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CBCS SCHEME

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BEC502

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026
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.	Determine the Power and Energy of the unit step sequence.	06	L2	CO1
	b.	The impulse response of a linear time-invariant system is h(n) = [1, 2, 1,–1] Determine the response of the system to the input signal x(n) = [1, 2, 2, 1]	08	L3	CO1
	c.	Write a program to perform the following operations on : (i) Signal Addition (ii) Multiplication	06	L3	CO1
		OR			
Q.2	a.	Define the following with an example linear system. Memoryless system and Causal system, Even and Odd signal, Periodic and Non-periodic signal.	10	L2	CO1
	b.	Discuss the advantages and limitations of Digital Signal Processing.	06	L2	CO1
	c.	Write a program to generate the following discrete time signals : (i) Unit Step Sequence (ii) Unit Sample Sequence	04	L3	CO1
		Module – 2			
Q.3	a.	Mention the properties of Z-transform with equation.	07	L2	CO2
	b.	Interpret the process of frequency domain sampling and reconstruction of discrete time signals with necessary equations.	08	L3	CO2
	c.	Find the 4-point DFT of the sequence x(n) = [1, 2, 2, 1] using matrix method.	05	L3	CO2
		OR			
Q.4	a.	Find the circular convolution of the sequences $x_1(n)$ = [1, 2, 3, 1] and $x_2(n)$ = [4, 3, 2, 2] using time domain approach and verify the result using frequency domain approach.	10	L3	CO2
	b.	Write a program to compute N-point DFT and also plot its magnitude and phase spectrum.	06	L3	CO2
	c.	A 498 point DFT of a real sequence has following DFT sequences: X(0) = 2 , X(11) = 7 + j3 , $X(K_1)$ = –2.2 – j1.5 X(112) = 3 + j0.7 , $X(K_2)$ = – 4.7 + j , X(249) = 2.9 X(309) = –4.7 – j1.9 , $X(K_3)$ = 3 – j0.7 , X(412) = –2.2 + j1.5 , $X(K_4)$ = 7 – j3.1 The other samples have '0' values. Find K_1, K_2, K_3, K_4 .	04	L3	CO2
		Module – 3			
Q.5	a.	State and prove Parseval's theorem.	05	L2	CO3
	b.	Given x(n) = [3, –1, 0, 1, 3, 8, 3, –3, 2, 7, 3] and h(n) = [1, –1, 2]. Use 5-point circular convolution. Find y(n) using Overlap Add Method.	10	L3	CO3

Q.5	**c.**	If x(n) = [1 , 1/2 , 1/4 , 1/8]. Find y(n) if the DFT are related as $y(k) = W_4^{3k} X(k)$ using time shift property.	**05**	**L3**	**CO3**
		OR			
Q.6	**a.**	State and prove circular frequency shift property.	**05**	**L2**	**CO3**
	b.	Find the DFT of x(n) = [1, 2, 3, 4, 4, 3, 2, 1] using DIT-FFT Algorithm.	**10**	**L3**	**CO3**
	c.	Compute the 4-point DFT of x(n) = [1, 0, 1, 0] . Also find y(n) if $y(k) = X((k-2))_4$.	**05**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	A low pass filter is to be designed for a desired frequency response $H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j2w} & \lvert w \rvert \le \pi/4 \\ 0 & \pi/4 \le \lvert w \rvert \le \pi \end{cases}$ Determine the filter coefficients $h_d(n)$ and h(n) if rectangular window is used. Also find the frequency response H(w) of the resulting FIR filter.	**10**	**L3**	**CO4**
	b.	Obtain the direct form and cascade form realization of $H(z) = \left(1 - \frac{1}{4}z^{-1} + \frac{3}{8}z^{-2}\right)\left(1 - \frac{1}{8}z^{-1} - \frac{1}{2}z^{-2}\right)$	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Design a low pass filter with a desired $H_d(e^{jw}) = \begin{cases} e^{-j3w} & -3\pi/4 \le w \le 3\pi/4 \\ 0 & 3\pi/4 \le \lvert w \rvert \le \pi \end{cases}$ Using hamming window with N = 7. Also obtain the frequency response.	**10**	**L3**	**CO4**
	b.	Realize the given system function in direct form and cascade form : $H(z) = 1 + 5z^{-1} + 6z^{-2}$	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Given analog filter whose transfer function is $H(s) = \frac{10}{s+10}$ Convert it to digital filter transfer function. Assume T = 0.01 sec. Using BLT technique and also find difference equation.	**10**	**L3**	**CO5**
	b.	Realize the following digital filter in Direct form I and II : $H(z) = \frac{0.7 + 1.4z^{-1} + 0.7z^{-2} + 0.5z^{-3}}{1 + 1.3z^{-1} + 0.5z^{-2} + 0.7z^{-3} + 0.3z^{-4}}$	**10**	**L3**	**CO5**
		OR			
Q.10	**a.**	Derive the Bilinear transformation used for converting analog filter into digital filter.	**08**	**L2**	**CO5**
	b.	A digital lowpass filter is required to meet the following specifications: (i) Monotonic pass band and stop band (ii) –3.01 dB cutoff frequency of 0.5π rad (iii) Stop band attenuation of atleast 15 dB at 0.75π rad. Find the system function H(z). Also find the difference equation realization. Verify the design for pass band and stop band attenuation.	**12**	**L3**	**CO5**

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