Q. Code:181999

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

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

Fifth Semester

EC18502 – PRINCIPLES OF DIGITAL SIGNAL PROCESSING

(Electronics and Communication Engineering)

(Regulation 2018 / 2018A)

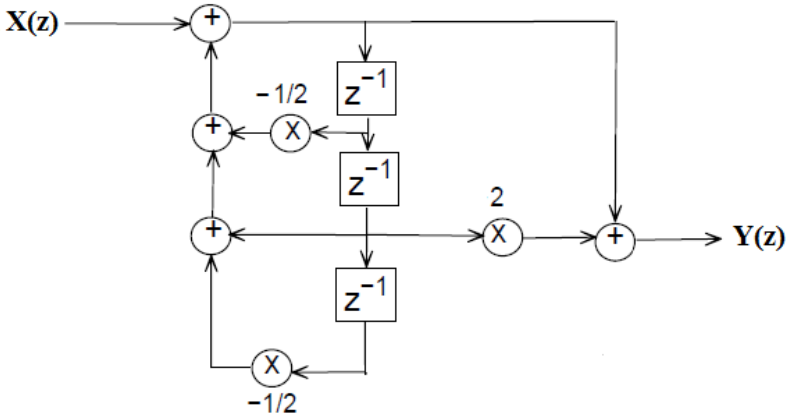
TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Determine the frequency spectrum of Discrete time signal using Discrete Fourier Transform.	**3**
CO 2	Interpret the characteristics of FIR filters and articulate the design of finite impulse response filters for filtering undesired signals.	**4**
CO 3	Observe the IIR filter characteristics and manipulate IIR filters in real time applications.	**4**
CO 4	Assess the word length effect in signal processing systems.	**3**
CO 5	Manipulate Multirate signal processing and observe its characteristics.	**3**

PART- A (10 x 2 = 20 Marks)

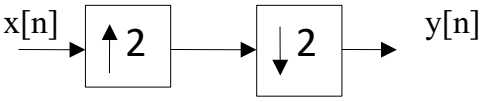
(Answer all Questions)

		CO	RBT LEVEL
1.	Find 4-point DFT of the sequence $x[n]=\{1,0,1,0\}$.	**1**	**3**
2.	Consider the 4-point Decimation-in-time (DIT) flow graph. What is the gain of the "signal path" that goes from x[1] to X(3)?	**1**	**3**
3.	List out the properties of FIR filter.	**2**	**1**
4.	Realize the FIR filter in direct form structure. $$H(z)=1+2z^{-1}+0.2z^{-2}-0.25z^{-3}+0.7z^{-4}$$	**2**	**3**
5.	Determine the transfer function for the given Direct form II realization structure.	**3**	**3**



6.	Given the specification $\alpha_p = 1$dB; $\alpha_s = 30$dB; $\Omega_p = 200$ rad/sec; $\Omega_s = 600$ rad/sec. Determine the order of the Butterworth filter.	**3**	**3**
7.	Compare the fixed point and floating point number representation.	**4**	**2**

8.	Convert + $(0.125)_{10}$ and – $(0.125)_{10}$ to 2's complement binary format.	**4**	**3**
9.	Find y[n] for the given block diagram.	**5**	**3**



10.	What is the need for anti-imaging filter after upsampler?	**5**	**2**

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	Find the DFT of a sequence $x[n]=\{1,1,1,1,1,0,0,0\}$ using DIF-FFT algorithm.	**(14)**	**1**	**3**
	(OR)			
(b)	Determine the IDFT of the sequence $X(k)=\{38,-5.828+j6.07,j6,-0.172+j8.07,-10,-0.172-j8.07,-j6,-5.828-$ using DIT-FFT algorithm.	**(14)**	**1**	**3**
12. (a)	Design a Linear phase FIR lowpass filter using hamming window by taking 5 samples of window sequence and with a cutoff frequency, $\omega_c = 0.35\pi$ rad/samples. Also realize the system using direct form structure.	**(14)**	**2**	**4**
	(OR)			
(b)	Design a Linear phase FIR lowpass filter with a cutoff frequency of 0.5π rad/samples by taking 7 samples of ideal frequency response using frequency sampling method.	**(14)**	**2**	**4**
13. (a)	Design a Butterworth digital IIR low pass filter using impulse invariant method by taking T=0.8 second to satisfy the following specifications. Passband ripple $\leq$ 1.938 dB Stopband ripple $\geq$ 10.46 dB Passband edge frequency = 0.3π rad/sample Stopband edge frequency = 0.7π rad/sample	**(14)**	**3**	**4**
	(OR)			
(b)	Design a Chebyshev digital IIR low pass filter using bilinear transformation by taking T = 1s to satisfy the following specifications.	**(14)**	**3**	**4**

$$0.707 \le \left|H\left(e^{j\omega}\right)\right| \le 1 ; 0 \le \omega \le 0.2\pi$$
$$\left|H\left(e^{j\omega}\right)\right| \le 0.1 ; 0.5\pi \le \omega \le \pi$$

14. (a)	Explain the characteristics of a limit cycle oscillation with respect to the system described by the equation, $y[n]=0.95\,y[n-1]+x[n]$. When the product is quantized to 5-bits (including sign bit) by rounding. The system is excited by an input x[n] = 0.75 for n=0 and x[n] = 0 for otherwise. Also evaluate the dead band of the filter.	**(14)**	**4**	**5**
	(OR)			
(b)	Two first order filters are connected in cascade whose system functions of the individual sections are $H_1(z)=\frac{1}{(1-0.35\,z^{-1})}$ and $H_2(z)=\frac{1}{(1-0.35\,z^{-1})}$. Evaluate the overall output noise power. Assume that the products are rounded to 4 bits (including sign bit).	**(14)**	**4**	**5**
15. (a)	Derive the input-output relationship in both time and frequency domain of Decimator and sketch its frequency spectrum.	**(14)**	**5**	**2**
	(OR)			
(b)	**(i)** Derive an expression for sampling rate conversion by a rational factor I/D.	**(7)**	**5**	**2**
	(ii) Discuss the Quadrature Mirror Filter bank with a suitable diagram.	**(7)**	**5**	**2**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Let X(k) denotes the 6-point DFT of the sequence x[n] = {-1, 4, 2, 3}, determine the sequence y[n] whose 6-point DFT is $Y(k)=W_3^{2k}X(k)$.	**(10)**	**1**	**3**

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