Reg. No.

B.E / B.TECH. DEGREE EXAMINATIONS, MAY 2023

Fifth Semester

EC18502 - PRINCIPLES OF DIGITAL SIGNAL PROCESSING

(Electronics and Communication Engineering)

(Regulation 2018)

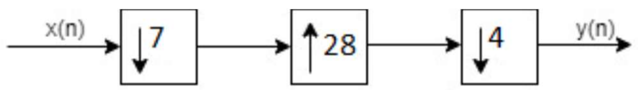
TIME: 3 HOURS **MAX. MARKS: 100**

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.	The first 6 points of 8-point DFT of a real valued sequence are {28, (-4+j9.565), (-4+4j), (-4+j1.656), -4, (-4-j1.656)}. Determine the remaining points.	1	3
2.	Perform Periodic convolution of two sequences $x_1[n]=\{1,2\}$ and $x_2[n]=\{3,4\}$ using concentric circle method.	1	2
3.	Why is the realization of an ideal low pass filter not possible?	2	4
4.	What causes Gibb's Phenomenon?	2	3
5.	Examine the limitations of Impulse invariant mapping technique.	3	4
6.	Apply bilinear transformation to $H(s) = \frac{5}{(s+1)(s+2)}$ with T = 1s and find H(z).	3	3
7.	Express the fraction (3/8) and (-3/8) in sign magnitude and 2's complement representation.	4	2
8.	How can overflow limit cycles be avoided?	4	3
9.	Find an expression for the output $y(n)$ for the given multi rate system.	5	3



Q. Code: 264280

		Marks	CO
10.	Investigate the various areas in which Multirate Signal Processing can be employed.	5	2

PART- B (5 x 14 = 70 Marks)

			Marks	CO	RBT LEVEL
11. (a)	**(i)**	Compute the output y[n] of a filter whose impulse response is h[n]= {1,1,1} and the input signal is x[n]= {3, -1,0,1,3,2,0,1,2,1} using overlap save method.	(7)	1	3
	(ii)	Compute 4 - point IDFT of the sequence X(k) = {2, 1-j, 0 1+j} using radix-2 DIF -FFT algorithm.	(7)	1	3
		(OR)			
(b)		Determine the DFT of a sequence x[n] = {1, 1, 1, 1, 1, 1} using radix-2 DIT-FFT algorithm.	(14)	1	3
12. (a)		If the desired response of a low-pass filter is $H_d(\omega) = \begin{cases} e^{-j3\omega} & \lvert\omega\rvert \le 3\pi/4 \\ 0 & 3\pi/4 < \lvert\omega\rvert \le \pi \end{cases}$ Determine H(ω) for N=7 using Hamming window.	(14)	2	4
		(OR)			
(b)	**(i)**	Design a linear phase FIR low pass filter with a cut-off frequency of (π/2) rad/sec using frequency sampling technique. Take N=9.	(7)	2	4
	(ii)	Realize the digital system obtained in 12.b(i) using minimum number of multipliers.	(7)	2	4
13. (a)		Design a Butterworth digital IIR LPF using impulse invariant transformation by taking T=1s satisfying the following specifications, $0.707 \le \lvert H(e^{j\omega})\rvert \le 1, \quad 0 \le \omega \le 0.3\pi$; $\lvert H(e^{j\omega})\rvert \le 0.2, \quad 0.75\pi \le \omega \le \pi$	(14)	3	4
		(OR)			
(b)		Design a Chebyshev low pass filter with specifications α_p = 1dB ripple in the passband $0 \le \omega \le 0.2\pi$, α_s = 15dB ripple in the stopband $.3\pi \le \omega \le \pi$ using bilinear transformation.	(14)	3	4

Q. Code: 264280

Q. No.			Question	Marks	CO	RBT LEVEL
14.	**(a)**	**(i)**	Explain the characteristics of Limit cycle oscillations with respect to the system described by the differential equation, y[n]=0.875y[n-1] +x[n] Determine the dead band of the filter if it is a 4-bit sign magnitude representation and x[0]=3/4 and x[n]=0 for n>0 and y'[n]=0 for n<0 .	**(7)**	**4**	**3**
		(ii)	Derive the expression for output quantization noise power.	**(7)**	**4**	**3**
			(OR)			
	(b)	**(i)**	Determine the scaling factor S_0 in adder 1 of the given digital system described by the transfer function, $H(z) = \frac{0.5+0.2z^{-1}}{1-0.624z^{-1}}$	**(7)**	**4**	**3**
		(ii)	Find the effect of coefficient quantization on pole locations of the given second order IIR system when it is realized in cascade form. Assume a word length of 4-bits through truncation. $H(z)= 1/(1-0.9z^{-1}+0.2z^{-2})$	**(7)**	**4**	**3**
15.	**(a)**	**(i)**	Explain the concept of interpolation of discrete time signals in detail with relevant diagrams and mathematical equations.	**(7)**	**5**	**3**
		(ii)	Explain with a neat block diagram, the sub-band coding of speech signal.	**(7)**	**5**	**3**
			(OR)			
	(b)		Explain with a neat diagram and mathematical equations, how the sampling rate will be reduced by a factor D.	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

Q. No.	Question	Marks	CO	RBT LEVEL
16.	Implement the following transfer function using Direct form-I, Direct form-II, Cascade and parallel realization of the system governed by the difference equation y[n] =0.1y[n − 1] + 0.2 y[n − 2] + 3x [n] + 3.6x [n − 1] + 0.6 x [n − 2]	**(10)**	**3**	**4**

****