals
CO5	Implement discrete time systems using DSP processors
CO6	Apply signal processing techniques for various applications

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

PART- A(10x2=20Marks)
(Answer all Questions)

Q.No.	Questions	Marks	CO	BL
1	State the condition for causality.	2	1	2
2	Define energy and power signal.	2	1	2
3	Define DTFT pair.	2	2	2
4	Find the time domain signal for $X(z)=1+2z^{-1}+3z^{-2}-z^{-3}$	2	2	2
5	State the advantages of FFT.	2	3	2
6	Draw the basic butterfly structure of 2 point DIF FFT.	2	3	2
7	How IDFT is computed using FFT algorithm?	2	4	2
8	What is meant by prewarping?	2	4	2
9	Distinguish between IIR and FIR filter.	2	4	2
10	Mention the salient features of DSP processor..	2	5	2

PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

Q.No.	Questions	Marks	CO	BL
11 (a)(i)	Compute the cross correlation of the signals $x[n]=\{2,1,3,-1\}$ $y[n]=\{4,2,-2,1\}$	8	1	3
(ii)	Determine whether the following signal is periodic or not. If periodic find the fundamental period. $x[n]=\cos\left(\frac{\pi n}{3}\right)+\sin\left(\frac{\pi n}{6}\right)-2\cos\left(\frac{\pi n}{12}\right)$	5	1	3
	OR			
11 (b)	Determine whether the following systems are (i) memoryless, (ii) stable, (iii) causal, (iv) linear and (v) time invariant. a) $y[n]=nx[n-1]$ b) $y[n]=x[-n]$	13	1	3

12 (a)(i)	Find the signal $x[n]$ given $X(e^{j\omega}) = \begin{cases} 1 & -W \le \omega \le W \\ 0 & \lvert\omega\rvert > W \end{cases}$	8	2	3
(ii)	State and prove time shifting property of DTFT	5	2	3
	OR			
12 (b)(i)	A stable and causal system is described by the difference equation $y[n]+\frac{1}{4}y[n-1]-\frac{1}{8}y[n-2]=-2x[n]+\frac{5}{4}x[n-1]$. Find the impulse response of the system using Z-Transform.	8	2	3
(ii)	State the properties of ROC of Z transform.	5	2	3
13 (a)	Find the output y[n] of a linear time invariant system given $x[n]=\{1,3,2,-3,2,1,1,3,-1,-3,2\}$ *and* $h[n]=\{1,-1\}$ using Overlap add method.	13	3	3
	OR			
13 (b)	Compute 8 point DFT of $x[n]=\{2,-1,3,-2,1,-2,1,2\}$ using DIT FFT algorithm.	13	3	3
14 (a)	Design a digital Butterworth IIR filter using bilinear transformation by taking T = 0.2 second, to satisfy the following specifications. $\lvert H(e^{j\omega})\rvert \le 0.2$; for $0 \le \omega \le 0.3\pi$ $0.7 \le \lvert H(e^{j\omega})\rvert \le 1$; for $0.8\pi \le \omega \le \pi$	13	4	4
	OR			
14 (b)(i)	Explain the method to design an analog Chebyshev lowpass filter	8	4	4
(ii)	Obtain the cascade form realization of the IIR digital filter transfer function $H(z)=\frac{(1-z^{-1})^3}{(1-\frac{1}{2}z^{-1})(1-\frac{1}{8}z^{-1})}$	5	4	4
15 (a)	Design a linear phase FIR lowpass filter with cutoff frequency of $\frac{\pi}{2}$ radian using rectangular window with N=7.	13	4	4
	OR			
15 (b)	Determine the coefficients of a linear phase FIR filter of length N=11 which has a symmetric unit sample response and a frequency response that satisfies the conditions $H\left(\frac{2\pi k}{13}\right)=\begin{cases} 1 & ; \ k=0,1,2 \\ 0.2 & ; \ k=3,4 \\ 0 & ; \ k=5,6 \end{cases}$	13	4	4

ADDITIONAL CONTROLLER OF EXAMINATIONS AU CHENNAI 600 025

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 the high frequency noises in ECG signal.	10	6	4
b.	What are the noises that corrupt ECG signals? State the methods to eliminate them.	5	6	4