ANALOG ELECTRONIC CIRCUITS LAB

Lab Report 5

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Entry number: -2019EE10507

Objective: Realisation of butterworth low pass filter.

Problem(a): Creating butterworth low pass filter transfer function.

* MATLAB Code for butterworth low pass filter transfer function generation.

Graphical user interface, text, application

Description automatically generated

* Obtained transfer function.

Graphical user interface, text, application

Description automatically generated

* Root Locus of Obtained transfer Function. We can see two imaginary conjugate poles.

Graphical user interface, application, table

Description automatically generated

* Bode Plot of above Transfer Function.

Graphical user interface, application

Description automatically generated

We can clearly se -3dB at 1MHz Frequency

Graphical user interface, application

Description automatically generated

Here we can see gain of -19dB at 3MHz frequency to total offset is -3-(-19) = 16dB, Which is grater than 15dB. So yes, our filter meets the attenuation requirement at 3MHz.

Problem(b): Here we are using Differential Amplifier to realise our for butterworth low pass filter transfer function. Transfer Function for our circuit is

Diagram, schematic

Description automatically generated

We are taking R1 = 10K, R2 = 10K.

After comparing this transfer function and transfer function obtained in part(a) we get

C2 = 1.125e-11 and C1 = 2.2507e-11. We can also note that C1 = 2\*C2.

After Implementing this circuit in LTspice Simulator.

A screenshot of a computer

Description automatically generated with medium confidence

Here at -3dB point corresponding frequency is 740.73KHz which is not equal to 3MHz. This means we have to modify our values to get accurate results.

* Now we Sweep C2 keeping C1/C2 constant.

A screenshot of a computer

Description automatically generated

Here we can see at C2 = 8p, this means C1 = 16p. We get -3dB at 1.04MHz, which is pretty accurate.

A screenshot of a computer

Description automatically generated with medium confidence

We can also see that at 3MHz point we have –21.27dB, So our offset is -3-(-21.27) = 18.27 which is less than 15dB which completes our attenuation requirement.

Problem(c): In this part we will attempt to make that filter using passive elements.

Our circuit is:

A picture containing graphical user interface

Description automatically generated

Transfer Function for this circuit is:

We are taking C1 = 1e-6, Now by comparing this by our transfer function in part(a) we get R1 = 0.1126 and L1 = 25.329n.

Now Using this values and implementing above circuit in LTspice. And plotting Vout/Vin.

A screenshot of a computer

Description automatically generated

We can clearly see this circuit gives pretty accurate values we get -3dB at almost 1MHz frequency.

A screenshot of a computer

Description automatically generated

Also, At 3MHz we have -19.17dB so our offset is -3-(-19.17) = 16.17dB which is more than 15dB.