DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING
LAB MANUAL
Analog Circuits Lab
II - B. Tech. II - Semester

PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(Autonomous, Accredited by NBA & NAAC, an ISO 9001:2008 certified institution)

(Sponsored by Siddhartha Academy of General & Technical Education)

VIJAYAWADA – 520 007,

ANDHRA PRADESH

Analog Circuits Lab
MANUAL

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PRASAD V POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
ANALOG CIRCUITS LAB

Course Code	20EC3451	**Year**	II	**Semester**	II
Course Category	Program Core	**Branch**	ECE	**Course Type**	Lab
Credits	1.5	**L-T-P**	0-0-3	**Prerequisites**	EDAC
Continuous Internal Evaluation	15	**Semester End Evaluation**	35	**Total Marks**	50

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Analyze** the feedback amplifiers using FET (L4)
CO2	**Evaluate** the performance of Power Amplifiers using BJT(L5)
CO3	**Design** the various applications using Op-amp (L6)
CO4	**Design** the various applications using IC 555 Timer (L6)
CO5	Make an effective report based on experiments.

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)

Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation

* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1			3				3				3	
CO2				2	3				3				3	
CO3			3		3				3				3	
CO4			2		3				3				3	
CO5										3				
Average* (Rounded to nearest integer)		1	3	2	3				3	3			3	

LIST OF EXPERIMENTS

Syllabus		
Expt. No.	**Contents**	**Mapped CO**
I	Calculation of gain, input resistance, output resistance of a feedback amplifier with and without feedback using FET	**CO1,CO5**
II	Design and verify an RC phase-shift oscillator for a given frequency using Op-Amp	**CO3,CO5**
III	Design and verify a Wein-bridge Oscillator for a given frequency using Op-Amp	**CO3,CO5**
IV	Design and verify a Colpitt's Oscillator for a given frequency using Op- Amp	**CO3,CO5**
V	Evaluate the Conversion efficiency of a Class A power amplifier using BJT	**CO2,CO5**
VI	Evaluate the Conversion efficiency of Class B Push - pull power amplifier using BJT	**CO2,CO5**
VII	Design and Simulate the RC differentiator using Op-Amp	**CO3,CO5**
VIII	Design and Simulate the RC integrator using Op-Amp	**CO3,CO5**
IX	Design and verify Adder and Subtractor circuits using Operational Amplifier	**CO3,CO5**
X	Design and verify an Astable multivibrator using 555 timer	**CO4,CO5**
XI	Design and verify Monstable multivibrator using 741Op-Amp	**CO3,CO5**
XII	Design and verify Monstable multivibrator using 555 timer	**CO4,CO5**
XIII	Design and verify an Astable multivibrator using 741 Op-Amp	**CO3,CO5**
XIV	Design and verify LPF and HPF using Op-Amp	**CO3,CO5**
XV	Design and verify a 4 bit DAC using OP-Amp	**CO3,CO5**

Learning Resources

Text Books

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e,Oxford University Press, 2013.
2. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003
3. Ramakanth Gayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education,2007

Reference Books

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6/e, Pearson, 2008.
3. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3/e,Tata Mc-Graw Hill, 2002.

INSTRUCTIONS TO THE STUDENTS

1. Students are required to attend all labs.

2. Students have to bring the lab manual cum observation book, record etc. along with them whenever they come for lab work.

3. Should learn the prelab questions. Read through the lab experiment to familiarize themselves with the components and assembly sequence.

4. Should utilize 3 hours' time properly to perform the experiment and to record the readings. Do the calculations, and take signature from the instructor.

5. If the experiment is not completed in the stipulated time, the pending work has to be carried out in the leisure hours or extended hours.

6. Should submit the completed record book according to the deadlines set up by the instructor.

7. For practical subjects there shall be a continuous evaluation during the semester for 15 internal marks and 35 end examination marks.

8. Out of 15 internal marks, 10 marks shall be awarded for day-to-day work and 5 marks to be awarded by conducting an internal laboratory test.

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EXPERIMENT NO: 1

FET AMPLIFIER WITH AND WITHOUT FEEDBACK

AIM:

To obtain gain, input resistance, output resistance of a feedback amplifier with and without feedback using FET.

Experimental Requirements:

1.MOSFET -2N7000
2.Resistors
3.Capacitors
4.Regulated Power Supply
5.CRO

Circuit Diagram:

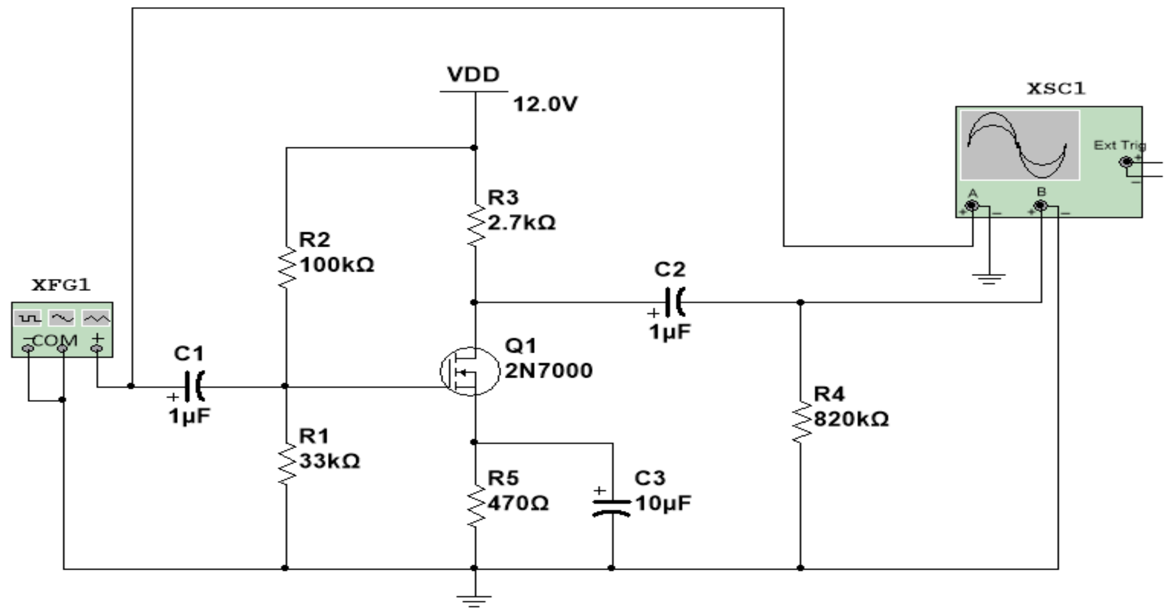

Fig.1 Circuit Diagram of MOSFET amplifier

Design:

Assume V_{DD}=12V, V_{RD}=5v, V_{DS}=6V, I_D=2Mamp

$$R_D = \frac{V_{RD}}{I_D} = \frac{5}{2\times10\times10^{-3}} = 2.5k\Omega\text{, Use 2.7k}\Omega\text{ resistor}$$

Now the voltage across the source side resistance V_{RS}= V_{DD} - V_{DS} - V_{RD}= 12-6-5=1V

As, I_S=I_D (No current flows through the gate)

$$R_S = \frac{V_{RS}}{I_D} = \frac{1}{2\times10\times10^{-3}} = 500\Omega,$$ Use 470Ω resistor

Voltage- divider bias circuit design:

Assume R_1=100kΩ.   By, Voltage Division rule,R_2 can be obtained as,

$$V_G = V_{DD} \times \frac{R_2}{R_1 + R_2}$$

Selecting the value of V_G as 4V

$$4 = 12 \times \frac{R_2}{100 \times 10 \times 10^3 + R_2}$$

$$R_2 \sim\sim 47k\Omega$$

Design of capacitors:

Assume impedance of coupling capacitor be $X_{C1} \ll 1.5k\Omega$

Therefore, $\frac{1}{2\pi f C_1} \leq 1.5k\Omega$

i.e., $\frac{1 \quad 1}{2\pi f C1 2\pi f C1}$≤ 1.5kΩ

Given, the frequency of the input signal is 100Hz.

C_1=1.06μf. Use 1μf capacitor

Let C_1=C_2=1μf

For the bypass capacitor, $X_{cs} = \frac{1}{2\pi f C_s} \leq 150\Omega$

C_S= 10μf

<u>**Procedure**</u>:

1. Set up the circuit as shown in the figure.
2. Apply an input signal of 0.2V (peak-to-peak) at 1000 Hz.
3. Observe the output on the CRO.
4. Vary the frequency of the input signal over a range of values (from 50Hz to a few MHz).
5. Obtain the frequency response which is a graph between frequency (x- axis) and gain in dB (y-axis).

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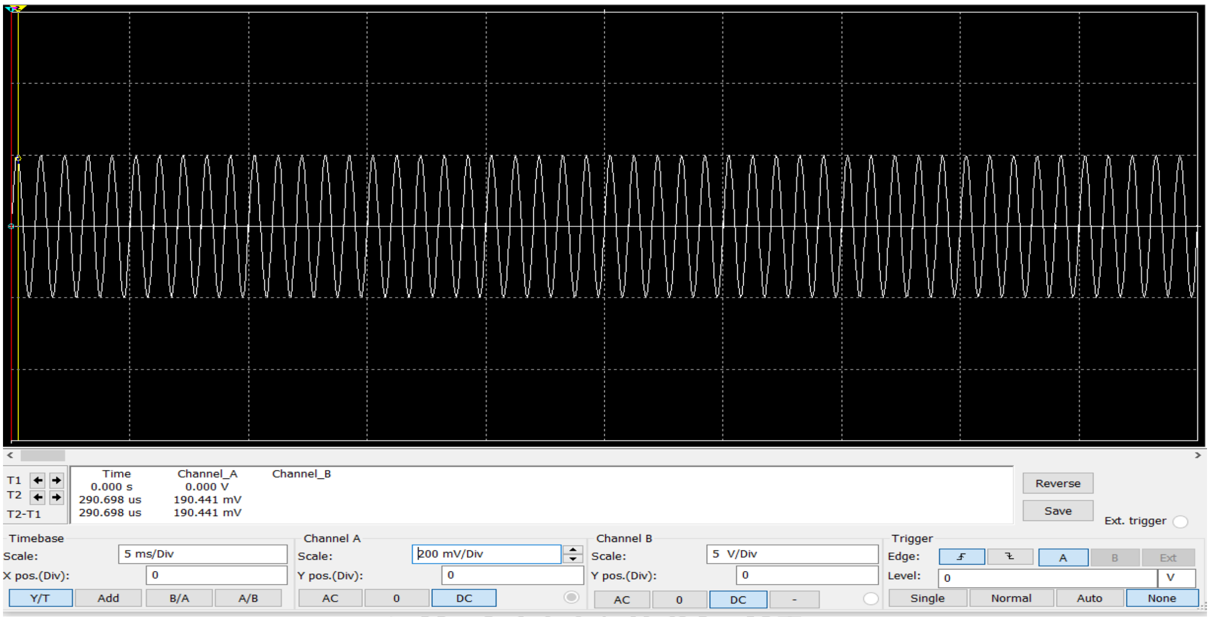
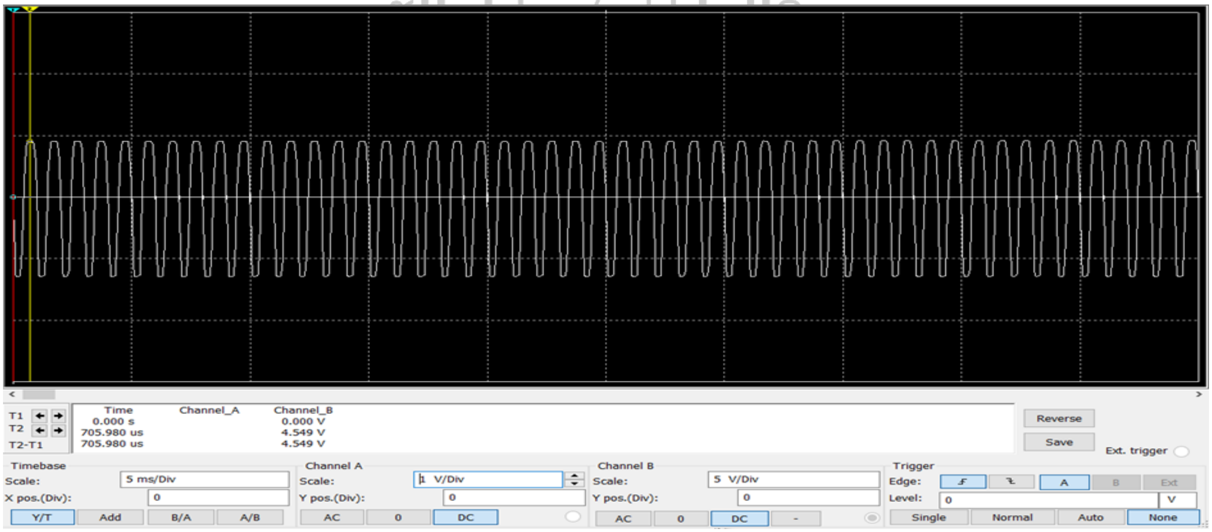
Model Waveforms:

Input:



Output:



Observations:

With Feedback

Frequency(Hz)	Output Voltage V_O	Gain=$\frac{V_0}{V_i}$	Gain in dB 20log($\frac{V_0}{V_i}$)

Without Feedback

Frequency(Hz)	Output Voltage V_O	Gain=$\frac{V_0}{V_i}$	Gain in dB 20log($\frac{V_0}{V_i}$)

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Precautions:

1. Avoid loose connections
2. Don't switch on power supply while making connections
3. Handle components carefully

Result:

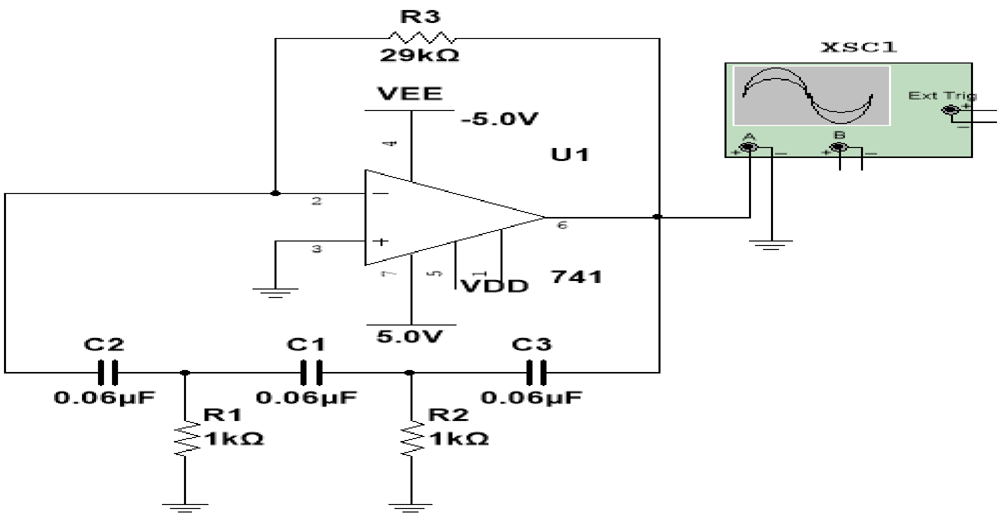
EXPERIMENT NO: 2

RC PHASE SHIFT OSCILLATOR

AIM:
To design an RC Phase Shift oscillator using op-amp for a given frequency

Experimental Requirements: Op-amp-741C
Resistors
Capacitors
Fixed Power Supply -12V- 0-+12V
CRO

Circuit Diagram:



Design:

The gain of feedback network is $\beta = \frac{1}{29}$.

To meet the greater than unity loop gain requirement, the closed loop voltage gain of op-amp must be greater than 29. That is $-(\frac{R_F}{R_1}) \geq 29$

$R_F \geq 29\ R_1$

Assume R_1, find out R_F

The frequency of output $f_0 = \frac{1}{2\pi RC\sqrt{6}}$

For a given frequency, assume C, find out value of 'R'

Procedure:

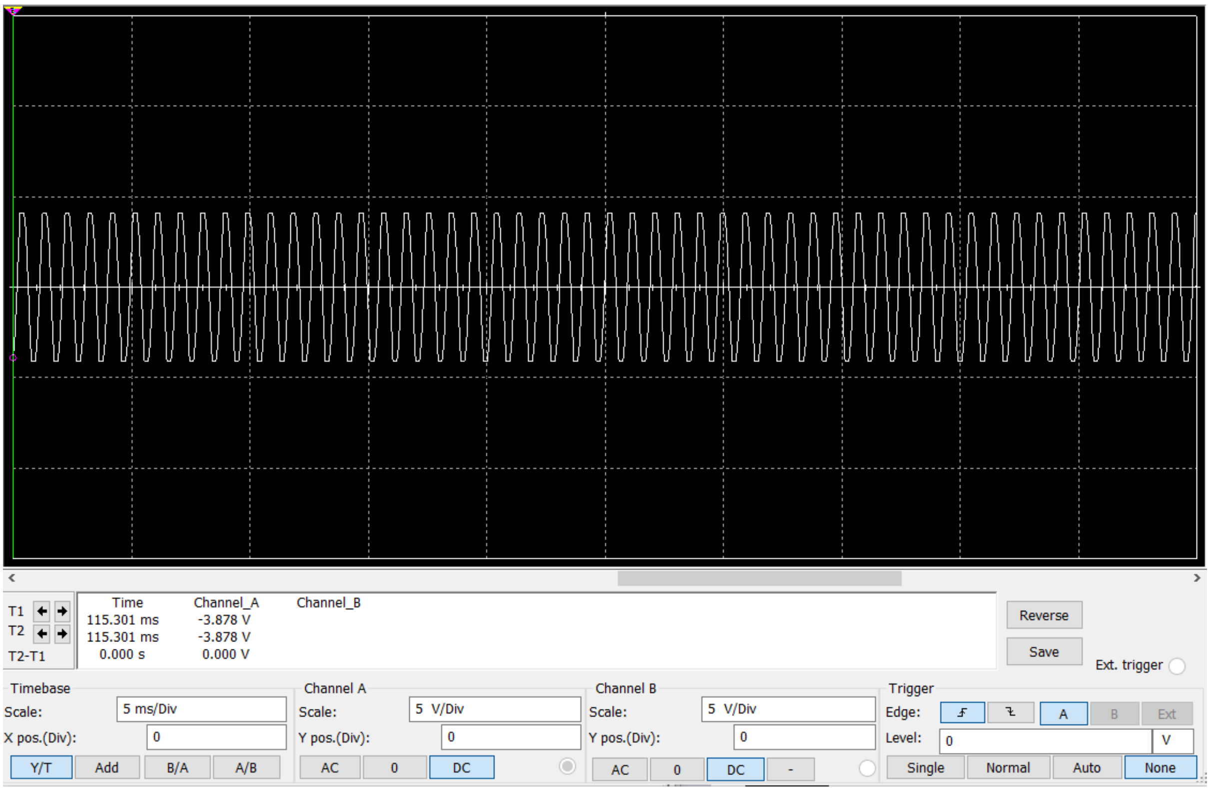
1. On a bread board set up the circuit as shown in the figure.

2. Obtain the sine wave in CRO.

3. Note down time period of sine wave & calculate its frequency

4. Compare theoretical and practical frequencies

Wave Forms:



Precautions:

1. Avoid loose connections

2. Do not switch on power supply while making connections

3. Handle components and apparatus carefully

Result:

EXPERIMENT NO: 3

WEIN BRIDGE OSCILLATOR

AIM:

To design Wein Bridge oscillator using op-amp for a given frequency.

Experimental Requirements:

1. Op-amp-741C

2.Resistors

3.Capacitors

4.Fixed Power Supply -12V- 0-+12V

5.CRO

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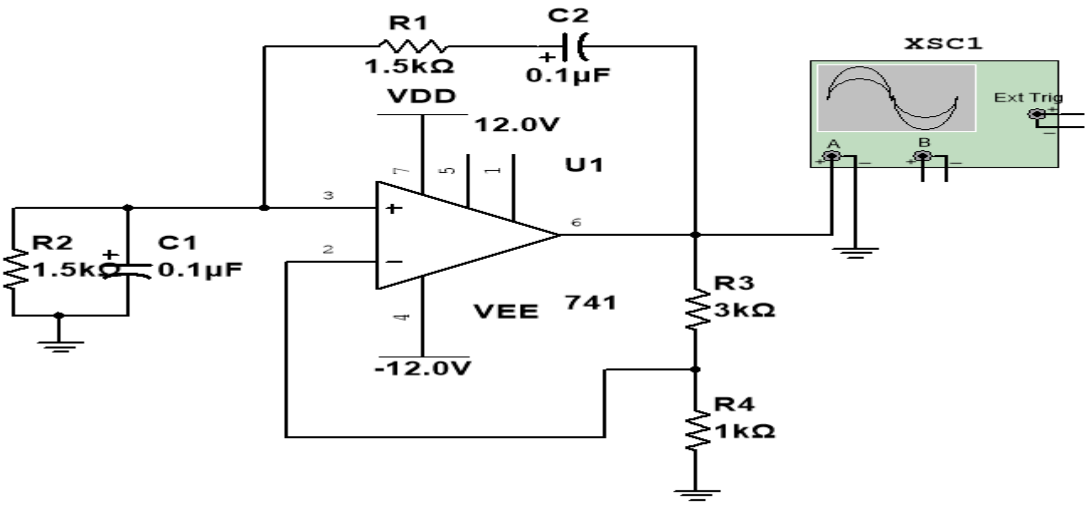
Circuit Diagram:



Design:

The gain of feedback network is $\beta = 1/3$.

To meet the greater than unity loop gain requirement, the closed loop voltage gain of op-amp must be greater than 3. That is $1 + (R_F/R_1) >= 3$

$$R_F \geq 2 R_1$$

Assume R_1, find out R_F

The frequency of output $f_0 = \frac{1}{2\pi RC}$ For a given frequency, assume C, find out value of 'R'

Procedure:

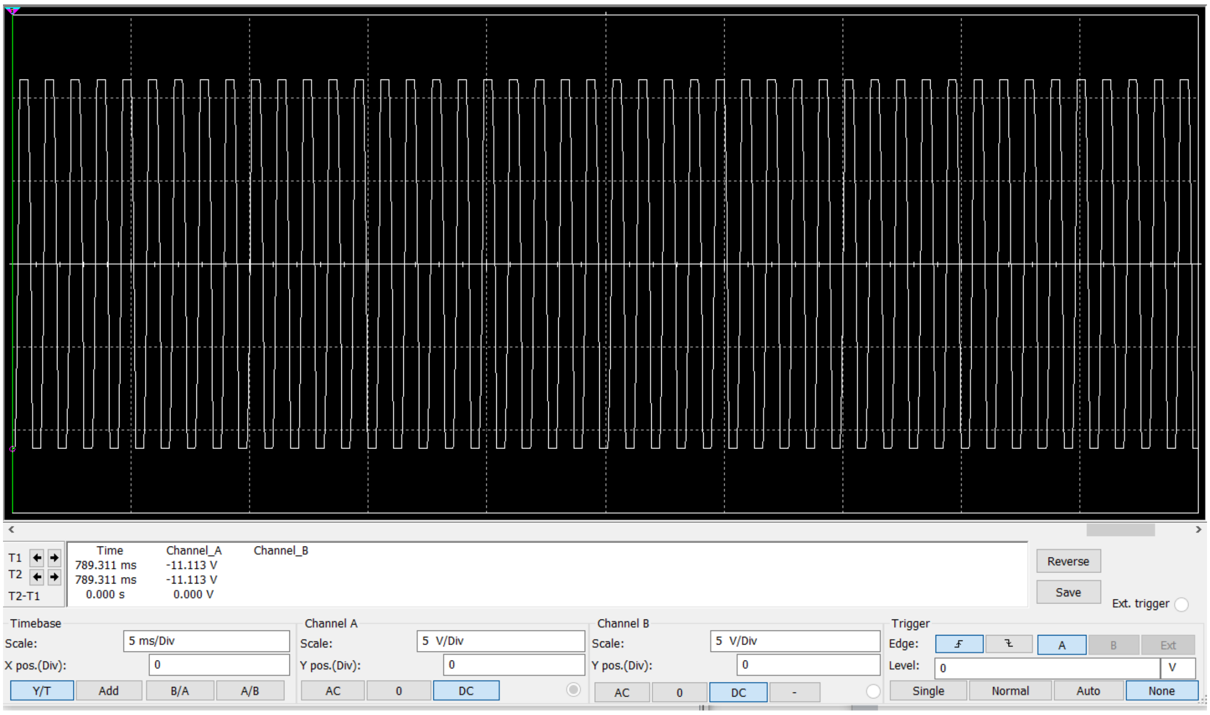
1.On a bread board, set up the circuit as shown in the figure.

2.Obtain the sine wave in CRO

3.Note down time period of sine wave & calculate its frequency

4. Compare theoretical and practical frequencies

Wave forms:



Precautions:

1. Avoid loose connections
2. Do not switch on power supply while making connections
3. Handle components and apparatus carefully

Result:

EXPERIMENT NO: 4

STUDY OF COLPITTS OSCILLATOR

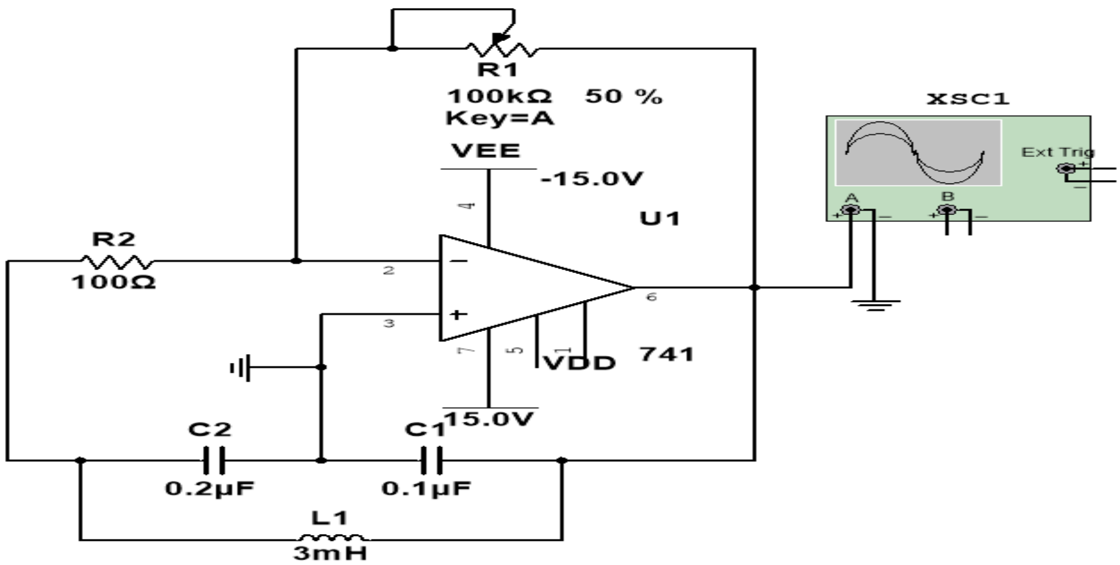
AIM:

To design and setup a colpitts oscillator using Op-amp and to observe the sinusoidal output waveform.

Experimental Requirements:

1. Power- supply
2. Oscilloscope
3. Operational amplifier (µA741)
4. Decade capacitor
5. Decade inductor
6. 100 ohm resistor
7. Potentiometer of 100kohm

Circuit Diagram:



Design Procedure:

$f_0 = \frac{1}{2\pi\sqrt{LC}}$ Assume C, find out the value of L

Procedure:

1. Connect the circuit shown in Fig, with L=3mH, Cl=C2=2μF. Draw the output & measure (f_o).
2. For C1=C2=2μf, vary (L) from (3 to 9)mH. Then measure output frequency in each case.
3. For L=3mH, C2=2μF, vary Cl from (2μF to 8μF). Then measure output frequency in each case.
4. For L=3mH, C1=2μF, vary C2 from (2uF to 8μF). Then measure output frequency in each case.

Waveform:

Precautions:

1. Avoid loose connections

2. Do not switch on power supply while making connections

3. Handle components and apparatus carefully

Result:

EXPERIMENT NO: 5

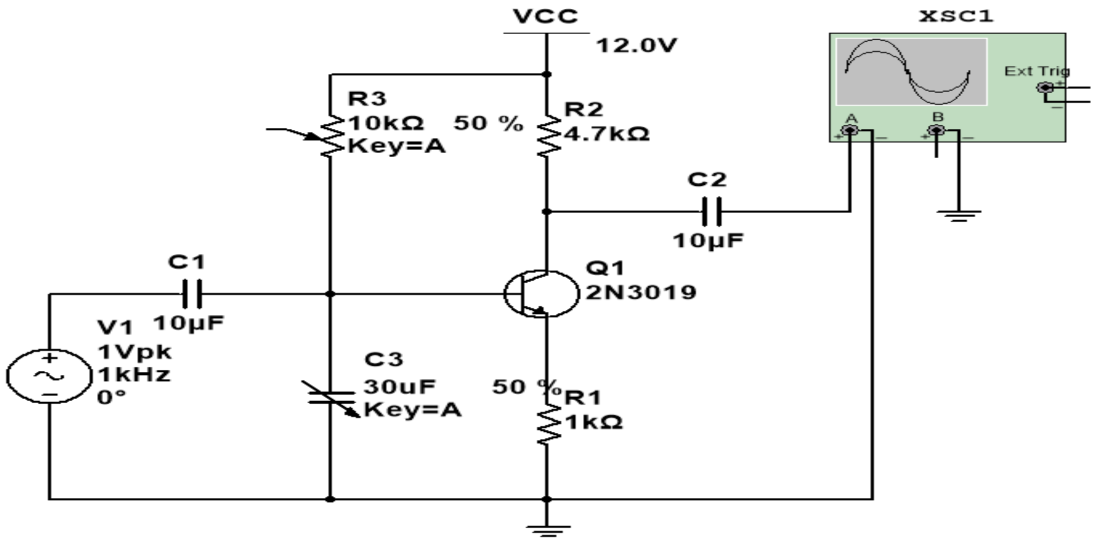
CLASS A POWER AMPLIFIER USING BJT

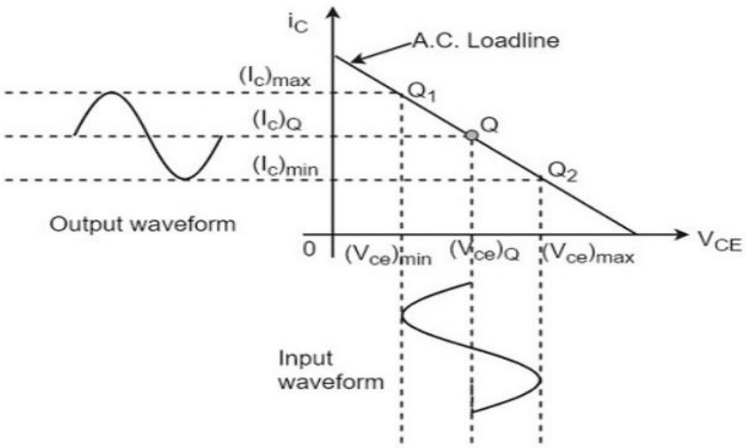
AIM:

To construct and find the Gain of the class A power amplifier using BJT.

Experimental Requirements: PC loaded with Multisim

Circuit Diagram:





Design:

$$\eta = \frac{output\ power}{input\ power} \times 100 = \frac{P_{out}}{P_{in}} \times 100$$

$$\eta = \frac{P_{ac}}{P_{dc}} \times 100$$

$$\eta = \frac{V_m I_m}{2V_{CC} I_C} \times 100$$

We know that $$I_m \cong I_C$$

$$V_m = \frac{V_{max} - V_{min}}{2} \cong V_{CEQ} \cong \frac{V_{cc}}{2}$$

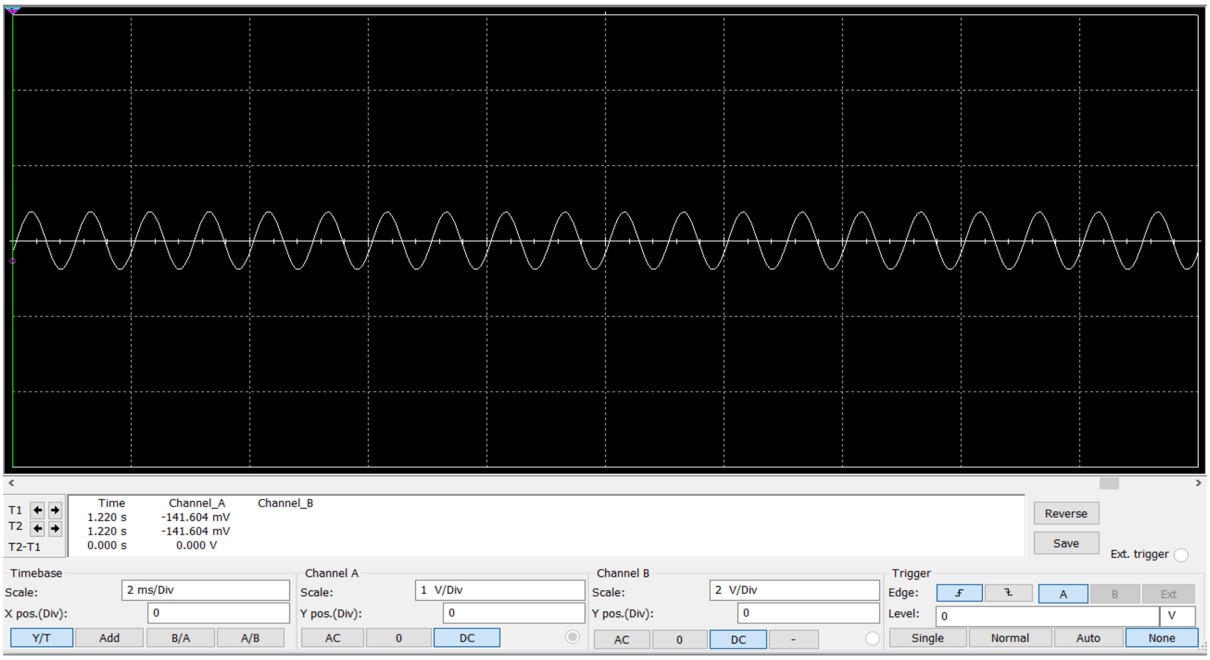
<u>Procedure:</u>

1. Open the Multisim software in the system.

2. Build the circuit as shown in the diagram.

3. Calculate the efficiency of the Class A power amplifier.

<u>Waveform:</u>



<u>Precautions:</u>

Design the circuit without any disconnections

<u>Result:</u>

EXPERIMENT NO: 6

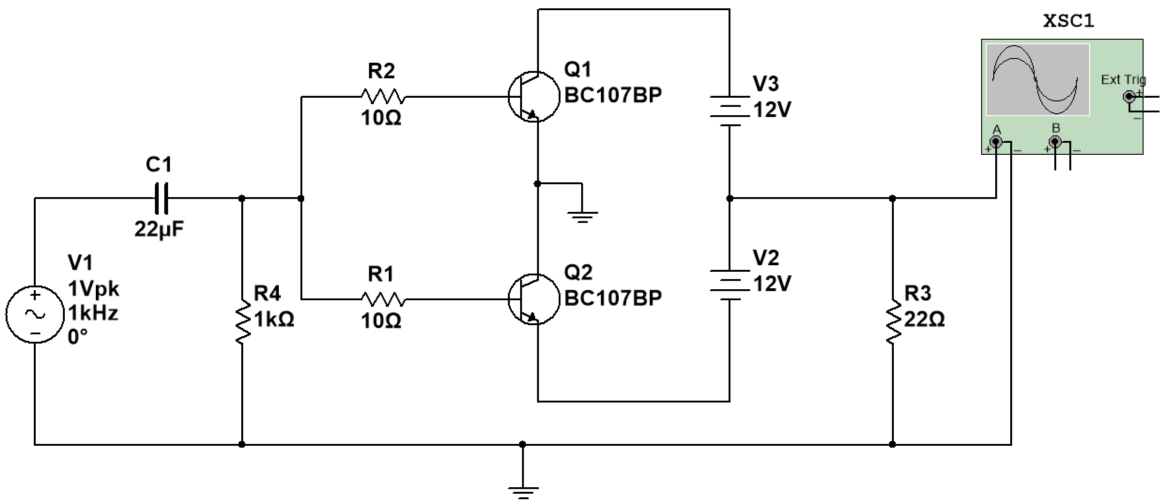
CLASS B COMPLIMENTARY SYMMETRY AMPLIFIER

AIM:

To find the efficiency of a complimentary symmetry class B power amplifier.

Experimental Requirements: PC loaded with Multisim.

Circuit Diagram:



Design:

$$I_{CQ} = \frac{V_{cc}}{2\pi R_L}$$

$$P_{in}(dc) = \frac{V_{CC}^2}{2\pi R_L}$$

$$P_{out}(ac) = \frac{(V_{max} - V_{min}) \times (I_{max} - I_{min})}{8}$$

$$(I_{max} - I_{min}) = \frac{V_{cc}}{R_L}$$

$$(V_{max} - V_{min}) = V_{cc}$$

$$P_{out}(ac) = \frac{V_{CC}^2}{8R_L}$$

$$\%\eta = \frac{P_{out}(ac)}{P_{in}(dc)} \times 100 = \frac{\pi}{4} \times 1 = \frac{\pi}{4}$$

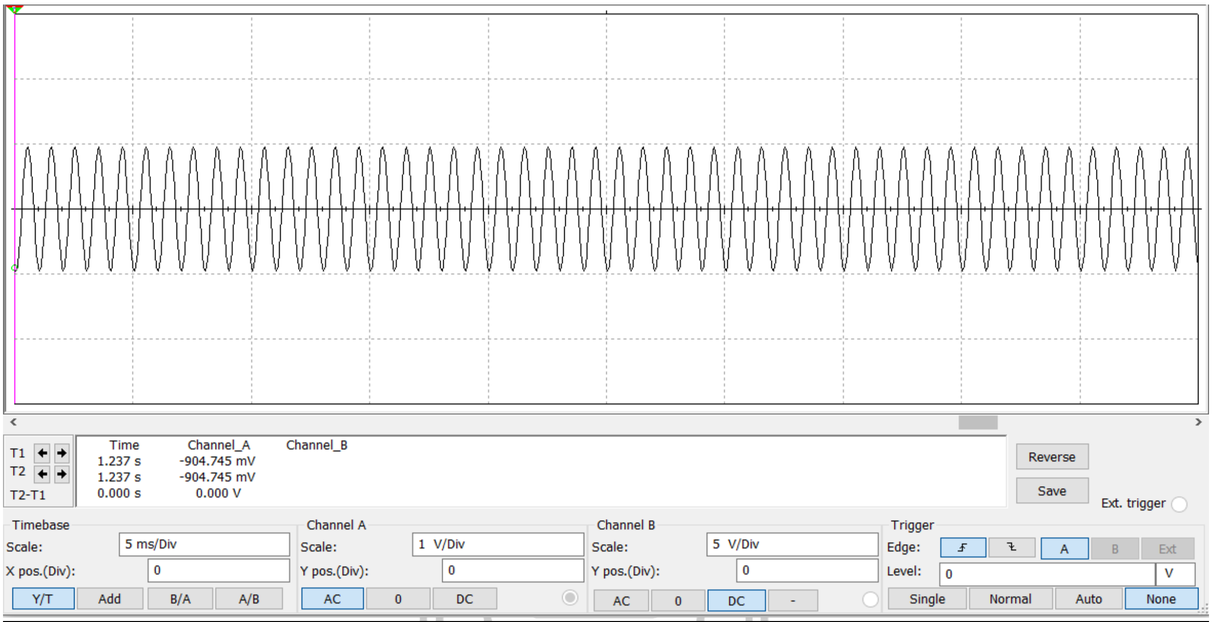
Procedure:

1. Open the Multisim software in the system.

2. Build the circuit as shown in the diagram.

3. Calculate the efficiency of the Class A power amplifier.

Waveform:



Precautions:

Design the circuit without any disconnections

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Result:

EXPERIMENT NO: 7

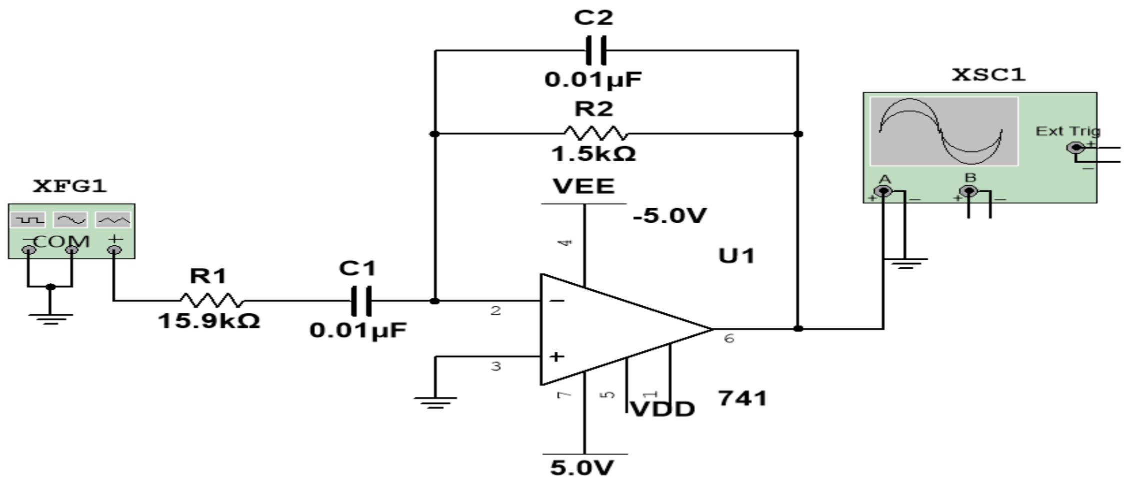
RC DIFFERENTIATOR USING OP AMP

AIM:

To Design and Simulate the RC differentiator using Op-Amp

Experimental Requirements: PC loaded with multisim software

Circuit Diagram:



Design Procedure:

Given f_a = 1KH$_z$ and f_b=10 KH$_z$

So t = 1/f =1ms

Design equation $T=1/2\pi R_1C_1$
Let C_1=0.01 µF then R_1=15.9kΩ

For f_a =10 f_b

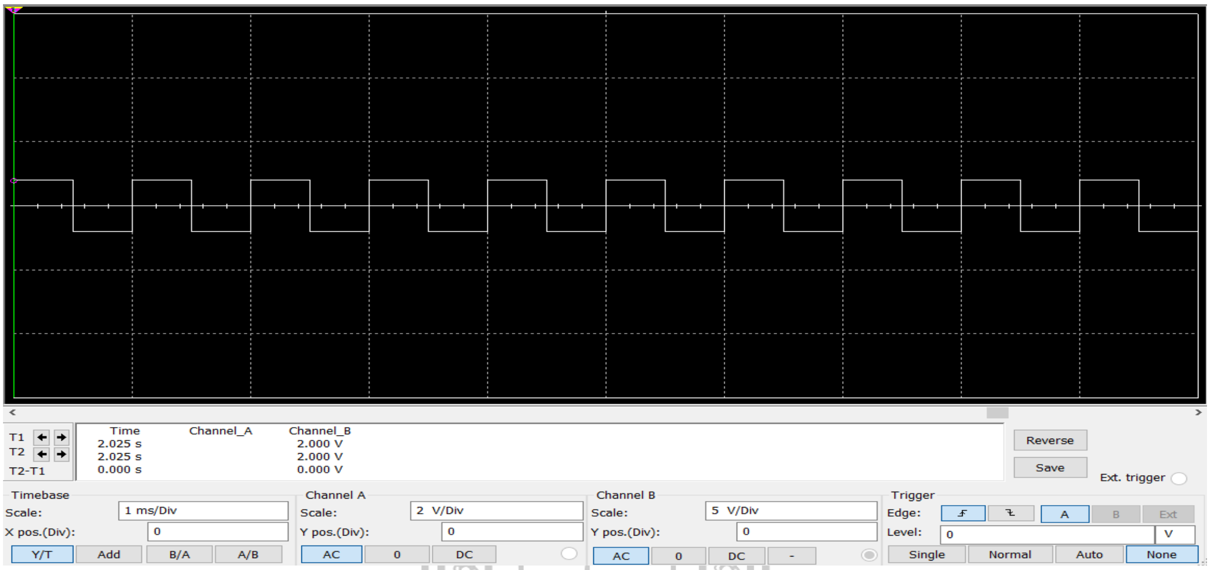
Take $R_f=10R_i$=1.5kΩ and C_f=0.01 µF

Procedure:

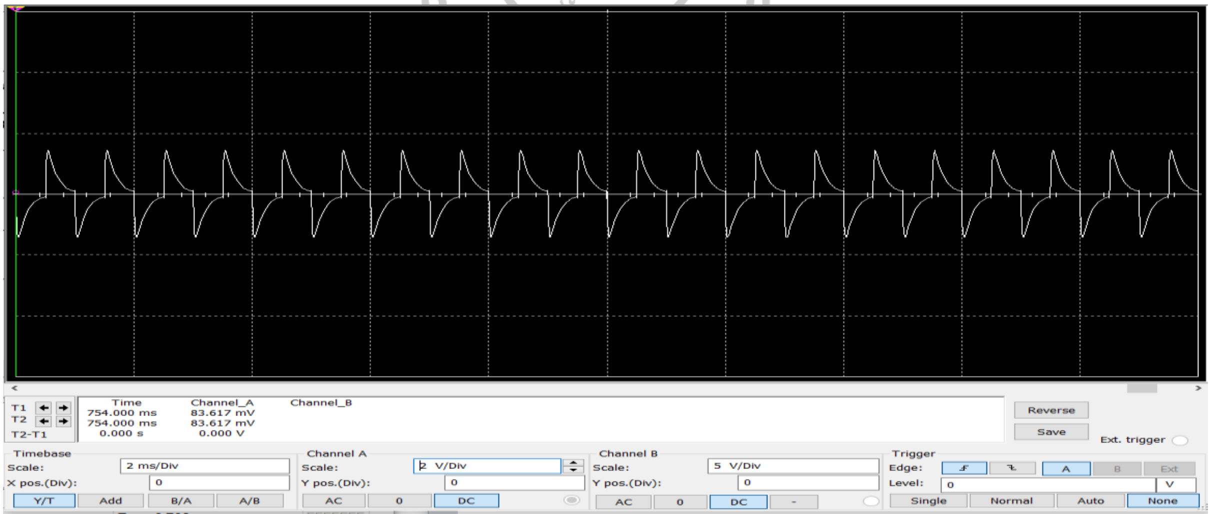
1. Switch on pc
2. Open multisim software
3. Setup the circuit on and check the connections.
4. Give Vi= $2V_{pp}$, 1KHz square wave.
5. Keep the oscilloscope in AC coupling mode.
6. Observe input and output on two channels of the oscilloscope simultaneously.
7. Draw the input and output waveforms on the graph

Waveforms:

Input:



Output:



Precautions:

1. Check your connections before observing graph
2. Handle your pc carefully

Result:

EXPERIMENT NO: 8

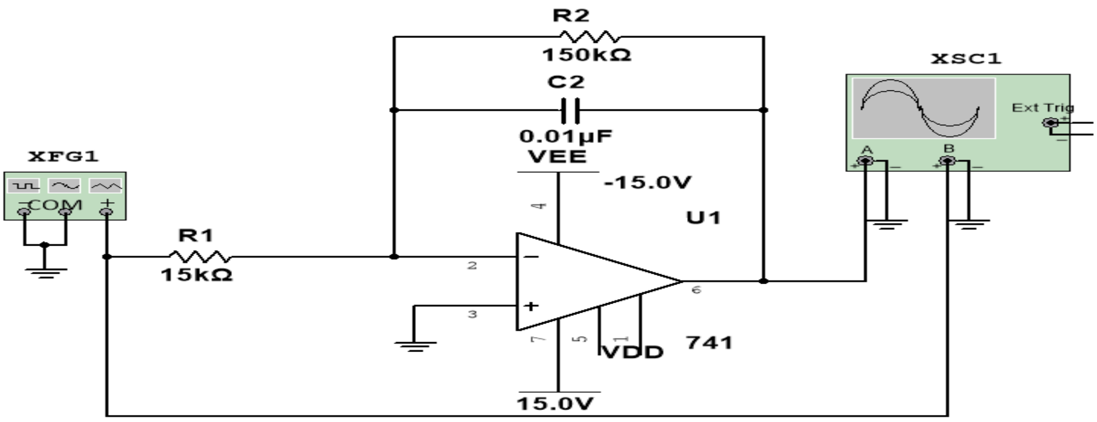
RC INTEGRATOR USING OP-AMP

AIM:

To design and setup an integrator circuit using op amp IC741 and plot its response

Experimental Requirements: PC loaded with multisim software

Circuit Diagram:



Design Procedure:

Given f = 1KH$_z$ So t = 1/f =1ms

Design equation $T=1/2\pi R_iC$

Let C=0.01 µF then R_i=15KΩ

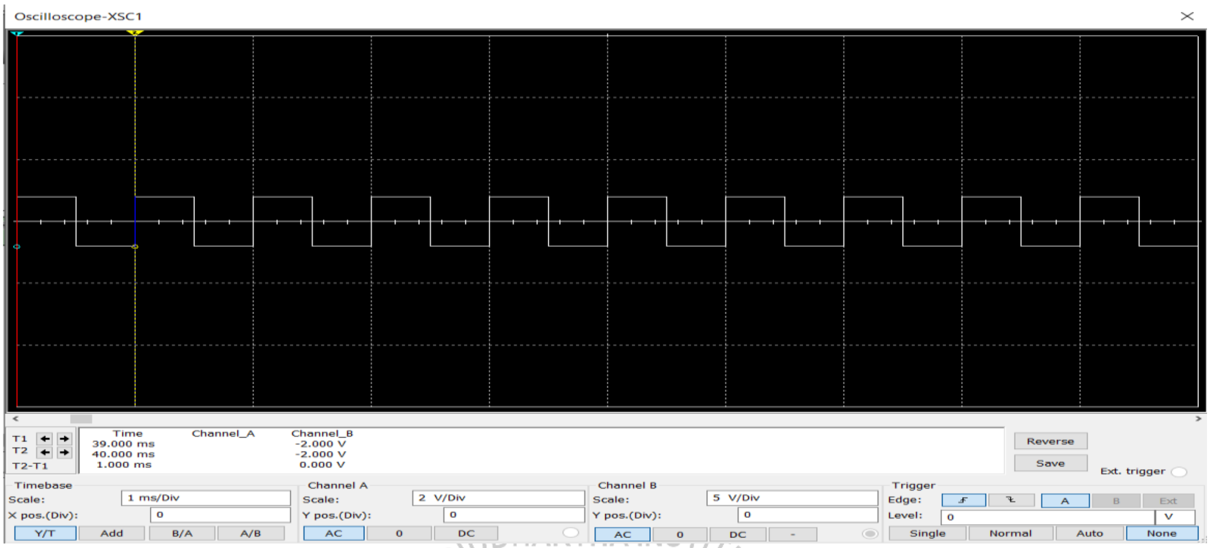
Take $R_f=10R_i$=150KΩ

Procedure:

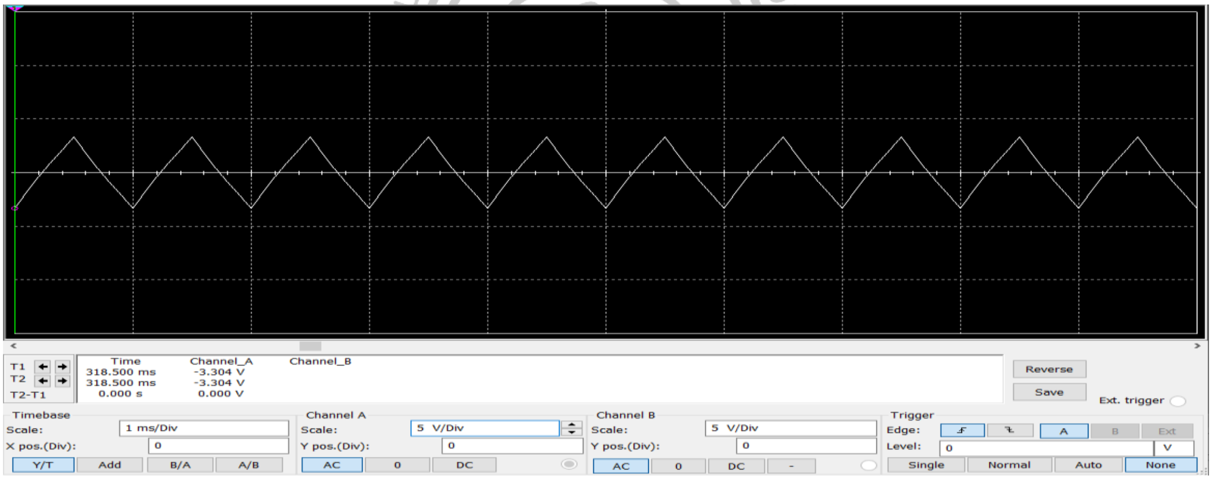
1. Switch on pc
2. Open multisim software
3. Setup the circuit on and check the connections.
4. Give Vi= 2Vpp, 1KHz square wave.
5. Keep the oscilloscope in AC coupling mode.
6. Observe input and output on two channels of the oscilloscope simultaneously.
7. Draw the input and output waveforms on the graph

Wave forms:

Input:



Output:



Precautions:

1. Check your connections before observing graph
2. Handle your pc carefully

Result:

EXPERIMENT NO: 9

ADDER AND SUBTRACTOR CIRCUITS USING OP-AMP

AIM:

To design and verify the adder and subtractor circuits using Op-amp circuits.

Experimental Requirements:

1. IC 741
2. 4 Resistor (1KΩ)
3. Regulated power supply
4. IC breadboard trainer
5. Patch cords
6. Multimeter

Circuit Diagram:

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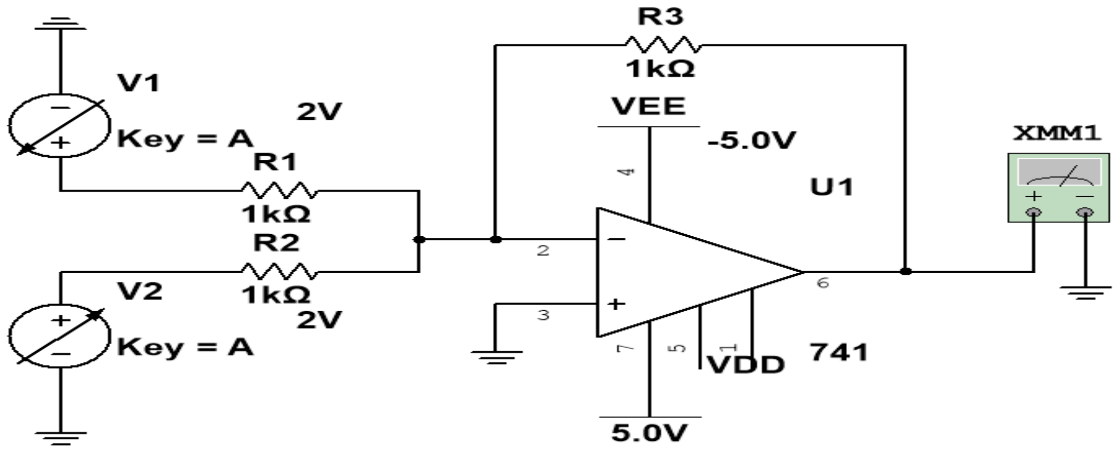
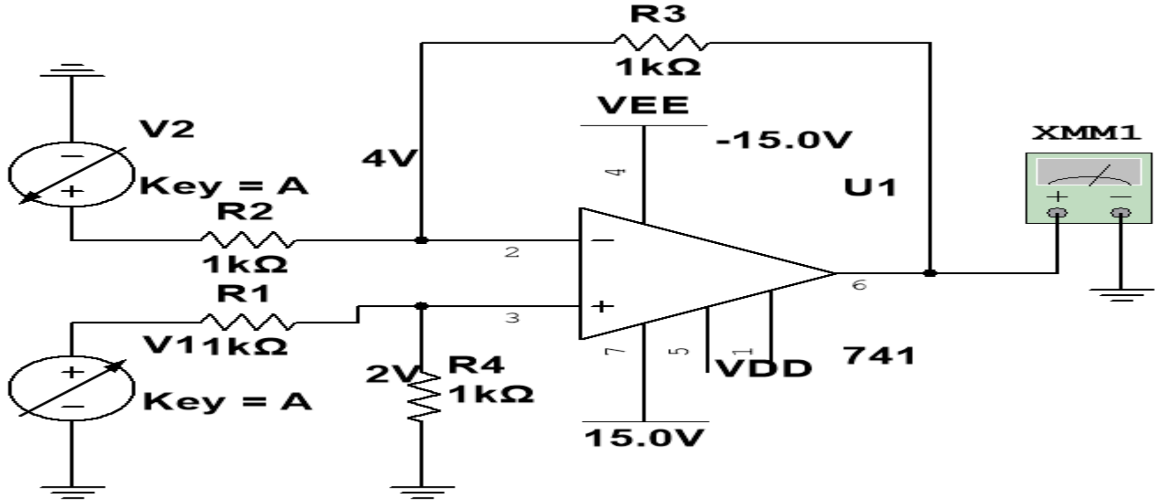
Adder:



Subtractor:



Design Procedure:

Adder circuit:

$V_o = -(V_1 + V_2)$

If V_1 = 2V and V_2 = 2V, then

$V_o = -(2+2) = -4V$.

Subtractor circuit:

$V_o = V_2 - V_1$

If V_1=4 and V_2 = 2, then

$V_o = 4 - 2 = -2$

Procedure:

Adder circuit:

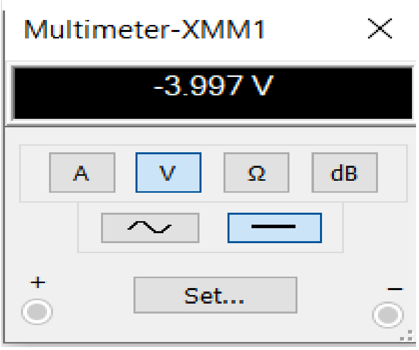
1. Connect the circuit as per the diagram.
2. Apply the supply voltages of +15V to pin7 and pin4 of IC741 respectively.
3. Apply the inputs V_1 and V_2 as shown.
4. Apply two different signals (DC/AC) to the inputs.
5. Vary the input voltages and note down the corresponding output at pin 6 of the IC 741 adder circuit.
6. Notice that the output is equal to the sum of the two inputs.

Subtractor circuit:

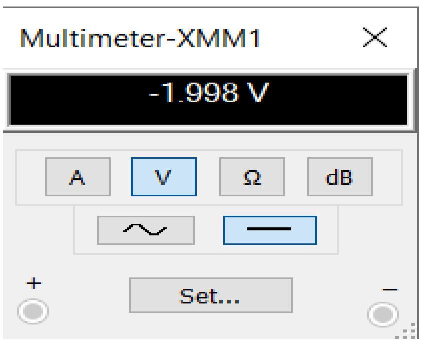
1. Connect the circuit as per the diagram.
2. Apply the supply voltages of +15V to pin7 and pin4 of IC741 respectively.
3 Apply the inputs V_1 and V_2.
4. Apply two different signals (DC/AC) to the inputs.
5. Vary the input voltages and note down the corresponding output at pin 6 of the IC 741 subtractor circuit.
6. Notice that the output is equal to the difference of the two inputs.

Output:

Adder:



Subtractor:



Tabular values:

Adder circuit:

V_1	V_2	$V_{o/p}$

Subtractor Circuit:

V_1	V_2	$V_{O/P}$

Precautions:

1. Make null adjustment before applying the input signal
2. Maintain proper V_{CC} levels
3. Don’t switch ON power supply while making connections.

Result:

EXPERIMENT NO: 10

ASTABLE MULTIVIBRATOR USING 555 TIMER

AIM:

To Design and verify an Astable multivibrator using 555 timer

Experimental Requirements:

1. _IC 555 Timer

2. Resistors (10 KΩ, 4.7 KΩ)

3. Diode (IN 4007)

4. Capacitors (0.1µF, 0.01µF)

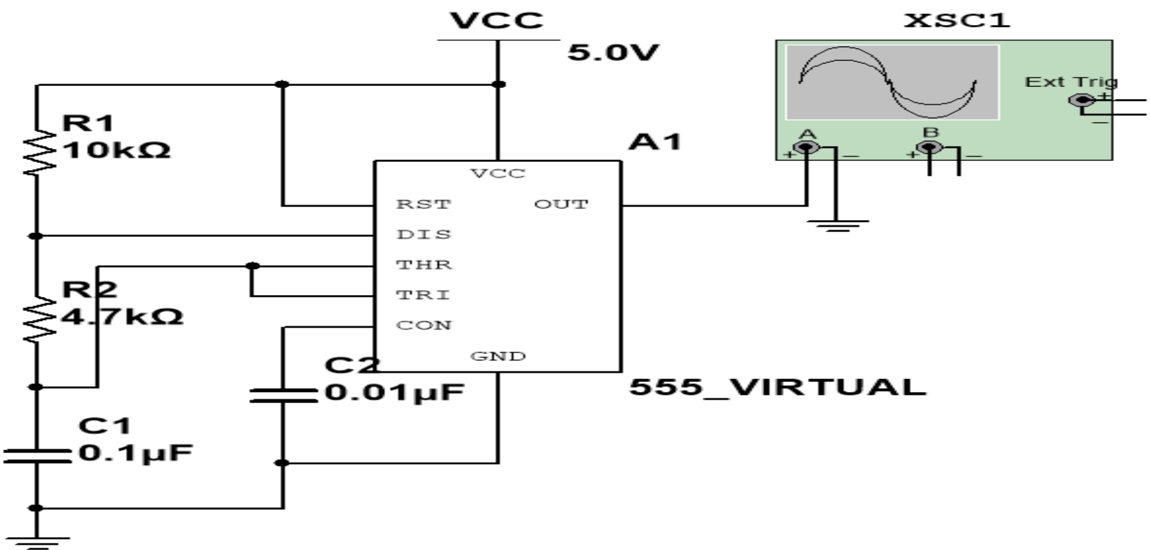
5. CRO

6. Patch cards

7. CRO Probes

8. Connecting wires

Circuit Diagram:



Design:

Theoretically without diode charging time Tc is given by Tc=0.69(R_1+R_2) C1,

Discharging time Td is given by Td= 0.69R_2C_1

The frequency f is given by $f= 1.45/(R_1+2R_2)C_1$

% of Duty cycle is $(T_c / (T_c + T_d))*100$

Procedure:

1. Connections are made as per the circuit diagram.
2. Pins 4 and 8 are shorted and connected to power supply Vcc (+5V)
3. Between pins 8 and 7 resistor R_1 of 10KΩ is connected and between 7 and 6 resistor R2 of 4.7KΩ is connected. Pins 2 and 6 short circuited.
4. In between pins 1 and 5 a Capacitor of 0.01µF is connected.
5. The output is connected across the pin 3 and GND.
6. In between pins 6 and GND a Capacitor of 0.1µF is connected.
7. Theoretically without diode charging time Tc is given by $T_c=0.69(R_1+R_2) C_1$,
   Discharging time T_d is given by $T_d= 0.69R_2C_1$

   The frequency f is given by $f= 1.45/(R_1+2R_2)C_1$

   % of Duty cycle is $(T_c / (T_c + T_d))*100$

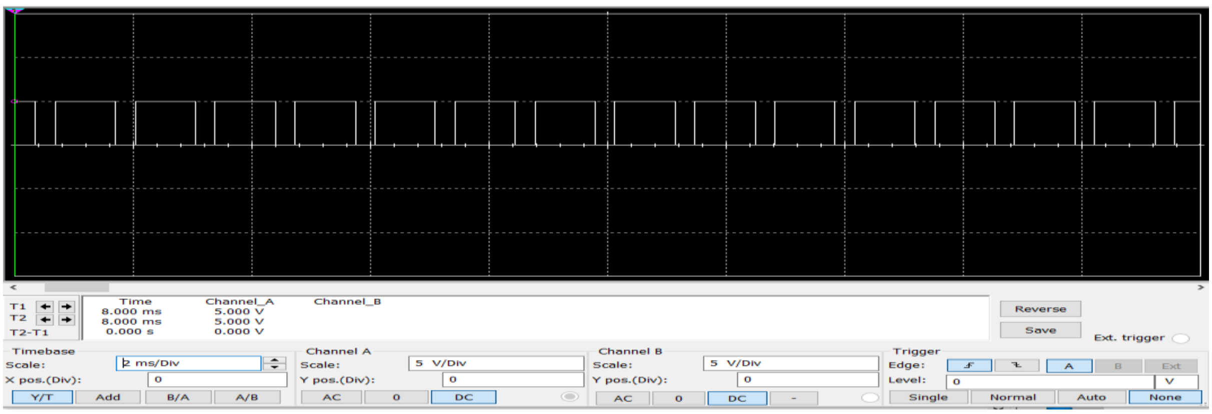
8. Practically T_d and T_c are measured and wave forms are noted and theoretical Values are verified with practical values

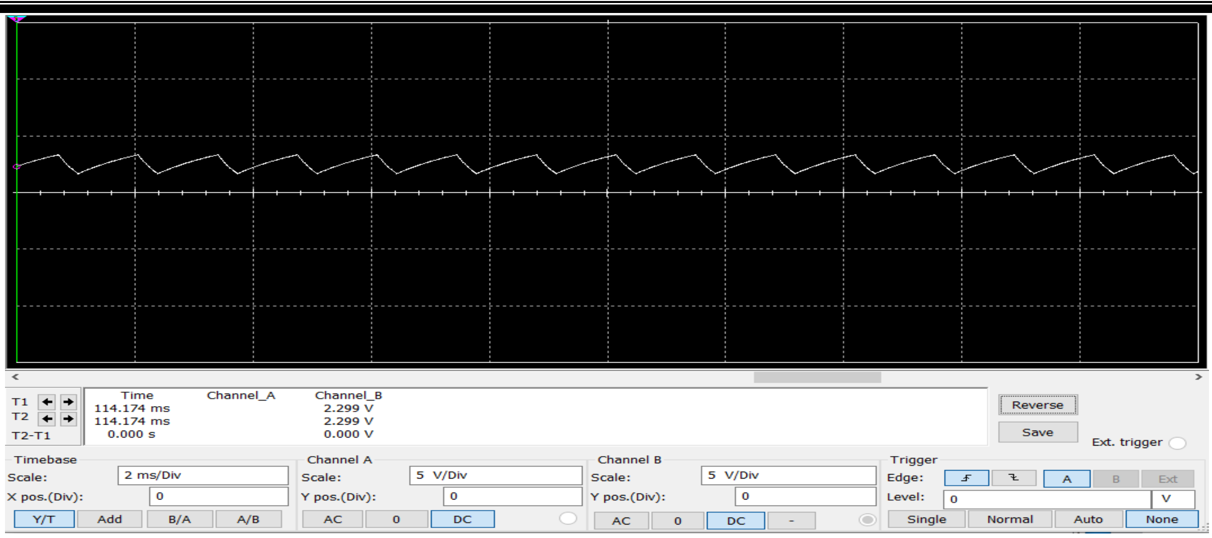
9. Connect diode between pins 7 and 2.
10. Theoretically with diode connected charging time is given by $Tc=0.69R_1C_1$ Discharging time is given by

    $Td=0.69R_2C_1$

11. Practically T_d and T_c are noted and verified with theoretical values.

Wave Forms:





Precautions:

1.Make null adjustment before applying the input signal

2.Maintain proper Vcc levels

3.Handle components care fully

Result:

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EXPERIMENT NO: 11

MONOSTABLE MULTIVIBRATOR USING 741 OP- AMP

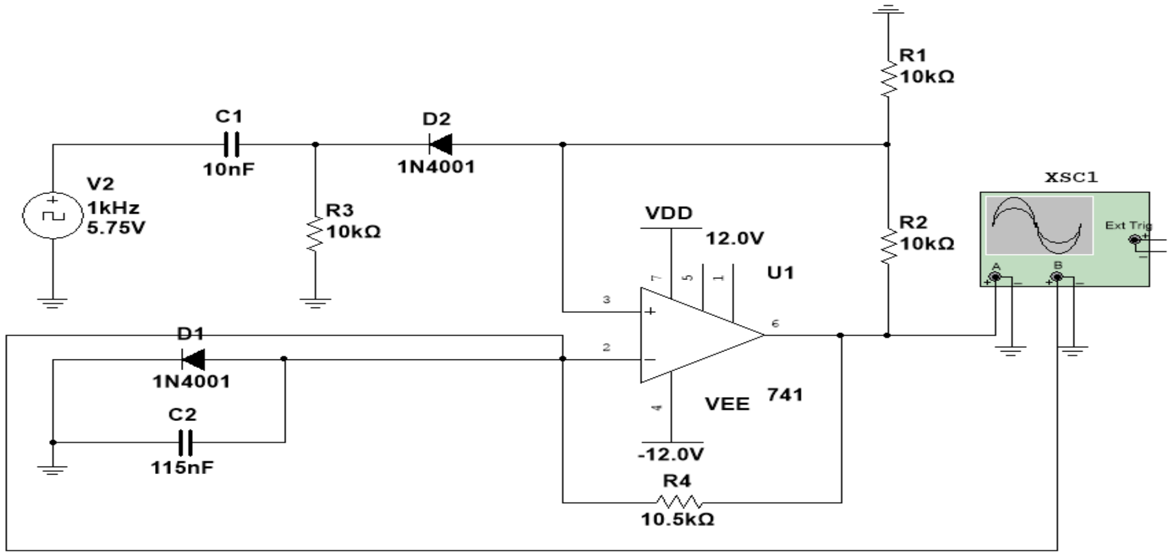
AIM:

To construct a monostable multivibrator using operational amplifier 741 and to determine the duration of the output pulse generated and to compare it with that of theoretical value.

Experimental Requirements:

1. Operational amplifier(IC741)
2. CRO
3. RPS
4. 4 Non inductive fixed resistors (R_1, R_2, R_4 and R_5)
5. 1 Non inductive Variable resistor (R_3)
6. 2 Capacitors(C_1andC_2)
7. 3 Diodes(D_1, D_2 and D_3)
8. Connecting terminals

Circuit Diagram:



Design Procedure:

$$V_C = -V_{out} + (V_{out} + V_D)e^{-t/\tau}$$

At instant, $t = \tau \; and \; V_c = -\beta V_{out}$, where $\beta = \frac{R_2}{R_1+R_2} = Feedback\ Factor$

So, $-\beta V_{out} = -V_{out} + (V_{out} + V_D)e^{-t/\tau}$

where Time Constant, $\tau = R_3C_1$

$$V_{out}(1-\beta) = V_{out}\left(1+\frac{V_D}{V_{out}}\right)e^{-T/\tau}$$

In general, $V_D \ll V_{out}$

so $(1-\beta) = e^{-T/\tau}$

$$T = R_3C_1 \log_e \frac{1}{1-\beta}$$

Substuition of $\beta = \frac{R_2}{R_1+R_2}$, assume R_1=R_2 gives β=$\frac{1}{2}$. Upon substitution of these values in above equation, gives

$$T = 0.69R_3C_1$$

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Procedure:

1. Connect the circuit as shown in the figure.

2. Take the R_1=R_2=1KΩ, C_1=C_2=0.1μF and R_3= 10KΩ (variable resistance) or any convenient values.

3. Apply the DC power supplies to the terminals (7) and (4) of the operational amplifier.

4. Keep the R_3 value at a convenient value.

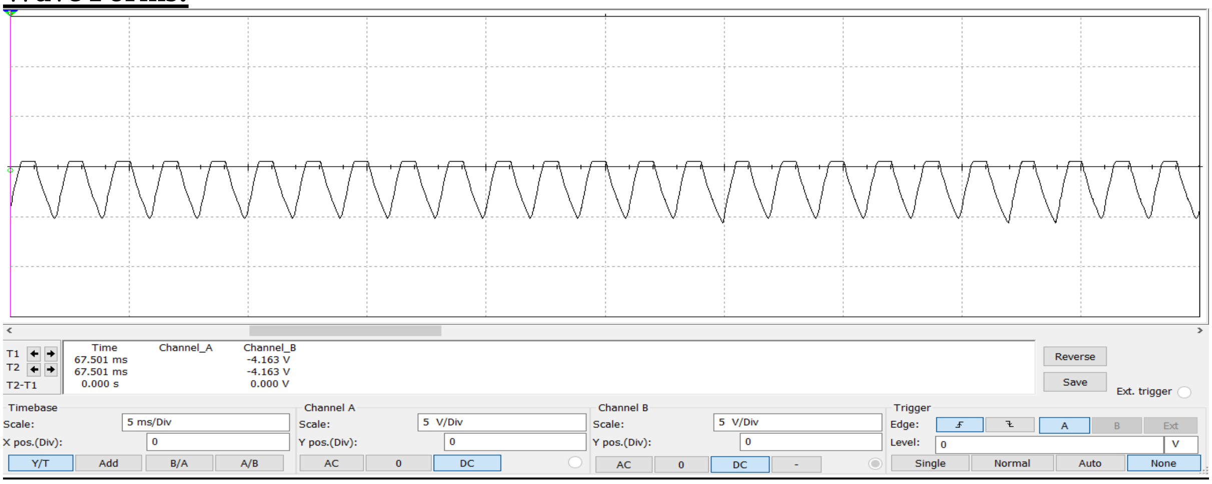
5. Set the voltage sensitivity band switch of the Y- plate and time base band switch of C.R.O. to the convenient positions such that at least two or more complete square wave forms are observed on the screen of CRO. The length of –ve value or $-V_{out}$ is the duration of the quasi-stable state.

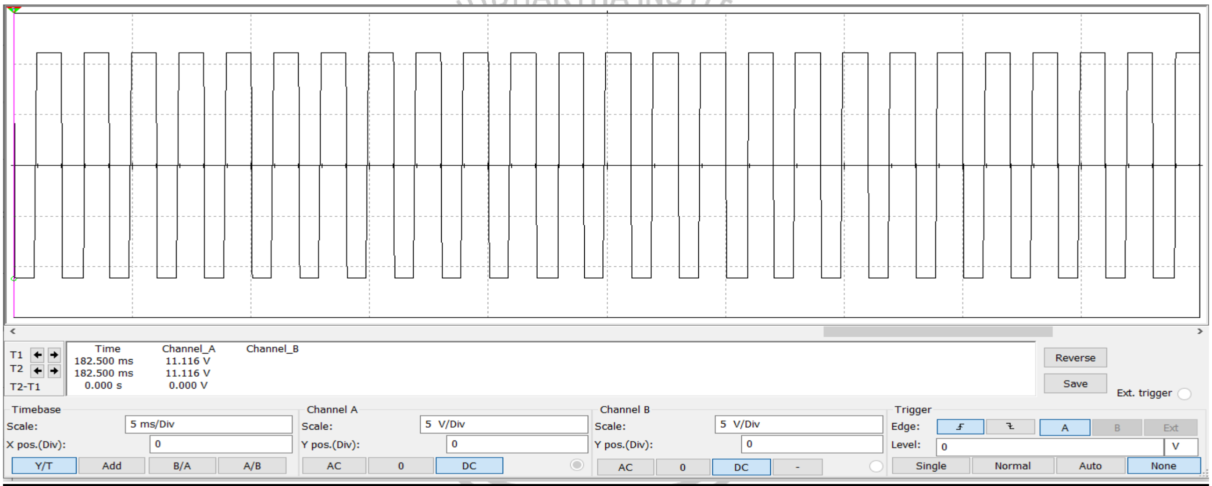
6. Now measure the horizontal length (l) of the quasi-stable state. Also note the time base value (m) of the X-plates of the CRO in the table.

7. From this calculate the time duration of the quasi- stable state. This is the experimental value. Similarly the theoretical value can also be calculated by substituting the values of R_3, R_1, R_2 and C_1 in the above given equation.

8. Now the experiment is repeated for different values of R_3 by increasing its value in equal steps (Multiples of 100 Ω).

Wave Forms:





Precautions:

1. Make sure there are no circuit breaks
2. Take the values without any error.

Result:

EXPERIMENT NO: 12

MONOSTABLE MULTIVIBRATOR USING 555 TIMER

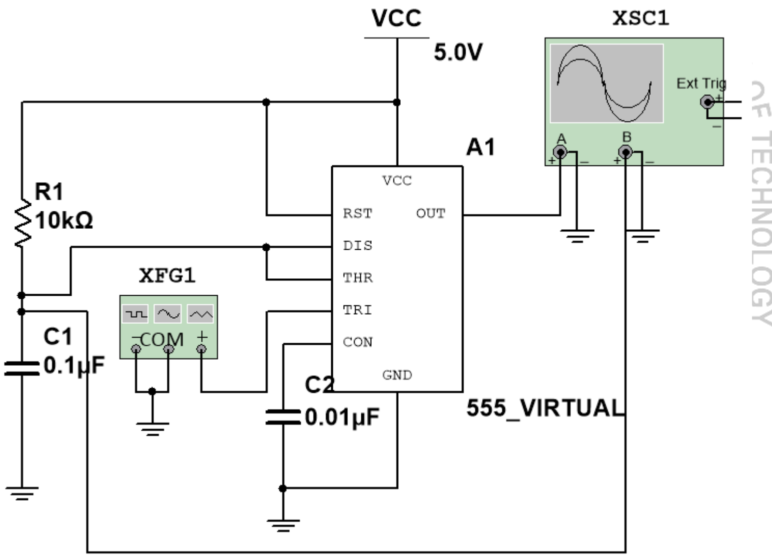
AIM:

To design and verify the operation of a monostable multivibrator using 555 timer.

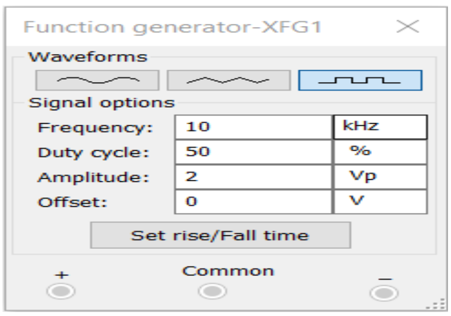
Experimental Requirements:

1. 555 IC Timer
2. Capacitors(0.1µF, 0.01 µF)
3. Resistors(10kΩ)
4. Bread board IC Trainer
5. CRO
6. Connecting wires and patch cords

Circuit diagram:



Input:



Design:

$$V_o = V_f + (\mathrm{V_i} - \mathrm{V_f})\mathrm{e}^{\mathrm{t}/\mathrm{R}}$$

$$\beta = \frac{R_2}{R_1 + R_2}$$

if $V_{sat} \gg V_p$ and $R_1 = R_2$, $\beta = 0.5$

Then $T = 0.69RC$

Procedure:

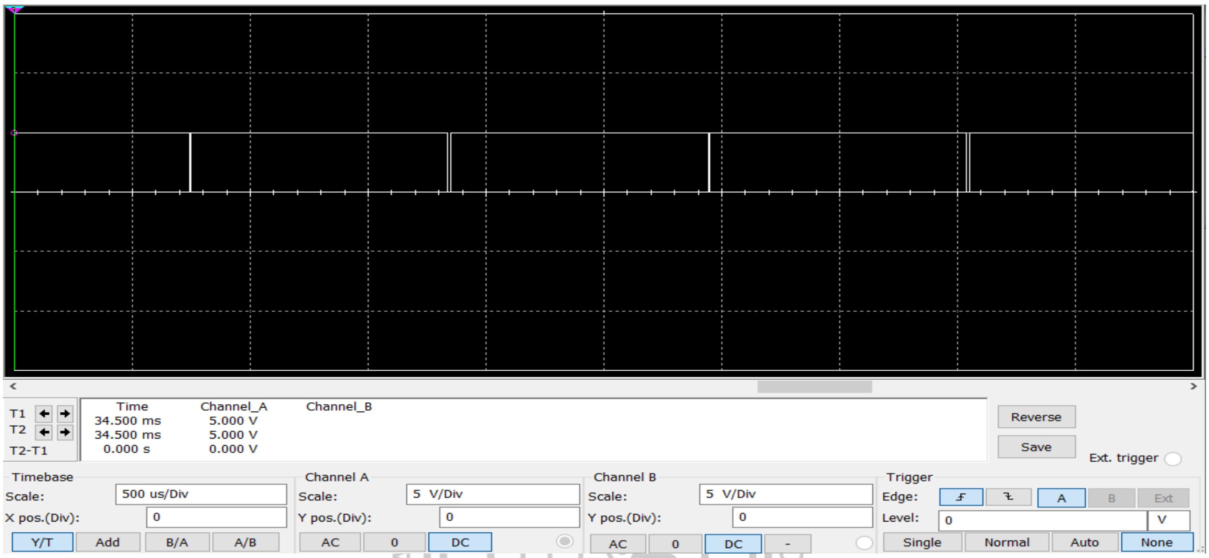
1. Connect the circuit as shown in the circuit diagram.

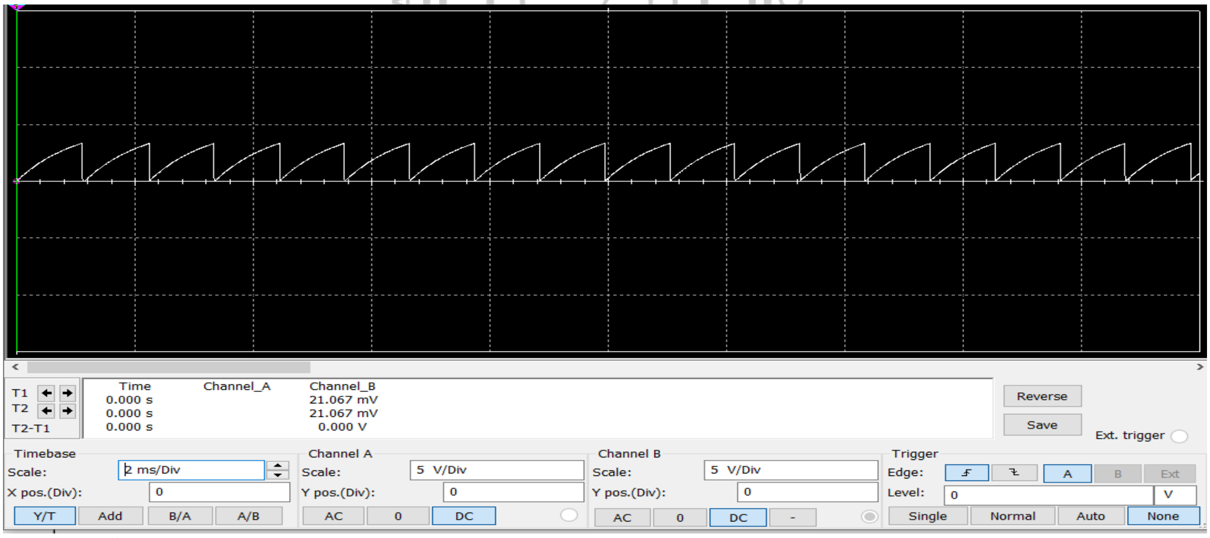
2. Apply Negative triggering pulses at pin 2 of frequency 1 KHz as shown in Fig.

3. Observe the output waveform and capacitor voltage as shown in Figure and measure the pulse duration.

4. Theoretically calculate the pulse duration as Thigh =1.1 RC 5. Compare it with experimental values.

Wave forms:





Precautions:

1. Make sure there are no circuit breaks
2. Take the values without any error.

Result:

EXPERIMENT NO: 13

ASTABLE MULTIVIBRATORS USING IC 741 OP AMP

AIM:

To design and verify symmetrical and asymmetrical Astable multivibrators using Op- amp 741 ,plot the waveforms and measure the frequency of oscillation

Experimental Requirements:

Dual power supply +/- 15V -1

Function generator (0- 1MHz) -1

Oscilloscope-1

Bread Board -1

IC741 -1

Resistors-5

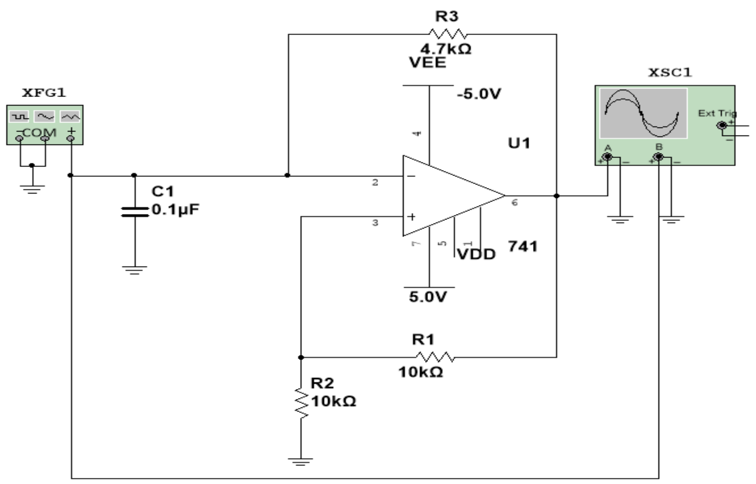
Capcaitors-0.1µF -2

Diode 1N4007-2

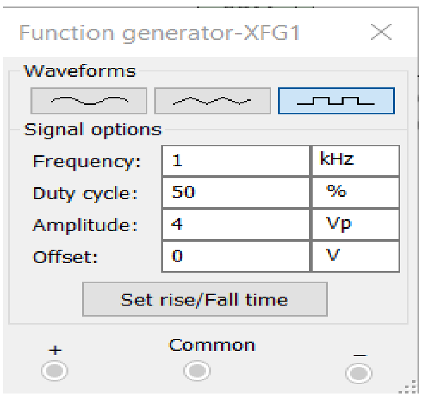
Probes and connecting wires- as required

SYMMETRCAL ASTABLE MULTIVIBRATOR:

Circuit Diagram:



Input:



Design:

Given f = 1 KHz

So, $T = \frac{1}{f} = 1msec$

And

$$\beta = \frac{R_2}{R_1 + R_2}$$

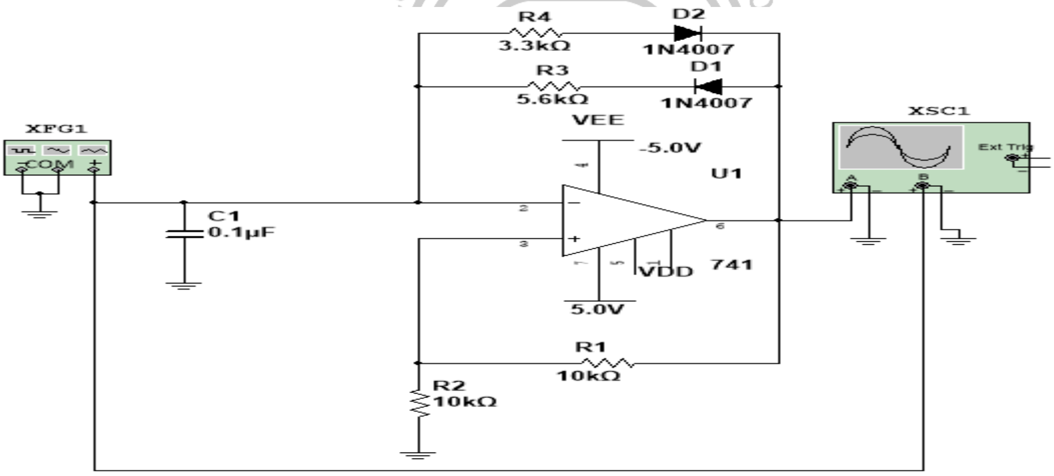
Let R_1 = 10 kΩ, and R_2 =10 kΩ

Then β = 0.5

Therefore, $T = 2.2RC = 1msec$

Let C = 0.1µF, then R = 4.7kΩ

ASYMMETRCAL ASTABLE MULTIVIBRATOR:



Design:

Given f = 1 KHz

So $T = T_{ON} + T_{OFF} = \frac{1}{f} = 1msec$

Also $Duty\ Cycle = \frac{T_{ON}}{T_{ON}+T_{OFF}} = 0.66\ or\ 66\%$.

$$Solving\ above\ two\ equations, T_{ON} = 0.66msec, T_{OFF} = 0.33msec$$

For β=0.5, $, T_{ON} = 1.1R_{f1}C = 0.66msec$

Let C = 0.1µF

Then R_{f1} = 6.2kΩ , use 5.6KΩ (Std)

$$T_{OFF} = 1.1R_{f2}C = 0.33msec$$

Similarly, $T_{off} = 1.1R_{f2}C$ = 0.33ms

Then $R_{f\,2}$ = 3kΩ , use 3.3 KΩ (Std)

Procedure:

1. Connect the circuit as shown in the circuit diagram.

2. Observe the output waveform and capacitor voltage as shown in Figure and measure the pulse duration

Observations:

a) Asymmetrical astable multivibrator

Duty cycle =

V_0 =

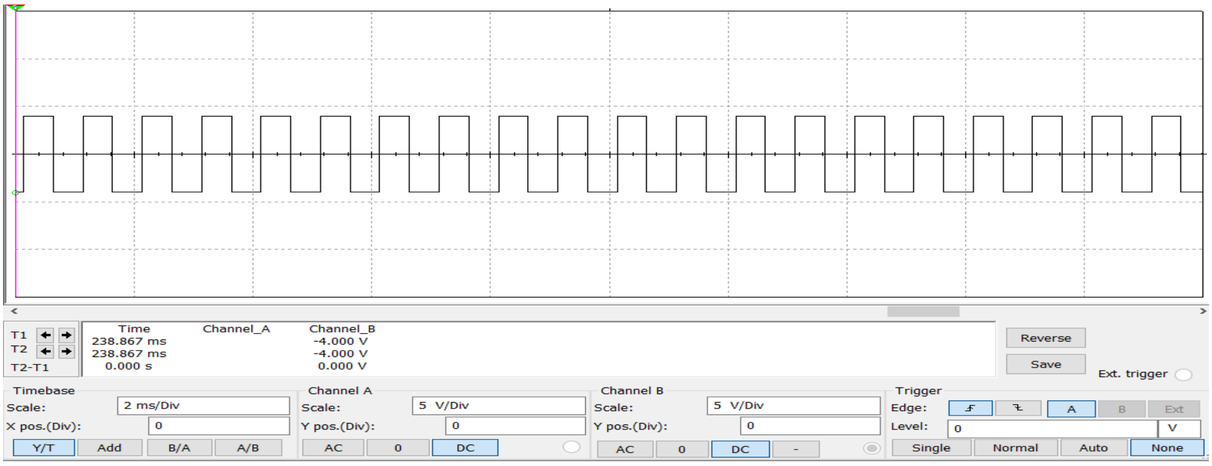
b) Symmetrical astable multivibrator

Duty cycle =

V_0 =

Wave Forms:

SYMMETRICAL WAVE FORM



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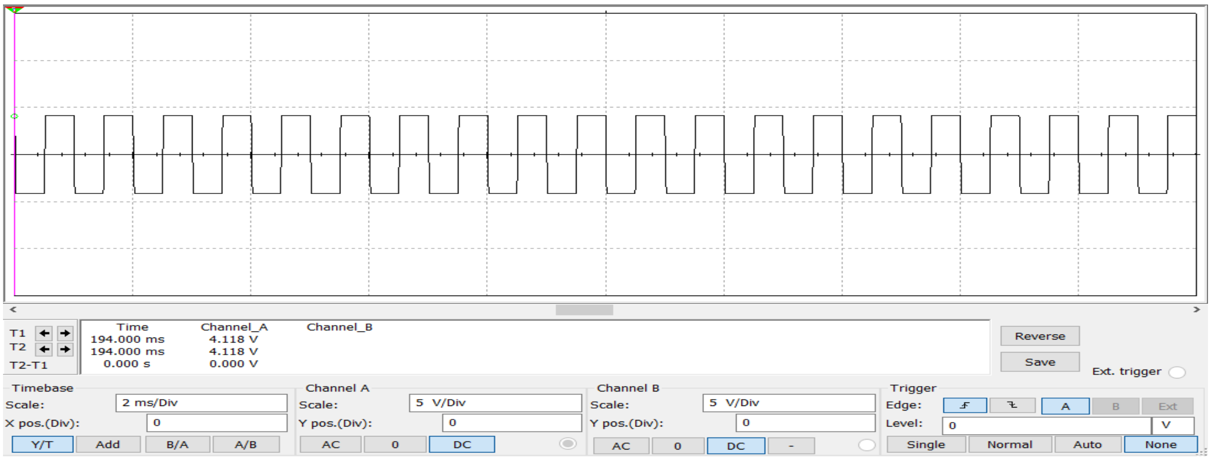
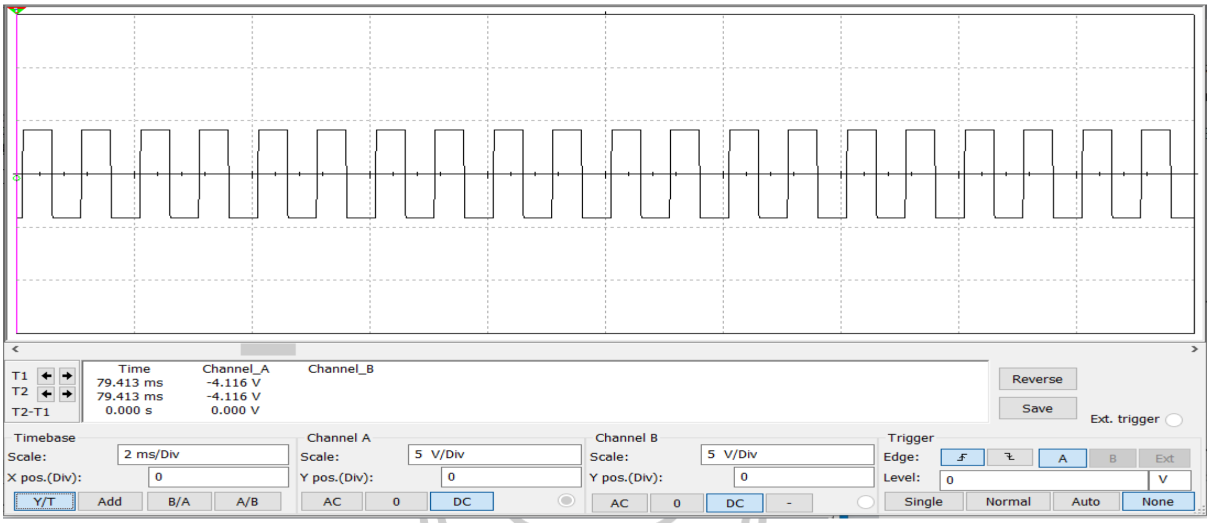


ASYMMETRICAL WAVEFORM:



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Precautions:

1. Make sure there are no circuit breaks
2. Take the values without any error.

Result:

EXPERIMENT NO: 14

LPF AND HPF USING OP-AMP

AIM:

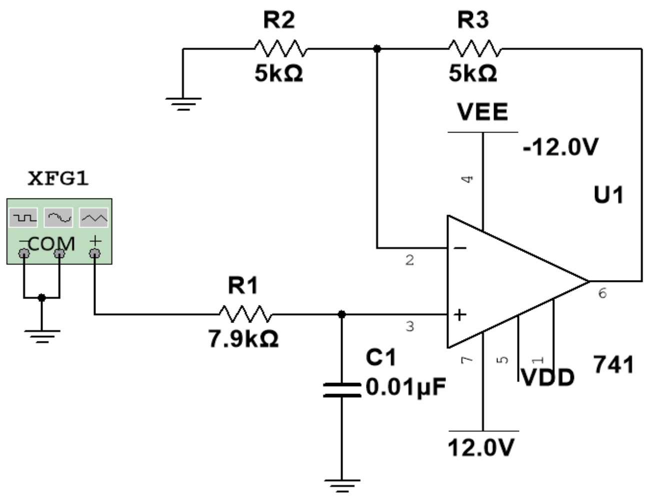
To design and the Lowpass and Highpass filters using Op-amp.

Experimental Requirements:

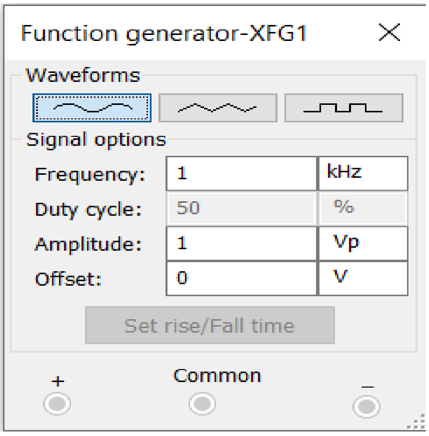
1. Signal Generator
2. Op-amp(IC741)
3. Resistors(1k,1.5k,5k,10k)
4. Capacitor(0.1µf)
5. Linear power supply
6. Digital storage oscilloscope(DSO)

Circuit Diagram:

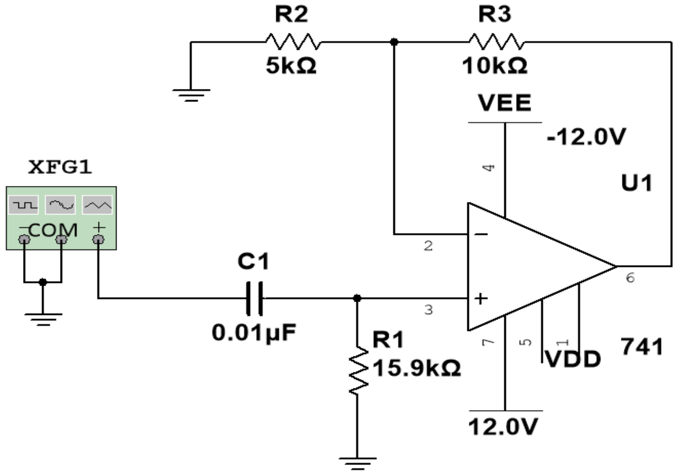
LPF:



Input:



HPF:



Design :

$$f_c = \frac{1}{2\pi RC} = \frac{1}{2\pi\tau}, \text{ where } \tau = RC$$

$$Gain = \left(1 + \frac{R_f}{R_i}\right)$$

Procedure:

1. Connect the circuit as shown in the diagram.

2.Connect the DSO to the probes and switch it on.

3.Check the graph for both positive and negative voltage and note down the output.

Tabular Forms:

Lowpass Filter:

Input Frequency (Hz)	Output Voltage (V)	Gain	Gain in dB

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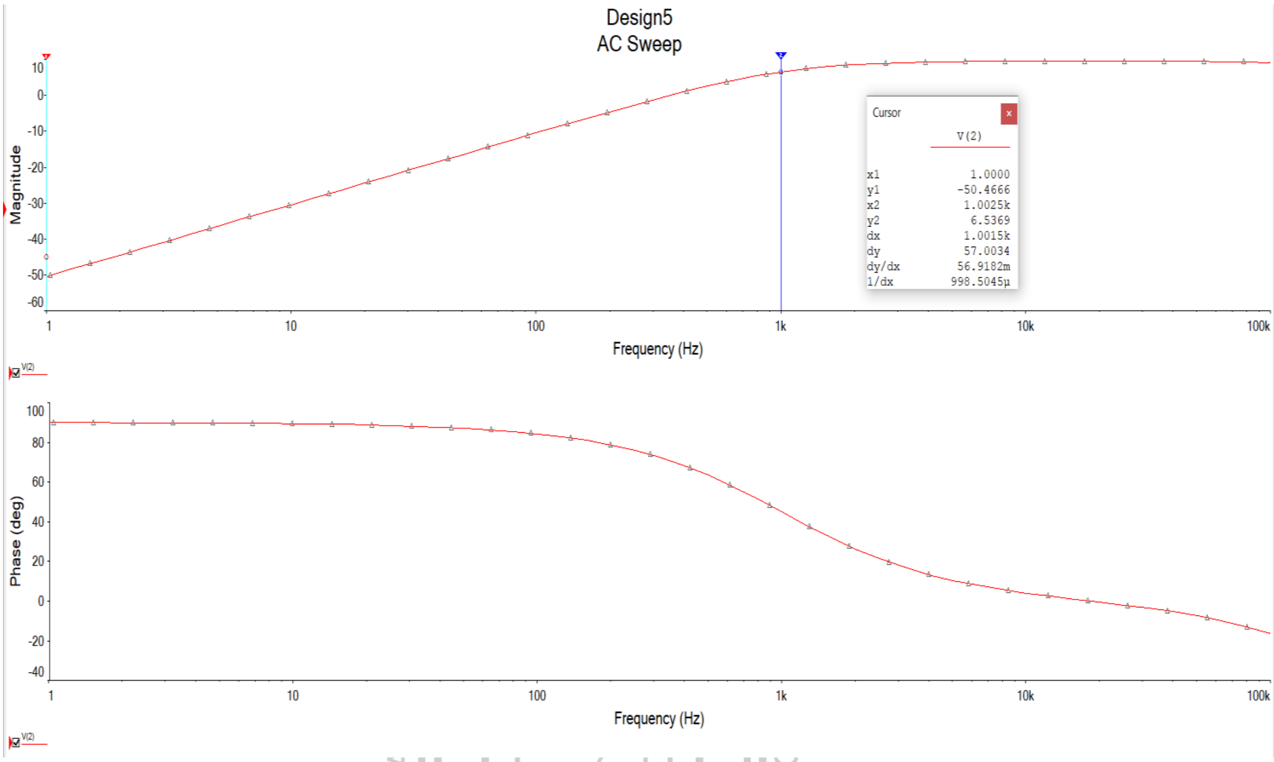
Highpass Filter:

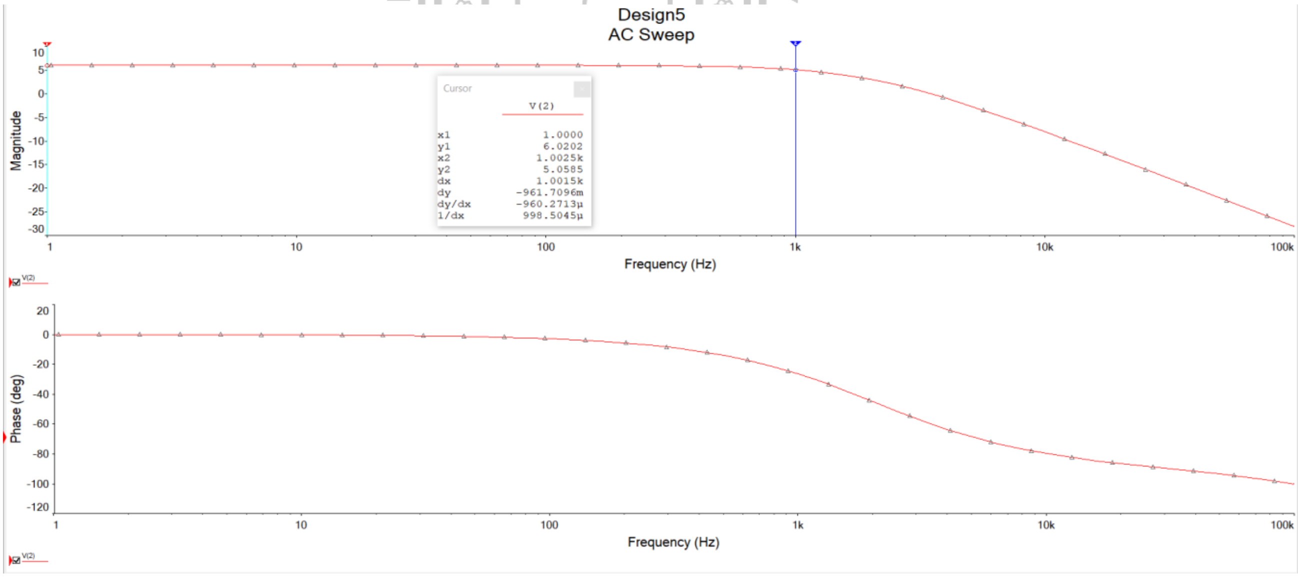
Input Frequency (Hz)	Output Voltage (V)	Gain	Gain in dB

Wave Forms:

LPF:



HPF:



Precautions:

1.Make sure that there are no loose connections
2.Power off the supply while making the connections

Result:

EXPERIMENT NO: 15

4-BIT DAC USING OP-AMP

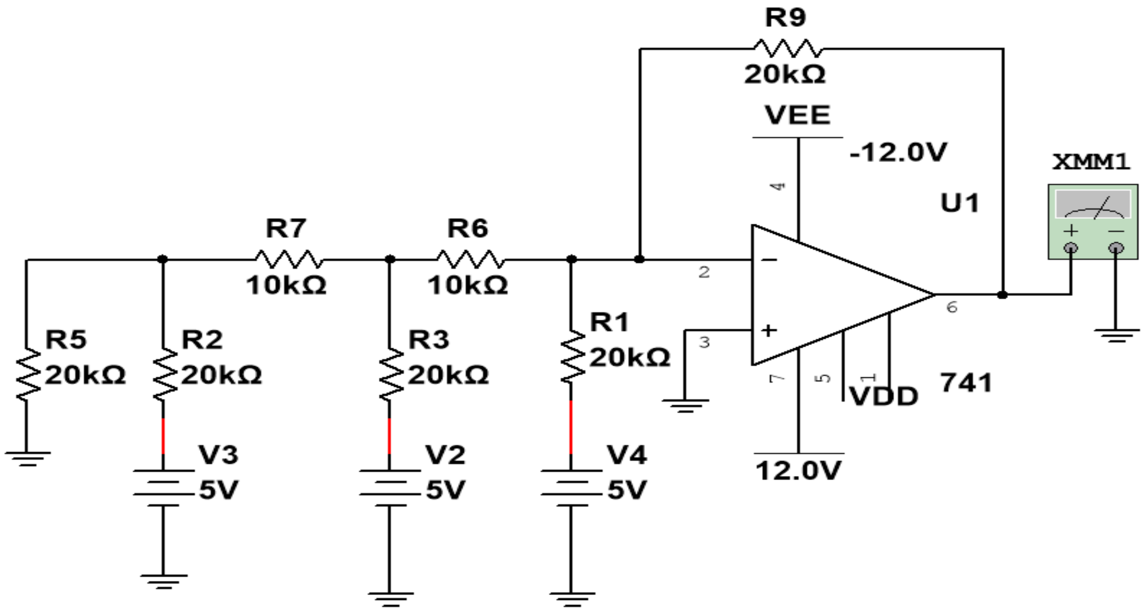
AIM:

To construct and to study the Digital to analog convertor circuit using Op-amp.

Experimental Requirements:

1. IC741
2. Multimeters patch
3. Connecting cards
4. Resistors (1k,2k,8k)
5. IC breadboard trainer

Circuit diagram:



Procedure:

1. Connections are made as per circuit diagram.
2. Pin2 is connected to resistor 1MΩ and ground.
3. $+V_{cc}$ are available at Pin7 and $-V_{cc}$ is applied atPin4.
4. Output is taken between pin6 and ground
5. Voltage at each bit (vr) is found at bits b0, b1, b2, b3.
6. Pin3 of op amp is connected to resistor 1kΩ and is given to b3 (msb).
7. A resistor of 2kΩ is connected between pin2 and pin 6 of op amp

Tabular forms:

D3	D2	D1	D0	R-2R Ladder DAC(V)	
				Theoretical	Practical

Precautions:

1.Make sure that there are no loose connections
2.Power off the supply while making the connections

Result:

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