U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

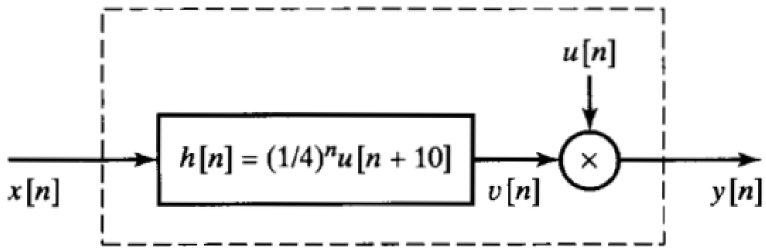
Branch: Electronics & Telecommunication Engineering **Duration: 3 hrs.**

Course Code: 23ET4PCSSD **Max Marks: 100**

Course: SIGNALS AND SYSTEMS: DIGITAL

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	***CO***	***PO***	**Marks**
1	a)	Consider the discrete time sequence $$x(n) = \cos\left({}^{n\pi}/_{8}\right)$$ Find a continuous-time signal that would produce this sequence when sampled at a frequency of f_s = 10 Hz.	*CO3*	*PO2*	**05**
	b)	Consider the system shown in Fig 1b.  Fig 1b i) Is the overall system LTI? ii) Is the overall system causal? iii) Is the overall system BIBO stable	*CO2*	*PO1*	**07**
	c)	Determine which of the following signals is periodic. If periodic, determine its period i) $x[n] = e^{j(2\pi n/5)}$ ii) $x[n] = \sin(\pi n/19)$ iii) $x[n] = ne^{j\pi n}$ iv) $x[n] = e^{jn}$	*CO2*	*PO1*	**08**
		OR			
2	a)	Consider the sequence given below: x[n] = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10] Sketch the following: (i) x[2n] (ii) x[n/2] (iii) x[-n] (iv) x[-n+3] (v) x[2n-4] Obtain Energy and Power of the signal	*CO1*	*PO1*	**10**

		b)	What are PRBS sequences? List few applications of PRBS.	*CO1*	--	**04**
		c)	Consider the system given below: $y[n] = 2x[n] + 1.5y[n-1]$ With suitable justification: (i) Classify the system as FIR/IIR (ii) Classify the system as Stable/Unstable	*CO2*	*PO2*	**06**
			UNIT - II			
	3	a)	Consider an LTI system with input x[n] and output y[n] that satisfies the difference equation $y[n] – 5/2\ y[n-1] + y[n-2] = x[n] – x[n-1]$ Determine all possible values for the system's impulse response at n = 0	*CO2*	*PO1*	**08**
		b)	Obtain a 5-point Circular Convolution of two signals given below $x(n) = (1.5)^n \quad 0 \le n \le 2$ $h(n) = 2n-3 \quad 0 \le n \le 3$	*CO2*	*PO1*	**07**
		c)	Let Θ be Uniform [-π,π], X(t) = cos(ωt + Θ). Find $R_{XX}(t_1,t_2)$	*CO2*	*PO1*	**05**
			OR			
	4	a)	State the properties of Impulse response	*CO1*	--	**05**
		b)	Consider the sequence given below: x[n] = [1, 3, 5, 7] y[n] = [2, 4, 6, 8] (i) Perform convolution of the above sequences, assume they are periodic, with period 4 (ii) Obtain and sketch the auto-correlation of x[n] (iii) Obtain and sketch the cross-correlation of x[n] and y[n]	*CO1*	*PO1*	**10**
		c)	Consider the sequence given below: x[n] = [1, 3, 5, 7] y[n] = [2, 4, 6, 8] Obtain the linear convolution of the above sequence using Z-Transform	*CO1*	*PO1*	**05**
			UNIT - III			
	5	a)	Use the 8 point radix-2 DIT-FFT algorithm to find the DFT of the sequence x(n)={0.707,1, 0.707,0,-0.707, -1,-0.707,0}.	*CO2*	*PO1*	**10**
		b)	Derive computational complexity in DIF-FFT in terms of i) Total Number of butterfly operations ii) Total number of complex additions iii) Total number of complex multiplications. Consider N = 8.	*CO2*	*PO1*	**06**
		c)	Given a continuous-time signal $x(t) = cos(2\pi ft)$ with frequency f = 5 Hz, and a sampling rate f_s = 8Hz, demonstrate aliasing by finding the frequency of the sampled signal.	*CO2*	*PO1*	**04**
			OR			
	6	a)	Explain up-sampling and its impact on the spectrum	*CO1*	--	**04**
		b)	Obtain the inverse DFT using suitable DIF-FFT algorithm X[k] = [10, 3-4j, 5, 3+4j]	*CO1*	*PO1*	**06**

		c)	Obtain the DFT using the DIF-FFT algorithm, and hence sketch the magnitude spectrum of the sequence given below. Assume the sampling frequency is 80Hz. x[n] = [0, 0.707, 1, 0.707, 0, -0.707, -1, 0.707]	*CO1*	*PO1*	**10**
			UNIT - IV			
	7	a)	Design a low-pass filter using rectangular window of length M = 5, given $\omega_c = \pi/2$ rad/s. Find the values of h(n).	*CO3*	*PO2*	**10**
		b)	Consider a system described by the difference equation y(n) = 6y(n-1) -9y(n-2) + x(n) + 0.5x(n-1). Find the response of the system to the input $x(n) = (0.5)^n u(n)$. The initial conditions are given as y(-1) = 1 and y(-2) = 1.	*CO2*	*PO1*	**06**
		c)	Given the autocorrelation function $R_{xx}[k] = 2\delta[k] + \delta[k-1] + \delta[k+1]$, find the power spectral density.	*CO2*	*PO1*	**04**
			OR			
	8	a)	Design a 5-tap low-pass FIR filter with a cut-off frequency of 0.4π using frequency sampling method.	*CO3*	*PO2*	**10**
		b)	For the function shown find and plot poles and zeros $$H(z) = \frac{(z-j)(z+j)}{\left(z-\left(\frac{1}{2}-\frac{1}{2j}\right)\right)\left(z-\left(\frac{1}{2}+\frac{1}{2j}\right)\right)}$$	*CO2*	*PO2*	**05**
		c)	Obtain transfer function of the given equation. y[n] = 4y[n-1] - 3y[n-2] + 1.5x[n] -0.5x[n-1]	*CO2*	*PO1*	**05**
			UNIT - V			
	9	a)	Design a digital low-pass filter with a cutoff frequency of $\omega_c = \pi/4$ radians/sample using the bilinear transform. The analog filter is a first-order low-pass filter with a cutoff frequency $\omega_c = \pi/2$ radians/second. Find the digital filter's transfer function	*CO3*	*PO2*	**10**
		b)	Find the Direct form I and Direct Form II representation of the filter with the transfer function $H(z) = \frac{0.5(1-z^{-2})}{1+1.3z^{-1}+0.36z^{-2}}$	*CO3*	*PO2*	**10**
			OR			
	10	a)	Design a digital low-pass filter using the Impulse Invariant Method with the following specifications: Analog filter transfer function: H(s) = 1/(s+1), Sampling Period: T = 1 second	*CO3*	*PO2*	**10**
		b)	With relevant equations and figures explain the design of IIR Butterworth Filters using Impulse Invariant method	*CO2*	*PO1*	**10**

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