CBCS SCHEME

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BEE502

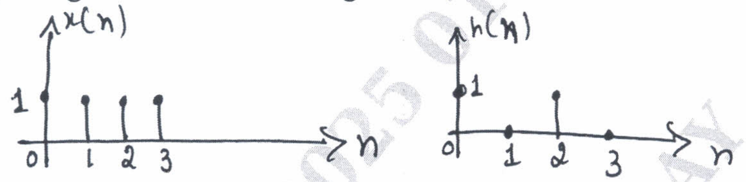
Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
Signals and DSP

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.	For each of the following signals, determine whether it is periodic and if it is find fundamental period. (i) $x(t) = \sin^3(2\pi t)$ (ii) $x(n) = [-1]^n$	10	L3	CO1
	b.	Determine the system is (i) linear (ii) time invariant (iii) causal (iv) static. Justify the answer. (1) $y(t) = x(3t)$ (2) $y(t) = x(t^2)$	10	L3	CO1
		OR			
Q.2	a.	Find the even and odd components of the following : (i) $x(t) = e^{-2t}\cos t$ (ii) $x(t) = (1 + t^3)\cos^{10}(t)$	10	L3	CO1
	b.	Evaluate the convolution integral for a system the input x(t) and impulse response h(t). Given $h(t) = e^{-t}u(t)$, $x(t) = e^{-4t}[u(t) - u(t-3)]$. Also sketch y(t).	10	L3	CO1
		Module – 2			
Q.3	a.	Solve for the output y(n) of a filter whose impulse response h(n) = {1, 2} and input signal. x(n) = {1, 2, –1, 2, 3, –2, –3, – 1, 1 } using overlap save method.	10	L3	CO2
	b.	Determine the 4-point circular convolution of sequences $x_1(n) = (\underset{\uparrow}{1}, 2, 3, 1)$ and $x_2(n) = (\underset{\uparrow}{4}, 3, 2, 2)$ using the time-domain approach and verify the result using frequency-domain approach.	10	L3	CO2
		OR			
Q.4	a.	Compute the 8-point DFT of the sequence x(n) given below. x(n) = (1 , 1 , 1 , 1 , 0 , 0 , 0 , 0)	10	L3	CO2
	b.	State and prove the following properties of DFT: (i) Linearity (ii) Circular time shift (iii) Circular frequency shift.	10	L2	CO2
		Module – 3			
Q.5	a.	Determine 8-point DFT of a sequence x(n) = {1, 2, 3, 4, 4, 3, 2, 1} using Radix-2 DIT-FFT algorithm.	10	L3	CO3
	b.	Compute the 8-point IDFT of the sequence X(K) X(K) = {0, 2 + 2j, –j4, 2 – 2j, 0, 2 + 2j, j4, 2 – 2j } using inverse radix-2 DIT-FFT algorithm.	10	L3	CO3

OR

Q.6	**a.**	Compute the 4-point DFT of the sequence $x(n) = \left(\frac{\pi}{4} n\right)$ using DIT-FFT algorithm.	**06**	**L3**	**CO3**
	b.	Solve for the 4-point circular convolution of x(n) and h(n) given in Fig.Q6(b) using radix-2 DIF-FFT algorithm.  Fig.Q6(b)	**10**	**L3**	**CO3**
	c.	What are the differences and similarities between DIT and DIF-FFT algorithm?	**04**	**L2**	**CO3**
		Module – 4			
Q.7	**a.**	A butterworth lowpass filter has to meet the following specifications. (i) Passband gain $K_p = -1$ dB at $\Omega_p = 4$ rad/sec (ii) Stopband attenuation greater than or equal to 20 dB at $\Omega_S = 8$ rad/sec. Determine the transfer function $H_a(s)$ of the lowest – order Butterworth filter to meet the above specifications.	**10**	**L3**	**CO4**
	b.	Determine the system function H(z) of the lowest order Chebyshev filter that meets the following specifications. (i) 3 dB ripple in the passband $0 \le \|w\| \le 0.3\pi$ (ii) Atleast 20 dB attenuation in the stopband $0.6\pi \le \|w\| \le \pi$. Use bilinear transformation.	**10**	**L3**	**CO4**
		OR			
Q.8	**a.**	Draw the block diagrams of direct form-I and direct form-II realizations for a digital IIR filter described by the system 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**
	b.	Obtain a parallel realization for the transfer function H(z) given below. $H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{\left(z - \frac{1}{4}\right)\left(z^2 - z + \frac{1}{2}\right)}$	**10**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	The desired frequency response of a lowpass filter is given by $H_d(e^{jw}) = H_d(w) = \begin{cases} e^{-j3w}, & \|w\| < \frac{3\pi}{4} \\ 0, & \frac{3\pi}{4} < \|w\| < \pi \end{cases}$ Determine the frequency response of the FIR filter if Hamming window is used with N = 7.	**10**	**L3**	**CO5**

			Marks	Level	CO
	b.	A filter is to be designedwith the following desired frequency response: $$H_d(w) = \begin{cases} 0 \quad , & -\frac{\pi}{4} < w < \frac{\pi}{4} \\ e^{-j2w} \quad , & \frac{\pi}{4} < \lvert w \rvert < \pi \end{cases}$$ Determine the frequency response of the FIR filter designed using a rectangular window defined below. $$W_R(n) = \begin{cases} 1 \quad , & 0 \le n \le 4 \\ 0 \quad , & \text{otherwise} \end{cases}$$ Also find the frequency, H(w) of the resulting FIR filter.	10	L3	CO5
		OR			
Q.10	a.	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.	10	L3	CO5
	b.	A lowpass filter has the desired frequency response $$H_d(w) = H_d(e^{jw}) = \begin{cases} e^{-j3w} \quad , & 0 < w < \frac{\pi}{2} \\ 0 \quad , & \frac{\pi}{2} < w < \pi \end{cases}$$ Determine h(n) based on frequency-sampling technique. Take N = 7.	10	L3	CO5

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