Reg. No.															

Question Paper Code	12895

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Fifth Semester

Electronics and Instrumentation Engineering

(Common to Instrumentation and Control Engineering)

20EIPC503 - DIGITAL SIGNAL PROCESSING

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Show that $(\boldsymbol{n}) = \boldsymbol{u}(\boldsymbol{n}) - \boldsymbol{u}(\boldsymbol{n}-\mathbf{1})$ graphically.	2	K2	CO1
2.	What is aliasing effect?	2	K1	CO1
3.	State convolution theorem with respect to Z-Transform.	2	K2	CO2
4.	Find the Fourier transform of a sequence $\boldsymbol{x}(\boldsymbol{n}) = \begin{cases} \mathbf{1}, & -\mathbf{2} \le \boldsymbol{n} \le \mathbf{2} \\ \mathbf{0}, & \boldsymbol{otherwise} \end{cases}$	2	K2	CO2
5.	Find the DFT of the signal $\mathbf{x(n) = a^n}$.	2	K2	CO3
6.	Draw the basic butterfly diagram for Radix 2 DIT-FFT.	2	K1	CO3
7.	Distinguish between FIR and IIR filter.	2	K2	CO4
8.	Define a window.	2	K1	CO4
9.	How is pipelining effected in a DSP processor?	2	K1	CO5
10.	List some commercial DSP Processors.	2	K1	CO5

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	Check whether following system are linear, time invariant, causal and stable **(i) y(n) = cos x(n)** **(ii) y(n)= x(n^2)** **(iii) y(n)=x(n)+nx(n+1)**	13	K2	CO1
		OR			
	b) i)	Discuss in detail about different sampling techniques and comment on the condition if sampling frequency is less than the Nyquist rate.	9	K2	CO1
	ii)	Determine whether the following signals are energy or power or neither energy nor power signals. **a)** $\boldsymbol{x}(\boldsymbol{n}) = \left(\frac{\mathbf{1}}{\mathbf{3}}\right)^{\boldsymbol{n}} \boldsymbol{u}(\boldsymbol{n})$ **b)** $\boldsymbol{x}(\boldsymbol{n}) = \boldsymbol{sin}\left(\frac{\boldsymbol{n\pi}}{\mathbf{4}}\right)$	4	K2	CO1

12. a) i) Evaluate Z-transform of the following signals and plot the ROC *8 K2 CO2*

a) $x(n) = a^n \cos\omega_0 nu(n)$

b) $x(n) = -a^n u(-n-1)$

ii) Determine all possible signals x(n) associated with the following Z-transform function. *5 K2 CO2*

$$X(z) = \frac{5z^{-1}}{(1-2z^{-1})(1-3z^{-1})}$$

OR

b) i) Determine the transfer function and frequency response of the discrete time linear time invariant system which is governed by the following difference equation. *8 K2 CO2*

$$y(n) - 5y(n-1) = x(n) + 4x(n-1)$$

ii) Determine the magnitude and phase representation for the following system: $y(n) + \frac{1}{4}y(n-1) = x(n) - x(n-1)$ *5 K2 CO2*

13. a) i) Compute 8-point DFT of the given sequence using DIT algorithm. *9 K2 CO3*

$$x(n) = \begin{cases} n, & n \le 7 \\ 0, otherwise \end{cases}$$

ii) Compute the circular convolution of the following sequences. *4 K2 CO3*

$x_1(n) = \delta(n) + \delta(n-1) - \delta(n-2) - \delta(n-3)$

$x_2(n) = \delta(n) - \delta(n-2) - \delta(n-4)$

OR

b) Derive the butterfly structure for a radix-2 DIF algorithm that is used to compute FFT. Explain with an example. *13 K2 CO3*

14. a) Convert the analog filter with transfer function into digital filter by impulse invariant transformation. *13 K3 CO4*

$$H(s) = \frac{s + 0.1}{(s+0.1)^2 + 9}$$

OR

b) Design a low pass IIR filter with Butterworth design for the following specifications using bilinear transformation: *13 K3 CO4*

$$0.8 \le \left|H(e^{j\omega})\right| \le 1, \quad 0 \le |\omega| \le \frac{\pi}{4}$$

$$\left|H(e^{j\omega})\right| \le 0.2, \quad \frac{\pi}{2} \le |\omega| \le \pi$$

Realize the filter in direct form II structure.

15. a) Illustrate the architecture of any one Commercial Digital Signal Processor and explain with necessary diagram. *13 K2 CO5*

OR

b) i) Explain in detail any four addressing formats of digital signal processor. 8 K2 CO5

ii) Explain the classification of instructions in DSP processor with suitable examples. 5 K2 CO5

PART - C (1 × 15 = 15 Marks)

16. a) i) The desired frequency response of a low pass filter is given by 7 K3 CO4

$$\mathbf{H_d(\omega)} = \begin{cases} \mathbf{e^{-j3\omega}}, & 0 \le |\boldsymbol{\omega}| \le \mathbf{3\pi/4} \\ \mathbf{0}, & 3\pi/4 \le |\boldsymbol{\omega}| \le \boldsymbol{\pi} \end{cases}$$

Determine the impulse response of an FIR filter having length of 5 using rectangular window.

ii) Obtain the cascade and parallel form realization for the following system described by the difference equation 8 K3 CO4

$$\boldsymbol{y(n) - \frac{1}{4}y(n-1) - \frac{1}{8}y(n-2) = x(n) + 3x(n-1) + 2x(n-2).}$$

OR

b) Determine the coefficients of a linear phase FIR filter of length N=15 which has a symmetric unit sample response and a frequency response that satisfies the following condition. 15 K3 CO4

$$\mathbf{H_r}\left(\frac{\mathbf{2\pi k}}{\mathbf{15}}\right) = \begin{cases} \mathbf{1} & \mathbf{for\ k = 0, 1, 2, 3} \\ \mathbf{0} & \mathbf{for\ k = 4, 5, 6, 7} \end{cases}$$