Model Question Paper with effect from 2023-24(CBCS Scheme)

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Fifth Semester B.E. Degree Examination
Digital Signal Processing

Time: 03 Hours **Max. Marks: 100**

Note: Answer any FIVE full questions, choosing at least ONE question from each MODULE.

Sl No		Questions	BTL	Marks
		Module 1		
Q1	a	Determine the energy and power of the unit step sequence.	L2	4
	b	Consider an LTI system with input x(n) & unit impulse response h(n) given below, Compute y(n), $x(n) = 2^n u(-n)$ & $h(n) = u(n)$.	L3	8
	c	Define signal with example. Explain Classification of signals with examples also define Elementary Discrete-Time Signals.	L2	8
		OR		
Q2	a	Determine the response of the following systems to the input signal $x(n) = \begin{cases} \lvert n \rvert & -3 \leq n \leq 3 \\ 0, & \text{otherwise} \end{cases}$ a) y(n) = x(n) b) y(n) = x(n-1) c) y(n) = x(n+1) d) y(n) = 1/3 [x(n+1) + x(n)+x(n-1)]	L2	4
	b	The impulse response of a linear time-invariant system is $h(n) = \{1, \underset{\uparrow}{2}, 1, -1\}$. Determine the response of the system to the input signal x (n) = {1, 2, 3, 1}.	L3	8
	c	Define system with example. Explain Classification of Discrete-Time system with examples.	L2	8
		Module 2		
Q3	a	Determine the z-transform of the signal $x(n) = \alpha^n u(n) = \begin{cases} n, & n \geq 0 \\ 0, & n < 0 \end{cases}$ and $x(n) = -\alpha^n u(-n-1) = \begin{cases} 0, & n > 0 \\ -\alpha^n, & n \leq -1 \end{cases}$	L3	8
	b	Determine the z-transforms of the following finite-duration signals. $x_1(n) = \{\underset{\uparrow}{1}, 2, 5, 7, 0, 1\}$ (b) $x_2(n) = \{1, 2, \underset{\uparrow}{5}, 7, 0, 1\}$.	L3	4
	c	Mention the properties of Z transform with equations.	L2	8
		OR		
Q4	a	Perform Circular convolution of the following sequences using concentric circle method: $x_1(n) = \{2, 1, 2, 1\}$, $x_2(n) = \{1, 2, 3, 4\}$.	L3	8
	b	Find the DFT of the sequence $x(n) = \delta(n) + 2\delta(n-2) + \delta(n-3)$.	L3	4
	c	Explain Frequency Domain Sampling and Reconstruction of Discrete Time Signals with the help of necessary equations.	L2	8
		Module 3		
Q5	a	State and prove the following properties: i) Circular Time shift Property ii) Circular Frequency shift Property iii) Parsevals theorem iv) Complex conjugate property	L2	10
	b	Use the 8 point radix-2 DIT-FFT algorithm to find the DFT of the sequence x(n)={1,1,1,1,0,0,0,0}.	L3	10
		OR		

Q6	a	Illustrate the Inverse Decimation in Time FFT algorithm with the help of necessary equations and signal flow representation	L2	10
	b	Using linear convolution find y(n)= x(n) h(n) for the sequences x(n)={1, 2, -1, 2, 3, -2, -3, -1, 1, 1, 2, -1} & h(n)={1, 2}. Compare the result by solving the problem using overlap save & overlap add method.	L3	10
		Module 4		
Q7	a	The desired frequency response of a low pass filter is given by $H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j3\omega}, & \lvert\omega\rvert < 3\pi/4 \\ 0, & 3\pi/4 < \lvert\omega\rvert < \pi \end{cases}$ Determine the frequency response of the FIR filter if Hamming window is used with M=7.	L3	10
	b	Mention different windows with equations used in design of FIR filters.	L2	5
	c	Realize the system function $H(z) = 1 + 3/2\, z^{-1} + 4/5\, z^{-2} + 5/9\, z^{-3} + 1/9\, z^{-4}$ using direct form .	L2	5
		OR		
Q8	a	A filter is to be designed with the desired frequency response $H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} 0, & -\pi/4 < \omega < \pi/4 \\ e^{-j2\omega}, & \pi/4 < \lvert\omega\rvert < \pi \end{cases}$ Find the frequency response of the FIR filter designed using a rectangular window defined below: $w_R(n) = \begin{cases} 1, & 0 \le n \le 4 \\ 0, & \text{otherwise} \end{cases}$	L3	10
	b	Mention the Design steps followed in design of Linear Phase FIR Filter.	L2	5
	c	Realize a cascade form FIR filter for the following system function. $H(z) = (1+ \frac{1}{4} z^{-1} + z^{-2})\ (1+\frac{1}{8} z^{-1} + z^{-2})$.	L2	5
		Module 5		
Q9	a	Design a digital lowpass Butterworth filter with the following specifications: 1. 3 dB attenuation at the passband frequency of 1.5 kHz 2. 10 dB stopband attenuation at the frequency of 3 kHz 3. Sampling frequency of 8,000 Hz.	L3	8
	b	The normalized low pass filter with a cutoff frequency of 1 rad/sec is given as: $H_P(s) = 1/(s+1)$ Use the given $H_p(s)$ and the BLT to design a corresponding digital IIR lowpass filter with a cutoff frequency of 15 Hz and a sampling rate of 90 Hz.	L3	7
	c	Explain Bilinear Transformation design procedure in designing IIR filters.	L2	5
		OR		
Q10	a	Obtain analog lowpass prototype transformation to the low pass, high pass, band pass filter, band stop filters.	L2	8
	b	Obtain direct form I and direct form II for the system described by $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$.	L3	7
	c	Given the following IIR filter: $y(n) = 0.2x(n) + 0.4x(n-1) + 0.5y(n-1)$, Determine the transfer function, nonzero coefficients, and impulse response.	L2	5