Sub Code: R2331043 **R23** **Set No. 1**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY-GURUJADA VIZINAGARAM
III B. Tech I Semester Regular Examinations November -2025
DIGITAL SIGNAL PROCESSING
(ECE)

Time: 3 hours **Max. Marks: 70**

The Question paper consists of Part A & Part B.
Part A is compulsory, Answer all questions. Part B Answers any one question from each unit.
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1		PART-A	(20Marks)
	a)	Find the transfer function of the system described by the difference equation $y(n) + 3y(n-1) = 2x(n)$	[2]
	b)	Determine if the system $y[n] = x[n] + 2x[n-1] + 3x[n-2]$ is causal.	[2]
	c)	Write any two advantages of FFT over conventional DFT	[2]
	d)	Compute the circular convolution of x[n]={1,2,3} and h[n]={0,1,1}.	[2]
	e)	Write the mathematical formula to compute the order of a Chebyshev I filter.	[2]
	f)	What is Frequency warping in Bilinear Transformation technique?	[2]
	g)	Define a linear phase FIR filter.	[2]
	h)	How does increasing filter length affect FIR filter performance?	[2]
	i)	List any four key features of a DSP processor.	[2]
	j)	What is the purpose of DSP processor packaging?	[2]
		PART-B	(50Marks)
		Question from **Unit - I**	
2	a)	A second order recursive system is described by the LCCDE $y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) - x(n-1)$ Find the system's response to the input $x(n) = \left(\frac{1}{2}\right)^n u(n)$ with zero initial conditions.	[5]
	b)	Given that x(n) is the system input and y(n) is the system output, check whether the following system is linear shift invariant and causal $y(n) = 5x(n^2 - n)$	[5]
		(OR)	
3	a)	Realize the structure of following system with minimum number of multipliers $H(z) = \left(1 + \frac{1}{5}z^{-1} + z^{-2}\right)\left(1 + z^{-1} + \frac{1}{5}z^{-2}\right)$	[5]
	b)	Realize the following IIR filter using direct form- II structure $y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{3}x(n-1)$	[5]
		Question from **Unit - II**	
4	a)	Compute linear convolution of two sequences $x_1(n) =$	[5]

		$\{1,-1,1\}$ and $x_2(n)=\{1,-2,4\}$ using DFT	
	b)	Apply overlap-save method to find the response of the system with impulse response $h(n)=\{1,2,1\}$ and the input $x(n)=\{1,-1,2,1,2,-1,1,3,1\}$.	[5]
		(OR)	
5	a)	State and prove circular time shift property of DFT.	[5]
	b)	Given $x(n)=2^n$ and N=8, Find X(k) using DIFFFT algorithm	[5]
		Question from **Unit - III**	
6	a)	Compare the impulse invariance and bilinear transformation methods.	[5]
	b)	The specification of the desired lowpass filter is $0.9 \le \left\|H(e^{j\omega})\right\| \le 1 \quad ; \quad 0 \le \omega \le 0.25\pi$ $\left\|H(e^{j\omega})\right\| \le 0.24 \quad ; \quad 0.5\pi \le \omega \le \pi$ Design a Digital Butterworth filter using Bilinear Transformation Method.	[5]
		(OR)	
7	a)	Discuss Bilinear Transformation method and derive the necessary relations	[5]
	b)	Design a digital filter equivalent to the analog filter with transfer function $H(s)=\frac{10}{s^2+7s+10}$ using impulse invariant method with T=0.1 sec	[5]
		Question from **Unit - IV**	
8	a)	Prove that for a linear phase FIR filter the impulse response is symmetric.	[5]
	b)	Design an FIR lowpass filter with desired frequency response $H_d(e^{j\omega}) = e^{-j2\omega} \quad for\ |\omega| \le \frac{\pi}{2}$ $= 0 \quad for\ \frac{\pi}{2} \le |\omega| \le \pi$ Using Hamming window with N=5	[5]
		(OR)	
9	a)	Explain any three window techniques in designing FIR digital filters.	[5]
	b)	Given the filter specifications as $H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega} & for \quad 0 \le \|\omega\| \le \pi/2 \\ 0 & for \quad \pi/2 \le \|\omega\| < \pi \end{cases}$ using Hanning window, calculate causal impulse response coefficients.	[5]
		Question from **Unit - V**	
10	a)	Illustrate the process of instruction pipelining in TMS320C5x professors	[5]
	b)	Compare fixed-point and floating-point DSP processors	[5]
		(OR)	
11	a)	Explain the functional units of CPU in TMS320C5x DSP processors.	[5]
	b)	Explain the Harvard Architecture with a neat sketch	[5]

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