**LAB # 10**



**CSE-203L Circuit & Systems-II Lab**

**Fall 2022**

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“On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work.”

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Submitted to:

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4th January, 2023

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**TITLE:**

**Active Filters**

**OBJECTIVES:**

* To study the Active Low pass filter and to evaluate:
  + High cutoff frequency of Low pass filter.
  + Pass band gain of Low pass filter.
  + Plot the frequency response of Low pass filter.

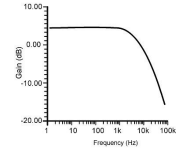
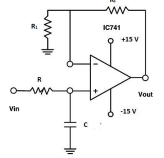
**APPARATUS:**

* DC power supplies +15V, −15V from external source
* Function generator
* Oscilloscope
* Digital Multimeter

**COMPONENTS:**

* Resistance 10kΩ
* Resistance 22kΩ
* Capacitor 0.01µF
* LM 741

**THEORY OVERVIEW:**



**Figure 1**

**Equation of low pass filter:**

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Vin =Input signal Voltage

Vout = Output signal Voltage

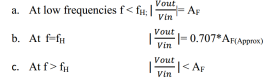
| Vout/Vin |= Gain of filter as a function of frequency

AF =1+RF/R1 = pass band gain of filter

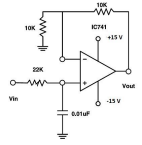
f = frequency of input signal

fH =1/2πRC =high cut off frequency, 3-dB frequency, corner frequency

Operation of low pass filter using equation 2

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The ideal low pass filter has a constant gain AF from 0 to high cut off frequency (fH) at fH the gain is 0.707 \* AF, and after fH it decreases at a constant rate with an increase in frequency i.e., when input frequency is increased tenfold (one decade), the voltage gain is divided by 10. Gain (dB) = 20 log | Vout / Vin | i.e., Gain Roll off rate is −20dB / decade.

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**Figure 2**

**PROCEDURE:**

1. Connect the circuit as shown in Figure 2.
2. Switch ON the power supply
3. Connect a sinusoidal signal of amplitude 1V (p-p) of frequency 1KHz to Vin of Low pass filter from function generator
4. Connect Ch-1 of oscilloscope to the signal source
5. Observe output on Ch-2 of oscilloscope
6. Increase the frequency of input signal step by step and observe the effect on output Vout on oscilloscope
7. Tabulate values of Vout, gain, gain (dB) at different values of input frequency shown in observation Table 2.
8. Plot the frequency response of low pass filter using the data obtained at different input frequencies.

**CALCULATIONS:**

Calculate all the following values

1. Pass band gain of Low pass filter AF = 1 + RF / R1
2. Pass band gain (dB) = 20 log |Vout / Vin|
3. 3 dB frequency fH = 1/2πRC
4. Gain at 3 dB frequency fH = 0.707 \* AF
5. Roll off rate = −20db/decade

**OBSERVATIONS:**

Table 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Input Frequency (Hz)** | **Vout** | **| Vout/Vin |= Gain** | **Gain (dB) = 20 log | Vout / Vin |** |
| 1 | 300 | 10 V | 2 | 6.02 |
| 2 | 500 | 10 V | 2 | 6.02 |
| 3 | 700 | 9 V | 1.8 | 5.11 |
| 4 | 1k | 8.4 V | 1.68 | 4.5 |
| 5 | 5k | 3.17 V | 0.634 | -3.96 |
| 6 | 10k | 1.52 V | 0.304 | -10.34 |
| 7 | 15k | 1 V | 0.2 | -13.98 |

**CONCLUSION:**

We conclude the following results from this experiment:

* **Op-Amp** can be used to make a low pass filter.
* A low-pass filter is a circuit that only passes signals below its **cutoff** **frequency** while **attenuating** all signals above it.
* low-pass filter is the **complement** of a **high-pass filter**, which only passes signals above its cutoff frequency and attenuates all signals below it.