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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: ES Cluster (EEE/ET/ECE/EIE/MD) **Duration: 3 hrs.**
Course Code: 23EI5PCDSA / 22ES5PCDSP **Max Marks: 100**
Course: Digital Signal Processing and Its Applications

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		MODULE - I	*CO*	*PO*	Marks
1	a)	An analog electrocardiogram (ECG) signal contain useful frequencies upto 100 Hz. (i) Determine the Nyquist rate for this signal? (ii) Suppose if this signal is sampled at a rate of 250samples/second, what is the highest frequency that can be represented uniquely at this rate?.	*CO1*	*PO2*	**04**
	b)	Given a sequence $x[n] = [1,1,2,3]$, using the properties of DFT (i) Find the IDFT of $X((k-2))_4$ (ii) Compute $X((-k))_4$ (iii) Write IDFT of $Y(k) = X^2(k)$	*CO1*	*PO2*	**08**
	c)	Let X(k) be a 14-point DFT of a length 14 real sequence x(n) . The first 8 samples of X(k) are given by : $X(k) = \{12, -1+j3, 3+j4, 1-j5, -2+j2, 6+j3, -2-j3, 10\}$. (i) Determine the remaining samples of $X(k)$ (ii) Using Parseval's relation, evaluate $\sum_{n=0}^{13} \lvert x(n) \rvert^2$	*CO1*	*PO2*	**08**
		OR			
2	a)	Given an analog signal $x_a(t) = 3\cos(2000\pi t) + 5\sin(6000\pi t) + 10\,cos(12000\pi t)$. (i) Determine the Nyquist rate for this signal? (ii) Suppose if this signal is sampled at a rate of 5000 samples/second. Write its discrete equivalent obtained after sampling	*CO1*	*PO2*	**04**

		b)	Apply DFT-IDFT method to compute the circular convolution of two given sequences x[n]={2,3,1,1}, h(n)= {1,3,5,3}.	CO1	PO2	**08**
		c)	If X(k)=[1, 2+j, 3-j, 4] be a 6-point DFT of a length 6 real sequence. Find (i) x(0) (ii) x(3) (iii) $\sum_{n=0}^{5} x(n)$ without computing IDFT.	CO1	PO2	**08**
			MODULE - II			
	3	a)	Compute the output y(n) of a filter whose impulse response is h(n)={1,1,1} and input signal x(n)={3,-1,0,1,3,2,0,1,2,1} using overlap and save method. Use 5-point circular convolution.	CO2	PO2	**08**
		b)	Compute 8-point DFT of h(n)=[1,1,-1,-1] using DIT-FFT radix-2 algorithm. Identify what type of filter is this: LPF|HPF|BPF|BSF?	CO2	PO2	**08**
		c)	Compare the complex multiplications and additions needed for a 512 point sequence in the calculation of DFT using (i) Direct computation (ii) radix-2 FFT algorithm	CO2	PO2	**04**
			OR			
	4	a)	Compute the output y(n) of a filter whose impulse response is h(n)={1,2} and input signal x(n)={1,-1,2,1,2,-1,1,3} using overlap and add method. Use 5-point circular convolution.	CO2	PO2	**08**
		b)	Determine the time domain sequence x[n] corresponding to the 8-point DFT using DIF-FFT radix-2 algorithm. $X(k) = \{4, 1 - j2.414, 0, 1 - j0.414, 0, 1 + j0.414, 0, +j2.414\}$	CO2	PO2	**08**
		c)	Find the relation between DFT and Z transform	CO2	PO1	**04**
			MODULE - III			
	5	a)	Design a digital IIR low pass Butterworth filter to meet the following specifications. Pass band ripple $\leq$ 3.01 dB Pass band edge frequency: 500 Hz. Stop band attenuation $\geq$ 15 dB Stop band edge frequency: 750 Hz. Sampling rate: 2000 Hz Use Bilinear transformation method.	CO3	PO2	**12**
		b)	Obtain the cascade form and Parallel form realization for the following system $y[n] = 0.75y[n-1] - 0.125y[n-2] + x[n] + \frac{1}{3}x[n-1]$	CO3	PO2	**08**
			OR			
	6	a)	Design a type-I Chebyshev analog lowpass filter to meet the following specifications. Pass band ripple $\leq$ 2.5 dB Pass band edge frequency= 20 rad/sec. Stop band attenuation $\geq$ 30 dB Stop band edge frequency=50 rad/sec	CO3	PO2	**12**

		b)	Given $H(s) = \frac{4}{(s+2)(s+3)}$, Use impulse invariant transformation to convert this to H(z). Assume sampling interval of 2 sec.	*CO3*	*PO2*	**08**
			MODULE - IV			
	7	a)	Design a FIR filter with a desired frequency response $$H_d(e^{j\omega}) = \begin{cases} e^{-j2\omega} & ; \frac{-\pi}{4} \le \omega \le \frac{\pi}{4} \\ 0 & ; \frac{\pi}{4} < \omega < \pi \end{cases}$$ Use a rectangular window with length 5. Also obtain the frequency response.	*CO3*	*PO2*	**08**
		b)	Realize the following system function in Direct form and linear phase form structures $$H(z) = 1 + 4z^{-1} + 4z^{-2} + z^{-3}$$	*CO3*	*PO2*	**08**
		c)	Compare FIR and IIR filters	*CO3*	*PO1*	**04**
			OR			
	8	a)	Use frequency sampling method to design a FIR filter with cutoff frequency 0.3π rad with 7 taps.	*CO3*	*PO2*	**10**
		b)	Design a high pass FIR filter using Hamming window with frequency response $$H_d(e^{j\omega}) = \begin{cases} 1 & ; \frac{\pi}{4} \le \lvert\omega\rvert \le \pi \\ 0 & ; \lvert\omega\rvert \le \frac{\pi}{4} \end{cases}$$ Find the value of h(n) for length 11.	*CO3*	*PO2*	**10**
			MODULE - V			
	9	a)	Apply the LMS algorithm to adaptive filter for the system identification with relevant block diagram.	*CO4*	*PO1*	**10**
		b)	With a neat block diagram describe two stage interpolator and decimator, representing multistage implementation of sampling rate conversion	*CO4*	*PO1*	**10**
			OR			
	10	a)	Discuss how the LMS algorithm is applied in adaptive filter for the noise cancellation	*CO4*	*PO1*	**10**
		b)	Discuss the role Adaptive filters in speech processing & radar systems.	*CO4*	*PO1*	**10**

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