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## Laboratory 1:

**Signal Processing with MATLAB**

Part 1:Experimental equipment and devices

1. A signal generator

2. An oscilloscope

3. Breadboard (bring your own one)

4. Resistors and capacitors

5. One op-amp (e.g., LM741)

Part 2:Experimental content

We construct two circuits to implement and analyze two analogue low pass filters

Part 3:Experimental procedure and results

Task 1

1. Procedure

We construct the circuit, and measure the Vout and Vin. We change the frequency from 0.1Khz to 100Khz. Then calculate the data and draw the conclusion

(2)Results

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| **Task 2:Explain why fc is called 3dB cutoff frequency.**  **Because when we switch frequency to fc, the Vpp becomes the times original Vpp. So, we call fc 3dB cutoff frequency**  图形用户界面  描述已自动生成  Task 3:   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Input(KHz) | Vin(V) | Vout(V) | Vout/vin | 20log10(Vout/Vin) | phase | | 0.1 | 10.2 | 10 | 0.980392 | -0.172003435 | -2.26° | | 1 | 10.2 | 8.08 | 0.792157 | -2.02377622 | -36° | | 10 | 10.2 | 1.6 | 0.156863 | -16.08960378 | -79.92° | | 100 | 10.2 | 0.24 | 0.023529 | -32.5677786 | -90° | | 1.5915 | 10.2 | 6.84 | 0.670588 | -3.470881401 | -44.73° |     Task 4: As we change the sine signal to square wave, and f=4fc, we get the output which meets our expectation    Task 5: As we change the sine signal to triangle wave, and f=4fc, we get the output which meets our expectation with just small error |

Your comments and opinions on the results:

As we change the frequency of input to higher level, the Gain will become smaller, and 20log10(Vout/Vin) become smaller at the mean time. The phase between output and input voltage become smaller too.

Part2

1. Procedure

We construct the circuit, and measure the Vout and Vin. We change the frequency from 0.1Khz to 100Khz. Then calculate the data and draw the conclusion

(2)Results

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Task 6:    Task 7:     |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | input | vin | vout | vout/vin | 20log10(vout/vin) | phase | | 0.1 | 10.2 | 10.2 | 1 | 0 | 7.21° | | 1 | 10.2 | 6.88 | 0.67451 | -3.420234671 | 66.23° | | 10 | 10.2 | 0.6 | 0.058824 | -24.60897843 | 190° | | 100 | 10.2 | 2.23 | 0.218627 | -13.20590617 | 280° | | 1.5915 | 10.2 | 4.68 | 0.458824 | -6.767086374 | 88.3° |   电脑萤幕画面  描述已自动生成  As we change the sine signal to square wave, and f=4fc, we get the output which meets our expectation  电脑显示屏  描述已自动生成  As we change the sine signal to square wave, and f=4fc, we get the output which meets our expectation with just small error |

Your comments and opinions on the results:

As we change the frequency of input to higher level, the Gain will become smaller, and 20log10(Vout/Vin) become smaller at the mean time. The phase between output and input voltage become smaller too. But when we change frequency too high, the output will not meet our expectation and the data does not have value.

Part 4: A summary of what you gained in the lab.

We have constructed two circuits to implement and analyze two analogue low pass filters. Through this lab we have a deeper understanding of low pass filters and know more accurate properties about them.