Spring BOOTCAMP - Elektronica Club

Problem Statement

In this assignment, you will design a digital filter using MATLAB's `filterDesigner` tool and apply it to filter a mixture of sine waves. Follow the steps outlined below:

Filter Design in MATLAB

1. Open MATLAB and type the following command in the command window: (You should have DSP ToolBox installed) as we have discussed in the session.

   `filterDesigner`

2. This opens the **Filter Designer** window.
3. Select the following options:
   (a) **Type of Filter**: Choose an appropriate type (Band-pass, Low-pass, etc.) as per the requirement.
   (b) **Filter Order**: Set to **Minimum**.
   (c) **Density Factor**: Set to 20.
   (d) **Frequency Specifications**: Set the Sampling Frequency to **48,000 Hz**.
4. Click on **Design Filter**.
5. Observe the filter response plot.
6. Export the filter coefficients by navigating to:

   File → **Export** → Export as MATLAB file.

7. This MATLAB file will contain all the filter coefficients.

Signal Generation and Filtering

1. Write a MATLAB script to:
   (a) Generate a mixture of ten sine waves with different frequencies of your choice.
   (b) Compute and plot the **Fast Fourier Transform (FFT)** of the generated signal.
   (c) Analyze the frequency spectrum.
2. Use the exported filter coefficients to filter the generated signal.
3. Compute and plot the FFT of the filtered signal.
4. Analyze the output and compare it with the original signal.

Submission Requirements

- Submit a report detailing your process, including:
  - Explanation of steps followed.
  - Filter design choices and justification.
  - MATLAB code used for signal generation, filtering, and FFT analysis.
  - Plots of input and output signals in both time and frequency domains.
  - Observations and conclusions.