PRACTICAL WORK BOOK
For The Course
EE-315 Electric Filter

For

Third Year

(Electrical & Telecommunication Engineering)

Name of Student: ____

Class: ______________________________Batch :____________________

Discipline: ____

Class Roll No.: _______________Examination Seat No._________________

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ELECTRICAL FILTERS LAB

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Experiment#01

***OBJECT*:**

To study the types of filters and their parameters.

Filter

Any combination of passive (R, L and C) and/or active (transistors or operational amplifiers) elements design to select or reject a band of frequencies is called a filter.

Filtering has a commonly accepted meaning of separation, something retained, something rejected. In electrical engineering we filter signals, usually voltages.

Types of Filters:

Low Pass Filter:

A low pass filter is one which the pass band extends from $\omega = 0$ to $\omega = \omega_o$, where ω_o is the cutoff frequency.

High Pass Filter:

A high pass filter is the complement of the low pass filter. It stops the frequency from $\omega=0$ to $\omega = \omega_o$ and the pass band extends to infinity.

Band Pass Filter:

An ideal band pass filter is one in which radian frequencies extending from ω_1 to ω_2 are pass while all other frequencies are stopped.

Band Elimination Filter:

An ideal band elimination filter is one in which radian frequencies extending from ω_1 to ω_2 are stopped while all other frequencies are passed.

Parameters

Cut-off Frequency:

Frequencies that define the points on the resonance curve that are 0.707 of the peak current or voltage value. In addition, they define the frequencies at which the power transfer to the resonant circuit will be half the maximum power level.

Transfer Function:

Transfer function is usually defined as the ratio of output to the input quantity.

$$\text{Transfer Function} = \frac{\text{Output quantity}}{\text{Input quantity}}$$

Attenuation:

Components of a signal are rejected by designing a filter that provides attenuation over a band of frequencies. We define attenuation as:

$$\alpha = -20\log|T| \text{ dB} \qquad |T| <= 1$$

Gain:

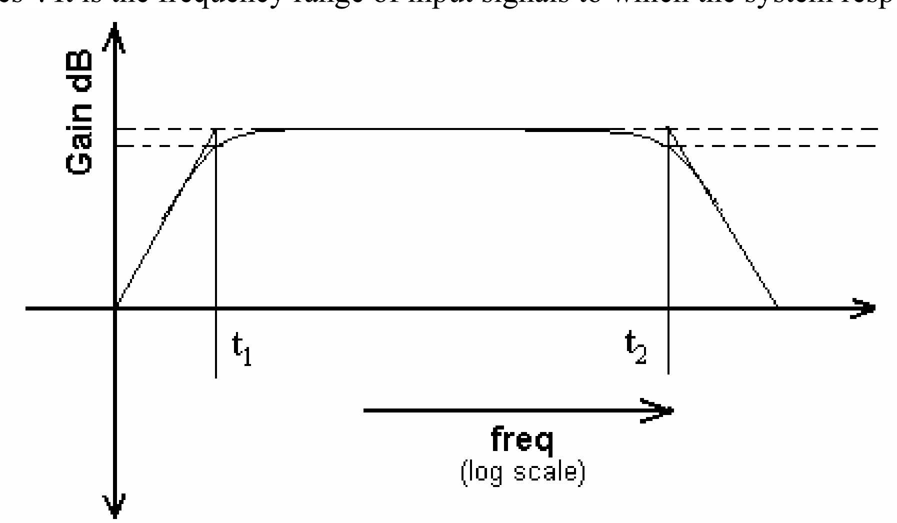
Components of a signal are retained by the absence of attenuation or perhaps even gain. We define gain as:

$$A = 20\log|T| \text{ dB} \qquad |T| > 1$$

Bandwidth:

Bandwidth is the difference between the upper and lower cut off frequencies. Also between these two frequencies the gain of the amplifier should be substantially flat.

Also the bandwidth of the electronic system refers to the "capability of the system to either amplify and transmit or just simply transmit process signals of different frequencies". It is the frequency range of input signals to which the system responds.



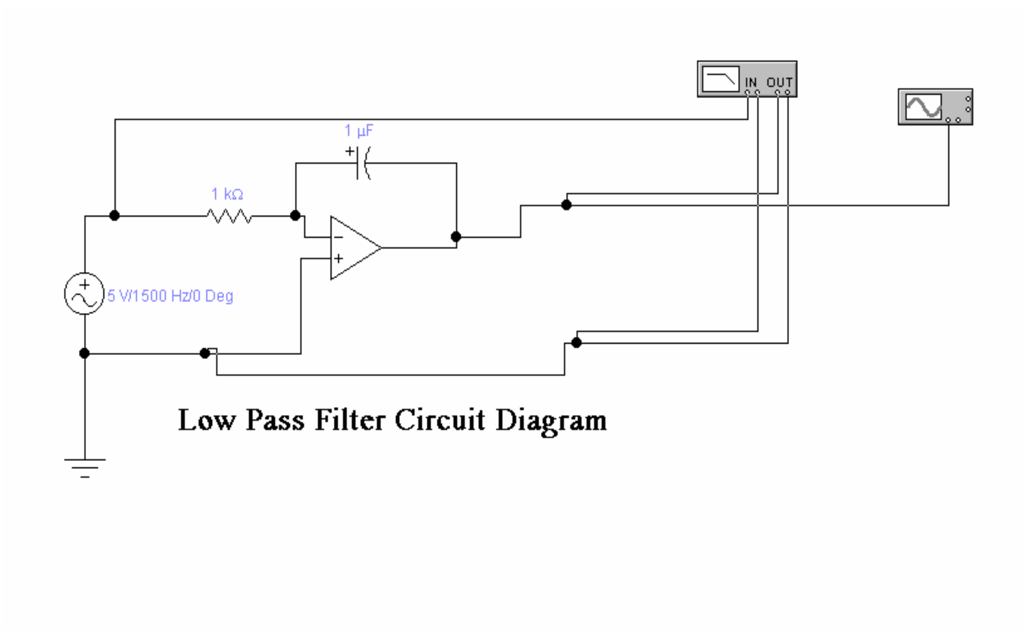
EXPERIMENT # 2

OBJECT:

To Observe the output response of any circuit from the book

SELECTION:

A low Pass Filter



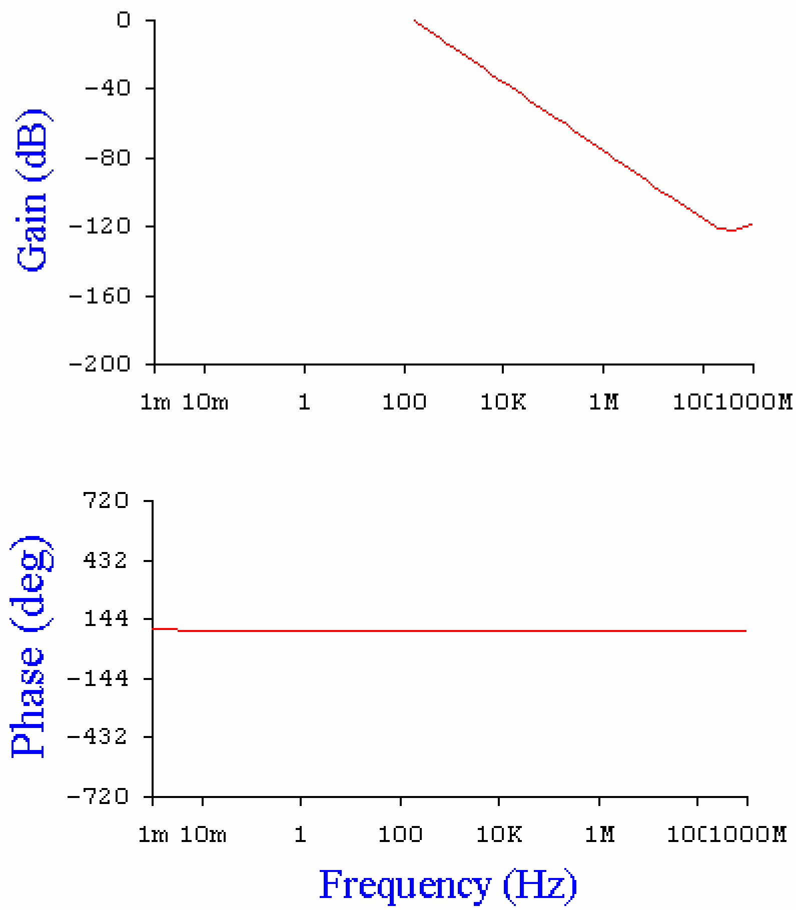
Low Pass Filter Circuit Diagram

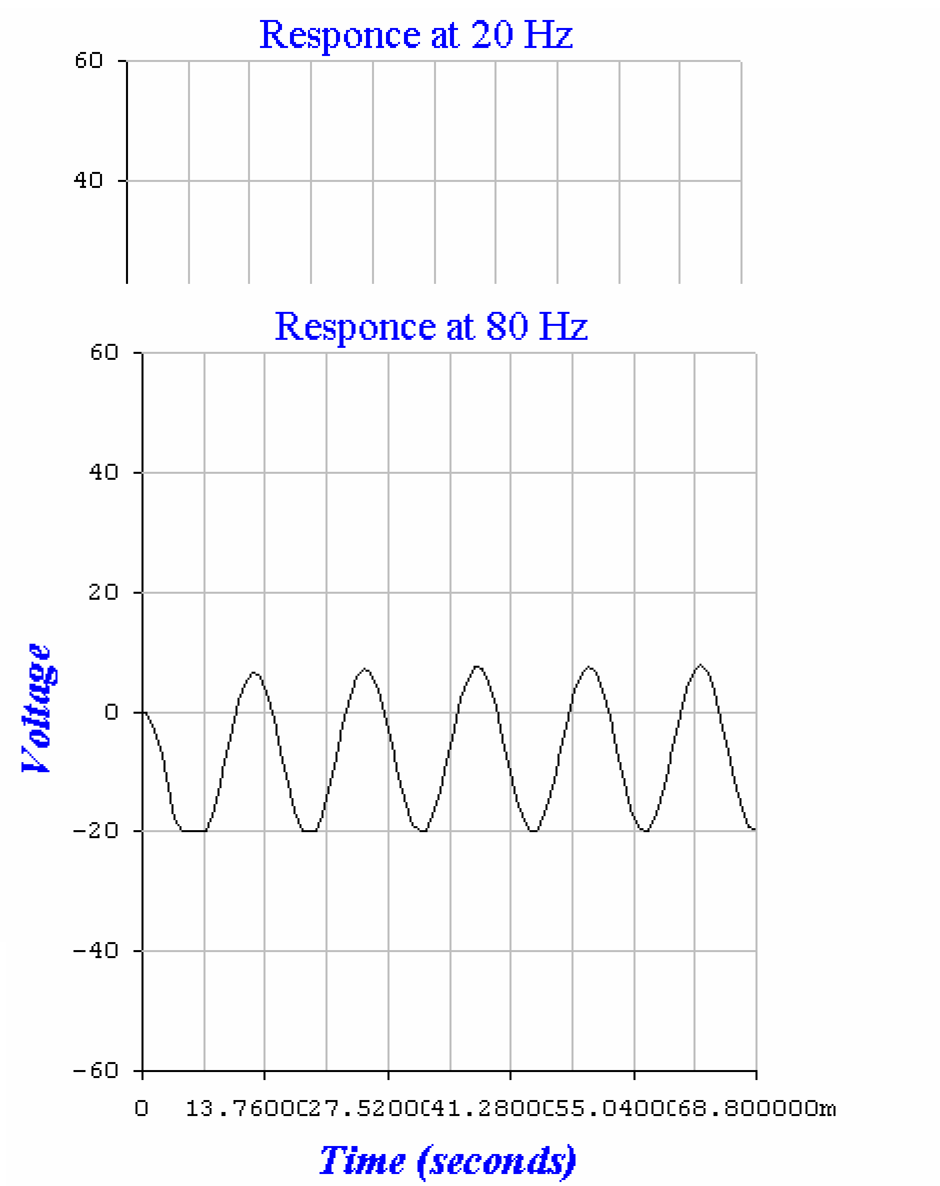
As it is clear from above that R=1K ohm and C=1uF

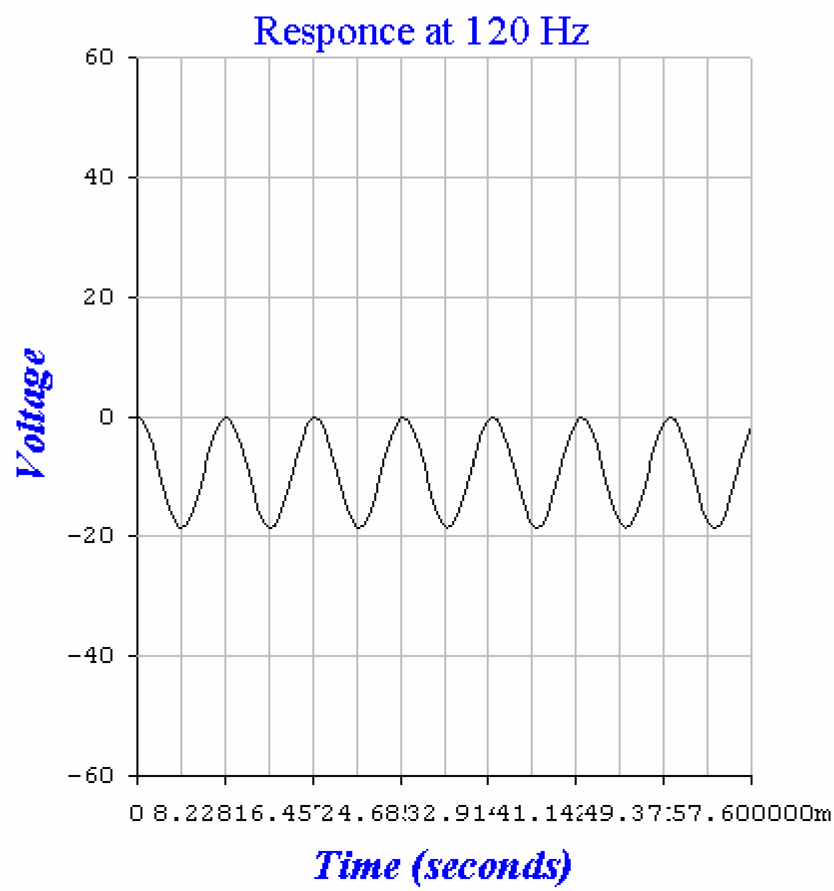
So cut off frequency is f=1/2(3.14)*1K*1u =160 Hz

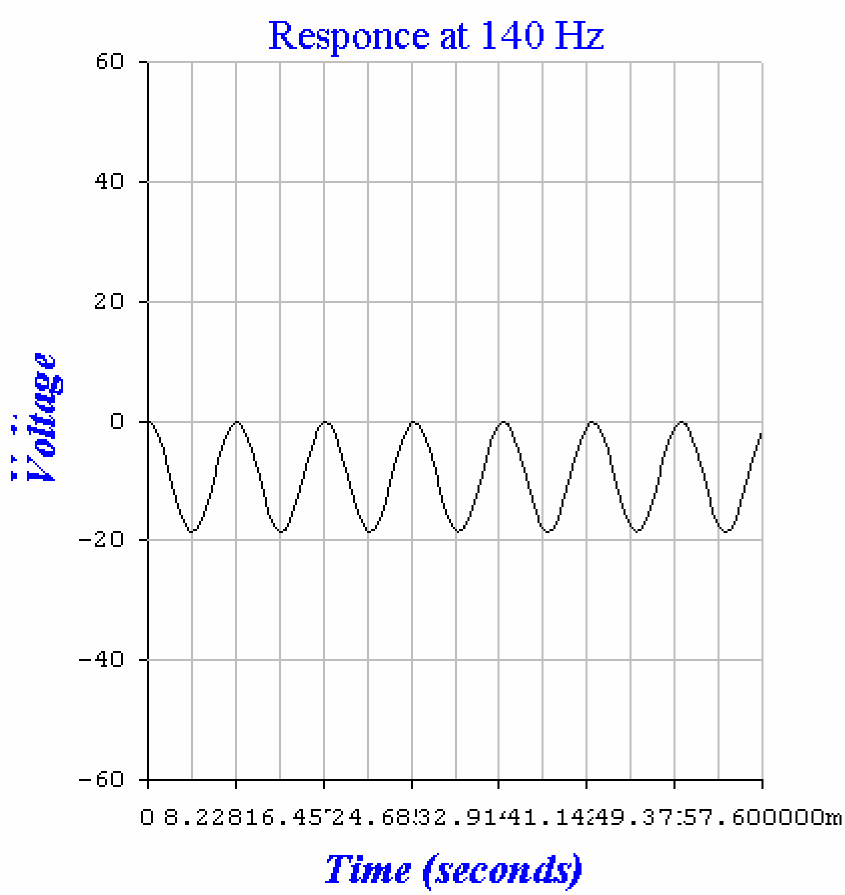
So it will allow frequencies less than 160Hz to pass and discard frequencies higher than 160 Hz.

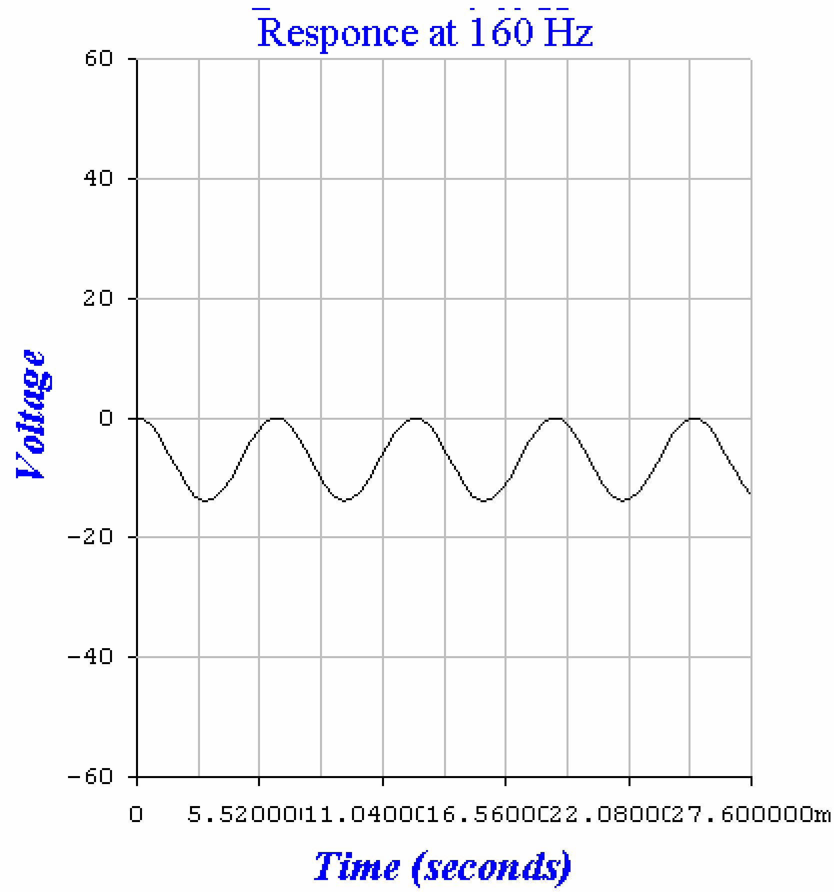
The responses at different frequencies are given below.

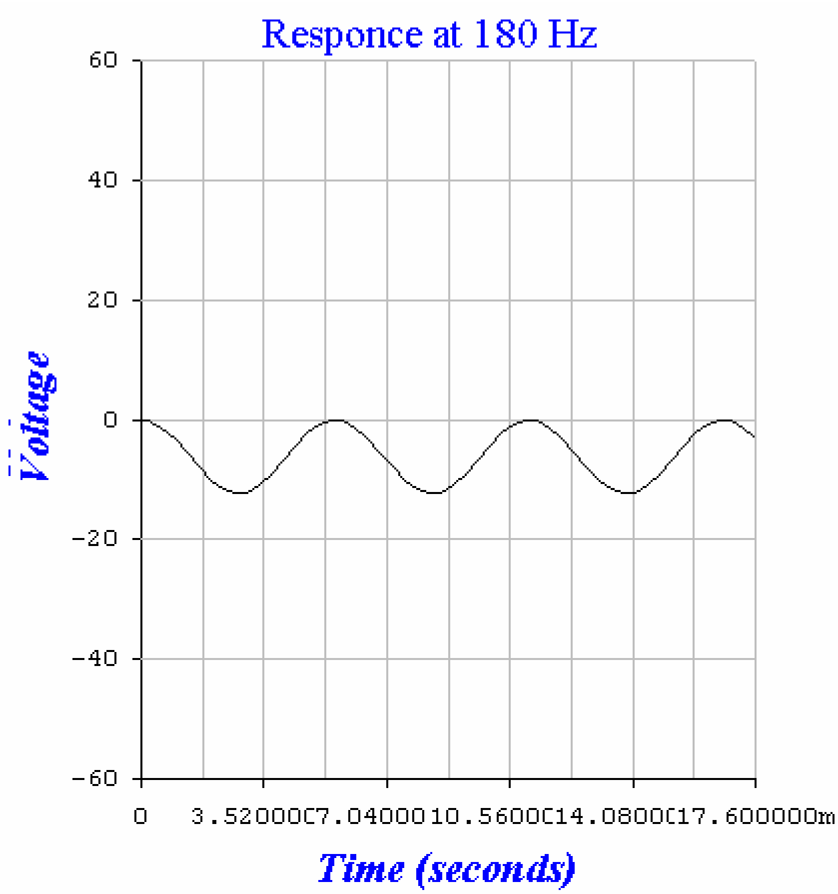

Gain (dB)
0
-40
-80
-120
-160
-200
1m 10m
1
100
10K
1M
10C1000M
Phase (deg)
720
432
144
-144
-432
-720
1m 10m
1
100
10K
1M
10C1000M
Frequency (Hz)

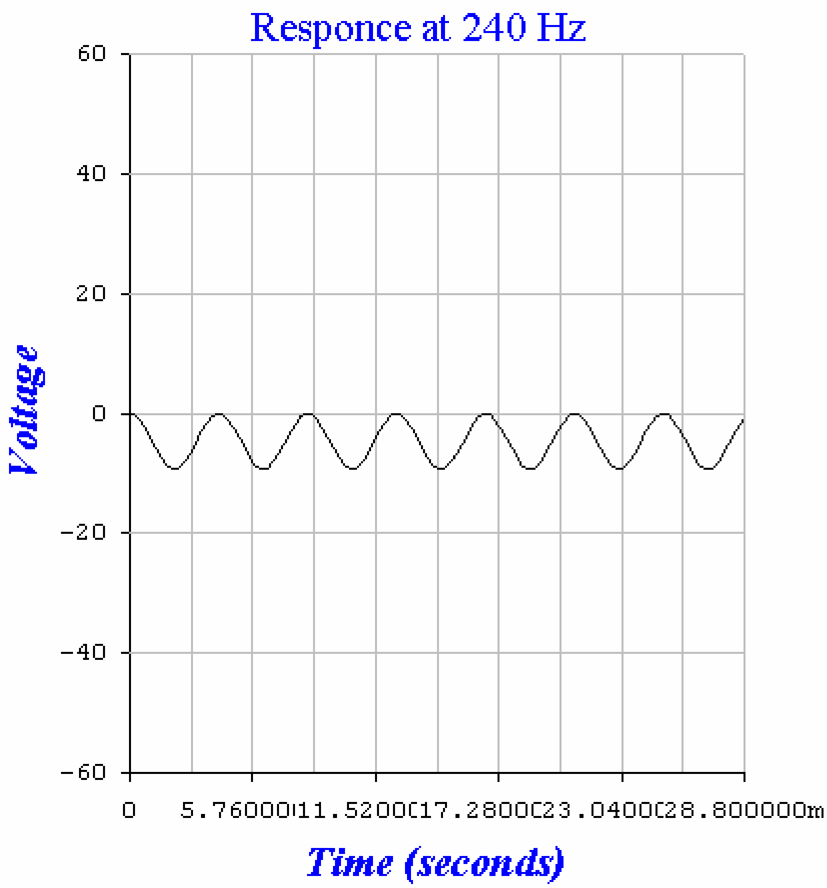

Responce at 20 Hz
60
40
Responce at 80 Hz
60
40
20
0
-20
-40
-60
Voltage
0
13.7600C27.5200C41.2800C55.0400C68.800000m
Time (seconds)

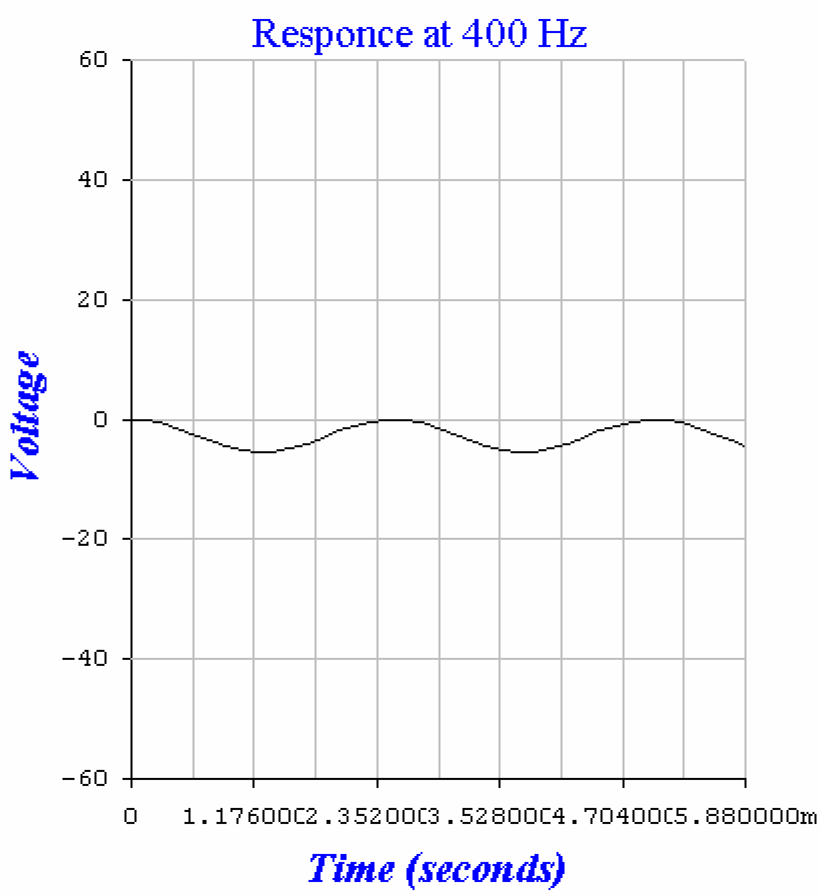

Responce at 120 Hz
60
40
20
0
-20
-40
-60
Voltage
0 8.22816.45724.68532.91441.14249.37157.600000m
Time (seconds)

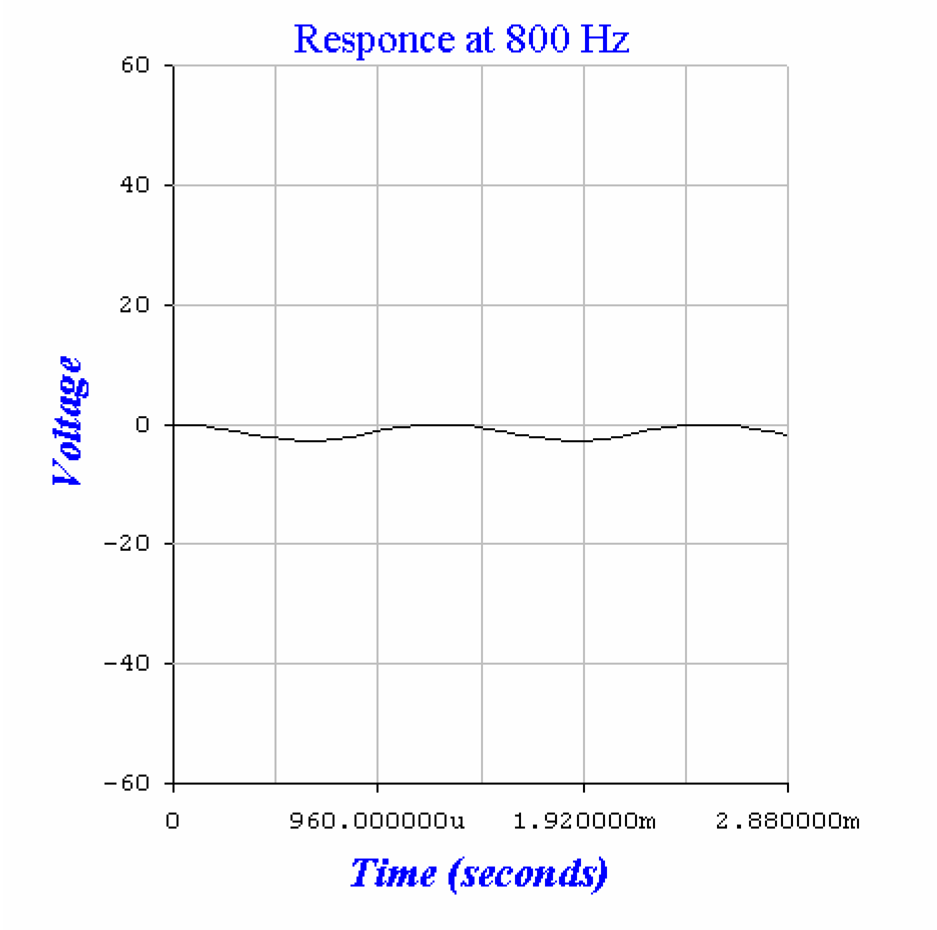

Responce at 140 Hz
60
40
20
0
-20
-40
-60
Voltage
0 8.22816.45724.68532.91441.14249.37157.600000m
Time (seconds)


Responce at 160 Hz
60
40
20
0
-20
-40
-60
Voltage
0
5.52000011.040000016.560000022.080000027.600000m
Time (seconds)


Responce at 180 Hz
60
40
20
0
-20
-40
-60
Voltage
0
3.5200007.04000010.56000014.08000017.600000m
Time (seconds)


Responce at 240 Hz
Voltage
Time (seconds)
60
40
20
0
-20
-40
-60
0
5.76000
11.5200
17.2800
23.0400
28.800000m


Responce at 400 Hz
Voltage
Time (seconds)
60
40
20
0
-20
-40
-60
0
1.17600
2.35200
3.52800
4.70400
5.880000m



RESULT:

We observed that as the frequency of the signal increased the magnitude started decreasing after cutoff frequency.

EXPERIMENT # 3

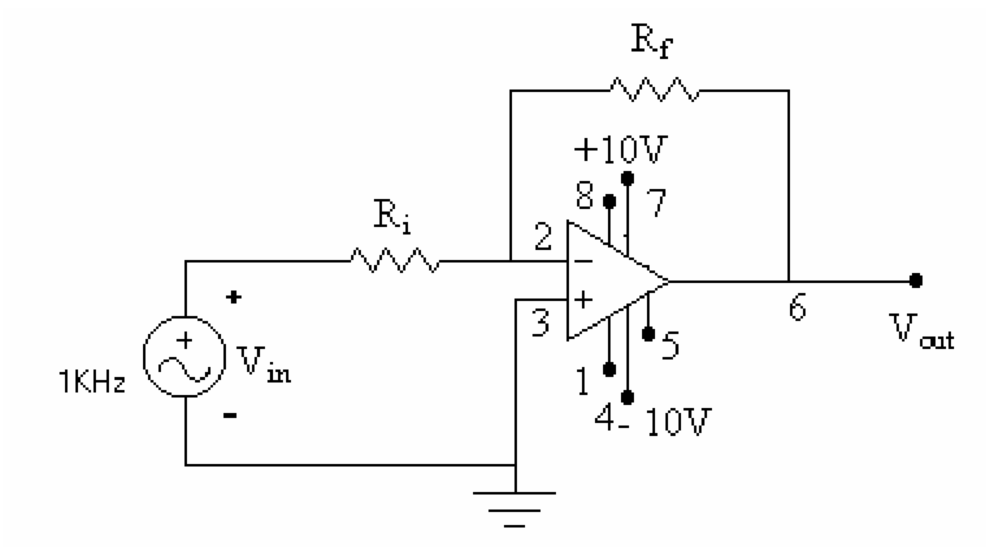
OBJECT:

To study an op-amp in inverting mode

APPARATUS:

1. Dual power supply.
2. Oscilloscope.
3. Function generator.
4. Op – Amp 741 circuit kit board.

CIRCUIT DIAGRAM:



PROCEDURE:

1) Connect the circuit as shown in figure.
2) Set power supply to ±10V.
3) Set the function generator at 1 KHz (sine wave).
4) Connect the oscilloscope to the output of the Op-Amp.
5) Measure and record the peak-to-peak output signal of voltage V_o and the input signal V_{in} to the amplifier and record the phase of the output.
6) Calculate the gain of the amplifier i.e. $A_v = V_{out}/V_{in}$.
7) Check the output voltage is __________ i.e. $V_o = (-R_f/R_i)V_{in}$.

OBSERVATIONS:

1. R_i = ________ Ω.
2. R_f = ________ Ω.
3. $V_{in(p-p)}$ = ________ V.
4. $V_{out(p-p)}$ = ________ V.
5. Ǿ of V_{in} = __________ .
6. Ǿ of V_{out} = __________ .

CALCULATION:

RESULT:

EXPERIMENT # 4

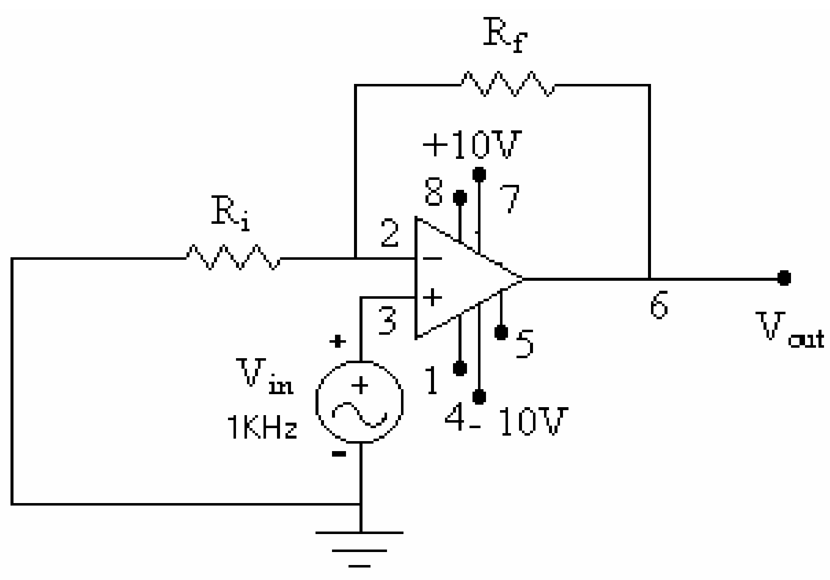
OBJECT:

To study an op-amp in non-inverting mode

APPARATUS:

5. Dual power supply.
6. Oscilloscope.
7. Function generator.
8. Op – Amp 741 circuit kit board.

CIRCUIT DIAGRAM:



PROCEDURE:

1) Connect the circuit as shown in figure.
2) Set power supply to $\pm$10V.
3) Set the function generator at 1 KHz and sine wave and connect the +ve terminal to pin #3 and –ve terminal to ground.
4) Connect the oscilloscope to the output of the Op-Amp and supply power to the circuit.
5) Repeat steps (as for inverting amplifier) for non-inverting amplifier.
6) Calculate the gain of the amplifier.

OBSERVATIONS:

1. R_i = ________ Ω.
2. R_f = ________ Ω.
3. $V_{in(p-p)}$ = ________ V.
4. $V_{out(p-p)}$ = ________ V.
5. Ǿ of V_{in} = _________.
6. Ǿ of V_{out} = _________.

CALCULATION:

Gain $A_v = V_{out}/V_{in}$

RESULT:

EXPERIMENT # 5

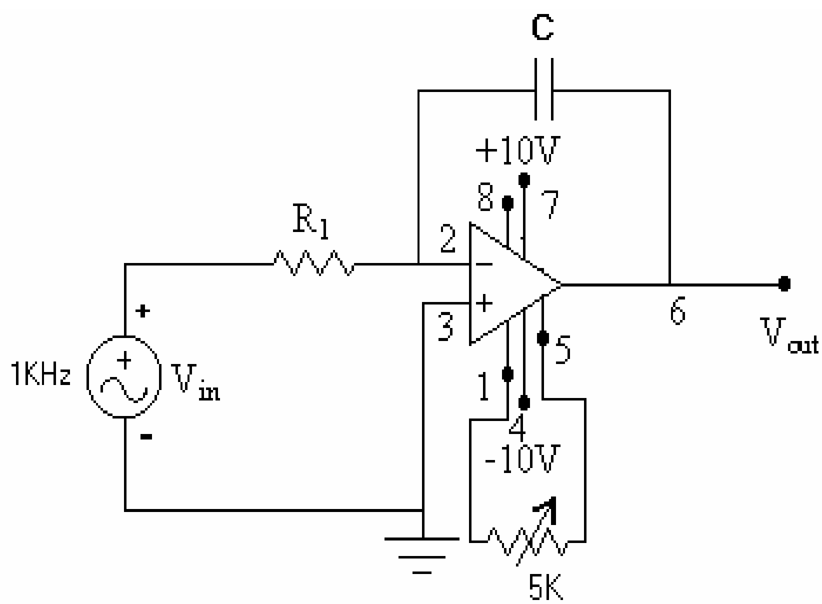
OBJECT:

To study an op-amp as an integrator.

APPARATUS:

9. Dual power supply.
10. Oscilloscope.
11. Function generator.
12. Op – Amp 741 circuit kit board.

CIRCUIT DIAGRAM:



PROCEDURE:

1) Modify the circuit as an integrator.
2) Connect the feedback capacitor between the inverting terminal and output terminal of Op-Amp and connect the resistor R across inverting and output.
3) Supply power $\pm$10V across pins 7 and 4 of Op-Amp.
4) Set the function generator at 1 KHz and 0.2 V_{p-p} square wave and apply phase signal terminal R_1 and ground.

5) Record the output of the integrator.

OBSERVATION:

1. R_1 = ________ Ω.
2. C = ________ F.
3. $V_{in(p-p)}$ = ________ V.
4. $V_{out(p-p)}$ = ________ V.

CALCULATION:

$$V_o(t) = -1/(RC) \int_0^t V_i(t)\, dt + V_o$$

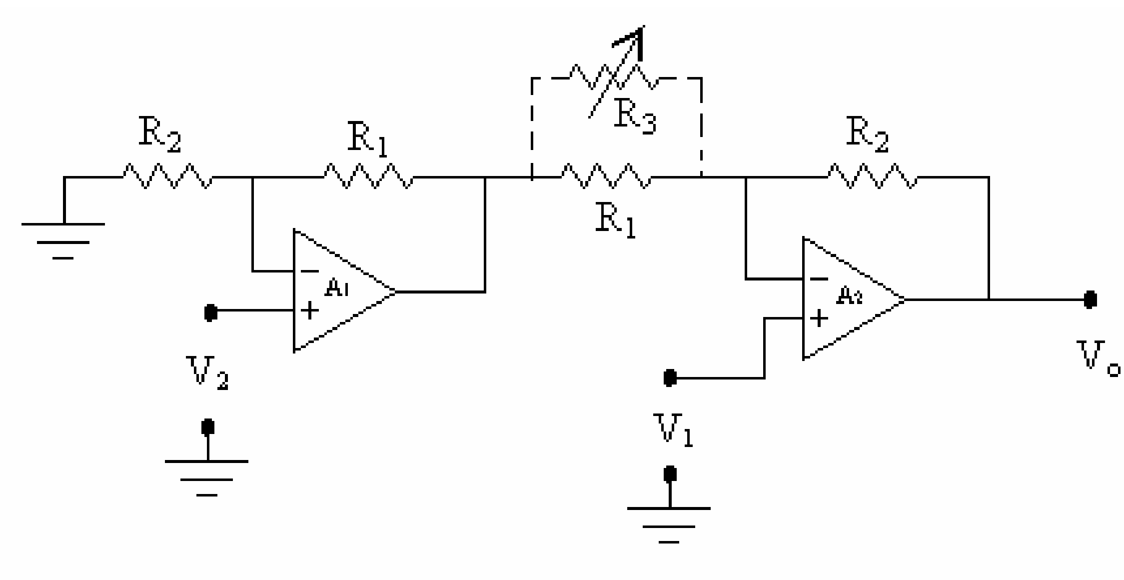
RESULT:

EXPERIMENT #06

Object:

To study a high input impedance differential input circuit using two Op-Amps.

Circuit Diagram:



Formulae:

1. $Vo = [1 + R_2/R_1]\ [V_1 - V_2]$
2. With R_3 in circuit

   $Vo = [1 + R_2/R_1 + 2\ R_2/R_3]\ [V_1 - V_2]$

<u>Observatioons And Calaulations</u>:

EXPERIMRNT # 7

OBJECT:

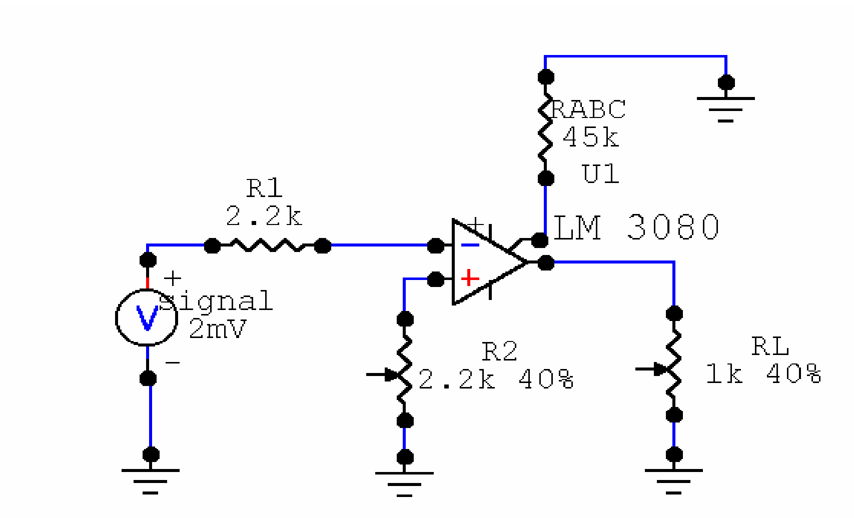
To study the basic OTA configuration i.e. Inverting configuration

THEORY:

OTA may also be described as being a voltage to current converter or voltage controlled current source (VCIS).

A conventional Op-APM can be used as a transmission conductance amplifier for this purpose monolithic IC is specially designed. Such devices are called OTAs

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in fig and set power supply to $\pm$15 volts
2. Set the signal generator at sine wave to 1KHz
3. Connect oscilloscope to the output of op-amp
4. Measure and record the peak to peak output signal voltage Vo and input signal Vin to amplifier and record the phase of input with the phase of output.

RESULT:

The OTA was studied in inverting configuration and it different parameters were observed on oscilloscope.

EXPERIMENT # 8

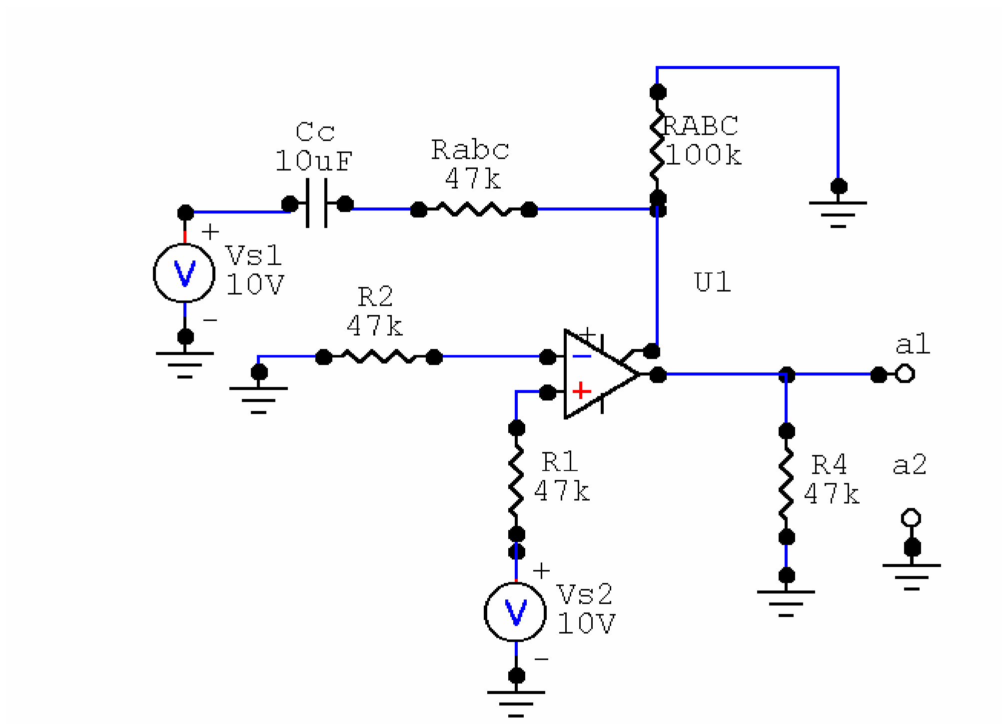
OBJECT:

To study an OTA used as an AM modulator.

APPARATUS:

i) OTA kit
ii) LM 3080
iii) Resistors(47k,100k) 0hm
iv) Capacitors(10uF)
v) Function generator
vi) Oscilloscope

CIRCUIT DIAGRAM:



FORMULA:

- Vc= vc sin$w$ct
- Vc= 20sin2π 5000t

- $Vm = Vm \sin w_m t$
- $Vm = 2 \sin 2\pi 500t$
- $Vo = \frac{Rl * gm_q\, Vc \sin wct + KRlVcVmCos(Wc-Wm)t - KRlVcVmCos(Wc+Wm)t}{2Rabc}$

Modulation index:

m= Vsf/Voc

Vsf= peak amplitude of either side frequency.
Voc= peak amplitude of output frequency component.

OBSERVATION:

Sketch the frequency domain representation for o/p signal and determine the modulating index.

CALCULATION:

RESULT: