CBCS SCHEME

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BEC502

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

Digital Signal Processing

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Estimate the signal x[n] in terms of its odd and even components.	4	L2	CO1
	b.	Classify whether each of the following signal is periodic or not. If periodic determine its fundamental period: i) $x_1(n) = \cos(2n)$ ii) $x_2(n) = \sin(3\pi n)$	6	L2	CO1
	c.	Predict whether the given system y[n] = x[n] + nx[n + 1] is static / dynamic, linear or non linear, time invariant or time variant, causal or non causal and stable or unstable. Justify your statements.	10	L3	CO1
		OR			
Q.2	a.	Distinguish between continuous and discrete signal. Compute the convolution of two finite sequence x[n] = [-1, 4, 2, 1] and h[n] = [1, 2, 3, 5].	10	L2	CO1
	b.	Write a program to perform the following operations on i) signal addition and ii) multiplication.	4	L3	CO1
	c.	Interpret whether each of the following signal is energy or power signal: i) $x(n) = 1; \; \|n\| \le 1$ $= 0;$ otherwise ii) $x(n) = u(n)$	6	L3	CO1
		Module – 2			
Q.3	a.	Calculate Z transform and ROC of the sequence $x(n) = a^n u(n)$.	5	L2	CO2
	b.	Write a program to compute N-point DFT and plot magnitude and phase spectrum.	5	L2	CO2
	c.	Interpret the process of frequency domain sampling and reconstruction of discrete time signals.	10	L2	CO2
		OR			
Q.4	a.	Describe any 5 properties of Z-transform with respect to ROC. Explain the periodicity and linearity DFT property.	10	L2	CO2
	b.	Compute 4-point DFT of the signal x[n] = [0, 1, 2, 3] using matrix method.	4	L2	CO2
	c.	Develop the equation for DFT of multiplication of 2 sequences.	6	L3	CO2

		Module – 3			
Q.5	**a.**	Explain the circular time shift property.	5	L2	CO3
	b.	Calculate the circular convolution using the following sequences $x_1[n] = [2, 1, 2, 1]$ and $x_2[n] = [1, 2, 3, 4]$.	5	L2	CO3
	c.	Compute the 8-point DFT of the sequence $x[n] = [1, 1, 0, 0, -1, -1, 0, 0]$ using DIT-FFT algorithm.	10	L2	CO3
		OR			
Q.6	**a.**	Calculate the output y[n] of a filter whose impulse response is $h[n] = [3, 2, 1, 1]$ and the input signal to the filter $x[n] = [1, 2, 3, 3, 2, 1, -1, -2, -3, 5, 6, -1, 2, 0, 2, 1]$ using overlap add method. Assuming the length of block as 7.	10	L3	CO3
	b.	An FIR filter has the impulse response of $h[n] = [1, 2, 3]$. Determine the response of the input $x[n] = [1, 2]$. Use DFT and IDFT and verify the result using direct computation of linear convolution.	10	L3	CO3
		Module – 4			
Q.7	**a.**	Determine the filter coefficients hd(n) and h(n) frequency response of low pass FIR filter for the desired frequency response. $H_d(e^{jw}) = e^{-j2w} \quad \lvert w \rvert < \pi/4$; $= 0 \quad \frac{\pi}{4} < \lvert w \rvert < \pi$ using the rectangular window with window length M = 5.	10	L3	CO4
	b.	Explain the Gibb's phenomenon.	4	L2	CO4
	c.	Realize the linear phase FIR filter with the following impulse response and give necessary equations $h(n) = \delta(n) + \frac{1}{2}\delta(n-1) - \frac{1}{4}\delta(n-2) + \frac{1}{2}\delta(n-3) + \delta(n-4)$	6	L3	CO4
		OR			
Q.8	**a.**	Develop a high pass FIR filter using Hamming window with cutoff frequency of 1.2 rad/sec and N = 9.	10	L3	CO4
	b.	Construct direct and cascade realization of system function $H(z) = 1 + \frac{5}{2}z^{-1} + 2z^{-2} + 2z^{-3}$	10	L3	CO4
		Module – 5			
Q.9	**a.**	Summarize how the first order analog low pass filter prototype is transformed into a different types of filter.	5	L2	CO2
	b.	Discuss the general mapping properties of Bilinear transformation and show the mapping between the s-plane and z-plane.	5	L2	CO5

	c.	Build a second order digital Lowpass Butter worth filter with a cutoff frequency of 3.4 kHz at a sampling frequency of 8000 Hz. Draw the direct form – II structure of this filter use bilinear transformation.	10	L3	CO5
		OR			
Q.10	a.	Illustrate the following digital systems using direct form – I and direct form – II $y(n) = \frac{3}{4}y(n-1) - \frac{1}{8}y(n-2) + x(n) + \frac{1}{2}x(n-1)$	10	L3	CO5
	b.	The normalized lowpass filter with a cut off frequency of 1 rad/sec is given as $H_P(s) = \frac{1}{s+1}$ use a given $H_P(s)$ and the BLT to design a corresponding digital IIR lowpass filter with a cut off frequency of 50 Hz and a sampling rate of 90 Hz.	10	L3	CO5

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