CBCS SCHEME

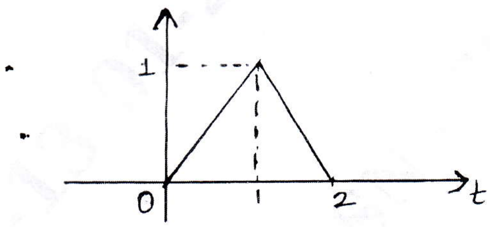
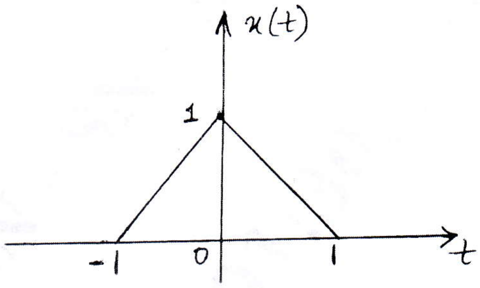
USN | | | | | | | | | | | **BEE502**

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Signals and DSP

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.	Explain the classification of signals with examples.	06	L2	CO1
	b.	Determine and sketch the even and odd parts of the signal shown in Fig.Q1(b).  Fig.Q1(b)	06	L3	CO1
	c.	For the continuous time single x(t) shown in Fig.Q1(c), sketch the signal: (i) $y_1(t) = x(3t+2)$ (ii) $y_2(t) = x(3t) + x(3t+2)$  Fig.Q1(c)	08	L3	CO1
		OR			
Q.2	a.	Check whether the following signals are periodic or not. If periodic, solve the fundamental period: (i) $x_1(n) = (-1)^n$ (ii) $x_2(n) = \cos\left(\frac{\pi}{3}n\right) + \cos\left(\frac{\pi}{4}n\right)$	06	L3	CO1
	b.	Determine the following signal y(n) = 2x(n) + 3 is linear, time variant, causal, memory and invertible.	06	L3	CO1
	c.	Evaluate the continuous time convolution integral given as $y(t) = e^{-at}u(t) * u(t)$.	08	L3	CO1
		Module – 2			
Q.3	a.	State and prove the following properties of DFT: (i) Linearity (ii) Circular time shift (iii) Symmetry of real valued sequences	08	L2	CO2
	b.	For the sequences $x_1(n) = \cos\left(\frac{2\pi n}{N}\right)$, $x_2(n) = \sin\left(\frac{2\pi n}{N}\right)$, $0 \le n \le N-1$, solve for N-point circular convolution $x_1(n) \circledast_N x_2(n)$.	06	L3	CO2

	c.	Determine the 4-point DFT of the sequence, $x(n) = (1, -1, 1, -1)$. Also, using time shift property, find the DFT of the sequence, $y(n) = x((n-2))_4$.	06	L3	CO2
		OR			
Q.4	a.	Define DFT and IDFT and compute 4-point DFT of a single $x(n) = (1, 2, 1, 0)$ using DFT matrix.	08	L3	CO2
	b.	The 5-point DFT of a complex sequence x(n) is given as $X(K) = (j, 1+j, 1+j2, 2+j2, 4+j)$ Compute Y(K), if $y(n) = x^*(n)$.	06	L3	CO2
	c.	Using DFT, IDFT method, compute circular convolution of the sequences $x_1(n) = (1, 1, 1)$ and $x_2(n) = (1, -2, 2)$.	06	L3	CO2
		Module – 3			
Q.5	a.	Compute 8 point DFT of the sequence $x(n) = (1, 2, 3, 4, 4, 3, 2, 1)$ using radix-2 DIT-FFT algorithm.	12	L3	CO3
	b.	Determine the 4-point real sequence x(n), if its 4-point DFT samples are $X(0) = 6$, $X(1) = -2 + j2$, $X(2) = -2$. Use DIF-FFT algorithm.	08	L3	CO3
		OR			
Q.6	a.	Given the sequence $x_1(n)$ and $x_2(n)$ below, compute the circular convolution $x_1(n) \circledast_N x_2(n)$ for N = 4. Use DIT-FFT algorithm.	10	L3	CO3
	b.	Solve for the 4-point circular convolution of x(n) and h(n) using radix-2 DIF-FFT algorithm. Given $X(n) = (1, 1, 1, 1)$, $h(n) = (1, 0, 1, 0)$.	10	L3	CO3
		Module – 4			
Q.7	a.	Design a Butterworth analog highpass filter that will meet the following specifications: (i) Maximum passband attenuation = 2 dB (ii) Passband edge frequency = 200 rad/sec (iii) Minimum stopband attenuation = 20 dB (iv) Stopband edge frequency = 100 rad/sec	10	L3	CO4
	b.	Obtain the direct form I and direct form II of the following transfer function: $$H(z) = \frac{8z^3 - 4z^2 + 11z + 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$$	10	L3	CO4
		OR			
Q.8	a.	Design a Chebyshev I filter to meet the following specifications: (i) Passband ripple : ≤ 2 dB (ii) Passband edge : 1 rad/sec (iii) Stopband attenuation : ≥ 20 dB (iv) Stopband edge : 1.3 rad/sec	10	L3	CO4
	b.	The system function of an analog filter is given by $H(s) = \frac{s+0.1}{(s+0.1)^2 + 9}$. Obtain the system function of IIR digital filter by using impulse invariant method.	10	L3	CO4

Module – 5

Q.9	**a.**	A filter is to be designed with the following desired frequency response: $$H_d(\omega)=\begin{cases}0 & -\frac{\pi}{4}<\omega<\frac{\pi}{4}\\ e^{-j2\omega} & \frac{\pi}{4}<\lvert\omega\rvert<\pi\end{cases}$$ Compute the frequency response of the FIR filter designed using a rectangular window defined below: $$\omega_R(n)=\begin{cases}1 & 0\le n\le 4\\ 0 & \text{otherwise}\end{cases}$$	**10**	**L3**	**CO5**
	b.	Determine the filter coefficients h(n) obtained by sampling $H_d(\omega)$ given by, $$H_d(\omega)=\begin{cases}e^{-j3\omega} & 0<\omega<\frac{\pi}{2}\\ 0 & \frac{\pi}{2}<\lvert\omega\rvert<\pi\end{cases}$$ Also, obtain the frequency response, $H(\omega)$. Take N = 7.	**10**	**L3**	**CO5**

OR

Q.10	**a.**	The desired frequency response of a lowpass filter is given by $$H_d(e^{j\omega})=H_d(\omega)=\begin{cases}e^{-j3\omega} & \lvert\omega\rvert<\frac{3\pi}{4}\\ 0 & \frac{3\pi}{4}<\lvert\omega\rvert<\pi\end{cases}$$ Determine the frequency response of the FIR filter if Hamming window is used with N = 7.	**10**	**L3**	**CO5**
	b.	The frequency response of an FIR filter is given by $H(\omega)=e^{-j3\omega}(1+1.8\cos 3\omega+1.2\cos 2\omega+0.5\cos\omega)$ Determine the coefficients of the impulse response h(n) of the FIR filter.	**10**	**L3**	**CO5**

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