BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

USN											Course Code	2	1	E	C	4	3

Fourth Semester B.E. Degree Examinations, Sept/Oct 2023

DIGITAL SIGNAL PROCESSING

Duration: 3 hrs **Max. Marks: 100**

Note: 1. Answer any **FIVE** *full questions, choosing* **ONE** *full question from each module.*
2. Missing data, if any, may be suitably assumed

Q. No		Question	Marks	(RBTL:CO: PI)
		MODULE – 1		
1	a.	Define DFT. Explain the frequency domain sampling of discrete time signal.	06	(2:1: 1.3.1)
	b.	Compute 8-point DFT of $x(n) = [1\ 0\ 1\ 0\ 1\ 0\ 1\ 0]$. Use formulae method.	07	(3:1: 2.4.1)
	c.	Evaluate 4-Point circular convolution of the sequences $x(n) = [1,2,3,-1]$ and $h(n) = [4,3,1,1]$ using time domain approach and verify the same using frequency domain approach.	07	(3:1: 2.4.1)
		OR		
2	a.	State and prove the following Properties i)Circular frequency shift ii) Multiplication in time domain	06	(2:1: 1.3.1)
	b.	Find N-point DFT of sequence $x(n) = e^{j\omega mn}$ where $\omega = \frac{2\pi}{N}$.	07	(3:1:2.4.1)
	c.	Determine the 5-point DFT of sequence $x(n) = [3\ -1\ 1\ 0\ 2\ ]$. Verify symmetry property.	07	(3:1:2.4.1)
		MODULE – 2		
3.	a.	Develop Radix-2 DIT-FFT algorithm and draw complete signal flow graph for N=8.	07	(2 :2:1.3.1)
	b.	Compute 8-Point IDFT of $X(K) = [0,2+j2,-j4,2-j2,0,2+j2,j4,2-j2\ ]$ using decimation in time –FFT algorithm.	07	(3 :2:2.4.1)
	c.	Explain chirp-Z-Transform algorithm with applications.	06	(2:2:1.3.1)
		OR		
4.	a.	Write the computational procedure to find the filtered output using overlap add method.	07	(2:2:1.3.1)
	b.	Consider a FIR filter with impulse response $h(n) = [1,,1,3]$ if the input is $x(n) = [1,0,-1,3,2,1,-1,-2,3,5,6,1]$ .Find the output $y(n)$ using overlap save method.	07	(3:2:2.4.1)
	c.	Explain the Goertzel algorithm and obtain the direct form II realization of Goertzel filter.	06	(2:2:1.3.1)
		MODULE – 3		
5.	a.	Briefly explain the characteristics of FIR filter.	06	(2:3:1.3.1)
	b.	A LPF FIR is to be designed with the following specification $H_d(\omega) = \begin{cases} e^{-j2\omega}, & \lvert\omega\rvert \le \frac{\pi}{4} \\ 0, & \frac{\pi}{4} \le \lvert\omega\rvert \le \pi \end{cases}$.		

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator**)

Determine the frequency response $H(\omega)$ of the resulting FIR filter if hamming window N=5 is used; **07** (3:3:2.4.1)

c. The frequency response of an FIR filter is given by **07** (3:3: 2.4.1)

$$H(\omega) = e^{-j3\omega}(1 + 1.8\cos(3\omega) + 1.2\cos(2\omega) + 0.5\cos(\omega))$$

Determine the coefficient of the impulse response of the FIR filter

OR

6. a. List the different types of windowing techniques used in the design of FIR filter. Write analytical equations, draw the magnitude response and show the largest side lobe value below the dc magnitude. **06** (2:3:1.3.1)

b. Determine the coefficient of the lattice filter corresponding to FIR filter described by system function $H(z) = 1 + 2z^{-1} + \frac{1}{3}z^{-2}$.Also draw lattice structure **07** (3 :3: 2.4.1)

c. Realize the direct form I and linear phase structure of FIR filter when its **07** (3 :3: 2.4.1)

$h(n) = \frac{1}{4}\delta(n) - \frac{1}{12}\delta(n-1) + \frac{1}{2}\delta(n-2) + \frac{1}{2}\delta(n-3) - \frac{1}{12}\delta(n-4) + \frac{1}{4}\delta(n-5)$.

MODULE – 4

7. a. Define the normalized low pass prototype function of Butterworth filter. Derive the expression for the filter order. **06** (3:4:2.1.3)

b. Design an analog high pass filter (maximally flat) that will have a -1db cut off frequency at 75 HZ and have greater than 20db of attenuation for all frequencies greater than 150 HZ. **07** (3:4:1.3.1)

c. Find the transfer function of following analog filter using frequency transformation when prototype LPF transfer function $H(S) = \frac{1}{s^2+s+1}$ .i) A low pass filter with a pass band of 10 red/sec. ii) A high pass filter with a cut off frequency of 1 rad/sec. **07** (3:4:2.4.1)

OR

8. a. Derive and discuss the general mapping properties of bilinear transformation and show the mapping between the s-plane and the z-plane. **06** (3:4:2.1.3)

b. Design a second order digital low pass Butterworth filter with a cut off frequency of 3K HZ at a sampling frequency of 8000 HZ. Use bilinear transformation. **07** (3:4:1.3.1)

c. Draw the direct form –I and direct form II structure for the IIR system given by **07** (3:3:2.4.1)

$$H(Z) = \frac{Z^{-1} - 3Z^{-2}}{(10 - Z^{-1})\ (1 + 0.5Z^{-1} + 0.5Z^{-2})}$$

MODULE – 5

9 a. Explain the following DSP hardware units **07** (2:5:1.3.1)
i) MAC ii) Shifters iii) Address Generators

b. Explain digital signal processor using Harvard architecture **07** (2:5:1.3.1)

c. Discuss Signed Q-15 fixed format. Find the signed Q-15 representation for decimal number -0.160123 **06** (3:5:2.4.1)

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**

OR

10	**a.**	Explain fixed point digital signal processer using basic architecture of TMS320C54X family.	**07**	(2:5:1.3.1)
	b.	Discuss IEEE Single Precision floating format. Convert the following number in the IEEE Single Precision format to decimal format: 110000000.010 0000.	**07**	(2:5:1.3.1)
	c.	Convert the following decimal number into the floating point representation i)0.640492×2^{-2} ii) -0.638454×2^{5} use 4 bits for exponent and 12 bits for mantissa	**06**	(3:5:2.4.1)

Note: (**RBTL - Revised Bloom's Taxonomy Level: CO - Course Outcome: PI - Performance Indicator)**