Model Question Paper -1 with effect from 2020-21(CBCS Scheme)

USN | | | | | | | | | |

Fifth Semester B.E. Degree Examination

Digital Signal Processing

TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.
02.
03.

		Module – 1	
Q.1	**(a)**	Let x(n) be a finite – length sequence given by x(n)={2,1,1,0,3,2,0,3,4,6} with a 10 point DFT given by X(k).Evaluate the following functions of X(k) without computing the DFT (i) X(0) (ii) X(5) (iii) $\sum_{k=0}^{9} X(k)$	6
	(b)	If DFT (x(n))=X(K) then prove the following properties of DFT (i) Circular Folding (ii) Conjugate symmetry of DFT	6
	(c)	Find the 8-point DFT of real sequence x(n)=(1,2,2,2,1,0,0,0) using decimation in frequency FFT algorithm	08
		OR	
Q.2	**(a)**	Derive an algorithm to compute DFT using decimation in Frequency algorithm and discuss their computational efficiency.	08
	(b)	State and prove Parseval's theorem pertaining to DFT and hence find the energy of the 4-pont sequence x (n) = $\sin(2\frac{\pi}{N}n)$ 0≤n≤3	12
		Module – 2	
Q.3	**(a)**	Compare the correlation and convolution results for the two data sequences given by x (n) = [3 4 3 4], h (n) = [2 1 2 1] using DIT FFT algorithm.	14
	(b)	Given the system function $H(z) = \frac{1}{1-0.386z^{-1}} + \frac{-1+0.66z^{-1}}{1-0.786z^{-1}+0.368z^{-2}}$ Realize the system in its parallel form	06
		OR	
Q.4	**(a)**	Compute x(n) by using decimation in time and decimation in frequency IFFT algorithm if X(k)=[7,-1,3,-1]	08
	(b)	A digital high pass Chebyshev filter for cut-off frequency 50Hz , designed for a biomedical application is given by $H(z) = \frac{1931z^{-1}}{1-1.226z^{-1}+0.570z^{-2}}$ Give its Direct form 1, Direct form II and cascade realization .	12
		Module – 3	
Q.5	**(a)**	Design a fifth order band-pass FIR filter using Hanning window to extract theta band 4Hz to 8Hz of an EEG signal with sampling frequency of 100Hz	10

	(b)	Show that FIR filter exhibits a linear phase response for even symmetry of h(n) and give the corresponding frequency response function	10
		OR	
Q.6	**(a)**	A low pass filter has the desired frequency response $H_d(e^{j\omega})=\begin{cases} e^{-j3\omega} & 0\le \lvert\omega\rvert \le \frac{\pi}{2} \\ 0 & \frac{\pi}{2}\le \lvert\omega\rvert \le \pi \end{cases}$ Determine h(n) using frequency sampling technique and find the magnitude response function of the designed filter	10
	(b)	Using a rectangular window technique design a LPF with passband gain unity cutoff frequency of 1000Hz and working at a sampling frequency of 5kHz.The length of the impulse response should be 7	10
		Module – 4	
Q.7	**(a)**	A digital filter is required to pre-process raw fetal electrocardiogram (ECG data) that is the electrical activity of the heart, Baseline sways the movement artefacts tend to occupy the frequency range 1-15Hz. Design a digital high pass butter-worth filter to remove the baseline wander with pass band gain 3dB and stop band attenuation of 20 dB. Use Bilinear transformation	10
	(b)	Describe the features of the magnitude response of the Chebyshev filters and the characteristics of Chebyshev polynomial and derive an expression for the order of the Chebyshev filter	10
		OR	
Q.8	**(a)**	Compare the characteristic features of following filters (i) Butterworth and Chebyshev filters (ii) IIR and FIR filters	08
	(b)	Derive an expression for the order and cut-off frequency of Butterworth filter.	08
	(c)	Given the transfer function H(s) of an analog filter, find its corresponding digital transfer function which is suitable for filtering a biomedical signal using bilinear transformation. $H(s)=\frac{4s^2+10s+8}{(s^2+2s+3)(s+1)}$ choose T=0.2 sec	06
		Module – 5	
Q.9	**(a)**	Illustrate the need of multirate signal processing.	05
	(b)	Explain why interpolation is generally followed by a low pass filter	05
	(c)	With a neat block diagram explain the working of adaptive noise canceller and derive the filter coefficient updating equation using LMS algorithm.	10
		OR	
Q.10	**(a)**	What is meant by aliasing in decimation process? Explain how it is avoided.	10
	(b)	Derive the filter coefficient updating equation using RLS algorithm.	10

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome

Question		Bloom's Taxonomy Level attached	Course Outcome	Programme Outcome
Q.1	(a)	L5	1	3
	(b)	L2	1	3
	(c)	L3	1	3
Q.2	(a)	L2	1	3
	(b)	L3	1	3
	(c)			
Q.3	(a)	L3	2	2
	(b)	L4	2	2
	(c)			
Q.4	(a)	L3	2	2
	(b)	L4	2	2
	(c)			
Q.5	(a)	L4	3	3
	(b)	L2	3	3
	(c)			
Q.6	(a)	L4	3	3
	(b)	L2	3	3
	(c)			
Q.7	(a)	L4	4	3
	(b)	L2	4	3
	(c)			
Q.8	(a)	L3	4	3
	(b)	L2	4	3
	(c)	L4	4	3
Q.9	(a)	L2	5	2
	(b)	L2	5	2
	(c)	L2	5	2
Q.10	(a)	L2	5	2
	(b)	L2	5	2
	(c)			

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge):L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6