EE3025 Assignment-1

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Download all python codes from

https://github.com/saivarsha17/EE3025/tree/main/Assignment_1/codes

and latex-tikz codes from

https://github.com/saivarsha17/EE3025/blob/main/Assignment_1/ee18btech11042.tex

1 Problem

1.1. The command

```
Output_signa1 = signal.lfilter(b,a,
    input_signal)
```

1.2. can be executed using following difference equation

$$\sum_{m=0}^{M} a(m)\, y(n-m) = \sum_{k=0}^{N} b(k)\, x(n-k) \quad (1.2.1)$$

where $x(n), y(n)$ are input and output signals

2 Solution

2.1. Z transform of $x(n-k)$ is

$$\mathcal{Z}\{x(n-k)\} = z^{-k}X(z) \quad (2.1.1)$$

Z transform of $y(n-m)$

$$\mathcal{Z}\{y(n-m)\} = z^{-m}Y(z) \quad (2.1.2)$$

So, applying Z transform on both sides,

$$\sum_{m=0}^{M} a(m)\, Y(z)\, z^{-m} = \sum_{k=0}^{N} b(k)\, X(z)\, z^{-k} \quad (2.1.3)$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^{N} b(k)\, z^{-k}}{\sum_{m=0}^{M} a(k)\, z^{-m}} \quad (2.1.4)$$

We know a and b coefficients from passing x(n) through low pass butterworth filter.

2.2. Substitute,

$$z = e^{j\omega} \quad (2.2.1)$$

Where,

$$\omega = \frac{2\pi i}{N} \quad (2.2.2)$$

$$Y\left(e^{j\omega}\right) = H\left(e^{j\omega}\right) X\left(e^{j\omega}\right) \quad (2.2.3)$$

Calculate DFT of $y(n)$ and use np.fft.ifft to calculate $y(n)$.

2.3. Find below plots from

https://github.com/saivarsha17/EE3025/tree/main/Assignment_1/figs

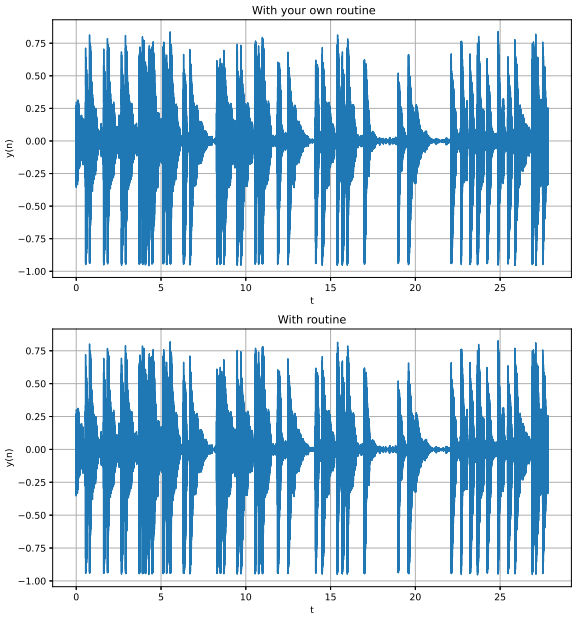

Fig. 2.3: Time response

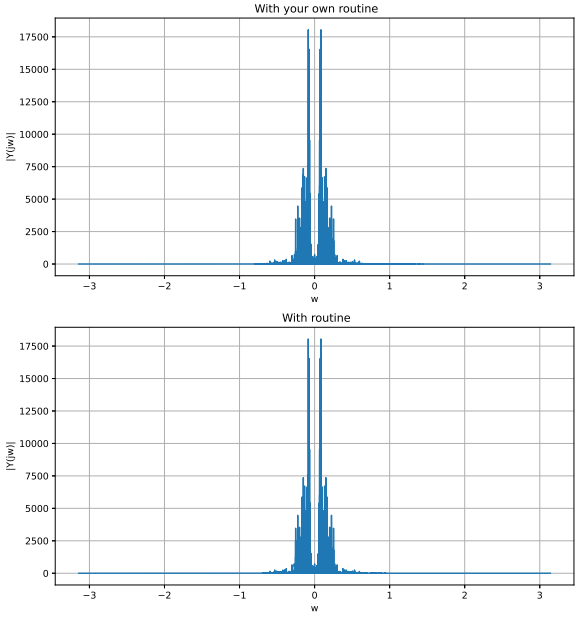

Fig. 2.3: Frequency response