Model Question Paper -1 with effect from 2020-21 (CBCS Scheme)

USN | | | | | | | | | | |

Fifth Semester B.E. Degree Examination

Digital Signal Processing

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module – 1	**Marks**
Q.1	**(a)**	Why is it necessary to perform frequency domain sampling? Illustrate the relationship between the sampled Fourier transform and the DFT.	6
	(b)	Compute the N – point DFT of the following signals. $(i)\quad x(n) = \delta(n-n_0)\,;\, 0 < n_0 < N \qquad (ii)\;\; x(n) = an\,; 0 \le n \le (N-1)$	(2 + 4) 6
	(c)	If $x(n)$ is real valued sequence, obtain its DFT, $X(k)$ for the following two cases. And comment on the nature of $X(k)$. (i) $x(n)$ is an even sequence. (ii) $x(n)$ is an odd sequence.	(4 + 4) 8
		OR	
Q.2	**(a)**	Determine the 4 - point circular convolution of the sequences $x_1(n) = cos\left(\frac{2\pi n}{N}\right) \quad and \quad x_2(n) = \sin\left(\frac{2\pi n}{N}\right) \quad ; \quad 0 \le n \le 3$ Using the time – domain formula.	4
	(b)	Illustrate how the DFT & IDFT can be viewed as a Linear Transformations on sequences $\{x(n)\}$ and $\{X(k)\}$ respectively.	6
	(c)	Compute 4 – point DFT of the signal $x(n) = \{0, 1, 2, 3\}$ using DFT matrix.	4
	(d)	Show that multiplication of the DFTs of two sequences is equivalent to the circular convolution of the two sequences in the time – domain.	6
		Module – 2	
Q.3	**(a)**	By means of DFT & IDFT, determine the response of the FIR filter with impulse response $h(n) = \{5, 6, 7\}$ to the input sequence $x(n) = \{1, 2, -1, 5\ 6\}$.	6
	(b)	Using overlap & save method, compute the output of an FIR filter with impulse response $h(n) = \{1, 2, 3\}$ and input $x(n) = \{2, -2, 8, -2, -2, -3, -2, 1, -1, 9, 1, 3\}$ use only 8 – point circular convolution in your approach.	6
	(c)	Develop radix – 2, DIT – FFT algorithm and write signal flow graph for $N = 8$.	8
		OR	
Q.4	**(a)**	Develop radix – 2 decimation – in – frequency FFT algorithm.	6
	(b)	Using overlap & add method, compute the output of an FIR filter with impulse response $h(n) = \{1, -2, 3\}$ and input $x(n) = \{2, -2, 8, -2, -2, -3, -2, 1, -1, 9, 1, 3\}$ use only 8 – point circular convolution in your approach.	6
	(c)	Given $x(n) = (n+1)\ for\ 0 \le n \le 7$. Find $X(k)$ using DIT – FFT algorithm.	8
		Module – 3	
Q.5	**(a)**	Determine a direct – form realization for the following linear phase filter. $h(n) = \{\underset{\uparrow}{1}, 2, 3, 4, 3, 2, 1\}$	4

Q.5	**(b)**	Prove that an FIR filter having impulse response with even length & symmetric nature has a linear – phase response.	6
	(c)	A low pass filter is to be designed with the following desired frequency response: $$H_d(\omega) = \begin{cases} 1, & for\ \|\omega\| \le \frac{\pi}{6} \\ 0, & for\ \frac{\pi}{6} < \|\omega\| \le \pi \end{cases}$$ Determine the coefficients of a 25 – tap filter based on the window method with the Hamming window.	10
OR			
Q.6	**(a)**	Determine the lattice coefficients corresponding to the FIR filter with system function $$H(z) = A_3(z) = 1 + \frac{13}{24}z^{-1} + \frac{5}{8}z^{-2} + \frac{1}{3}z^{-3}$$ And sketch the lattice structure.	4
	(b)	Consider a three – stage FIR lattice structure having the coefficients $k_1 = 0.65,\ k_2 = -0.34\ \&\ k_3 = 0.8$ Realize this filter in direct form.	6
	(c)	Based on the frequency – sampling method, determine the coefficients of a linear – phase FIR filter of length $M = 15$ which has a symmetric unit sample response and a frequency response that satisfies the conditions: $$H_r\left(\frac{2\pi k}{15}\right) = \begin{cases} 1, & k = 0,1,2,3 \\ 0.4, & k = 4 \\ 0, & k = 5,6,7 \end{cases}$$	10
Module – 4			
Q.7	**(a)**	Given a lowpass prototype $$\boldsymbol{H_P(s)} = \frac{1}{s+1}$$ (i) Determine the high pass filter with a cut off frequency of 40 radians per second. (ii) Determine the band pass filter with a center frequency of 100 rad / sec and bandwidth of 20 rad / sec.	6
	(b)	Realize the following digital filter using a direct form II structure. $$\boldsymbol{H(z)} = \frac{0.7157 + 1.4314z^{-1} + 0.7151z^{-2}}{1 + 1.3490z^{-1} + 0.5140z^{-2}}$$	6
	(c)	Using BLT design a second order digital lowpass Butterworth filter with a cut off frequency of 3.4 kHz at a sampling frequency of 8000 Hz.	8
OR			
Q.8	**(a)**	Assuming that $T = 2\ sec$ in BLT, and given the following points: (i) $s = -1 + j$, on the left half of the s – plane. (ii) $s = 1 - j$, on the right half of the s – plane. (iii) $s = j$, on the positive $j\omega$ on the s – plane. (iv) $s = -j$, on the negative $j\omega$ on the s – plane. Convert each of these points in the s – plane to the z – plane, and verify the mapping properties.	8
	(b)	Design a digital band stop Butterworth filter with the following specifications: • Center frequency of 2.5 kHz • Passband width of 200 Hz and ripple of 3 dB • Stop band width of 50 Hz and attenuation of 10 dB • Sampling frequency of 8000 Hz.	12

Module – 5			
Q.9	(a)	With the block diagram explain Digital signal processors based on the Harvard architecture.	6
	(b)	Discuss briefly the following special Digital Signal Processor hardware units. (i) Multiplier and Accumulator (MAC) Unit (ii) Shifters (iii) Address Generators	(3+2+5) 10
	(c)	Convert the following decimal numbers into Q – 15 representation. (i) -0.1958 (ii) 0.560123	4
OR			
Q.10	(a)	Given the FIR filter $y(n) = 0.9\,x(n) + 3\,x(n-1) - 0.9x(n-2)$ With the passband gain of 4, and assuming that the input range occupies only ¼ of the full range for a particular application. Develop the DSP implementation equations in the Q – 15 fixed – point system.	6
	(b)	Discuss the following IEEE Floating – Point Formats. (i) Single Precision Format (ii) Double Precision Format	6
	(c)	With the diagram explain the basic architecture of TMS320C54x family processor.	8

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q.1	(a)	L2	CO1	PO1
	(b)	L3	CO2	PO1
	(c)	L3	CO2	PO1
Q.2	(a)	L3	CO1	PO1
	(b)	L2	CO1	PO1
	(c)	L3	CO2	PO1
	(d)	L2	CO1	PO1
Q.3	(a)	L3	CO3	PO2
	(b)	L3	CO3	PO2
	(c)	L3	CO3	PO2
Q.4	(a)	L3	CO3	PO2
	(b)	L3	CO3	PO2
	(c)	L3	CO3	PO2
Q.5	(a)	L3	CO4	PO3
	(b)	L3	CO4	PO3
	(c)	L3	CO4	PO3
Q.6	(a)	L3	CO4	PO3
	(b)	L3	CO4	PO3
	(c)	L3	CO4	PO3
Q.7	(a)	L3	CO4	PO3
	(b)	L3	CO4	PO3
	(c)	L3	CO4	PO3
Q.8	(a)	L3	CO4	PO3
	(b)	L4	CO4	PO3
Q.9	(a)	L1	CO5	PO1
	(b)	L2	CO5	PO1
	(c)	L3	CO5	PO1
Q.10	(a)	L4	CO5	PO1
	(b)	L3	CO5	PO1
	(c)	L1	CO5	PO1

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering (knowledge): L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6