.Basavarajeswari Group of Institutions

BALLARI INSTITUTE OF TECHNOLOGY & MANAGEMENT

(Autonomous Institute under Visvesvaraya Technological University, Belagavi)

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

Course Code | 2 | 2 | E | E | 6 | 2 |

Sixth Semester B.E. Degree Examinations, June/July 2025

SIGNALS AND 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.**	Explain signals and systems with examples	**04**	**(2 :1 : 1.2.1)**
	b.	Determine the even and odd components of the signal shown in Fig.Q1 (a).	**06**	**(3 :1 : 1.2.1)**

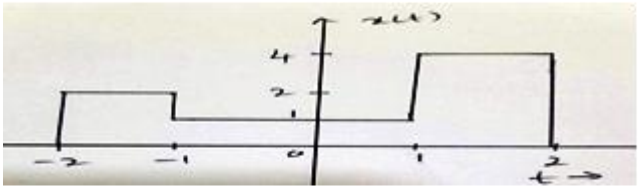

Fig.Q1 (a)

	c.	Sketch the following signal: $x(t)= u(t+4)-4\,u(t+2)+4\,u(t+1)-u(t-2)$	**05**	**(3 :1 : 1.2.1)**
	d.	Determine whether the system $y(t)= e^{x(t)}$ is linear, memoryless, casual, time invariant and stable.	**05**	**(3 :2 : 1.2.1)**
		(OR)		
2.	**a**	Give the classification of signals.	**04**	**(2 :1 : 1.2.1)**
	b	Find the product x(3t) and h(t+2) for the signals shown in Fig.Q2 (b)	**06**	**(3 :1 : 1.2.1)**

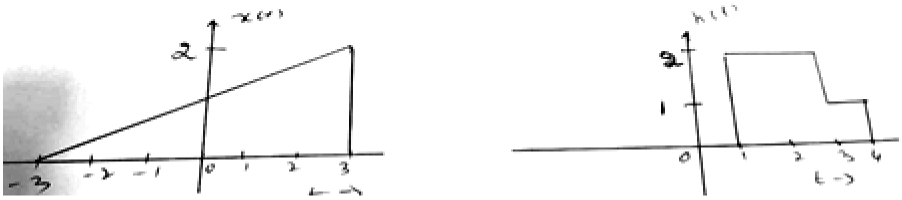

Fig.Q2 (b)

	c.	Determine the energy and power of the signal $x(n)= (1/3)^n u(n)$	**05**	**(3 :1 : 1.2.1)**
	d.	Determine whether the system $y(t) = x(t) +10$ is linear, memoryless, casual, time invariant and stable.	**05**	**(3 :2 : 1.2.1)**
		Module-2		
3.	**a.**	Given $x(n)=(-2, 6,3,8)$. Obtain 4 point DFT of x(n). Using the suitable property of DFT determine DFT of $x((n-3))_4$	**06**	**(3 :3 : 1.2.1)**
	b.	Given $x_1(n)= (2, -4, 5, -2)$ and $x_2(n)= (2,1,3)$. Determine 4-point circular convolution of these sequences using concentric circles method.	**06**	**(3 :3 : 1.2.1)**

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

	c.	The sequence x(n)= (8, -2,-3,4,1,2,6, 1, -1, -2,7,6,) is filtered through a filter whose impulse response is h(n) = (1,-1). Compute the output of the filter using overlap and add method. Use 6 point circular convolution.	**08**	**(3 :3 : 1.2.1)**

(OR)

4.	**a.**	Obtain 4 point DFT of the sequence x(n)= (1,6,-3,2). Draw its magnitude and phase spectrum.	**06**	**(3 :3 : 1.2.1)**
	b.	Given x(n)=(-3,2,-2,4) . Obtain 4 point DFT of x(n). Using the suitable property of DFT determine of the sequence y(n) where $Y(k)= X((k-1))_4$	**06**	**(3 :3 : 1.2.1)**
	c.	Given the sequences x(n) = (1,3,2,1) and h(n)= (4,4,1,-1). Find their circular convolution using Stockham's method.	**08**	**(3 :3 : 1.2.1)**

Module-3

5.	**a.**	Determine IDFT using Radix 2-Decimation In Time - Fast Fourier Transform algorithm for the sequence X(K)=(300, 60+j20, -15-j25, -78.63+j46.05,-85 , -78.63-j46.05, -15+j25, 60-j20)	**10**	**(3 :3 : 1.2.1)**
	b.	Using Radix 2-DIF- FFT algorithm find the 8 point DFT of the sequence x(n)= 3n -2 $0 \le n \le 7$	**10**	**(3 :3 : 1.2.1)**

(OR)

6.	**a.**	Find the circular convolution of x(n)= [1,-4,3,6] with h(n) = [4,1,5,9] . Use Radix 2-DIF- FFT algorithm.	**10**	**(3 :3 : 1.2.1)**
	b.	Using Radix 2-DIT- FFT algorithm find the 8 point DFT of the sequence x(n)= 2n-4 $0 \le n \le 7$	**10**	**(3 :3 : 1.2.1)**

Module-4

7.	**a.**	Design a Butterworth low pass filter, that will meet the following specifications: Maximum pass band attenuation = 2 dB Pass band edge frequency=150 rad/sec Minimum pass band attenuation = 20 dB Stop band edge frequency=300 rad/sec	**10**	**(3 :4 : 1.2.1)**
	b.	Design a low pass filter Chebyshev filter using bilinear transformation to satisfy the following specifications: (i) -3 dB cut-off frequency at 0.4π rad (ii) magnitude down atleast by 20 dB at 0.8π	**10**	**(3 :4 : 1.2.1)**

(OR)

8.	**a.**	Design a Chebyshev analog filter with a ripple of 1.2 dB for $\Omega \le 0.2\pi$ rad/sec and $\lvert H(\Omega)\rvert \le -18$ dB for $\Omega \ge 0.6\pi$ rad/sec	**10**	**(3 :4 : 1.2.1)**
	b.	Design a digital Chebyshev low pass filter using impulse invariant transformation. The digital filter specifications are as follows: $20\log\lvert H(\omega)\rvert_{\omega=0.2\pi} \le -3$ dB $20\log\lvert H(\omega)\rvert_{\omega=0.7\pi} \ge -18$ dB	**10**	**(3 :4 : 1.2.1)**

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

Module-5

9. **a.** The desired frequency response of a low pass filter is given by **10** **(3 :4 : 1.2.1)**

$$H_d(\omega) = \begin{cases} e^{-j2\omega}, & |\omega| \le \frac{3\pi}{4} \text{ rad} \\ 0\ , & \frac{3\pi}{4} \le |\omega| \le \pi \text{ rad} \end{cases}$$

Determine the filter coefficients of the F.I.R. filter, if Hamming window is used with N=5.

b. Draw the direct form I, direct form II and cascade realizations for IIR filter described by the following system function. **10** **(3 :5 : 1.2.1)**

$$H(z) = \frac{\left(1+\frac{1}{4}z^{-1}\right)}{\left(1-\frac{1}{3}z^{-1}\right)\left(1+\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)}$$

(OR)

10. **a.** A low pass filter is to be designed with the following desired frequency response of a low pass filter given by **10** **(3 :4 : 1.2.1)**

$$H_d(\omega) = \begin{cases} e^{-j3\omega}, & |\omega| \le \frac{3\pi}{4} \text{ rad} \\ 0\ , & \frac{3\pi}{4} \le |\omega| \le \pi \text{ rad} \end{cases}$$

Determine the filter coefficients of the F.I.R. filter, if Hanning window is used with N=7.

b. Obtain direct form I, direct form II and cascade form realization for the system **10** **(3 :5 : 1.2.1)**

y(n)= -2y(n-1)+5y(n-2)+3x(n)+ 6x(n-1)+8x(n-2)

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