15EC52

Visvesvaraya Technological University, Belagavi

MODEL QUESTION PAPER

5th Semester, B.E (CBCS) EC/TC

Course: 15EC52 - Digital Signal processing

Time: 3 Hours **Max Marks: 80**

Note: (i) Answer Five full questions selecting any one full question from each Module.
(ii) Question on a topic of a Module may appear in either its 1st or 2nd question.

Module 1			
1	(a)	Explain the frequency domain sampling and reconstruction of discrete time signals.	8
	(b)	The first five points of the eight point DFT of a real valued sequence are {0.25, 0.125-j0.3018, 0, 0.125-j0.0518, 0}. Determine the remaining three points.	3
	(c)	Determine the circular convolution of the sequences, x1(n) = {1,2,3,1}, x2(n)={4,3,2,2} using time domain approach.	5
OR			
2	(a)	Obtain the relationship of DFT with the Z-transform.	5
	(b)	Show that the multiplication of two DFTs leads to circular convolution of respective time sequences.	7
	(c)	Consider a finite duration sequence x(n) = {0,1,2,3,4}. (i) Determine the sequence y(n) with six point DFT Y(k) = Real[X(k)] (ii) Determine the sequence v(n) with six point DFT V(k) = Imaginary[X(k)]	4
Module 2			
3	(a)	Explain the linear filtering of long data sequences using overlap-save method.	6
	(b)	The 4-point DFT of a real sequence x(n) is X(k) = (1, j, 1, -j). Find the DFTs of the following. i) $x_1(n) = (-1)^n x(n)$, ii) ii) $x_2(n)=x((n+1))_4$, iii) iii) $x_3(n) = x(4-n)$	6
	(c)	Explain the computational complexity of direct computation of DFT. What are the efficient algorithms for the evaluation of the DFT?	4
OR			
4	(a)	Find the response of an LTI system with an impulse response h(n) = (3,2,1) for the input x(n) = (2, -1, -1, -2, -3, 5,6,-1, 2,0,2,1) using overlap and add method. Use 8 point circular convolution.	7
	(b)	The 5-p0int DFT of a complex sequence x(n) is X(k)=(j, 1+j, 1+j2, 4+j). Compute Y(k), if y(n)=x*(n).	4
	(c)	State and prove the property of circular time shift of a sequence.	5
Module 3			

5	(a)	Derive the radix-2 decimation in time FFT algorithm and draw the signal flow graph for eight point DFT computation.	8
	(b)	Find the number of complex additions and complex multiplications required for 128-point DFT computation using i) Direct method, ii) FFT method. What is the speed improvement factor?	3
	(c)	Find the 4-point real sequence x(n), if its DFT samples are X(0)=6, X(1)=-2+j2, X(2)=-2. Use DIF-FFT algorithm.	5
		OR	
6	(a)	Compute the eight point DFT of the sequence x(n) = { ½, ½, ½, ½, 0,0,0,0} using the inplace radix-2 decimation in frequency FFT algorithm.	8
	(b)	Explain the Goertzel algorithm and obtain the direct form II realization.	8
		Module 4	
7	(a)	Obtain the cascade realization for a system described by H(z) = $\frac{1+\frac{1}{4}z^{-1}}{\left(1+\frac{1}{2}z^{-1}\right)\left(1+\frac{1}{2}z^{-1}+\frac{1}{4}z^{-2}\right)}$.	5
	(b)	Explain the design of IIR filter by Impulse invariance technique.	6
	(c)	Determine the order and cut off frequency of Butterworth analog highpass filter to meet the specifications: Maximum passband attenuation = 2 dB, Minimum stop band attenuation = 20 dB, Passband edge frequency = 200 rad/sec, stopband edge frequency = 100 rad/sec.	5
		OR	
8	(a)	Obtain the parallel realization of the system function H(z) = $\frac{(1+z^{-1})(1+2z^{-1})}{\left(1+\frac{1}{2}z^{-1}\right)\left(1-\frac{1}{2}z^{-1}\right)(1+\frac{1}{8}z^{-1})}$	6
	(b)	Design a digital low pas Butterworth filter using bilinear transformation to meet the specifications: i) -3 dB cut-off frequency at 0.5 π rad, ii) -15 dB at 0.75π rad. Obtain H(Z) assuming T=1 sec.	6
	(c)	What are the characteristics of Chebyshev filters? Define its magnitude response and list the properties of polynomial for type I Chebyshev filters.	4
		Module 5	
9	(a)	Realize the linear phase FIR filter for the impulse response h(n)= δ(n)+ ¼ δ(n-1)- ½δ(n-1)+ ¼ δ(n-3)+ δ(n-4) using direct form.	3
	(b)	Describe the frequency sampling realization of FIR filter.	7
	(c)	Determine the filter coefficients of an FIR filter for the desired frequency response $H_d(\omega)=\begin{cases} e^{-j2\omega}, \lvert\omega\rvert < \frac{\pi}{4} \\ 0, \quad \frac{\pi}{4} < \lvert\omega\rvert \geq \pi \end{cases}$ Use rectangular window function. Find the frequency response H(ω) of the filter.	6
		OR	
10	(a)	Consider an FIR lattice filter with coefficients K1=0.65, K2=-0.34 and K3=0.8. Find its impulse response and draw the direct form structure.	7
	(b)	Determine the impulse response of an FIR filter to meet the specifications: Passband edge frequency of 1.5 KHz, Stopband edge frequency of 2 KHz, Sampling frequency of 8 KHz. Use the Hamming window function.	6
	(c)	Compare the different window functions used in FIR filter design.	3