Q. Code:946979

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

EC22403 – DISCRETE TIME SIGNAL PROCESSING

(Electronics and Communication Engineering)

(Regulation 2022)

TIME: 3 HOURS **MAX. MARKS: 100**

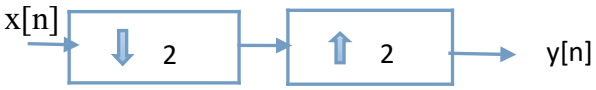
COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Analyze the frequency spectrum of Discrete time signal using Discrete Fourier Transform and Fast Fourier Transform.	**4**
CO 2	Interpret the characteristics of FIR filters and articulate the design of Finite Impulse Response filters for filtering undesired signals.	**3**
CO 3	Observe the IIR filter characteristics and design IIR filters according to the user specifications.	**3**
CO 4	Assess the word length effects in signal processing systems.	**4**
CO 5	Explore the architecture of Digital Signal Processor and inspect the various applications of Digital Signal Processing.	**3**

PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Obtain the circular convolution of the following sequences, x[n]={1,2,1} and h[n]={1,-2,1}	**1**	**3**
2.	How many additions and multiplications are required to compute 64-point radix-2 FFT algorithm?	**1**	**2**
3.	If x(n) = {1,0,2,3} ,then X(k) = {----, -1+3j, -------, ------}	**1**	**3**
4.	Compute the twiddle factor, W_{64}^{16}	**1**	**2**
5.	Give the equations for causal and non-causal Hamming window.	**2**	**2**
6.	For causal linear phase FIR filter, the partial filter coefficients are h[0] = 1, h[1] = 3 and h[2] = 2. Find the remaining coefficients of h(n). Assume N=5.	**2**	**2**
7.	Determine the frequency response of causal FIR filter with h[n]={0.75,0.25,1,0.25,0.75}.	**2**	**2**
8.	Draw the transversal structure of given system function $H(z) = 1 + 2z^{-1} - 3z^{-2} + 4z^{-3}$	**2**	**3**
9.	Why is prewarping required in IIR filter design?	**3**	**3**
10.	What is the advantage of Direct form-II structure over Direct form-I structure?	**3**	**3**
11.	Interpret the stability condition of an IIR filter.	**3**	**3**

12.	What are the techniques that can be employed for digitizing the transfer function of an analog filter?	**3**	**2**
13.	Express the fraction 7/8 and -7/8 in sign magnitude and 2's complement representation.	**4**	**3**
14.	What is the effect of quantization on pole locations?	**4**	**2**
15.	Quantize 0.0625_{10} by rounding off to 3 bits and hence calculate the roundoff error.	**4**	**2**
16.	Sketch the product quantization noise model of II order IIR system.	**4**	**3**
17.	If the sampling rate of a sequence x[n] is 20 samples/sec, what will be the sampling rate after decimating by a factor of 4?	**5**	**3**
18.	Compare fixed point and floating point processor.	**5**	**2**
19.	Draw a simple speech recognition model.	**5**	**3**
20.	Find the output of following block diagram.	**5**	**2**



PART- B (5 x 10 = 50 Marks)

		Marks	CO	RBT LEVEL
21. (a)	Compute 8-point DFT using DIF-FFT algorithm for the following sequence,	**(10)**	**1**	**4**

$$x[n]=\begin{cases} 1 \text{ for } 0\le n\le 7 \\ 0 \text{ for otherwise} \end{cases}$$

(OR)

(b)	Find the response of LTI system for x[n]={1,2,-1,2,3,-2,-3,-1,1,1,1,2,-1} and h[n]={1,2,1} using overlap-add method	**(10)**	**1**	**4**
22. (a)	The desired response of a filter is,	**(10)**	**2**	**3**

$$H_d(e^{j\omega}) = 1.\ e^{-j3\omega}, \qquad -3\pi/4 \le \omega \le 3\pi/4$$

$$0, \qquad 3\pi/4 \le |\omega| \le \pi$$

Identify the filter type and order of the filter and determine the impulse response and frequency response of the filter using Hanning window.

(OR)

(b)	Design a linear phase FIR-High pass filter with $\omega_c = 2\pi/3$ rad/sample for N=7 using frequency sampling method and determine filter coefficients.	**(10)**	**2**	**3**
23. (a)	Evaluate H(z) of a digital low pass Butterworth filter using bilinear transformation for the following specifications. (i) -3dB cutoff at pass band edge of 0.5π rad/sample (ii) magnitude down at least 15dB at $\omega = 0.75\pi$ rad/sample	**(10)**	**3**	**3**
	(OR)			
(b)	Design an IIR analog Chebyshev low pass filter using a Impulse invariant transformation for the following specifications $0.8 \leq \lvert H(e^{j\omega})\rvert \leq 1 \quad , \quad 0 \leq \omega \leq 0.2\pi$ $\lvert H(e^{j\omega})\rvert \leq 0.2 \quad , \quad 0.6\pi \leq \omega \leq \pi$	**(10)**	**3**	**3**
24. (a)	Consider the transfer function $H(z)=H_1(z).H_2(z)$ where $H_1(z)=1/(1-0.5\ z^{-1})$ and $H_2(z)=1/(1-0.6\ z^{-1})$.Find the output round off noise power. Assume word length is 4 bits(excluding sign bit). Draw the direct form-II structure.	**(10)**	**4**	**3**
	(OR)			
(b)	A digital system is characterized by the difference equation y[n]=0.5y[n-1]+x[n]. Determine the dead band of the system when x[n]=0.875for n=0 = 0 for n>0 and y[n]=0 for n<0. Assume 4- bit sign magnitude representation (Including sign bit)	**(10)**	**4**	**3**
25. (a)	Explain with a neat diagram and mathematical equations, how the sampling rate will be reduced by a factor D .	**(10)**	**5**	**3**
	(OR)			
(b)	Explain how digital filters are used for Image processing.	**(10)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

	Marks	**CO**	**RBT LEVEL**

26.	Compute the response of LTI filter for the following sequences, x[n] = {1,2,2} and h[n]={2,-1} using DFT and IDFT method.	**(10)**	1	4

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