U.S.N.										

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

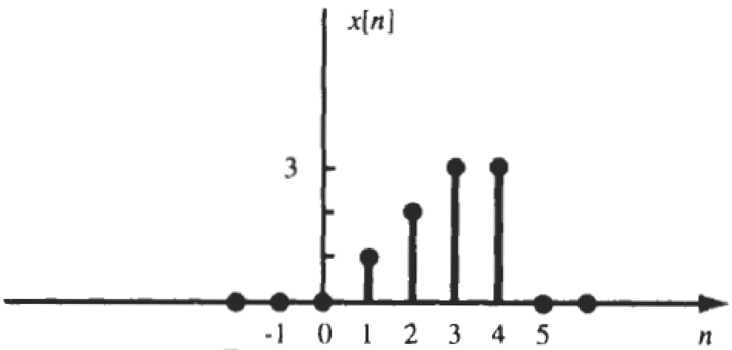
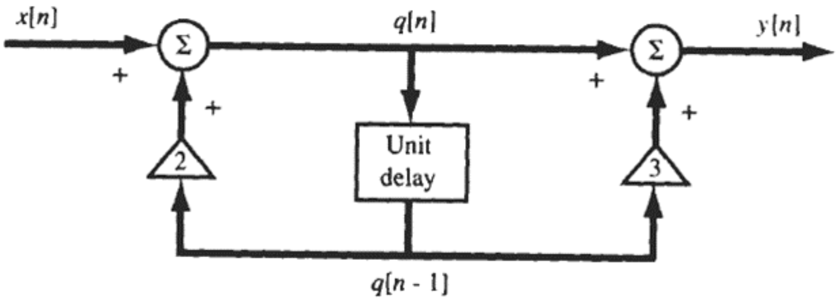
Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Electronics and Telecommunication Engineering **Duration: 3 hrs.**
Course Code: 22ET4PCSSD **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)	A discrete signal x[n] is shown in the figure Fig 1a. Sketch each of the following signals i) x[n-2] ii) x[2n] iii) x[-n] iv) x[-n+2]  Fig 1a	*CO2*	*PO2*	**10**
	b)	Compute $y[n] = x[n]*h[n]$, where $x[n] = \alpha^n u[n]$, $h[n] = \alpha^{-n}u[-n]$, $0 < \alpha < 1$	*CO2*	*PO2*	**10**
		OR			
2	a)	Classify the discrete time signals and systems with an example each	*CO1*	-	**10**
	b)	Consider the sinusoidal signal $x(t) = \cos 15t$. Find the fundamental period of $x[n] = x[nT_s]$, if $T_s = 0.1\pi$ seconds.	*CO2*	*PO2*	**10**
		UNIT - II			
3	a)	Write a difference equation for the figure Fig 2a to relate the output y[n] and the input x[n].  Fig 2a	*CO2*	*PO2*	**10**

		b)	Explain auto-correlation with relevant equations and an example. Also plot the result for the example considered	*CO2*	*PO1*	**10**
			OR			
	4	a)	Consider two sequences x[n] = cos(πn/2) and $h[n] = (1/2)^n$ where n = 0, 1, 2, 3. Calculate y[n] by finding the circular convolution between x[n] and y[n].	*CO2*	*PO2*	**10**
		b)	Explain cross-correlation with relevant equations and an example. Also plot the result for the example considered	*CO2*	*PO2*	**10**
			UNIT - III			
	5	a)	Assume that a complex multiplication takes 1μs, how much time is required to compute i) 1024-point DFT directly ii) If FFT is used iii) For 4096-point DFT using direct method and FFT method	*CO3*	*PO2*	**10**
		b)	With relevant equations and figures explain overlap-save method of evaluating DFT	*CO2*	*PO1*	**10**
			OR			
	6	a)	Let x(n) be a sequence of length N with x(n) = -x(n + N/2) n = 0, 1, ……N/2-1, where N is an even integer. Show that the N-point DFT has only odd harmonics, that is X(k) = 0, k even	*CO3*	*PO2*	**10**
		b)	With relevant equations and figures explain overlap-add method of evaluating DFT	*CO2*	*PO1*	**10**
			UNIT - IV			
	7	a)	Design a lowpass filter using rectangular window of length M = 11, given $\omega_c = \pi/2$ rad/s. Find the values of h(n).	*CO2*	*PO2*	**12**
		b)	Consider a system described by the difference equation y(n) = y(n-1) -y(n-2) + 0.5x(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) = 0.75 and y(-2) = 0.25.	*CO2*	*PO2*	**08**
			OR			
	8	a)	Consider a filter with a system function $H(z) = A\frac{1+z^{-4}}{1+a^4z^{-4}}$, where 0 < a < 1 i)Draw pole-zero diagram for H(z). ii)Find the value of A so that the peak gain of the filter is 2.	*CO2*	*PO2*	**06**
		b)	The z-transform of a sequence x(n) is given as $$X(Z) = \frac{z + 2z^{-2} + z^{-3}}{1 - 3z^{-4} + z^{-5}}$$ If the region of convergence includes the unit circle, find the DTFT of x(n) at ω = π.	*CO2*	*PO1*	**06**
		c)	Design a 9-tap lowpass FIR filter with a cutoff frequency of 0.25π using frequency sampling method.	*CO2*	*PO2*	**08**

			UNIT - V			
	9	a)	With relevant equations and figures explain the design of IIR Butterworth Filters using Impulse Invariant method	*CO2*	*PO1*	**10**
		b)	Explain Haar wavelet transform in detail with an example.	*CO2*	*PO1*	**10**
			OR			
	10	a)	Design a first-order digital low-pass filter with a 3-dB cutoff frequency of $\omega_c = 0.2\pi$ by applying the bilinear transformation to the analog Butterworth filter $$H_a(s) = \frac{1}{1 + s/\Omega_c}$$	*CO3*	*PO2*	**10**
		b)	Find the Direct form I and Direct Form II representation of the filter with the transfer function $$H(z) = \frac{3 + 3.6z^{-1} + 0.6z^{-2}}{1 + 0.2z^{-1} - 0.2z^{-2}}$$	*CO3*	*PO2*	**10**

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