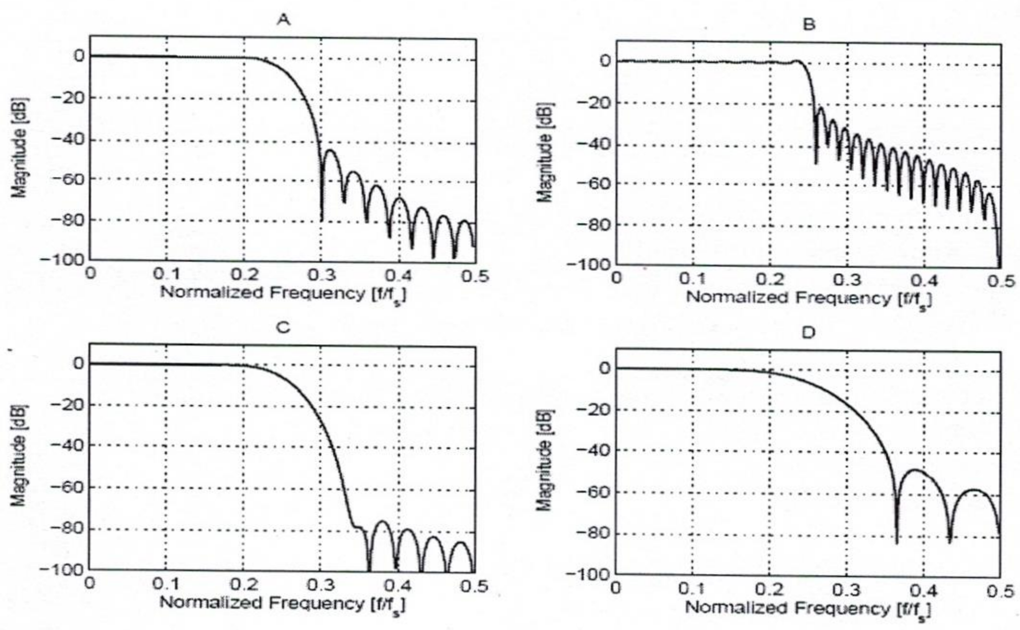
	International Islamic University Chittagong Department of Electronics & Telecommunication Engineering B. Sc. in ETE Semester Final Examination, Autumn-2021 Course Code: ETE-4723/4703, Course Title: Digital Signal Processing Time: 2:30 Hour Full Marks: 50 *[Answer any two questions from Part-A and any three questions from Part-B. The figures in the right margin indicate full marks]*		
1.(a)	Define the following transforms and explain how they are related to each other: (i) Discrete Fourier transform (DFT) **(ii)** Fast Fourier transforms (FFT).	5	CO1
1.(b)	"N-point DFT of a finite duration sequence can be obtained from the Z-transform of the sequence" Justify the statement with mathematical expression	5	CO1
2.	Briefly define and discuss the principle of multi rate sampling conversion. Give one example of a practical application. Analysis and discuss in detail the down-sampling (decimation) method and Up sampling process for Multi-rate DSP with block diagram and graphical representations.	10	CO1
3.	Explain and Compute the DFT of the sequence, X(n) = {0, 1, 2, 4}. Also find out the magnitude and phase sequence and make the plot for values of magnitude and phase sequences	10	CO2
	PART B		
4.(a)	Explain the filter response characteristics for the following filters i) Chebyshev filter ii) Butterworth filter In this regard, motive your answer briefly.	5	CO1
4.(b)	Point out the criteria to design the best filter. Evaluate and discuss the mathematical expression to determine the pass band ripple and stop band ripple of the filter.	5	CO1
5.(a)	Design a ChebyshevType 1 low-pass filter to meet the following specifications Pass band frequency, fp= 12 kHz, Stop band Frequency, fs= 24 kHz, Pass band ripple, $\delta p = \delta s = 0.3$ (i) Sketch the filter specification (ii) Calculate pass-band ripple controller, ε (iii) Calculate the Filter Order, N (iv) Determine the magnitude of the frequency response Justify your answer briefly	5	CO2

5.(b)	Design a Butterworth Filter with 3 dB cut off at 10 kHz and a minimum attenuation of 54 dB at 20 KHz. (i) Sketch the filter specification (ii) pass-band ripple controller, ε (iii) Stop-band ripple controller, A (iv) Calculate the Filter Order, N Justify your answer briefly	5	CO2
6.(a)	Briefly state the advantages and disadvantages of infinite impulse-response (IIR) digital filters as compared with finite impulse-response (FIR) types	5	CO1
6.(b)	There are two main methods to transform a continuous-time IIR filter into a discrete-time IIR filter. With examples, name the two methods. Explain the frequency transfer function for the following filters with examples and applications i) Low pass filter ii) Band pass filter iii) Notch filter	5	CO1
7.(a)	In Fig. 1 the frequency response of four different low pass FIR filters designed using the window method are shown. The cut off frequency is the same for all filters but they have been constructed using different windows. Clearly state the names of the windows that have been used during the design of the filters A, B, C and D. Motivate your answers briefly.  Fig.1. Filter constructed with different windows and number of filter taps.	5	CO2

7.(b)	Explain and compute the step by step process to 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 speciation in the following Fig.2. Determine also the Filter length, M, needed to fulfill the requirements for an equiripple FIR Filter and motive your answer briefly.	5	CO2

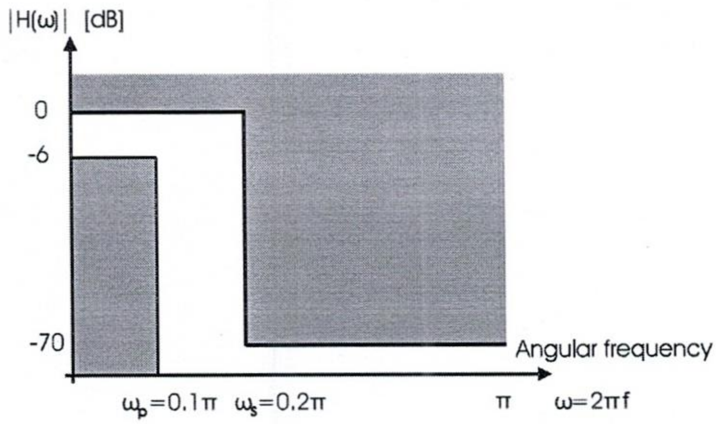


Fig.2

Appendix

Chebyshev filter coefficients a_ν.

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

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_ν in Butterworth polynomials $s^N + a_{N-1}s^{N-1} + \ldots + a_1 s + 1$

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	21.848	25.691	21.848	13.138	5.126