EE/CE 453/352: Digital Signal Processing

Saad Baig

Homework 3
Assigned: April 4, 2024
Due by: April 16, 2024
Total marks: 50

Important Notes

There are problems for which pen and paper solutions have to be submitted for grading. Preceding the solutions, you must include the following information:

- Your name
- Student ID
- Course ID
- Homework number
- Date and time submitted

Solution should be elaborative, sketch neat circuits wherever required, show clearly all steps of calculation & mention reference (for example formula, law, rule) to strengthen your understanding to solve the electric circuit problems.

Also, please comply with Academic Integrity Policies of Habib University related to plagiarism while submitting this assignment for grading.

Late Submission Policy

You need to submit your solution by the due date. Every day the assignment is late, 10% will be reduced from the total score. Assignment will not be graded after fifth day of submission deadline.

Course Learning Outcomes targeted using this assessment		
CLO	**Description**	**Learning-Domain Level**
CLO 3	Design various types of digital filters to meet given specifications.	Cog - 5

Question 1 [50 points]: This is an open-ended group assignment (groups of 2 to 3) to design standard **notch** filters designed to allow frequency $\omega_o = \pi/A$, where A is assigned to you in the groups on LMS.

The specifications are as follows:

1. The bandwidth $\Delta\omega$ of the notch filter should be at most $A/100$. The bandwidth is the range of frequencies over which the filter's gain is within 3 dB (or 70.7%) of its maximum gain, in radians, around the null frequency.
2. The passband ripple may be $A/200$ at most and stop band ripple be $A/100$.

Also note the following additional instructions:

1. As this is an open-ended assignment, you are free to use any and all resources available to you online or offline, especially MATLAB. But your submission will require references and AI prompts for any information which isn't your own.
2. Be as accurate as possible to the required specifications (discuss
3. Share all relevant diagrams (including magnitude, phase and z- transform plots) in your submission.
4. You may be asked to justify your design with a viva.
5. It should not take you more than 8 hours to complete this assignment as a group.
6. 5 points are reserved for uniqueness (in other words, all submissions should not look the same) and the quality of your work (analysis, design, citations etc.).

Part (a) [10 pts]: Design an IIR filter using pole-zero placement in the z-domain, complete with difference equation and implementation.

Part (b) [10 pts]: Design an IIR filter using bilinear transformation or any other approximation method of your choice, complete with difference equation and implementation.

Part (c) [10 pts]: Design a FIR filter with linear phase, complete with difference equation and implementation.

Part (d) [10 pts]: Design a FIR filter using a windowing function of your choice to truncate the time domain function of an ideal filter, complete with difference equation and implementation.

Part (e) [05 pts]: Draw a comparison between each of these implementations in terms of possible end-user requirements.