M. V. P. Samaj's

KPG Arts, Commerce & Science College, Igatpuri

Class : F.Y.B.Sc.(Comp. Sci.) **Academic Year : 2024-25**

Subject : Electronics **SEM-I** **Practical Course : ELC-102**

I N D E X

Expt. No.	Title of Experiments	Date	Page No.	Remark & Sign
Group A				
1.	Study of forward bias characteristics of PN junction diode			
2.	Study of Zener diode as a voltage regulator			
3.	Study of Transistor as a switch			
4.	Study of IC 555 as astable multivibrator used as square wave generator			
5.	Study of Digital to Analog Converter using R-2R ladder network			
6.	Study of optical sensor (LDR)			
7.	Study of Op amp as inverting / non-inverting amplifier			
8.	Study of Op-amp as adder / subtractor			
9.	Study of Flash ADC			
10.	Study of crystal oscillator			
Group B				
A.	Identification of components and use of Multimeter			

C E R T I F I C A T E

This is to certify that, Mr /Miss _____

of Class F.Y.B.Sc.(Computer Science-Electronics) has completed _____experiments out of _____

in semester ____ satisfactorily during academic year 2024-2025 .

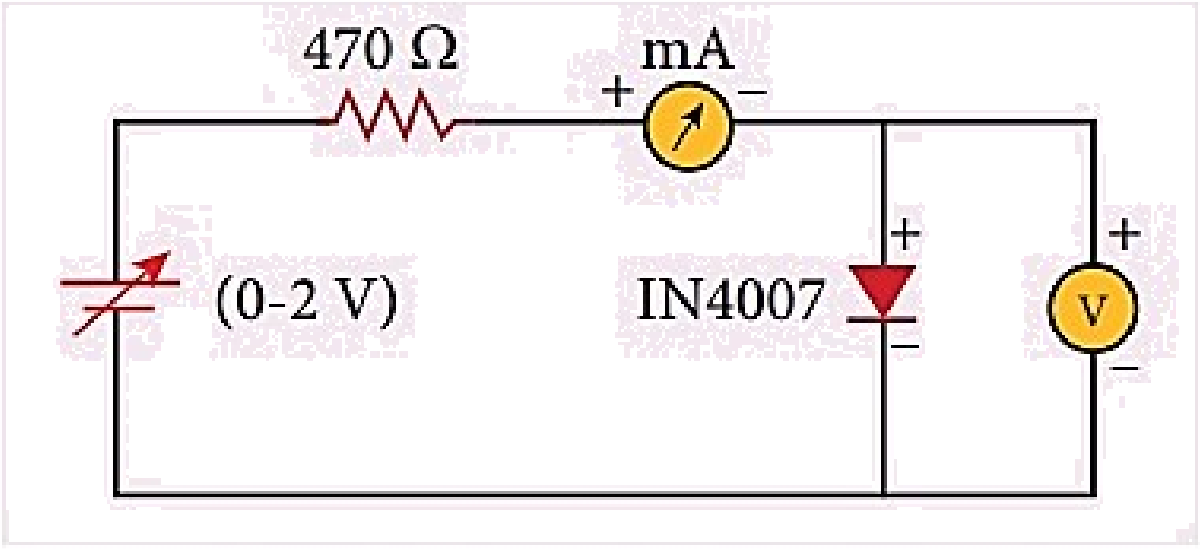
Practical Incharge **Internal Examiner** **External Examiner** **HOD**

Title: Diode Characteristics

Aim: To study of forward characteristics of a diode.

Components: Resistor – 330Ω (1), Rectified Diode (1N4007), connecting wires, Two digital Multimeter, Bread Board (1), etc.

Circuit Diagram:



Introduction:

The characteristics of diode depend on the semiconductor material used. Diode is two terminal devices possess unique characteristics (i.e. to put current in one direction but not in other direction). A diode conducts in forward bias & does not conduct in reverse bias.

Observation Table:

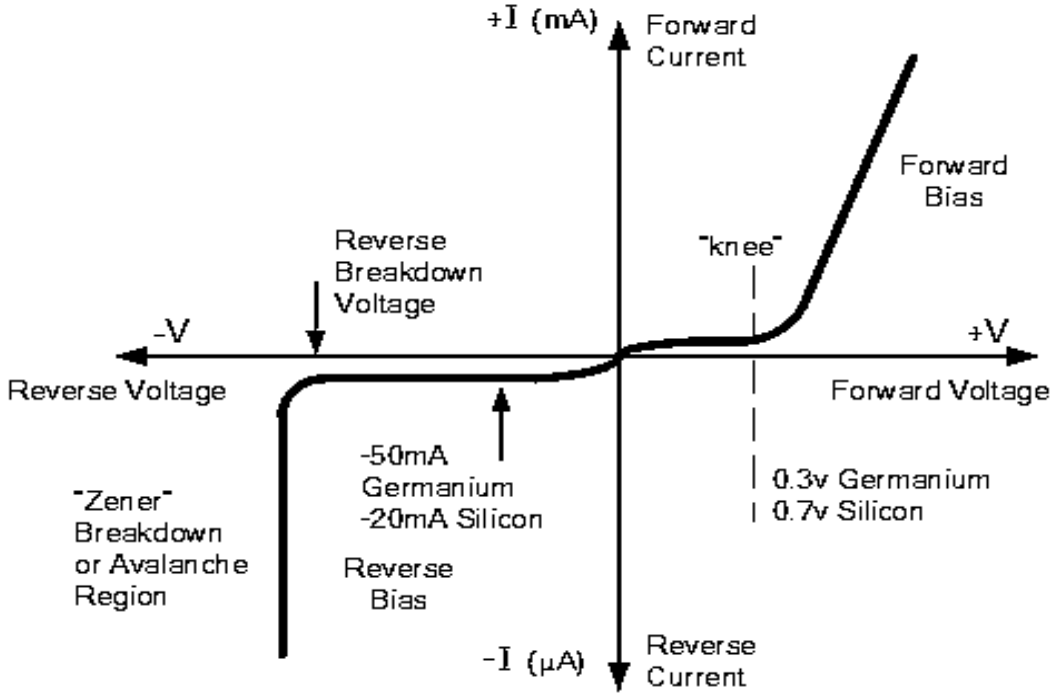
Obs. No.	Forward voltage V_F(volts)	Forward current I_F(mA)
1.	0.45	
2.	0.50	
3.	0.55	
4.	0.60	
5.	0.65	
6.	0.70	
7.	0.71	
8.	0.72	

Application:

Rectifiers, clipper, clamper, switching circuit (used in radio, TV, consumer electronics product, computers), etc.

Result: The forward bias characteristics of PN junction rectified diode are studied.

Graph:



STUDY OF VOLTAGE REGULATION ACTION OF ZENER DIODE

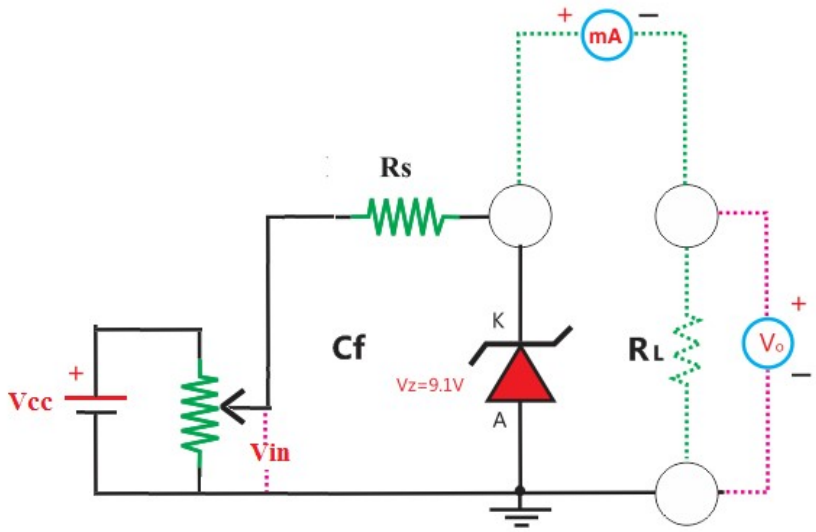
AIM: To Study of breakdown characteristic and voltage regulation action of Zener diode

OBJECTIVES:

1. To learn how zener diode works in Reversed bias Mode.
2. To understand the I-V characteristics of zener diode.
3. To study the voltage regulation action of zener diode.

APPARATUS: Experimental Board, DMM, Ammeter (mA, μA), Voltmeter (V)

CIRCUIT DIAGRAMS: Voltage Regulation:



Formulae:

% load Regulation = [(VNL – VFL) X 100] /VFL

A. Voltage Regulation:

1. Make the circuit connections according to circuit diagram shown on board using Patch Chord. Carefully change the polarities of the power supply.
2. Connect the bridge rectifier and note down the voltage before connecting to the zener diode.
   Vunregulated = _____ voltage

Load Regulation:

3. Fixed Line voltage= 230V, then measure output current for various load with fixed line voltage. Use resistance box or rheostat.
4. Note down the current and voltage reading across R_L.

5. Plot the graphs of output voltage and load current.
6. Calculate % load regulation

OBSERVATION TABLE: Load Regulation

Sr No	Load Resistance R_L(ohm)	Load Current I_L (mA)	Output Voltage observed Volt
1	Min(20)		
2			
3			
4			
5			
6			
7			
8	Max(infinite)		

RESULT:

Zener diode is studied as voltage regulators

% load regulation=_____

TRANSISTOR AS A SWITCH

AIM: *To study transistor work as switch (LED on /off).*

OBJECTIVES: *1. To observe transistor behavior as switch.*
2. To get familiar with circuit connection.

SKILLS TO BE DEVELOPED:

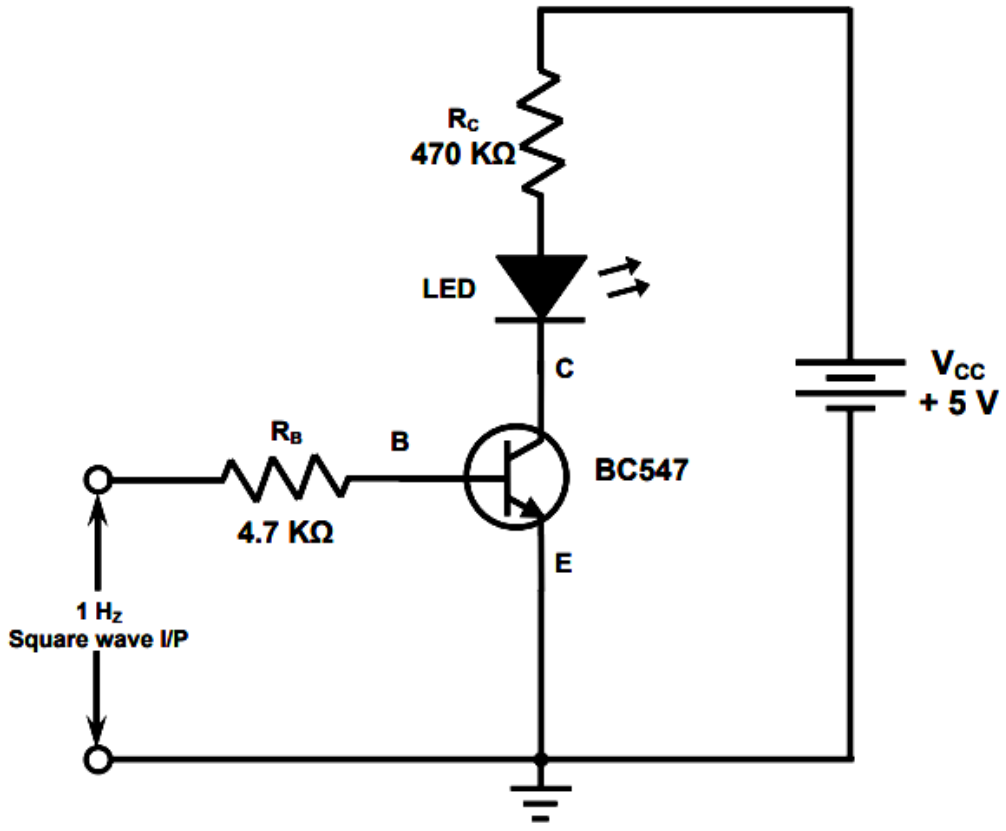
1. Drawing proper circuit diagrams using standard symbols of different elements and devices.
2. Identification of different components and devices on the circuit board.
3. Making proper circuit connections to obtain circuit as per the circuit diagram.
4. Drawing proper input, output waveforms on the graph paper reflecting student's understanding about the experiment.
5. Writing result and conclusion of the experiment.

APPARATUS: Bread board, Multimeter, Connecting wire, etc.

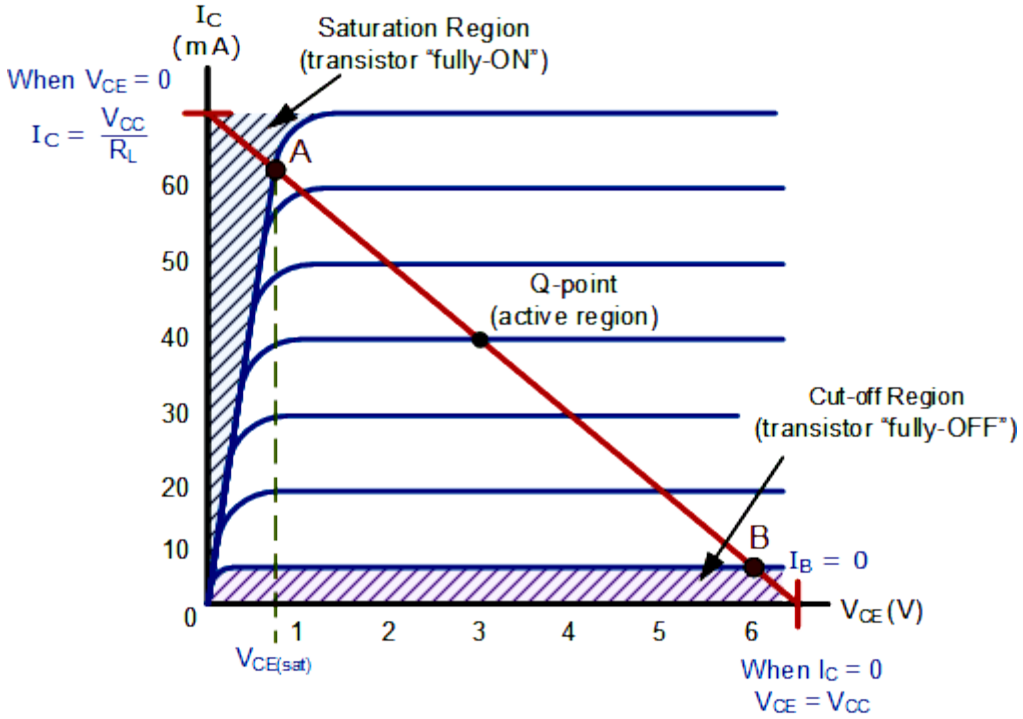
A. List of Components

Sr. No.	Component	Specifications
1	R	470KΩ
2	R	4.7KΩ
3	T	BC547

CIRCUIT DIAGRAM:



WAVEFORM:



THEORY:

Transistor is a three terminal, bipolar, current controlled device. It works in three different regions: Active, Cutoff and Saturation according to applied biasing condition. In this circuit, a square wave input is applied. When input is high, the transistor is turned on and works in saturation region. So maximum current IC flows through transistor as well as LED. Hence LED emits the light. When input is low (low means not enough to turn on the transistor), the transistor remains in cutoff. So current IC is zero thus LED does not emit the light. As the input is square wave, the LED will turn on and off alternately. If output is observed on CRO from the collector then it will be also a square wave but out of phase by 180° with input. Thus transistor is working as a switch which can be made on or off by an external input.

OBSERVATION TABLE:

Sr. No.	**Pulse**	**V_{CE}**
1	High pulse	
2	Low pulse	

RESULT : Transistor behavior as electronic switch were studied and verified.

Title: Astable multivibrator determination of frequency

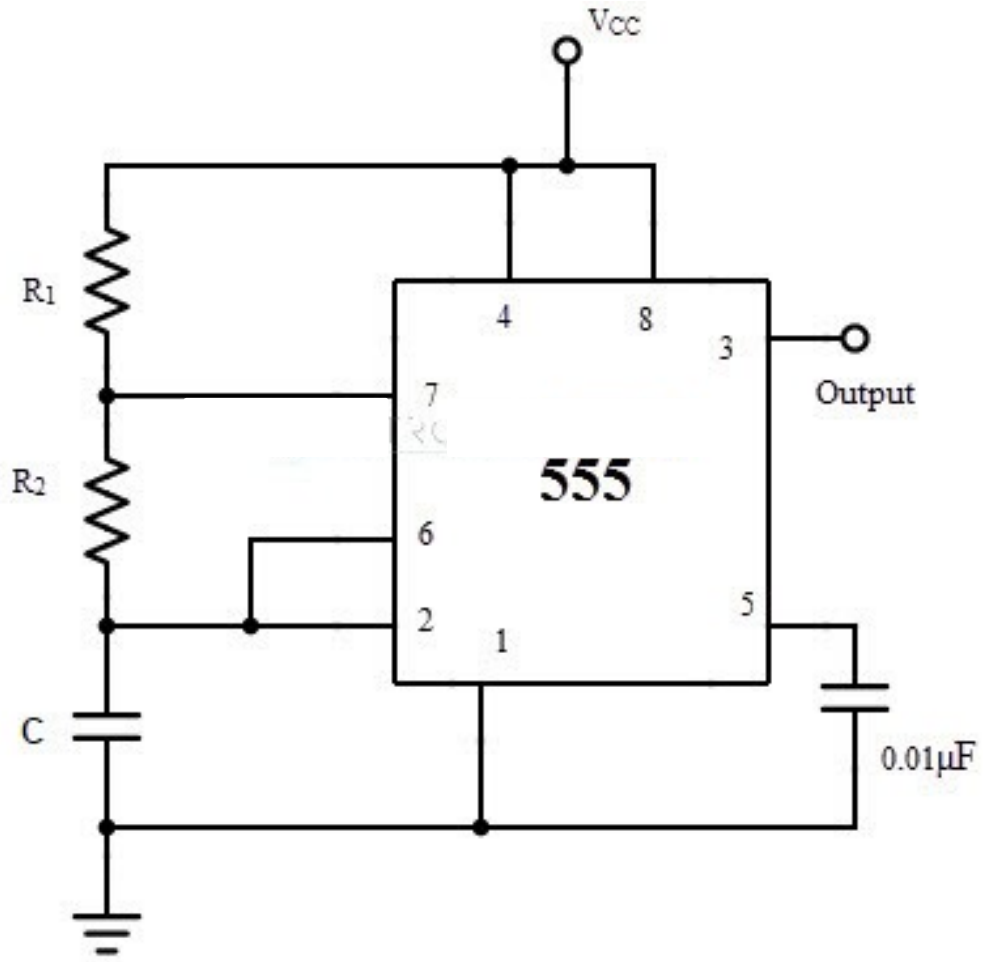
Aim: *To design astable multivibrator using IC 555 and determination of its frequency.*

Components:*Resistor – 1kΩ, 4.7kΩ,Transistor- BC108, LED, Two multimeter, Two Bread bard, connecting wires, One micrometer, One Voltmeter, etc.*

Procedure:

1. *Draw a neat circuit diagram.*
2. *Connect the components on the breadboard according to the circuit diagram.*
3. *Apply Vcc and then find the output frequency generated by the circuit using CRO.*

Circuit Diagram:



Observation :

Frequency using calculation :

Obsercation Table:

A *No. of Boxes and lines on X-axis*	*B* *time / division know value*	*T =A*B*	*f = 1/T*

Result: *The output Frequency of Astable multivibrator using IC 555 is*

4-Bit R-2R ladder digital to analog converter

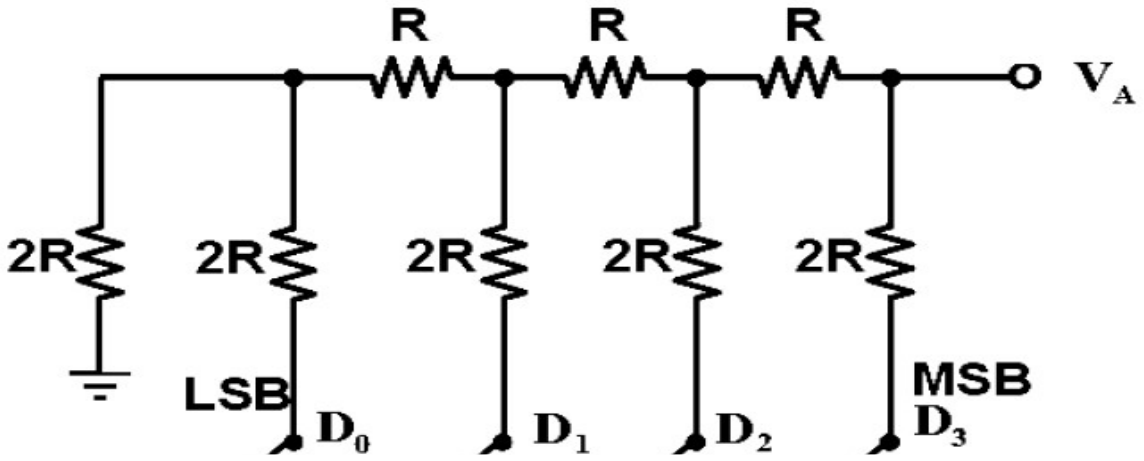
Aim: -To study of 4-Bit R-2R ladder digital to analog converter.

Objective:

1) To study R-2R ladder digital to analog converter.
2) To determine the corresponding analog output of a 4 bit digital input.

Components: Resistor –2KΩ (5), 1KΩ (4), connecting wires, Digital Multimeter, Bread Board.

Circuit Diagram:



Note : $V_R = 12V$

Observation:s

Mathematical expression for analog output voltage of n bit DAC:

$$V_A = \frac{V_R}{2^n} \times (2^0 \times D_0 + 2^1 \times D_1 + 2^2 \times D_2 + 2^3 \times D_3 + \ldots\ldots)$$

Observation Table:

Obs. No	Nibble Data				Analog o/p(V)	
	D_3	D_2	D_1	D_0	Expected	Using Multimeter
1.	0	0	0	0		
2.	0	0	0	1		
3.	0	0	1	0		
4.	0	0	1	1		
5.	0	1	0	0		
6.	0	1	0	1		
7.	0	1	1	0		
8.	0	1	1	1		
9.	1	0	0	0		
10.	1	0	0	1		

11.	1	0	1	0		
12.	1	0	1	1		
13.	1	1	0	0		
14.	1	1	0	1		
15.	1	1	1	0		
16.	1	1	1	1		

Result: 4-Bit R-2R ladder digital to analog converter studied.

LDR based light control system

AIM: To Build and test LDR based light control system.

OBJECTIVES:

1. To get familiar with the concept of lighting control system.
2. To understand the working principle of LDR.

SKILLS TO BE DEVELOPED:

1. Drawing proper circuit diagrams using standard symbols of different components and devices.
2. Identification of different components and devices on the circuit board
3. Making proper circuit connections to obtain circuit as per the circuit diagram.
4. Demonstration of working of the lighting control system.
5. Writing result and conclusion of the experiment.

APPARATUS: Breadboard , DC power supply, table lamp, DMM, Transistors, diodes, resistors and LED etc.

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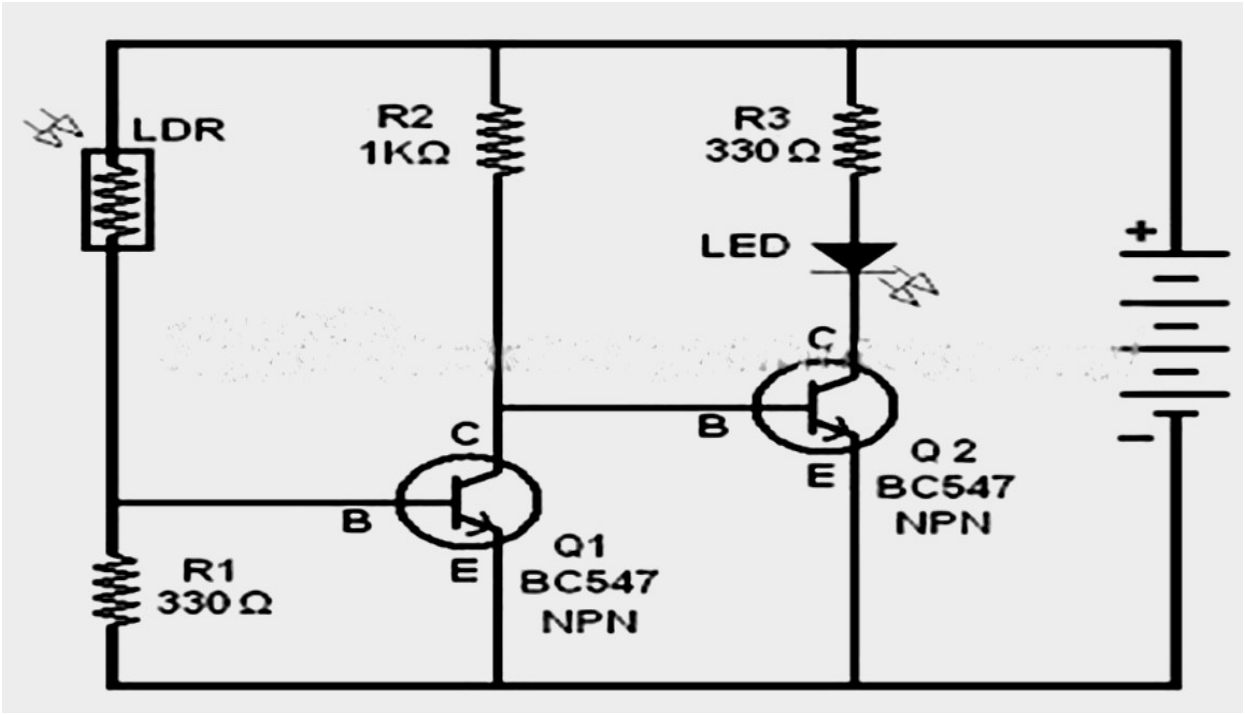
a. List of Components:

Sr.No.	Component	Specifications
1	BC 547	NPN Transistor
2	LDR	Light dependent resistor
3	330 ohm	Resistor
4	1Kohm	Resistor
5	LED	As an indicator
6	CFL	lamp

CIRCUIT DIAGRAMS:



PROCEDURE:

1. Make the circuit connections according to circuit diagram shown on board. Carefully look the polarities of the power supply.
2. Enlist the components with their specifications and values using DMM.
3. Test the circuits under different light conditions and measure the voltages at base and collector of the transistors used for both conditions.
4. From the above readings comment whether the transistors are in cut off or saturation or in active region

OBSERVATION TABLE:

Transistors	**T1**		**T2**	
Light Condition	**Max Intensity**	**Min Intensity**	**Max Intensity**	**Min Intensity**
LED	**ON**	**OFF**	**ON**	**OFF**
V_{BE} using Multimeter				
V_{BC} using Multimeter				
State of Transistor	**Saturated**	**Cut off**	**Saturated**	**Cut off**

RESULT:

Title: Inverting & Non-Inverting amplifier using OP-AMP.

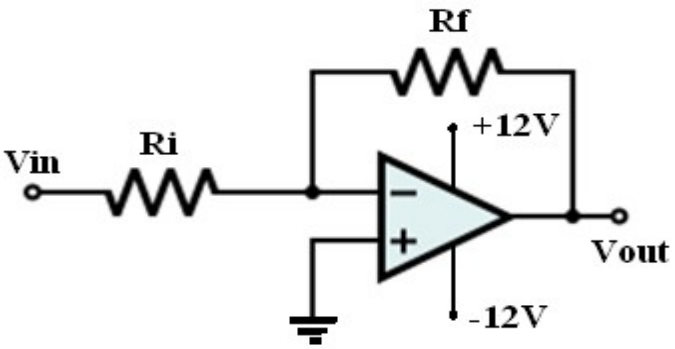
Aim: To design, build & study Inverting & Non-Inverting circuit using IC-741.

Apparatus: Multimeter (1), Bread board (1), connecting wires.

Components: IC-741(1), Resistor – etc.

A) Inverting Circuit –

1. **Circuit Diagram:**



2. **Formula: 1. Av = -Rf/Ri**

2. Vout = Av×Vin

3. **Observation Table:**

Obs. No	Vin(Volt)	Av=-Rf/Ri	Vout=Av×Vin(Volt)
1			
2			
3			
4			

4. **Theory:**

>Definition: Opposite is a diagram of an **INVERTING AMPLIFIER**. This means that if the voltage going into the 741 chip is positive, it is negative when it comes out of the 741. In other words it reverses polarity (inverts polarity).

Two resistors are needed to make the 741 work as an amplifier, Ri and Rf.

> How to calculate Gain and Vout :-

Example : if **Rf** is 100 kilo-ohm and **Ri** is 10 kilo-ohm the gain would be :

GAIN (AV) = -Rf / Ri.

-100 / 10 = -10 (Gain AV)

If the input voltage**(Vin)** is 0.5v the output voltage would be :

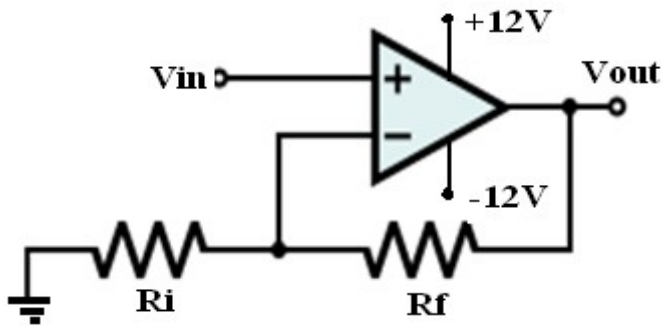
Vout = Av×Vin

-5V =-10 X0.5V

A negative input becomes a positive output.

B) Non-Inverting Circuit -

1. **Circuit Diagram:**



2. **Formula:** **1. Av = 1+ (Rf/Ri)**

2. Vout = Av×Vin

3. **Observation Table:**

Obs. No	Vin(Volt)	Av=1 + (Rf/Ri)	Vout=Av×Vin(Volt)
1			
2			
3			
4			

4. **Theory:**

> Definition: In a non-inverting amplifier, the output voltage changes in the same direction as the input voltage.

> How to calculate Gain and Vout :-

Example : if **Rf** is 100 kilo-ohm and **Ri** is 10 kilo-ohm the gain would be :

GAIN (AV) = 1+(Rf / Ri).

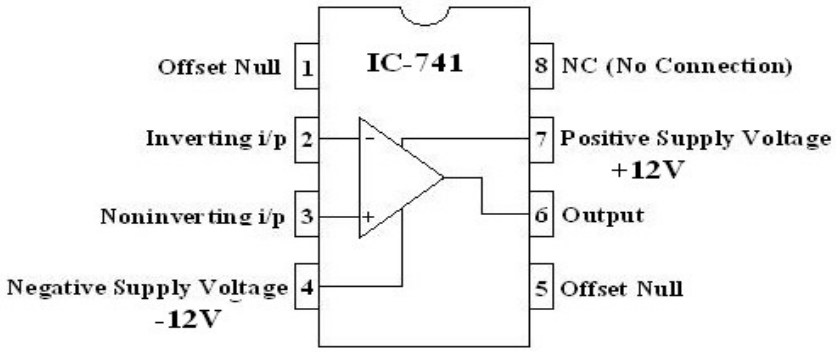
1 + (100 / 10) = 11 (Gain AV)

If the input voltage**(Vin)** is 0.5v the output voltage would be :

Vout = Av×Vin = 11X 0.5V=5.5V

A positive input remains a positive output .

C) Pin Diagram:



Result: Hence we build and studied Inverting and Non-Inverting using OP-Amp (IC-741).

Op-Amp. Adder and Subtractor

Aim: To study OP-Amp as a adder and subtractor

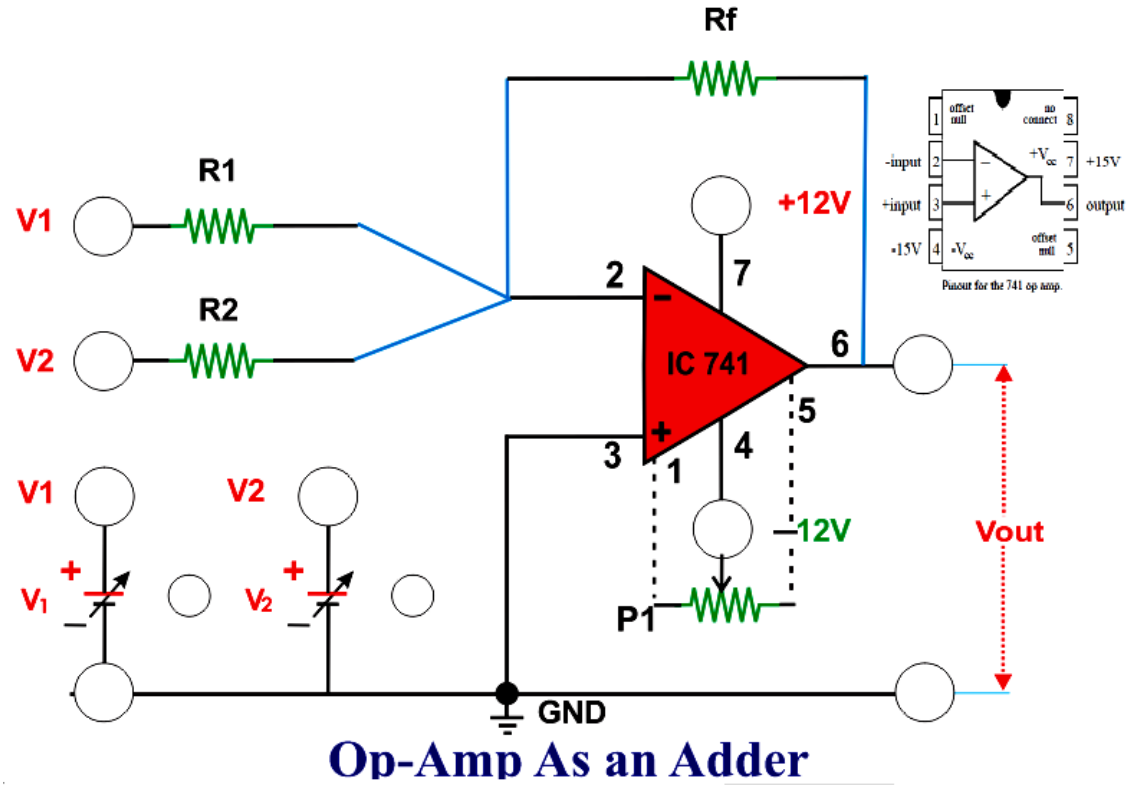
Objectives:

1. To study the operation of adder using Op-Amp.
2. To study the operation of subtractor using Op-Amp.

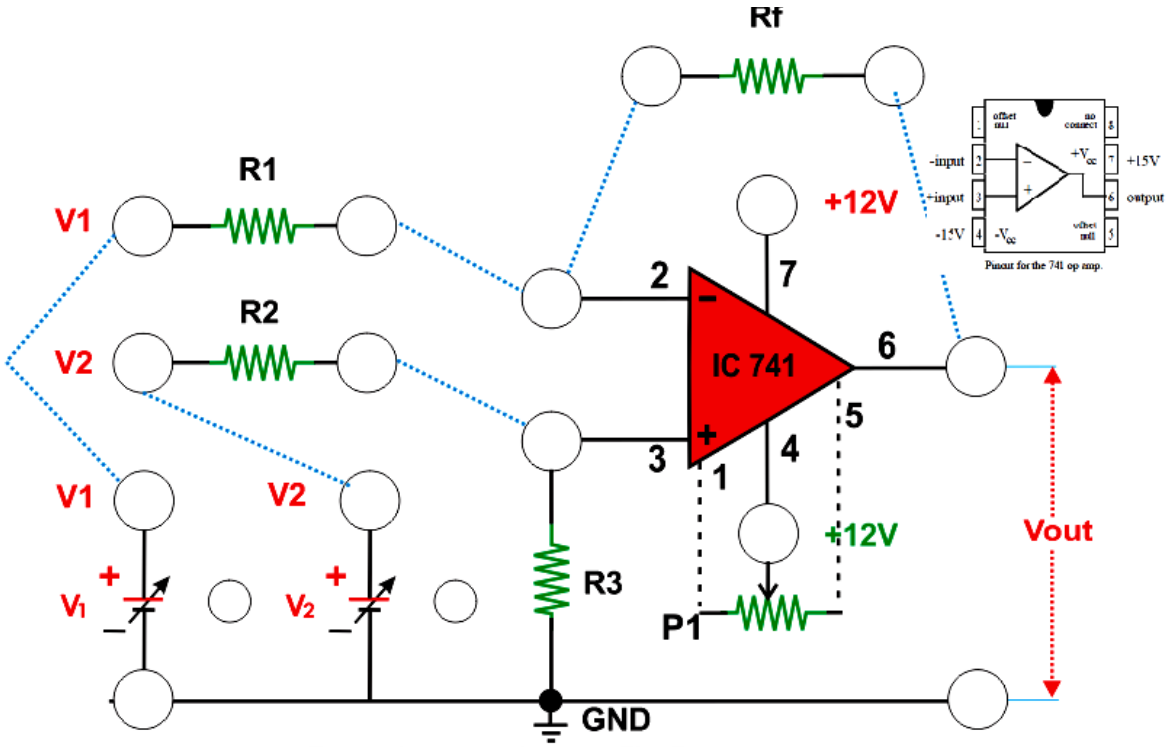
Components list:

Resistors R1=…Ω, R2=…Ω Rf=….Ω Op-Amp.IC741.

Circuit Diagrams:



Op-Amp As an Adder



Op-Amp As a Subtractor

Procedure:

1. Make the circuit connection according to the Fig.1.
2. Apply five combinations of known input voltages V1 and V2 and measure the corresponding output voltage Vo.
3. Note down the input voltages and output voltage in tabular form.
4. Then comment on the observations.
5. Repeat the same procedure for Subtractor. (Fig.2)

Observation table:

1.Adder using Op-Amp Circuit:

Obs.No.	Inputs in Volt		Output Vo in Volt	
	V1	V2	Vo (Obs.)	Vo (Cal.)
1				
2				
3				
4				
5				

2.Subtractor using Op-Amp Circuit:

Obs.No.	Inputs in Volt		Output Vo in Volt	
	V1	V2	Vo (Obs.)	Vo (Cal.)
1				
2				
3				
4				
5				

Conclusion:

Calculation:

For Adder Circuit

$$Vo = -\ Rf\left(\frac{V1}{R1} + \frac{V2}{R2}\right)$$

if Rf=R1=R2=R then

$$Vo = -(V1+V2)$$

For Subtractor Circuit

$$Vo = Rf\left(\frac{V1}{R1} - \frac{V2}{R2}\right)$$

if Rf=R1=R2=R then

$$Vo = (V2 - V1)$$

Title: Flash ADC using discrete components.

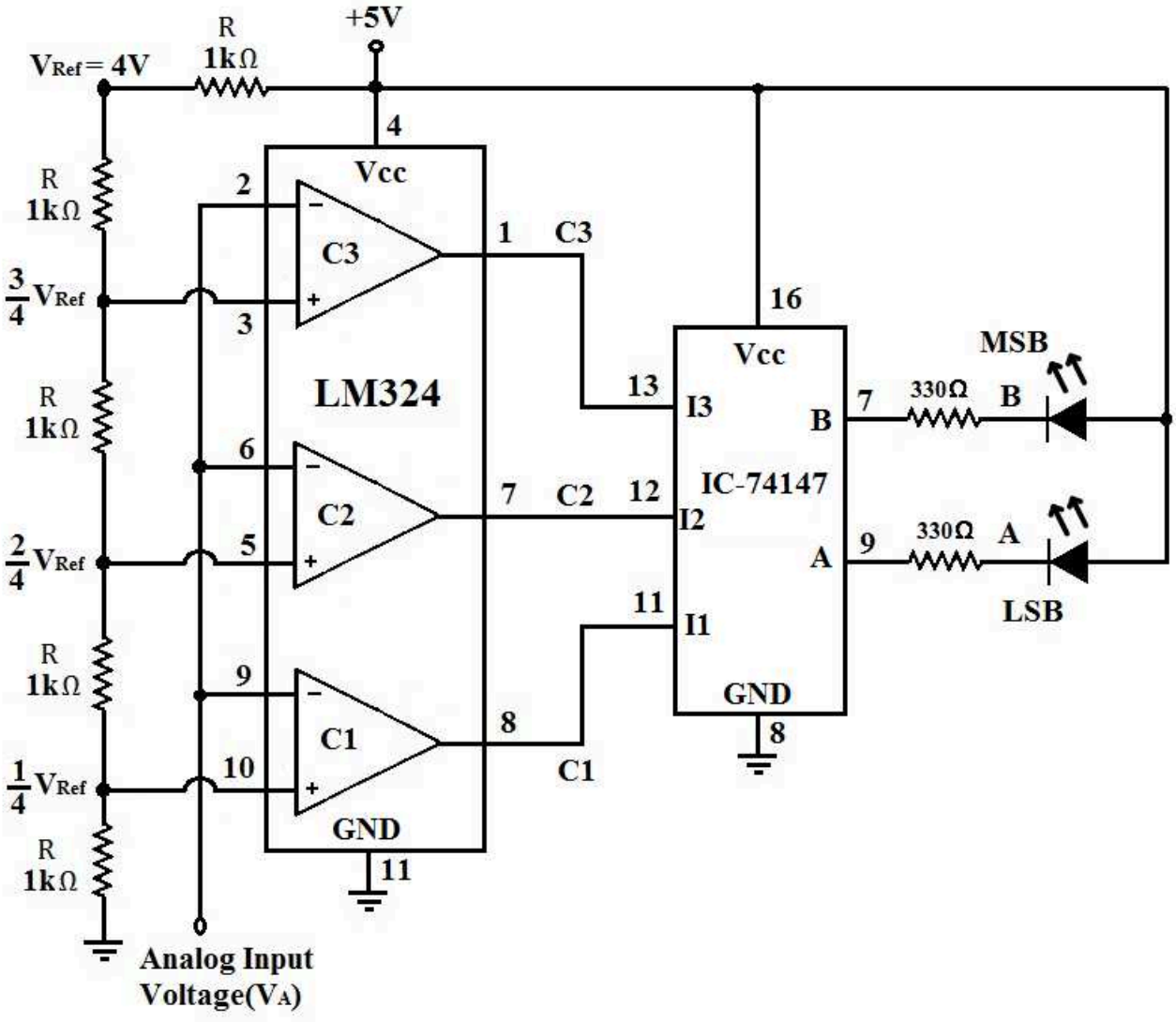
Aim: To build and study 2-bit Flash ADC using discrete components.

Objectives: To build and study 2-bit Flash ADC using op-amp and priority encoder.

Components: ICs: LM 324(1), 74147 (1)
Resistors: R =1kΩ (5), 330Ω (2)
LEDs (2),

Instruments: Variable DC power supply, wires.

Circuit Diagrams:

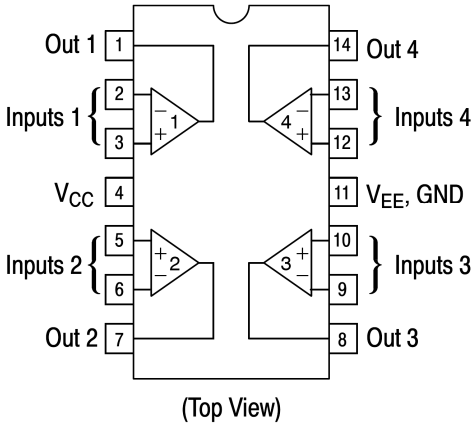


Observation Table:

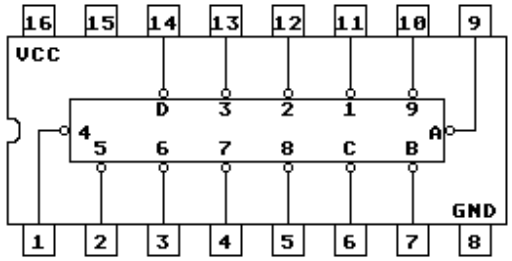
Ob. No.	Analog Input Voltage in Volts	Output of comparators			Digital Output	
	V_A	C3	C2	C1	B	A
1.	$V_A < 1$	1	1	1	0	0
2.	$1 \leq V_A < 2$	1	1	0	0	1
3.	$2 \leq V_A < 3$	1	0	0	1	0
4.	$3 \leq V_A$	0	0	0	1	1

Pin-out Diagrams:

LM-324: Quad Operational Amplifier



IC 74147: 10-line to 4-linePriority Encoder



Truth table of IC 74147:

Inputs									Outputs			
1	2	3	4	5	6	7	8	9	D	C	B	A
H	H	H	H	H	H	H	H	H	H	H	H	H
X	X	X	X	X	X	X	X	L	L	H	H	L
X	X	X	X	X	X	X	L	H	L	H	H	H
X	X	X	X	X	X	L	H	H	H	L	L	L
X	X	X	X	X	L	H	H	H	H	L	L	H
X	X	X	X	L	H	H	H	H	H	L	H	L
X	X	X	L	H	H	H	H	H	H	L	H	H
X	X	L	H	H	H	H	H	H	H	H	L	L
X	L	H	H	H	H	H	H	H	H	H	L	H
L	H	H	H	H	H	H	H	H	H	H	H	L

Results: 2-bit Flash ADC using discrete components is built and studied.

CRYSTAL OSCILLATOR

Aim: To Study Crystal Oscillator**.**

Apparatus: 1. Experimental trainer kit

2.CRO

3.Patch cords.

4.DMM

Theory:

The colpitts oscillator can be modified by using the crystal to behave like an inductor. The circuit is called as pierce oscillator. The crystal behaves as an inductor for a frequency slightly higher than the series resonance frequency Fs. The capacitor Cc1 required in the circuit along with the crystal to bring the effect of colpitts oscillator circuit and inductor is replaced by the crystal which behaves like inductor the basic working principle of pierce oscillator circuit is same as that of colpitts oscillator.

The resistance R1 , R2,Re and DC bias while the capacitor. Rfc provides isolation between AC and DC operation Cco and Cc2 are coupling capacitors. The resulting circuit frequency is set by series resonant frequency of the crystal on the circuit operating conditions and hence stability is obtained.

Calculation: Example:-

T=0.2us

Practically,

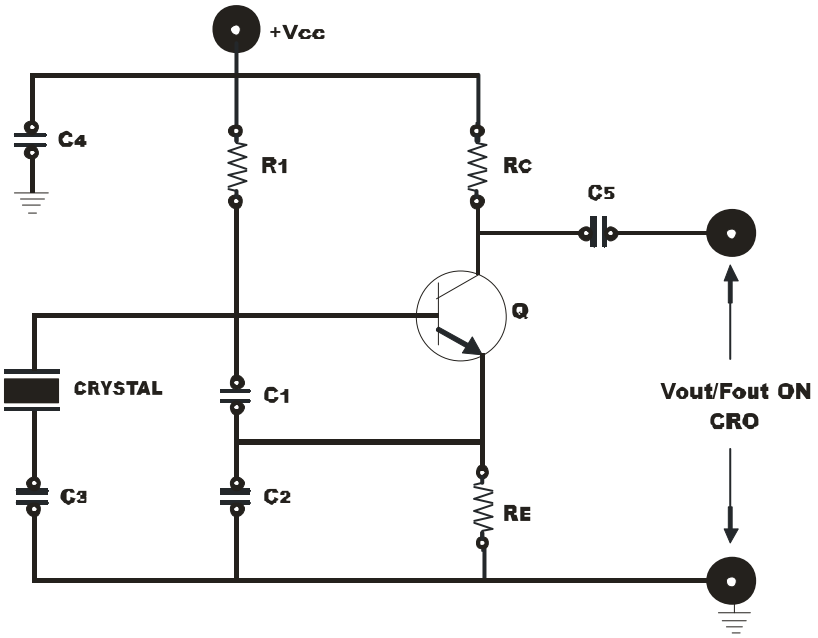
F=1/ T

Theoretically, F= 4.33 MHz.

Operating Procedure:-

1. Trace the given circuit.
2. Connect the CRO at the Output.
3. Adjust the voltage at +Vcc between 1V to 1.8 Volt with the help of adjustable POT & get the maximum undistorted output on CRO.
4. Verify the theoretical & Practical frequency of Oscillator.

Circuit Diagram:-



Conclusion:----------

STUDY OF COMPONENTS

Aim: *Finding values of Electronic components like resistors from color code, capacitors, inductors and their types.*

Objectives: *1. To identify the given components.*
2. To draw the circuit symbol.
3. To find technical specifications.
4. To write their observations.

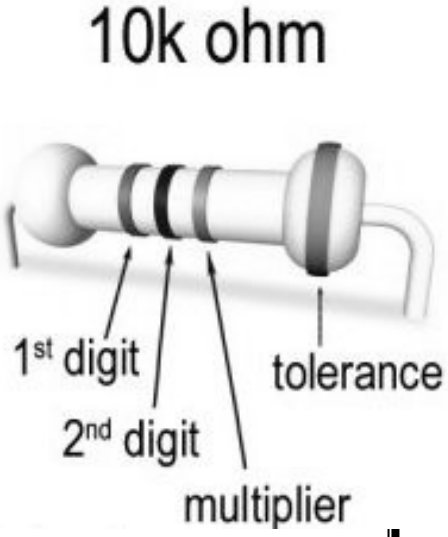
Apparatus: *Multimeter, Connecting wire, Bread borad, etc*

Components : *Resistors, Capacitors, Transformer, Diode, LED, Transistor Components: Resistor, Capacitor, Inductor, Transformer, Transistor, Diode, LED,IC, IC-base, Relay, Seven-segment, Potentiometer, etc.*

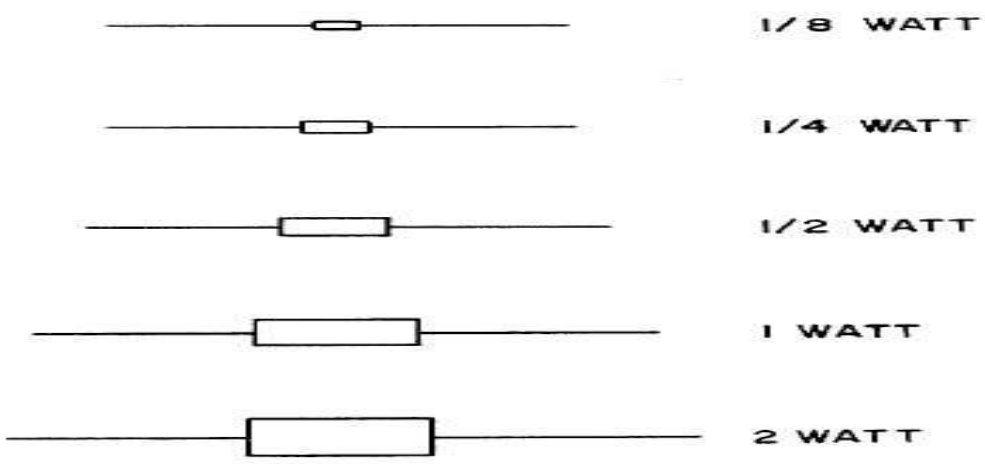
Resistors

Basic theory: *It is use to oppose the flow of current flowing through it. Resistor is made-up of carbon, on which different colour band will be used to identify its value. Following table will be used to find its value.*
Colour Code Chart

Color Name	1st digit 1st stripe	2nd digit 2nd stripe	Multiplier 3rd stripe	Tolerance 4th stripe
Black	0	0	x1	-
Brown	1	1	x10	1%
Red	2	2	x100	2%
Orange	3	3	x1,000	3%
Yellow	4	4	x10,000	4%
Green	5	5	x100,000	-
Blue	6	6	x1,000,000	-
Violet	7	7	-	-
Grey	8	8	-	-
White	9	9	-	-
Gold	-	-	x0,1	5%
Silver	-	-	x0,01	10%



Wattage: *Is the value of total power (product of Voltage & Current) which is handling by specific resistor preciously.*



3. **Type***: There are two type of resistors Fixed (whose value remain fixed i.e. not changed) and variable type (whose value can be adjust as per requirement)*

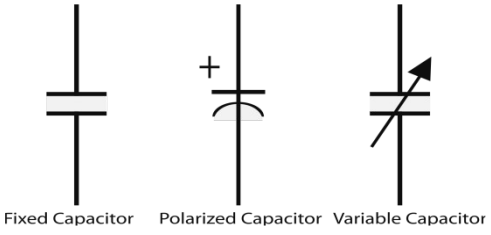
Fixed type: *Variable type:*

Observation table:-

Obs. No.	Type	Symbol	Specified value	Value using multimeter	Tolera-nce	Watt-age
1	*Fixed value-1*					
2	*Fixed value-2*					
3	*Potentiometer-1*					
4	*Potentiometer-2*					

Capacitor

*1***. Basic theory***: Capacitor is a component which holds the charge (+ve and -ve). The value of capacitor depends on 1. Area of conducting plate,*
2. Distance between the plate and
3. Type of insulator used.
2. Symbol :



3. **Type***: Type of capacitor (fixed): Depending upon use of insulator, capacitor can be classify as ceramic capacitor, mica capacitor, paper capacitor, electrolytic capacitor, etc.*

4. **Observations***: On some capacitors the value is shown as a straight number (4.7pF) On others the decimal point is replaced with the first letter of the prefix (4p7 = 4.7pF)*

Prefix	Abbr.	Multiplier
pico	p	10^{-12}
nano	n	10^{-9}
micro	μ	10^{-6}

1000 pico = 1 nano
1 nano = .001 micro
1000 nano = 1 micro

EXAMPLES:
223J = 22 x 10^3pF = 22nF = 0.022μF 5%
151K = 15 x 10^1pF = 150pF 10%

Code	*Picofarad (pF)*	*Nanofarad (nF)*	*Microfarad (uF)*
100	*10*	*0.01*	*0.00001*
150	*15*	*0.015*	*0.000015*
220	*22*	*0.022*	*0.000022*
330	*33*	*0.033*	*0.000033*
470	*47*	*0.047*	*0.000047*
331	*330*	*0.33*	*0.00033*
821	*820*	*0.82*	*0.00082*
102	*1000*	*1.0*	*0.001*
152	*1500*	*1.5*	*0.0015*
202	*2000*	*2.0*	*0.002*
502	*5000*	*5.0*	*0.005*
103	*10000*	*10*	*0.01*
683	*68000*	*68*	*0.068*
104	*100000*	*100*	*0.1*
154	*150000*	*150*	*0.15*
334	*330000*	*330*	*0.33*
684	*680000*	*680*	*0.68*
105	*1000000*	*1000*	*1.0*
335	*3300000*	*3300*	*3.3*

Obs. No.		Type	Symbol	Specified value	Operating temp.	Polarity
1	*Fixed value-1*					

2	*Fixed value-2*					
3	*Fixed value-3*					
4	*Fixed value-4*					

Transformer

Theory*: Transformer=Transfer + energy (without physical contact). In transformer there are two coils which are insulated from each other. Number of turns (i.e. wounding) in secondary coil decide the working of transformer. For example if no. of turns in 2ndary is less then primary then that transformer is called as step-down transformer and if no. of turns in 2ndary is greater then primary then that transformer is called as step-up transformer. Transformer works on mutual inductance of coil.*

Symbols*:*

1. Step up:- *2.Step down:-*

Observaion Table:

Type	*Secondary voltage range*	*Primary resistance*	*Secondary Resistance*

Diode

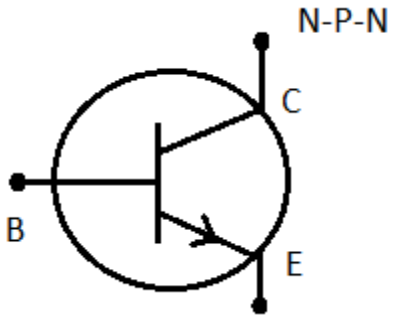
Observation Table:

Type	*Symbol*	*Application*	*Forward Resistance*	*Reverse Resistance*

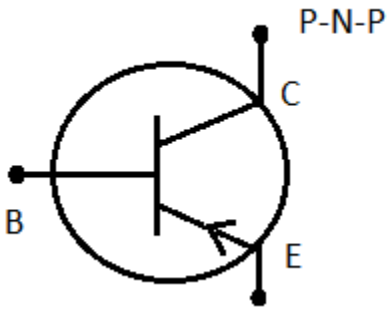
Transistors

For a given transistor identifying the type & find it's specification.
Symbols:

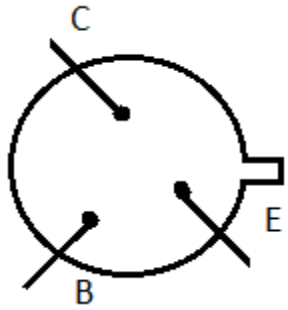
1. N-P-N transistor -



2.P-N-P transistor-



Pin specification of transistor-



Observation Table:

Type	*Label*	*Equivalent circuit*	*hfe value from multimeter*

Result:-

The result various electronic components are studied & their technical information, specifications.