

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
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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 $H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j2w} & w \leq \pi/4 \\ 0 & \pi/4 \leq w \leq \pi \end{cases}$ 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 $H_d(e^{jw}) = \begin{cases} e^{-j3w} & -3\pi/4 \leq w \leq 3\pi/4 \\ 0 & 3\pi/4 \leq w \leq \pi \end{cases}$ 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 at least 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
