

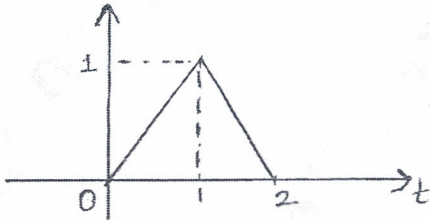
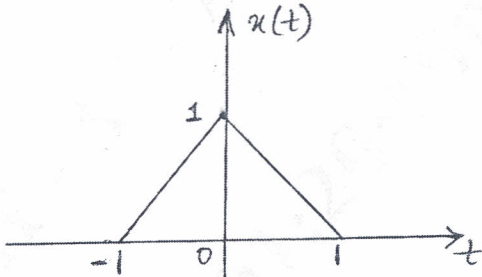
Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

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).		06	L3	CO1
 <p style="text-align: center;">Fig.Q1(b)</p>						
	c.	For the continuous time single $x(t)$ shown in Fig.Q1(c), sketch the signal: (i) $y_1(t) = x(3t + 2)$ (ii) $y_2(t) = x(3t) + x(3t + 2)$		08	L3	CO1
 <p style="text-align: center;">Fig.Q1(c)</p>						
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 $x_1(n) = \cos\left(\frac{2\pi n}{N}\right)$, $x_2(n) = \sin\left(\frac{2\pi n}{N}\right)$, $0 \leq n \leq N - 1$, solve for N-point circular convolution $x_1(n) \otimes_N x_2(n)$.		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 $x_1(n) \otimes_N x_2(n)$ 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.	<p>A filter is to be designed with the following desired frequency response:</p> $H_d(\omega) = \begin{cases} 0 & -\frac{\pi}{4} < \omega < \frac{\pi}{4} \\ e^{-j2\omega} & \frac{\pi}{4} < \omega < \pi \end{cases}$ <p>Compute the frequency response of the FIR filter designed using a rectangular window defined below:</p> $\omega_R(n) = \begin{cases} 1 & 0 \leq n \leq 4 \\ 0 & \text{otherwise} \end{cases}$	10	L3	CO5
	b.	<p>Determine the filter coefficients $h(n)$ obtained by sampling $H_d(\omega)$ given by,</p> $H_d(\omega) = \begin{cases} e^{-j3\omega} & 0 < \omega < \frac{\pi}{2} \\ 0 & \frac{\pi}{2} < \omega < \pi \end{cases}$ <p>Also, obtain the frequency response, $H(\omega)$. Take $N = 7$.</p>	10	L3	CO5
OR					
Q.10	a.	<p>The desired frequency response of a lowpass filter is given by</p> $H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j3\omega} & \omega < \frac{3\pi}{4} \\ 0 & \frac{3\pi}{4} < \omega < \pi \end{cases}$ <p>Determine the frequency response of the FIR filter if Hamming window is used with $N = 7$.</p>	10	L3	CO5
	b.	<p>The frequency response of an FIR filter is given by</p> $H(\omega) = e^{-j3\omega}(1 + 1.8\cos 3\omega + 1.2\cos 2\omega + 0.5\cos \omega)$ <p>Determine the coefficients of the impulse response $h(n)$ of the FIR filter.</p>	10	L3	CO5
