

International Islamic University Chittagong

Department of Electronics & Telecommunication Engineering

B. Sc. in ETE

Course Code: ETE-4703/4723

Time: 2:30 Hour

Final Examination, Autumn 2018

Course Title: Digital Signal Processing

Full Marks: 50

[Answer any two questions from Part-A and any three questions from Part-B. The figures in the right margin indicate full marks]

Part A

- 1.(a) Construct the relationship between DFT and Z transform. 5
- (b) Determine if the recursive system defined by the difference equation $y(n) = ay(n-1) + x(n)$ is linear. 5
- 2.(a) How does the FFT work? 4
- (b) Evaluate the 4 point DFT of causal three sample sequence given by, 6
- $$x(n) = \frac{1}{3}; 0 \leq n \leq 2$$
- $$= 0; \text{ else}$$

Construct that DFT coefficients are samples of Fourier transform of $x(n)$

- 3.(a) Compute the DFT of the sequence, $x(n) = \{0, 1, 2, 3\}$. Sketch the magnitude and phase spectrum. 6
- (b) Evaluate and discuss the mathematical expression to determine the pass band ripple and stop band ripple of the filter. 4

PART B

- 4.(a) Point out the criteria to design the best filter. 3
- (b) Describe the filter response characteristics for the following filters 3
- Chebyshev filter
 - Butterworth filter
- (c) Briefly state the advantages and disadvantages of Finite Impulse-Response (FIR) digital filters as compared with infinite impulse-response (IIR) types 4
5. Determine a discrete-time IIR low-pass filter $H(z)$ based on a Butterworth filter which fulfills the requirements given in Fig. 1. Use the bilinear transformation and do not use a higher order than necessary. 10

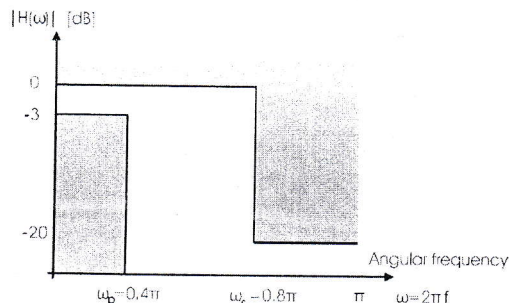


Fig 1.

6. Determine the impulse response $h(n)$ for a discrete-time FIR filter using the window method. Choose the minimal odd filter length which fulfills the specification in Fig.2

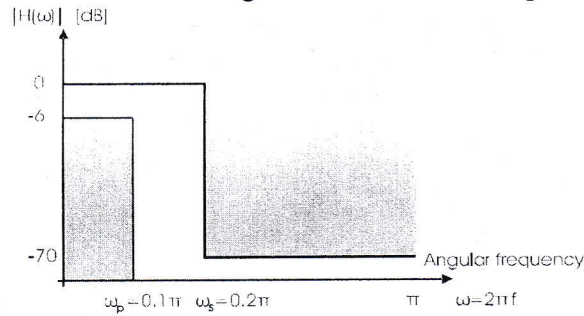


Fig.2 FIR Filter specification

- 7.(a) A finite duration sequence of length L is given as

$$x(n) = \begin{cases} 1 & \text{when } 0 \leq n \leq L-1 \\ 0 & \text{otherwise} \end{cases}$$

Determine the N -point DFT of this sequence for $N \geq L$

- (c) Explain the Multi rate digital signal processing interpolators and decimators.

Appendix

Chebyshev filter coefficients a_p .

0.5dB ripple ($z = 0.349$, $z^2 = 0.122$).

N	a_7	a_6	a_5	a_4	a_3	a_2	a_1	a_0
1								2.863
2							1.426	1.516
3						1.253	1.535	0.716
4					1.197	1.717	1.025	0.379
5				1.172	1.937	1.309	0.752	0.179
6			1.159	2.172	1.589	1.172	0.432	0.095
7		1.151	2.413	1.869	1.648	0.756	0.282	0.045
8	1.146	2.657	2.149	2.184	1.148	0.573	0.152	0.024

Coefficients a_p in Butterworth polynomials $s^N + a_{N-1}s^{N-1} + \dots + a_1s + 1$

N	a_1	a_2	a_3	a_4	a_5	a_6	a_7
1							
2	$\sqrt{2}$						
3	2	2					
4	2.613	3.414	2.613				
5	3.236	5.236	5.236	3.236			
6	3.864	7.464	9.141	7.464	3.864		
7	4.494	10.103	14.606	14.606	10.103	4.494	
8	5.126	13.138	21.818	25.691	21.818	13.138	5.126