ASSIGNMENT 7

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1 Finding the transfer of low pass filter

By solving the matrix you can get the output in terms of input. you can find the transfer function which comes out to be:

$$H(s) = \frac{0.0001586}{2 * 10^{-14}s^2 + 4.414 * 10^{-9}s + 0.0002} \tag{1}$$

The transfer function is plotted below:

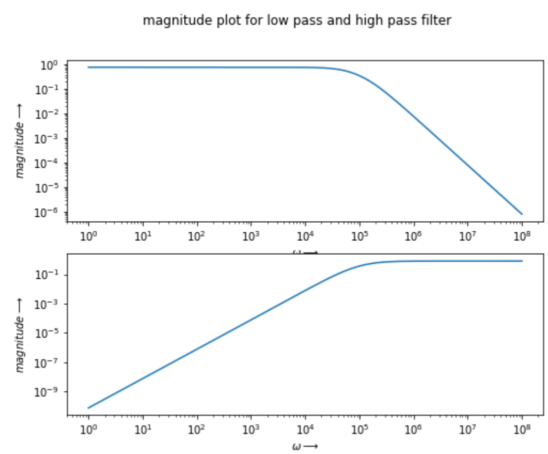

Figure 1: low pass filter

As you can see the transfer function represents a low pass filter. The cutoff frequency is around 10**5.

2 Finding the transfer function of high pass filter

By forming the matrices for high pass filter and solving them you can find the transfer function. The transfer function looks like:

$$H(s) = \frac{1.586e - 14 * s^2}{2.0e - 14 * s^2 + 4.414e - 9 * s + 0.0002} \tag{2}$$

The plot of impulse response:

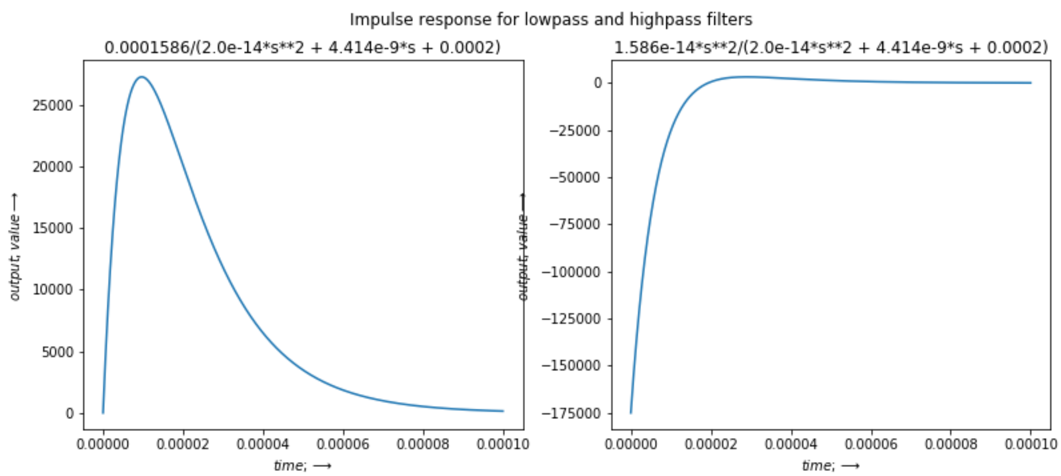

Figure 2: high pass filter

From the graph it is clear that the filter attenuates the low frequency inputs and passes out only the high frequency inputs. The cut-off frequency is around 10**5.

2.1 The step response of low pass filter

The output of low pass filter when unit step is given as input is show below:

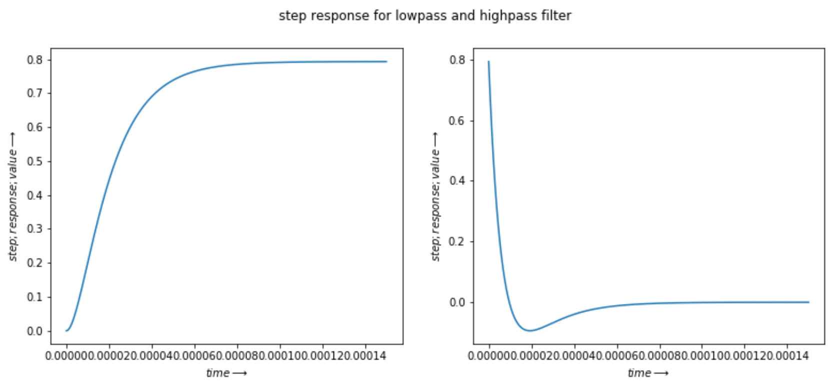

Figure 3: step response

The transients decay and finally the output reach value of 0.793. 0.793 is the dc gain of the transfer function. As it is a low pass filter it passes the input as it is but attenuates it by 0.793. The way in which the transients appear to decay tells us that the system is stable and well behaved.

2.2 Step response of High pass filter

The step response of high pass filter :

AS the frequency of unit step is zero(much less than the cutoff frequency). The high pass filter filters out the input and the output is nearly zero. The way how the transients die out tells us that there is slight ringing in the system. The ringing dies out soon. so the system is stable and well behaved. This can be understood from the graph.

2.3 The output for a particular input

The output of low pas filter for input :

$$v_{input} = \sin(2000\pi * t) + \cos(2 * 10^6 \pi t) \tag{3}$$

As you can see the input contains two frequency components. As the frequency of cos is more than the cut-off frequency the low pass filter filters it out. It passes only the sin through it. So the ouput is only the sin function.This can be seen below :

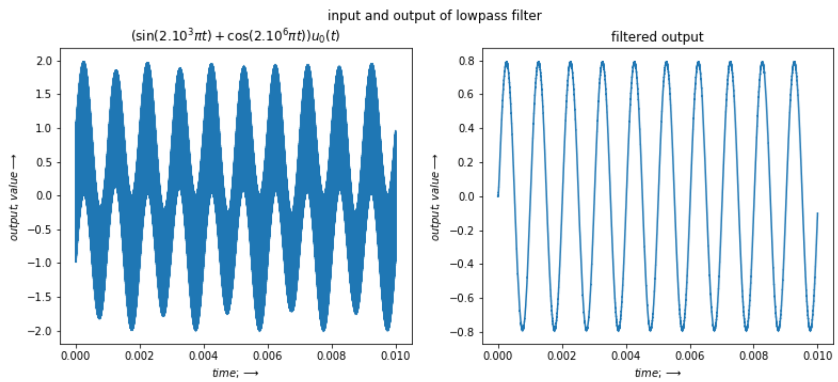

Figure 4: output

2.4 The output of high pass filter for decaying Sinusoid

The decaying sinusoid input given to the high pass filter is:

$$V_{input} = \exp -5 * 10^4 t \sin \pi 10^6 t \tag{4}$$

The input and output looks like:

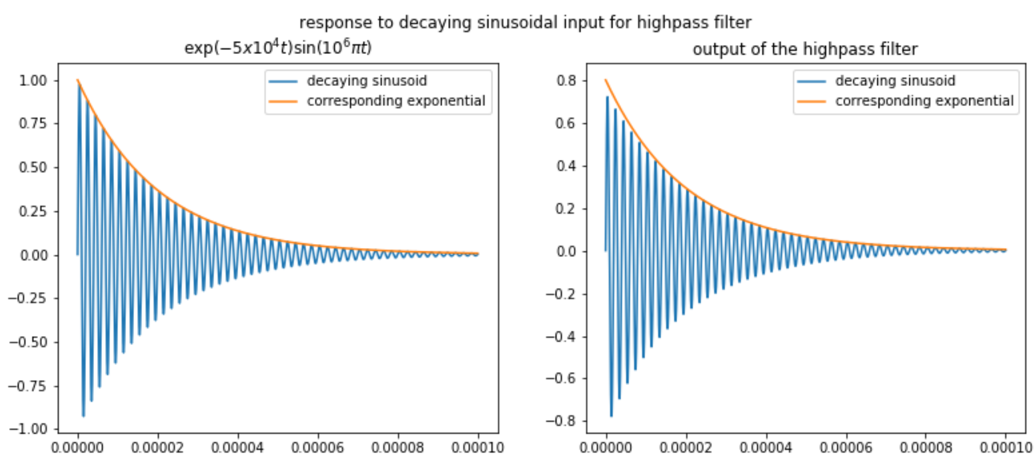

Figure 5: input

As the frequency of decaying sinusoid is more than the cut-off frequency. The high-pass filter passes the input through it. The output is same as the input .