CBCS SCHEME - Make-Up Exam

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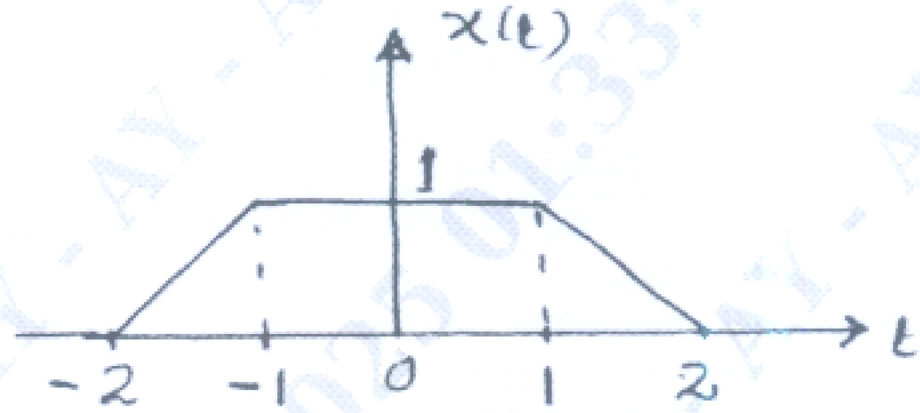
BEE502

Fifth Semester B.E./B.Tech. Degree Examination, June/July 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.	Distinguish between : i) Continuous and discrete time signals ii) Even and odd signals iii) Periodic and Non-periodic signals iv) Energy and Power signals.	8	L2	CO1
	b.	Find out the even and odd component of the following signals : i) $x(t) = \cos t + \sin t + \sin t \cos t$ ii) $x(t) = 1 + t + 3t^2 + 6t^3 + 9t^4$ iii) $x(t) = 1 + t\cos t + t^2 \sin t + t^3 \sin t \cos t$.	6	L1	CO1
	c.	For the given signal x(t) shown in Fig.Q1(c) sketch and level : i) $x(0.5\,t)$ ii) $x(3t + 2)$.  Fig.Q1(c)	6	L3	CO1
		OR			
Q.2	a.	Using convolution integral, determine and sketch output and LTI system whose input and impulse response is : $x(t) = e^{-3t}[u(t) - u(t-2)]$ and $h(t) = e^{-t}u(t)$.	7	L1	CO1
	b.	Evaluate the discrete time convolution sums given below : $y[n] = \beta^n u[n] * \alpha^n u[n]$ $\lvert\beta\rvert < 1, \lvert\alpha\rvert < 1$.	6	L2	CO1
	c.	Find the forced response for the system given by the difference equation : $y[n] - \frac{1}{4}y[n-1] - \frac{1}{8}y[n-2] = x[n] + x[n+1]$ With input $x[n] = (\frac{1}{8})^n u(n)$ with $y(-1) = 0, y(-2) = 0$.	7	L1	CO1

		Module – 2			
Q.3	a.	State and prove the following properties of DFT : i) Linearity ii) Circular time shift iii) Parseval's Theorem	12	L2	CO2
	b.	Find the circular convolutions of the two sequences : $x(n) = \{1, 1, 2, 2\}$, $h(n) = \{1, 2, 3, 4\}$.	8	L1	CO2
		OR			
Q.4	a.	Given and infinite sequence input : $x(n) = \{1, 2, 3, 4, 1, 3, 5, 7, 2, 4, 6, 8 - - - - - \}$ and $h(n) = \{1, 2, 1\}$. Find the output y(n) using overlap-add method, considering x(n) is made of segments of length 4.	10	L1	CO2
	b.	Using overlap save method, determine the output y(n) of a filter, whose impulse response $h(n) = \{1, 1, 1\}$ to an input $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1\}$. Use 6-point circular convolution.	10	L5	CO2
		Module – 3			
Q.5	a.	Comparison of complex multiplications and additions for direct computation of DFT versus the FFT algorithm for N = 16, 32, 128.	8	L2	CO3
	b.	Develop an 8-point DIT-FFT algorithm. Draw the complete flow graph.	12	L3	CO3
		OR			
Q.6	a.	Given $x(n) = \{1, 2, 3, 4, 4, 3, 2, 1\}$. Find x(K) using DIF-FFT algorithm.	10	L1	CO3
	b.	Given "$X(K) = \{36, -4 + j9.656, -4 + j4, -4 + j1.656, -4, -4 - j1.656, -4 - j4, -4 - j9.656\}$. Find x(n) using DIT-FFT algorithm.	10	L1	CO3
		Module – 4			
Q.7	a.	Design a digital low-pass filter using Bilinear transformation method to satisfy the following characteristics i) Monotonic stop band and pass band ii) -3.01 dB cut-off frequency of 0.5π rad iii) Magnitude down at least 15dB at 0.75π rad Take T = 1 sec.	10	L6	CO4
	b.	A digital low pass filter is required to meet the following specifications : $20 \log \lvert H(\omega)\rvert_{\omega} = 0.2\pi \geq -1.9328$ dB $20 \log \lvert H(\omega)\rvert_{\omega} = 0.6\pi \leq -13.9794$ dB Find H(z) to meet the above specifications using impulse invariant transformation. Assume T = 1.	10	L1	CO4
		OR			
Q.8	a.	Draw the direct form I and II realizations of a system with transfer function. $H(z) = \dfrac{0.28z^2 + 0.319z + 0.04}{0.5z^3 + 0.3z^2 + 0.17z - 0.2}$.	10	L3	CO4
	b.	Obtain the cascade and parallel realization for the system function given by $H(z) = \dfrac{1 + \frac{1}{4}z^{-1}}{(1 + \frac{1}{2}z^{-1})(1 + \frac{1}{2}z^{1} + \frac{1}{4}z^{-2})}$.	10	L3	CO4

Module – 5

Q.9	a.	A low-pass filter is to be designed with the following desired frequency response $H_d(e^{j\omega}) = H_d(\omega) = \begin{cases} e^{-j2\omega} & \lvert\omega\rvert \frac{\pi}{4} \\ 0 & \frac{\pi}{4} < \lvert\omega\rvert < \pi \end{cases}$ Determine the filter co-efficient $h_d(n)$ and $h(n)$ if $\omega(n)$ is a rectangular window defined as follows : $\omega_R(n) = \begin{cases} 1 & 0 \le n \le 4 \\ 0 & \text{otherwise} \end{cases}$ Also find the frequency response $H(\omega)$ of the resulting FIR filter.	10	L5	CO5
	b.	Design a filter with $H_d(e^{j\omega}) = \begin{cases} e^{-j3\omega} & -\pi/4 < \omega \le \pi/4 \\ 0 & \pi/4 < \omega \le \pi \end{cases}$ Using a hamming window with M = 7.	10	L6	CO5
OR					
Q.10	a.	Determine the filter co-efficients h(n) obtained by sampling : $H_d(e^{j\omega}) = \begin{cases} e^{\frac{-j(M-1)\omega}{2}} & 0 \le \lvert\omega\rvert \le \pi/2 \\ 0 & \pi/2 \le \lvert\omega\rvert \le \pi \end{cases}$	10	L3	CO5
	b.	Consider the system function : $H(z) = (1 - z^{-1} - z^{-2})(1 - z^{-1} + \frac{1}{2}z^{-2})$. Draw a direct form realization.	4	L3	CO5
	c.	Determine the coefficients K_m of the lattice-filter corresponding to FIR filter described by the system function : $H(z) = 1 + 2z^{-1} + \frac{1}{3}z^{-2}$ Also draw the corresponding second-order lattice structure.	6	L3	CO5

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