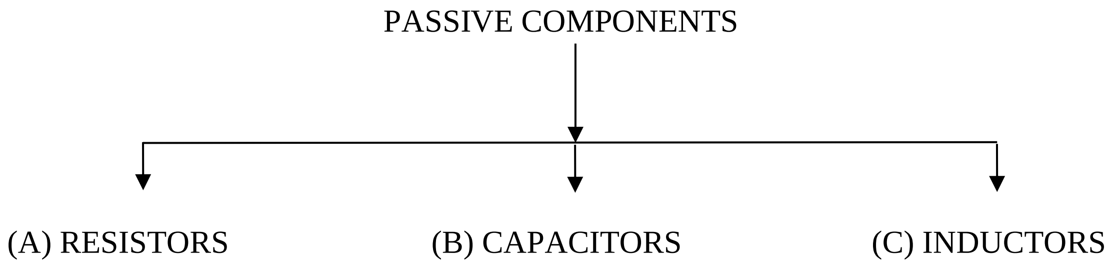
Experiment No: 1
Title: **STUDY OF ACTIVE & PASSIVE COMPONENTS**
Date of Performance:
Name of the student:
Roll No: **Division:**
Signature of Teacher:

EXPT. NO. : 1

STUDY OF ACTIVE & PASSIVE COMPONENTS.

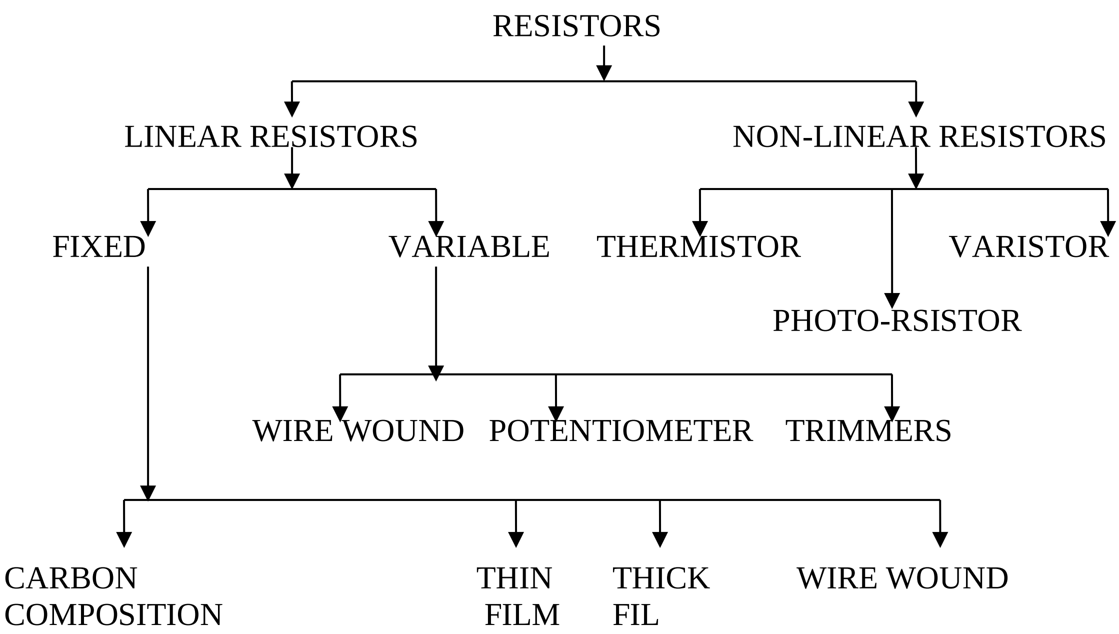
Aim: To study various Electronics components.

Theory: Passive components are the elements which do not introduce gain or do not have a directional function and are not capable of amplifying or processing an electrical signal.
They are classified as follows:



(A) RESISTORS

i) Resistance means opposition to the flow of current.
ii) Resistors provide electrical resistance.
iii) Resistors are used to reduce current to a specific value or to provide desired voltage drop.
iv) They are specified in terms of their resistance values, tolerances, power ratings and thermal stability.
v) Resistor is denoted by R and its unit is Ω.
vi) Resistors are classified as follows:



Linear Resistors

The resistors through which current is proportional to applied voltage are called linear resistors.
Types of linear resistors,

1. Fixed Resistors

The resistors whose values do not change with variation in applied voltage, temperature and light intensity are fixed resistors. They are in various shapes and sizes.
Types of fixed resistors,

a) **Carbon composition**

- They are made by mixing powder and insulating binder.
- They are also obtained through special techniques.
- There are two leads at the end provided for soldering.

b) **Thin Film**

They are made by depositing very thin layer of conducting material on an insulating rod which is made up of ceramic or glass.

i) Carbon film

It has good stability, wide operating frequency range, low noise.

ii) Metal Film

- Tolerance from + - 0.025 % to 2% of desired value.
- They are made by depositing a thin layer of metal on ceramic.

c) Thick Film

- They are made similar to thin film resistors.
- They also have similar properties.

i) Metal oxide film

- They are made by oxidizing the chloride on heated glass.
- Low noise, good temperature stability, high voltage ratings.

ii) Bulk property film

- They are made by metal film available from + - 0.1% to 1%.
- Low noise, virtually non-inductive.

iii) Cement film

They are made by placing coating of metal alloy along with insulating material on a ceramic substrate.

d) Wire Wound Resistors

- They are made by winding resistive wire on ceramic film.
- It is coated with insulating material.

- They are costly, excellent electrical properties.
- They have low noise, good time stability, good overload, suitable for use d.c.

2. Variable Resistors

- Resistors are used to control current and provide desired voltage.
- Resistors whose resistance values can be varied from 0 to specific value.
- Use to limit current in lamp and to vary gain.

Types of variable Resistors-

a) Wire-Wound Resistors

- They are made up of nichrome wire wound on ceramic core covered with insulating coating.
- Outer terminal is fixed and middle is variable.
- Variation is provided by wiper connected to control shaft.
- They are used as voltage divider, rheostat.

b) Potentiometer

- It is used to control voltage.
- Resistive element of potentiometer is made from material such as Carbon compositions, carbon film, cement wire.
- They have low cost, long life, low noise, good reliability, used as Volume.

c) Trimmers

- They are used to trim the circuit to required operating condition by inserting small screw drivers into slot and turning one/more times.
- They are available in both single and multiturn.

Non-Linear Resistors

They are made from semiconductor materials possessing conductivity.
Types of Non Linear Resistors-

a) Thermistors

- The word thermistor is a acronym for thermal resistance i.e. temperature resistor.
- These are of two types,

i) **NTC** (Negative Temperature Coefficient)
As resistance increases, temperature decreases and vice versa.

ii) **PTC** (Positive Temperature Coefficient)

- As resistance increases, temperature increases and vice versa.
- They are made up in the form of Beds, probes, disc, washers.
- They are used in high power application.
- They are used in industries, commercial, medical, house hold application,

temperature measurement and control, time delay circuit.

b) Variastor (variable Resistor)

- These voltage dependent resistor used to protect circuitory from high energy voltage transient called surge by rapidly changing from high standard by resistance to low conducting resistance.
- Current suddenly jumps, so sudden increase damage the circuit.
- They are available in variety of packages.

c) Photo-resistor

- They are also called photo-conductive cells.
- They are made up from semiconductor material like CdS (cadmium sulphide),CdSe(cadmium selenide), PbS(Lead sulphide).
- If the amount of light falling on surface is greater, greater will be current flow, and lower will be resistance.
  R α 1 / light.
- They are used in light meter, kight activated relay control circuit.

Resistance Designation

- Resistance values are printed on body of it used for industrial / Consumer resistors.
- Resistance values are printed on body as series of numbers and letter R.
- Also they are printed on body as a code using colour band.

Colour Code Table:

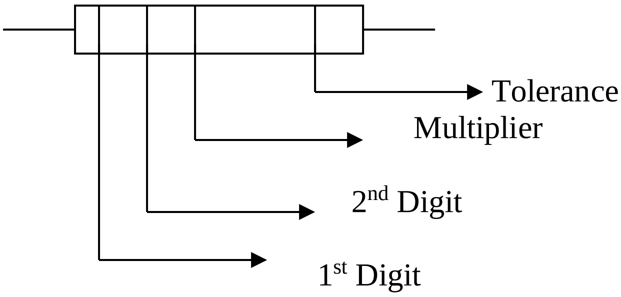
Colour	**1st Band**	**2nd Band**	**3rd Band Multiplier**	**4th Band Tolerance**
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold			0.1	+ - 5 %
Silver			0.01	+ - 10 %
No Colour				+ - 20 %

Resistors are available in several series of fixed decade values, the number of values provided with each series being governed by the tolerance involved in order to cover the full range of resistance values.

- Tolerance will be necessary to provide six basic values (known as E6 series).

- More values will be required in series which offers a tolerance of + - 10 % and consequently E12 series provides number less than 24 basic values and as with E6 and E12 series, decade multiples of basic series.

Nearest value from E24 series is 51 KΏ , which will actually produce a current of 98 µA.If the resistor of + - 5 % tolerance is used, the current will be within range 93 µA to 103 µA.



Factors which must be considered while selecting a resistor for a particular application normally include,

a. The required value of resistance expressed in Ώ , K Ώ or M Ώ.
b. The desire accuracy or tolerance (quoted as maximum pennissible percentage deviation from marked value) should have close tolerance.
c. The power rating which must be equal to or greater than maximum expected power dissipation.
d. The temperature co-efficient of the resistance (usually expressed in ppm, per unit temperature change.
e. It should have high stability.
f. Noise performance should be low.

Hints and Tips

1. Resistors should be rated at high temperatures and should be operated at well below their normal maximum power dissipation where reliability is required.
2. At much higher frequencies carbon and metal film resistors suffer.

(B) CAPACITORS:

Capacitors are basically two parallel metal plates separated by insulators. This insulator is called the dielectric. Types of capacitors are ceramic, mica, polyster, paper, air capacitor. It can be charged up & store electricity. The full charged capacitors can be discharge via resistor to limit the discharge current.D.C. can’t flow through capacitor since dielectric forms an open circuit. Capacitors are usually marked with their values measured in Farad. Most of capacitors are in µF, nF, or pF. They are often marked with their maximum voltage. The voltage across the terminals should not exceed this value. Some capacitors such as electrolytic & tantalum are polarized. They must be fitted the cored way round. They are marked to indicate polarity.

Types of capacitors

Depending on the geometrical shape of conducting surface, types of capacitors are parallel plate, co-axial, cylindrical, concentric spherical capacitor etc. According to nature of dielectric there are different type of capacitors.

1. **Paper capacitor**

In this type , a capacitor consist of long strip of metal foils of tin or aluminium, interleaved with parallel paper and rolled into a compact size. These capacitors are mainly used in power supplies for filtering purpose.

2. **Air capacitor**

In this type, a capacitor consists of number of parallel fixed & moving metallic vanes. Its capacitance can be changed by varying the position of moving vanes with respect to the fixed vanes. Such capacitors are used in frequency radio work.

3. **Mica capacitor**

Capacitors with alternate layer of mica & metal foil damped tightly together may be used for greater accuracy & high voltage. But it is more expensive. Mica capacitors are used in high frequency radio & electronic circuit where compact size is necessary. A thin wafer of mica with silver deposited on both side form such capacitors.

4. **Ceramic capacitors**

It has metallic coatings (of silver) on the opposite faces of thin disc or plate of ceramic material like Barium, Titanate, Hydoous silicate of magnesia of talk. Its application are similar to the Mica capacitor.

5. **Polycarbonate capacitors**

This type is of recent origin & consists of a film of carbonate metalized with aluminum rolled into a compact size.

6. **Electrolytic capacitors**

It consist of two aluminum foil separated with a material such as paper saturated with a suitable electrolyte like ammonium borate. The aluminum oxide film is formed on one of the foils by passing it through an electrolytic bath .This oxide film acts as dielectric.

APPLICATIONS

The main field of application is electronic circuit and filter circuit. However the reversible or non-polarized type electrolytic capacitors has been developed for the use in a.c. circuit & used with small signal phase induction motors. In variable capacitors values can be adjusted by controlling the amount of overlap of plates or the distance between them.

COLOUR CODE

Some values are indicated with a color code similar to resistors. A 2200 pF capacitor would have 3 red bands. These merge into one wide red band. Some values are marked in 'pF' using 3 digit number, The 1^{st} two digit are base number & the third digit is multiplier.
Example –
102 = 1000 pF & 104 = 100000 pF .
To find total value of capacitors in parallel their values are added & for serial connection following formula is used,

$$1 / C_{total} = 1 / C_1 + 1 / C_2 + - - - - 1 / C_n$$

In variable capacitors values can be adjusted by controlling the amount of overlap of plates or the distance between them.

Example – Band 1 : Orange   Band 2 : White
Band 3 : White   Band 4 : Brown

Colour	**Digit for band 1 & 2**	**Multiplier Band 3**	**Tolerance band < 10 pF >10 µF**		**Temp.Coefficient band**
Black	0	10 E -0	2 pF	20 %	0
Brown	1	10 E -1	0.1 pF		- 30 * 10E -6
Red	2	10 E -2	0.25 pF		- 80 * 10E -6
Orange	3	10 E -3	30 %		- 150 * 10E -6
Yellow	4	10 E -4	40%		- 220 * 10E -6
Green	5	10 E -5	2.5 pF		- 330 * 10E -6
Blue	6	10 E -6	0.25 pF		- 470 * 10E -6
Violet	7	10 E -7	1 pF		- 750 * 10E -6
Gray	8	10 E -8	+ 5%		30 * 10E -6
White	9	10 E -9	+10%	+10 %	+1
Gold	-	0.1		5 %	
Silver	-	0.01		10%	
No Colur	-	0.01		25 %	

(C) INDUCTORS:

An inductor is an electrical component with specific inductance. These are used in tuning & filter circuits. Also used in radio receivers as a built in antenna coil to peak up radio signals, in transformer & coupled circuits to transfer energy from one circuit to another.

It is also used to minimize the alternating current, while permitting flow of direct current. It is used for audio & radio frequency range. They are specified with inductance value & current capacity.

Types of Inductors

They are mainly of two types -

1**) Fixed Inductors**

They are of three types -

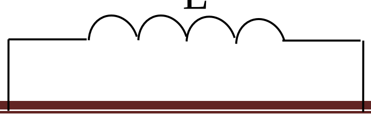
i) Air –core
ii) Iron –core
iii) Ferrite –core.

i) Air-core

It is made up at of coils at wire wound on a former made up of simple core board. The air core inductor has a very low value of inductance.

Symbol

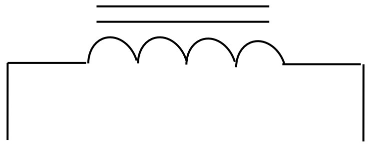
L



ii) Iron –core

It is made up of coils of wire wound on solid iron core. The iron core is laminated to avoid eddy current loss.

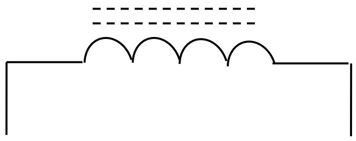
Symbol



iii) Ferrite –core

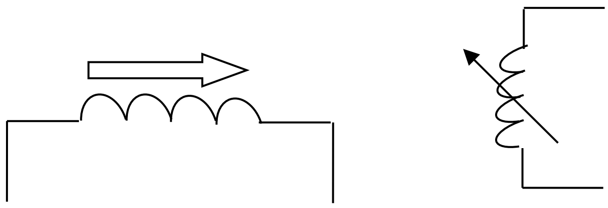
It is made up of coils of wire wound on ferrite core. A ferrite is a magnetic material consisting of fine particles of iron. It has very low eddy current loss.

Symbol



2. Variable Inductors

These are similar to fixed ferrite core inductors. But core is adjustable. It is used in tuning and filter circuits.



TRANSFORMER

A device that uses the principal of mutual induction to convert alternating current in the primary windings into alternating current with voltage and current of a different value in the secondary windings. Basic type of transformer -

1) Step up transformer
2) Step down transformer

1) Step up transformer

A transformer that increases voltage from primary to secondary (more secondary winding turns than primary winding turns) is called a *step-up* transformer.

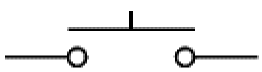
Fig.

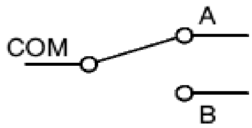
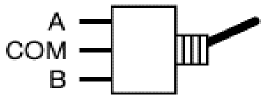
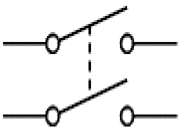
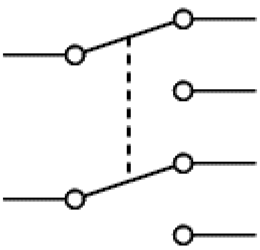
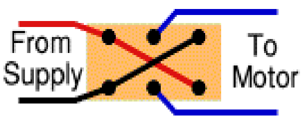
2) Step down transformer
A transformer that decreases voltage from primary to secondary (less secondary winding turns than primary winding turns) is called a *step-down* transformer.

Fig.

SWITCHES:

The term "switch" typically refers to electrical power or electronic telecommunication circuits. In the simplest case, a switch has two pieces of metal called contacts that touch to make a circuit, and separate to break the circuit. There are different types of standard switches used in electronics.

Type of Switch	Circuit Symbol	Example
1) ON-OFF Single Pole, Single Throw = SPST - A simple on-off switch. This type can be used to switch the power supply to a circuit.		 SPST toggle switch
(ON)-OFF Push-to-make = SPST Momentary - A push-to-make switch returns to its normally open (off) position when you release the button, this is shown by the brackets around ON. This is the standard doorbell switch.		 Push-to-make switch

ON-(OFF) Push-to-break = SPST Momentary- A push-to-break switch returns to its normally closed (on) position when you release the button.		 Push-to-break switch
2) ON-ON Single Pole, Double Throw = SPDT - This switch can be on in both positions, switching on a separate device in each case. It is often called a **changeover switch.** A SPDT toggle switch may be used as a simple on-off switch by connecting to COM and one of the A or B terminals shown in the diagram. **ON-OFF-ON SPDT Centre Off-** A special version of the standard SPDT switch. It has a third switching position in the centre which is off. Momentary (ON)-OFF-(ON) versions are also available where the switch returns to the central off position when released.	 	 SPDT toggle switch  SPDT slide switch (PCB mounting)  SPDT rocker switch
3) Dual ON-OFF Double Pole, Single Throw = DPST- A pair of on-off switches which operate together, DPST switch is often used to switch mains electricity because it can isolate both the live and neutral connections.		 DPST rocker switch
Dual ON-ON Double Pole, Double Throw = DPDT- A pair of on-on switches which operate together (shown by the dotted line in the circuit symbol). A DPDT switch can be wired up as a **reversing switch** for a motor as shown in the diagram. **ON-OFF-ON DPDT Centre Off -** A special version of the standard SPDT switch. It has a third switching position in the centre which is off. This can be very useful for motor control because you have forward, off and reverse positions. Momentary (ON)-OFF-(ON) versions are also available where the switch returns to the central off position when released.		 DPDT slide switch  Wiring for Reversing Switch

OBSERVATION :

1) Calculation of Resistor using colour coding:

Sr. No	Colours	Values /Multiplier	Theoretical Value	Practical value

2) Calculation of Capacitor using number coding:

Sr. No	Code	Values /Multiplier	Capacitor Value

Conclusion:

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Teacher's Sign

Experiment No: 2
Title: Study of Different Electronic Measuring Instruments
Date of Performance:
Name of the student:
Roll No: **Division:**
Signature of Teacher:

EXPT. NO. : 2

DIFFERENT ELECTRONIC MEASURING INSTRUMENTS

OBJECTIVE :

a. To study different controls of DMM & measurement of Parameters like AC& DC voltage, current, Resistance, checking of diode, BJT etc.

b. To study controls of CRO, measurement of frequency, AC, DC voltages also obtain the phase shift between to signals using CRO with the help of Lissagous pattern.

c. To study various controls of signal generator.

APPARATUS :

1. Digital multimeter with probes
2. Sample resistor ,diode ,transistor
3. Signal generator
4. CRO with probes

THEORY :

Advantage and features of DMM

1. DMMS have improved the accuracy, stability and versatility of older analog meters.
2. Low cost, portable and easier to use than analog meters.
3. Auto ranging facility – Some of the DMMs select the correct range for displaying the measured with maximum number of significant digits.
4. Auto-polarity selection: It enables the instrument to read either polarity of voltage or current or display the polarity.
5. Overload protection: Protection against the excessive measured.

BLOCK DIAGRAM OF DMM:

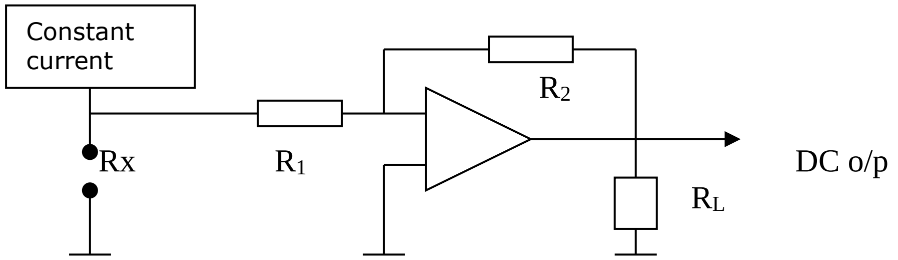
BRIEF DESCRIPTION OF BLOCK DIAGRAM:

DC Voltage attenuator:

The DC signals that can be handled by the input of an A/D converter are in general limited to less than 10V. This means that DC voltages of more than 10V have to be attenuated in the input stage of a DMM before they can be passed on to the ADC.

Resistance to voltage converter:

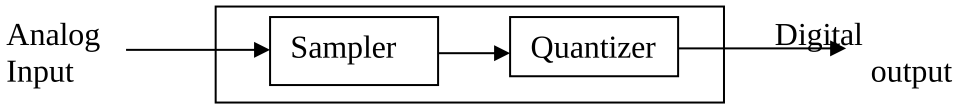
Resistances are measured by passing a constant current through unknown resistance Rx and then measuring voltage across it. A possible circuit is shown below.



In this case the input voltage to the OP-AMP is constant, while the output voltage is Rx (Vin/R1) that is proportional to Rx.

Analog to digital converter (ADC):

The function of ADC is to convert the analog input signal into discrete number of steps that can easily be counted and presented in decimal form on a numerical display.



RMS and TRUE RMS measurement:

Most DMMs rectify ac and measure the average of the rectified ac waveform. The value is converted in rms value for display by scaling the result by a factor of 1.11 (ratio of rms to average for sine waveform).

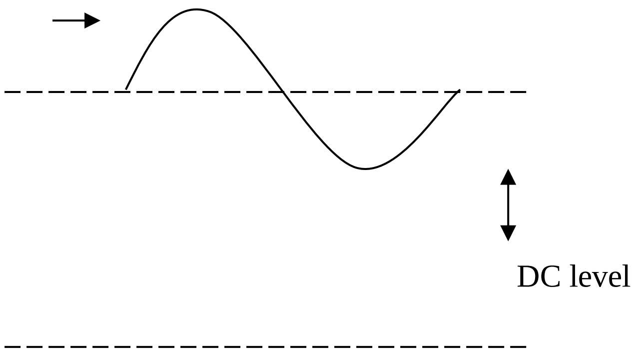
Bandwidth of the meter:

The ac voltage measurements are inaccurate if the input signal frequency is not within the limits of bandwidth of the meter.

Composite voltage measurement:

When a signal comprising of AC and DC components as shown in the following figure is measured with multimeter, the meter reads only the dc portion only in the dc voltage range and it measures the AC portion (RMS value) in the AC voltage range.

AC waveform



DIGITAL MULTIMETER SPECIFICATION:

Resolution: Resolution can be expressed by the number of digits, which can be displayed or it can be expressed as the smallest difference in voltage, current or resistance that the meter can display.

The number of digits shown on the DMM is expressed as mixed number as 3½ or 3¾ or 5½ etc. For eg. The fraction ½ indicates that MSD can be either 0 or 1, a ¾ indicates the MSD can either be 0,1 or 3. A 3¾ display can show the number from 000 to 3999 or 1 part in 4000 or .025%.
Resolution of DMM depends upon the resolution of A/D converter used within it.

Accuracy:

Accuracy is specified as a percentage of the reading plus or minimum a number of counts to reflect the behavior of the circuit. Accuracy specification depends upon the type of measurement as well as the range of measurement.

Sensitivity:

It is the ratio of output response to the input cause under static condition. It is related to the lowest range available for a given function. It can be expressed as division per volt or millimeter per volt.

Response Time:

It is the time required for the meter to respond to an input signal change. It is dependent on A/D conversion time and setting time. For automatic measurement, it is an indication of how many readings can be taken per second (measurement rate).

Fuses and batteries used in DMM:

Large current surges from overloads or short circuits can lead to component destruction or electric shocks in DMM. To guard the DMM a fuse is used.

Battery:

The battery used in DMM is generally a high-power zinc carbon battery of 9 volts. Zinc carbon batteries are commonly used because of their low cost and general application capability. The quantity termed as capacity of a battery indicates the number of ampere-hours (A-h).

B. CATHODE RAY OSCILLOSCOPE

THEORY: The cathode ray oscilloscope (CRO) is a very useful and versatile laboratory instrument used for display, measurement and analysis of waveforms and other phenomenon in electrical and electronics circuits.

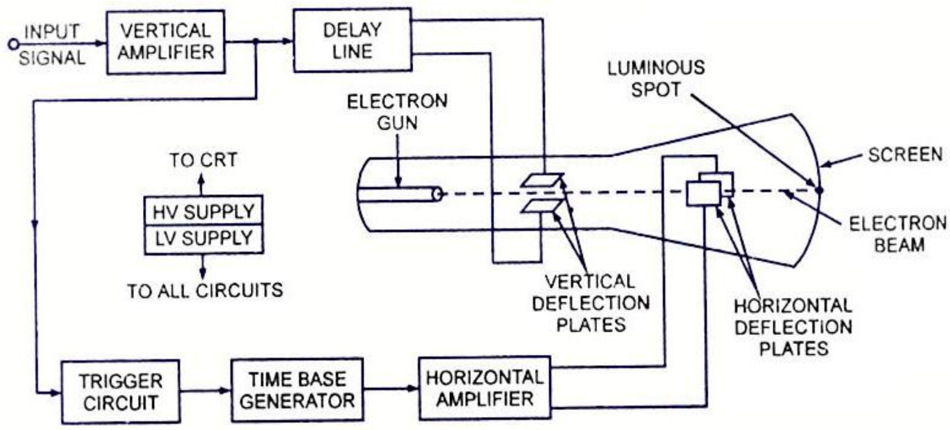


Fig.1*: Block diagram of CRO*

CRO Operation:

A simplified block diagram of a typical oscilloscope is shown in Fig. 1. The signal to be displayed is amplified by the vertical amplifier and applied to the vertical deflection plates of the CRT (cathode ray tube). A portion of the signal in the vertical amplifier is applied to the **sweep trigger** as a triggering signal.

MEASUREMENTS USING OSCILLOSCOPE:

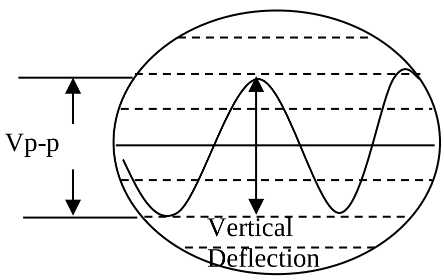
1. **Voltage Measurement :**

When voltage is applied to the vertical input, the height of the vertical deflection of the displayed trace combined with the setting of the V / Div switch yields the peak-to-peak voltage of the input signal.

We can get

$$V_P = \frac{V_{P-P}}{2}$$

$$V_{rms} = V_p/\sqrt{2} = V_{P-P}/2\sqrt{2}$$



2. **Current Measurement :**

Indirect measurement of current can be made by passing the current through a known resistor and measuring the resulting drop across it.

3. **Time Measurement :**
   In the triggered sweep mode, the time-base circuit is used to provide sweep waveforms with various values of sweep times (s / div.).

4. **Frequency Measurement :**
   For a periodic waveform time period T is the time of one cycle. By measuring T using time measurement we can compute frequency by
   f = 1/T

5. **Phase Measurement:**
   Phase measurement can be done with:
   1. Triggered Sweep Mode
   2. Lissagous Figures

   For exact details, the books discussing oscilloscope in detail should be referred. (e.g. Student Reference Manual – Stanley Wolf-Rechard F. M. Smith)

OPERATING THE OSCILLOSCOPE

Manufacturer **:** APLAB
Model No. **:** 3305

1. **FIRST TIME USE SETTINGS**
   SET CONTROLS AS FOLLOWS

POWER ON	: Switch in ON Position.
INTENSITY	: Mid Position.
FOCUS	: Mid Position.
ATTENUATOR CH1/CH2	: 50mV/div.
VERTICAL SHIFT CH1/CH2	: Mid Position.
dc /ac	: dc (Released Position).
GND	: gnd (Pressed Position).
ALT/CHOP	: ALT.
DUAL/MONO (X-Y)	: MONO (X-Y).
VARIABLE	: CAL Position (Fully anticlockwise).
LEVEL	: Mid Position.
AUTO/NORMAL	: AUTO (Released Position).
CH1/CH2	: CH1 (Released Position).
INT/EXT	: INT (Released Position).
+/-	: + (Released Position).
ac/dc	: ac (Released Position).
TV	: Released Position.
LINE	: Released Position.

SWP / X-Y	: SWP (Released Position).
HORIZONTAL SHIFT	: Mid Position.
CT	: Released Position.

2. SETTING UP FOR COMPONENT TESTING OPERATION

1. Press in CT push switch.
2. Set input coupling switch of both channels in ‘gnd’.
3. Set both attenuators of CH1 & CH2 in 5mV/div range.
4. Set DUAL/MONO switch in MONO position.
5. Adjust horizontal shift control, if necessary, to bring the traces to the middle of display area.
6. Connect the CT leads to the component under test.
7. Adjust vertical shift controls suitably for visualizing the displays.

C.SIGNAL GENERATORS
AC SIGNAL SOURCES

A function generator is a signal source that has capability of producing several different types of waveform at its output signals. Most function generators can generate sine waves, square waves and triangular waves over wide range of frequencies. (0.001Hz to 20MHz)

BLOCK DIAGRAM OF FUNCTION GENERATOR:

Specification of function generator:

1.**Frequency range**: This is the upper and lower frequency limits of the output signal which the generator can supply.

2. **Output voltage** :It specifies the type of output waveform and the output voltage range the generator can supply.

3. **Accuracy and dial resolution**: Accuracy of the generator specifies how closely the output frequency corresponds to the frequency indicated on the dial. Dial resolution indicates to what percentage of the output frequency value the dial setting can be read.

4. Amplitude and frequency stability: Amplitude stability is a measure of an oscillator's ability to maintain constant voltage amplitude with change in the frequency of the output signal.

5. Waveform distortion: It specifies how closely the sinusoidal output waveform of the Function generator resembles a pure sine wave. It is specified in %.

6. Output impedance : It specifies the output impedance of the function generator which

generally matches with the characteristic impedance of the co-axial cable in RF circuits or the

characteristics impedance of the communication systems in AF systems.

Application: 1. Sine wave and square wave are used for general purpose testing of circuits

such as amplifiers.

2.Square wave is used to check the transient response of the circuits as well as to check the frequency response of wideband amplifiers.
3.Triangular waves are useful for testing circuits like comparators to determine the threshold.

SPECIFICATION OF FUNCTION GENERATOR:

Manufacture : APLAB

Model : 2009

Frequency Range	0.03Hz to 3MHz in 7 decade ranges.
Frequency Indication Accuracy	±1% of full scale.
Output Waveforms	Sinusoidal, Triangle, Balanced Square and DC.
Sine Distortion	< 3%.
Maximum output voltage	10V p-p on sine, triangle and square(Into 50 ohms).
	20V p-p on sine, triangle and square(Open Circuit).
Level Accuracy	±0.5dB upto 200 KHz range. ±1.0dB for 3MHz range.

Attenuator	Two step attenuators of 20dB & 40dB. Fine attenuation of 20dB through vernier control.
Attenuator Accuracy	±0.5dB per 20dB at 1 KHz.
DC Offset	±5V ±5% in open circuit. ±2.5V ±5% in 50 ohms.
Power supply	Voltage **:** 230V AC ±10%, 50Hz. Consumption **:** 15VA.
Physical	Dimensions: 235 (W) x 85 (H) x 235 (D) mm. Weight : 3 Kg. (Approx.).

Procedure:

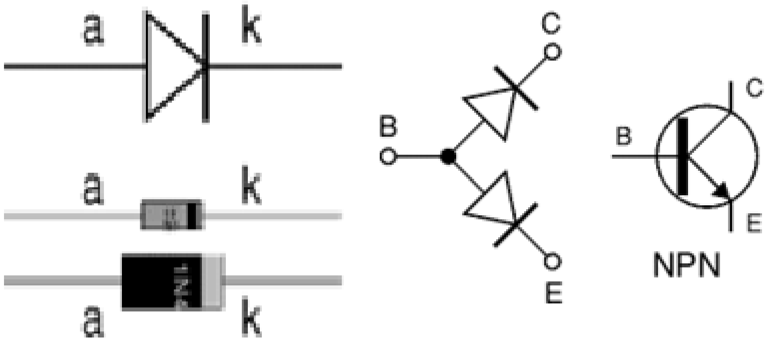
1) **Measuring voltage and current with DMM:**
   a) Select a range with a maximum greater than you expect the reading to be.
   b) Connect the meter, making sure the leads are the correct way round. Digital meters can be safely connected in reverse, but an analogue meter may be damaged.
   c) If the reading goes off the scale: immediately disconnect and select a higher range
2) **Testing diode with a DMM:**
   a) Digital multi-meters have a special setting for testing a diode, usually labelled with the diode symbol.
   b) Connect the **red** (+) lead to the anode and the **black** (-) to the cathode. The diode should conduct and the meter will display a value (usually the voltage across the diode in mV, 1000mV = 1V).
   c) Reverse the connections. The diode should NOT conduct this way so the meter will display "off the scale" (usually blank except for a 1 on the left).

a=anode
k = cathode

3) **Testing a transistor with DMM:**

a) Set a digital multi-meter to diode test and an analogue multi-meter to a low resistance range such as × 10, as described above for testing a diode.
b) Test each pair of leads both ways (six tests in total):

1.The base-emitter (BE) junction should behave like a diode and conduct one way only.
2.The base-collector (BC) junction should behave like a diode and conduct one way only.
3.The collector-emitter (CE) should not conduct either way.



CALCULATION:

1.Measurement of DC Voltage using DMM and CRO			
Sr. No	Applied DC voltage using DC power supply	DC Voltage measured on DMM	DC Voltage measured on CRO
1			
2			

2.Measurement of AC Voltage using DMM and CRO			
Sr. No	Applied AC voltage using signal generator	AC Voltage measured on DMM	AC Voltage measured on CRO
1			
2			

3.Measurement of Frequency using DMM and CRO			
Sr. No	Applied Frequency	Frequency measured on DMM	Frequency measured on CRO
1			
2			

4.Measurement of Resistor value using Color code and DMM			
Sr. No	Color Bands on Resistor	Resistance Value (Use color code)	Resistance Value measured on DMM
1			
2			

5. Testing of Diode				
Sr. No	Model Number of Diode	Type of diode	Probe Connection	
			Red -Cathode Black - Anode	Red - Anode Black - Cathode
1				
2				

6. Testing of Transistor						
Sr. No	Model Number of Transistor	Type of transistor and its hfe	Probe Connection			
			Red-Emitter Black - Base	Red - Base Black - Emitter	Red - Collector Black - Base	Red - Base Black- Collector
1						

7. Measurement of frequency using X-Y Mode of CRO:
F1=________ Hz

Sr. No	Frequency Ratio	Lissajous Pattern
1.	**F1=F2**	
2.	**F1=2F2**	
3.	**2F1=F2**	
4.	**3F1=F2**	

CONCLUSION :

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Teacher's Sign

REFERENCES:

1. MECO make Digital Multimeter manual.
2. APLAB manual

Q.1 Answer the following questions

1. Draw the block diagram of CRO.
2. Write down the application of CRO.
3. Write down the steps for testing component using CRO.
4. Write a short note on importance of measuring instrument in electronics.
5. Write down the application of DMM & Function generator in electronics.

Experiment No: 3
Title: V-I characteristics of P-N Junction Diode and zener diode
Date of Performance:
Name of the student:
Roll No: Division:
Signature of Teacher:

EXPT. NO. : 3

STUDY OF V-I CHARACTERISTICS OF PN JUNCTION DIODE AND ZENER DIODE

OBJECTIVE :

a. To study the datasheet of typical PN junction diode 1N 400X
b. To study and verify the functionality of **PN junction** diode and **Zener diode** in forward bias and reverse bias and to Plot Volt-Ampere Characteristics of P-N Diode.
c. To study and verify the functionality of Zener diode in forward bias and reverse bias and to Plot Volt-Ampere Characteristics of Zener Diode.

APPARATUS :

PN junction diode and Zener diode V-I characteristics KIT,
Dual DC Regulated Power supply (0 - 30 V),
Digital Ammeters (0 - 200 mA, 0 - 200 µA),
Digital Voltmeter (0 - 20V),patch cords

Specifications:

List of Parameters	**SILION DIODE (1N4007)**
Maximum Forward Current	1A
Maximum Reverse Current	5.0µA
Maximum Forward Voltage	0.8V
Maximum Reverse Voltage	1000V
Maximum Power Dissipation	30mW
Temperature	-65 to 200° C

Specificationsof 1N 4735A Zener diode:

- Breakdown Voltage = 5.1V
- Power dissipation = 0.75W
- Max Forward Current = 1A

- **THEORY :**

PART I:V-I characteristics of PN junction diode

Operation:

A PN junction diode is formed when a single crystal of semiconductor is doped with acceptors impurities (Pentavalent) on one side and donor impurities (Trivalent) on the other side. It has two terminals called electrodes, one each from P-region and N-region. Due to two electrodes it is called (i.e., Di-electrode) Diode.

Biasing of PN junction Diode

Applying external D.C. voltage to any electronic device is called biasing. There is no current in the unbiased PN junction at equilibrium.

Depending upon the polarity of the D.C. voltage externally applied to diode ,the biasing is classified as Forward biasing and Reverse biasing.

Forward bias operation

The P-N junction supports uni-directional current flow. If +ve terminal of the input supply is connected to anode (P-side) and –ve terminal of the input supply is connected the cathode. Then diode is said to be forward biased. In this condition the height of the potential barrier at the junction is lowered by an amount equal to given forward biasing voltage.

Reverse bias operation

If negative terminal of the input supply is connected to anode (p-side) and –ve terminal of the input supply is connected to cathode (n-side) then the diode is said to be reverse biased. In this condition an amount equal to reverse biasing voltage increases the height of the potential barrier at the junction.

Diode current equation

The volt-ampere characteristics of a diode explained by the following equations:

$I = I_0(e^{V/\eta V_T} - 1) where$

I = current flowing in the diode, I_0 = reverse saturation current

V = Voltage applied to the diode

V_T = volt- equivalent of temperature = k T/q = T/ 11,600 = 26mV (@ room temp)

η =1 (for Ge) and 2 (for Si)

Circuit Diagram:

Fig. (1) - Forward Bias Condition:

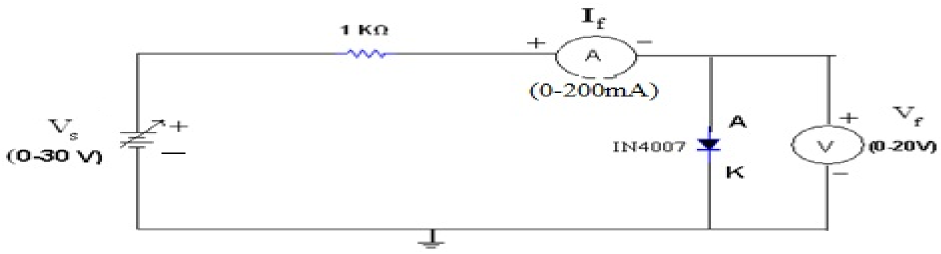
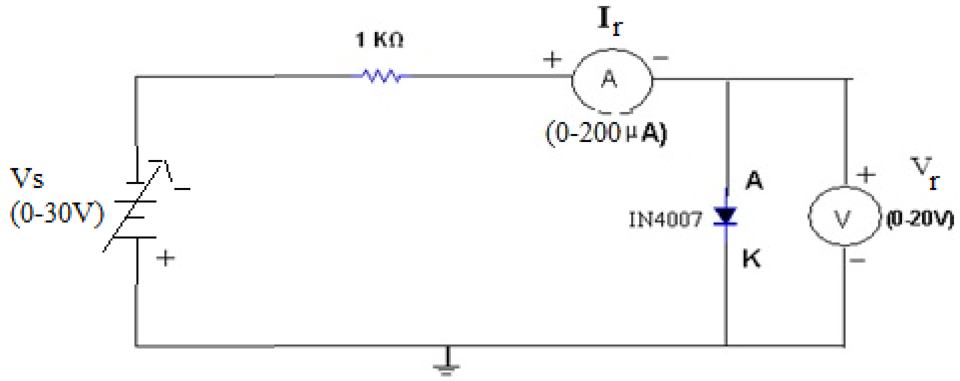


Fig. (2) - Reverse Bias Condition:



Procedure:

Forward Bias Condition:

1. Connect the circuit as shown in figure (1) using PN Junction diode.
2. Initially vary Regulated Power Supply (RPS) voltage $\mathbf{V_s}$ in steps of **0.1 V**. Once the current starts increasing vary $\mathbf{V_s}$from **1V** to **12V** in steps of **1V** and note down the corresponding readings $\mathbf{V_f}$ and $\mathbf{I_f}$.
3. Tabulate different forward currents obtained for different forward voltages.

Reverse Bias Condition:

1. Connect the circuit as shown in figure (2) using PN Junction diode.
2. Vary $\mathbf{V_s}$ in the Regulated Power Supply (RPS) gradually in steps of **1V** from **0V** to **12V** and note down the corresponding readings $\mathbf{V_r}$ and $\mathbf{I_r}$.
3. Tabulate different reverse currents obtained for different reverse voltages.
4. To get the graph in reverse region (theoretically), remove voltmeter and with reference to the supply voltage note down the reverse current readings in Ammeter because current always selects low reactance path.(Diode have infinite resistance in reverse bias ideally).To get the graph in reverse region (theoretically), replace voltmeter with nano ammeter. Voltmeter has less load resistance when compared to diode. Current conducts in low resistance path.

Observations:

Forward Bias Condition:

RPS Voltage V_s (volts)	Forward Voltage across the diode V_f (volts)	Forward Current through the diode I_f (mA)

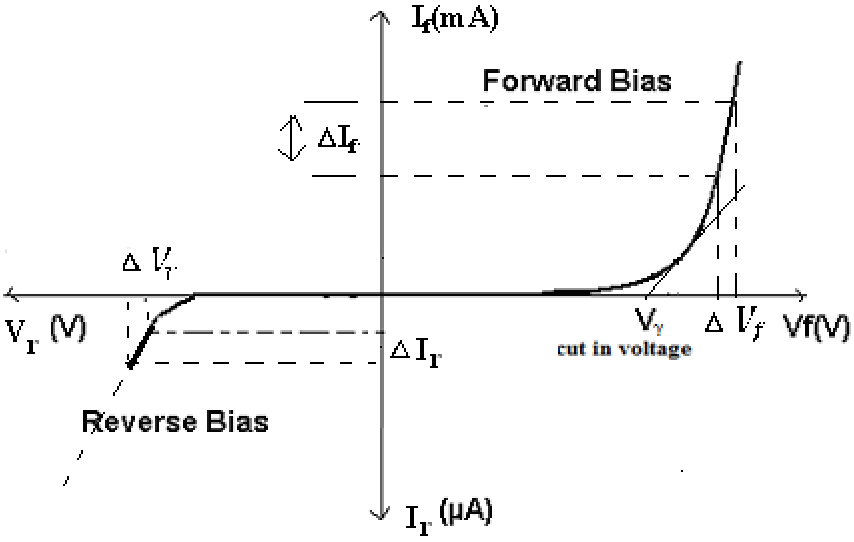
Reverse Bias Condition:

RPS Voltage V_s (volts)	Reverse Voltage across the diode V_r (volts)	Reverse Current through the diode I_r (μA)

Graph:

1. Take a graph sheet and divide it into 4 equal parts. Mark origin at the center of the graph sheet.
2. Now mark +ve X-axis as V_f, -ve X-axis as V_r, +ve Y-axis as I_f and –ve Y-axis as I_r.
3. Mark the readings tabulated for Si forward biased condition in first Quadrant and Si reverse biased condition in third Quadrant.

Fig: V- I Characteristics of PN Junction Diode under Forward & Reverse Bias Conditions



Calculations from Graph:

Cutin Voltage Vγ

Static forward Resistance $R_{dc} = V_f / I_f \Omega$

Dynamic Forward Resistance $r_{ac} = \Delta V_f / \Delta I_f \Omega$

Static Reverse Resistance $R_{dc} = V_r / I_r \Omega$

Dynamic Reverse Resistance $r_{ac} = \Delta V_r / \Delta I_r \Omega$

Precautions:

1. While doing the experiment do not exceed the readings of the diode. This may lead to damaging of the diode.
2. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.

Result: Volt-Ampere Characteristics of P-N Diode are studied.

a) Forward Bias of PN Junction Diode:

1. The Cut in Voltage or Knee Voltage (Vγ) of 1N4007 is _____________Volts.
2. The Dynamic Forward resistance of 1N4007 is __________________ Ω.
3. The Static Forward resistance of 1N4007 is __________________ Ω.

b) Reverse Bias of PN Junction Diode:

1. The Dynamic Reverse resistance of 1N4007 is __________________ Ω.
2. The Static Reverse resistance of 1N4007 is __________________ Ω.

PART II:V-I characteristics of Zener junction diode

Operation of Zener didoe:

Zener diodes are a special kind of diode which permits current to flow in the forward direction. What makes them different from other diodes is that Zener diodes will also allow current to flow in the reverse direction when the voltage is above a certain value. This breakdown voltage is known as the Zener voltage. In a standard diode, the Zener voltage is high, and the diode is permanently damaged if a reverse current above that value is allowed to pass through it. Zener diodes are designed in a way where the Zener voltage is a much lower value. There is a controlled breakdown which does not damage the diode when a reverse current above the Zener voltage passes through a Zener diode.

Avalanche Break down:

When the diode is in the reverse bias condition, the width of the depletion region is more. If both p-side and n-side of the diode are lightly doped, depletion region at the junction widens. In reverse bias, the minority charge carrier current flows through junction.

Zener Break down:

If both p-side and n-side of the diode are heavily doped, depletion region at the junction reduces compared to the width in normal doping. Applying a reverse bias causes a strong electric field get applied across the device.

Circuit Diagram:

Fig (1) - Forward Bias Condition:

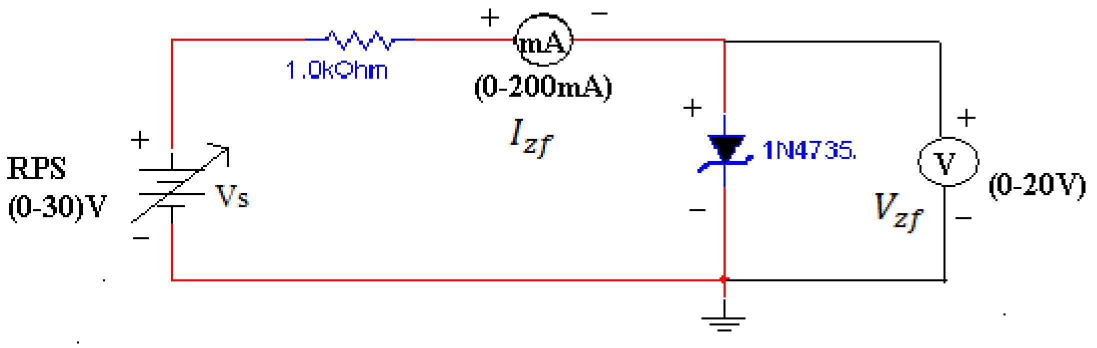


Fig (2) - Reverse Bias Condition:

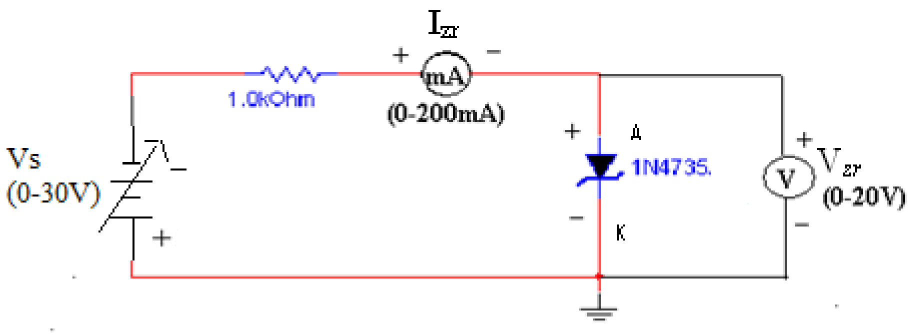


Fig (3) - Circuit Diagram of Zener Diode as Line Regulator:

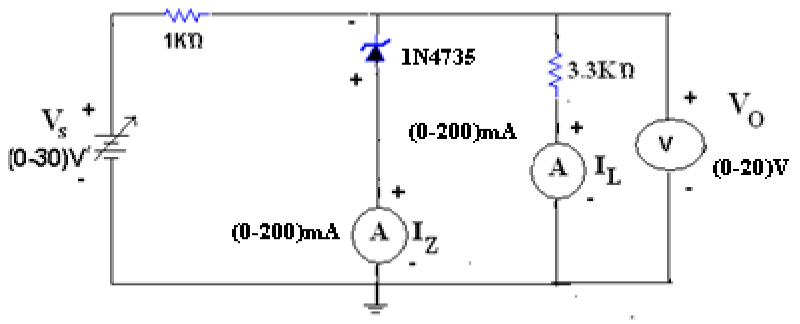
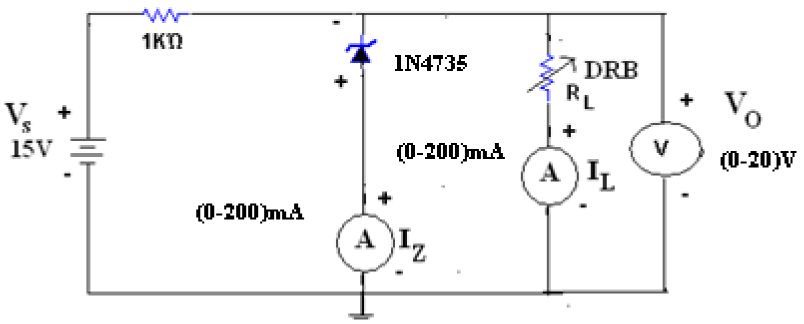


Fig (4) - Circuit Diagram of Zener Diode as Load Regulator:



Procedure:

a) Forward Bias Condition:

1. Connect the circuit as shown in figure (1).
2. Initially vary V_s in steps of 0.1V. Once the current starts increasing vary V_s in steps of 1V up to 12V. Note down the corresponding readings of V_{zf} and I_{zf}.

b) Reverse Bias Condition:

1. Connect the circuit as shown in figure (2).
2. Vary V_s gradually in steps of 1V up to 12V and note down the corresponding readings of V_{zr} and I_{zr}.
3. Tabulate different reverse currents obtained for different reverse voltages.

Zener Diode Characteristics in X-Y mode:

1. Adjust CRO TIME/DIV knob in X-Y mode.
2. Give the input as triangular voltage waveform from Function Generator (both positive and negative peaks).
3. Connect the CRO CH1 across the input and CH2 across resistor.
4. Zener diode characteristics can be observed.

Observations:

Table: 1 Forward Bias Condition:

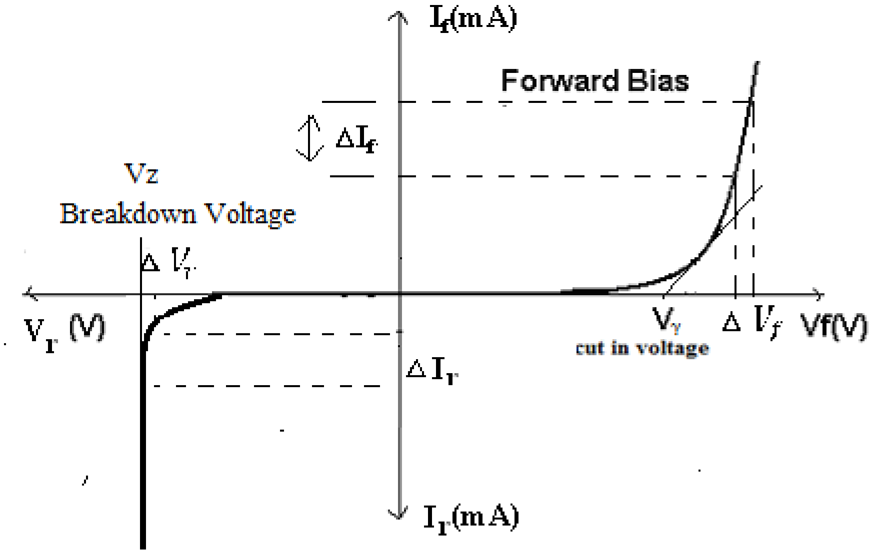
RPS Voltage Vs(volts)	Forward Voltage across the diode V_{zf} (volts)	Forward Current through the diode I_{zf} (mA)

Table: 2 Reverse Bias Condition:

RPS Voltage Vs(volts)	Reverse Voltage across the diode V_{zr} (volts)	Reverse Current through the diode I_{zr} (mA)

Expected Graph:

Fig: V- I Characteristics of Zener Diode under Forward & Reverse Bias Conditions



Calculations from Graph:

Static forward Resistance $R_{dc} = V_f / I_f\ \Omega$

Dynamic Forward Resistance $r_{ac} = \Delta V_f / \Delta I_f\ \Omega$

Static Reverse Resistance $R_{dc} = V_r / I_r\ \Omega$

Dynamic Reverse Resistance $r_{ac} = \Delta V_r / \Delta I_r\ \Omega$

Precautions:

1. While doing the experiment do not exceed the readings of the diode. This may lead to damaging of the diode.
2. Connect voltmeter and ammeter in correct polarities as shown in the circuit diagram.
3. Do not switch ON the power supply unless you have checked the circuit connections as per the circuit diagram.

Result: The characteristics and Voltage Regulation of Zener diode are studied.

a) Forward Bias Zener Diode:

1. The Knee voltage or Cut-in Voltage (V_y) is ___________________ Volts.
2. The Dynamic Forward resistance is ___________________ Ω.
3. The Static Forward resistance is ___________________ Ω.

b) Reverse Bias of Zener Diode:

1. Zener Breakdown Voltage (V_Z) is _____________________ Volts.
2. The Dynamic Reverse resistance is ___________________ Ω.
3. The Static Reverse resistance is ___________________ Ω.

CONCLUSION :

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Teacher's Sign

REFFRENCE: 1. Linear integrated circuits by Ramakant Gaikwad
2. Electronics Devices & circuits by L.Floyd

Q. 1. Answer the following Questions.

Assignment Questions:

1. What is the difference between p-n Junction diode and zener diode?
2. What is break down voltage?
3. What are the applications of Zener diode?
4. What is application of zener diode? Explain in detail
5. What is application of PN junction diode? Explain in detail

Experiment No: 4	
Title: **Rectifier Circuits**	
Date of Performance:	
Name of the student:	
Roll No:	**Division:**
Signature of Teacher:	

EXPT. NO. : 4

RECTIFIER CIRCUITS

TITLE :

Study of Rectifier circuits:

a) Implement half wave, full wave and bridge rectifier using diodes

b) Observe the effect of capacitor filter on rectifier output

OBJECTIVE :

APPARATUS :

1Rectifer circuit experimental Kit with Patch cord
2. Step down Transformer, center tap transformer
3. DMM
4. Function generator 1MHz
5. CRO with probe

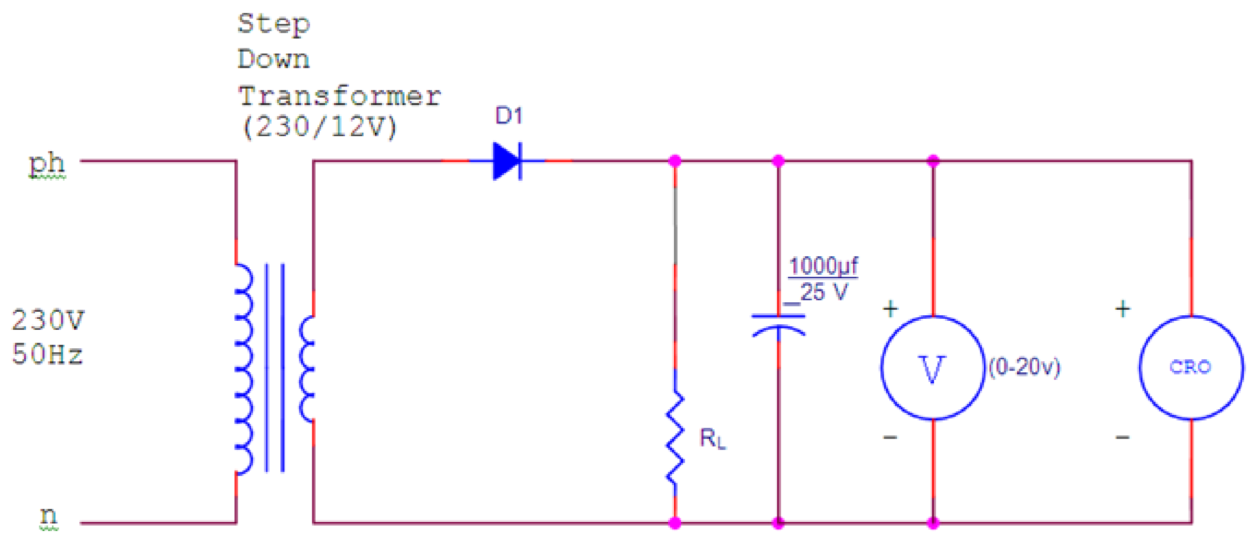
THEORY :

A device is capable of converting a sinusoidal input waveform into a unidirectional waveform with non zero average component is called a **rectifier.**

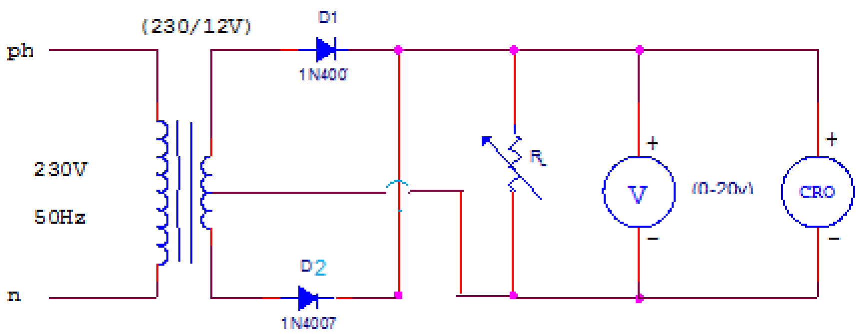
A practical half wave rectifier with a resistive load is shown in the circuit diagram. During the positive half cycle of the input the diode conducts and all the input voltage is dropped across RL. During the negative half cycle the diode is reverse biased and it acts as almost open circuit so the output voltage is zero. The filter is simply a capacitor connected from the rectifier output to ground. The capacitor quickly charges at the beginning of a cycle and slowly discharges through RL after the positive peak of the input voltage. The variation in the capacitor voltage due to charging and discharging is called ripple voltage. Generally, ripple is undesirable, thus the smaller the ripple, the better the filtering action.

CITCUIT DIAGRAMS:

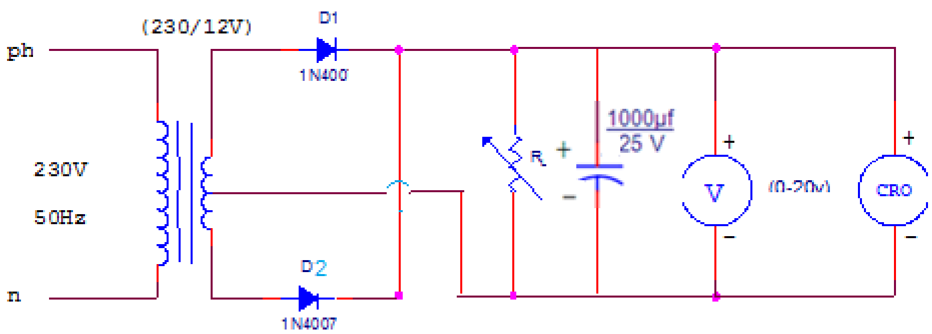
Circuit Diagram
Halfwave Rectifier without filter
Half wave Rectifier with Capacitor Filter
–



Full wave Rectifier without Filter



Full wave Rectifier with capacitor Filter



Procedure :

HWR Without Filter:

1. Connections are made as per the circuit diagram of the rectifier without filter.

2. Connect the primary side of the transformer to ac mains and the secondary side to the rectifier input.
3.Observe the waveform on CRO

HWR With Capacitor Filter:

1. Connections are made as per the circuit diagram of the rectifier without filter.
2. Connect the primary side of the transformer to ac mains and the secondary side to the rectifier input.
3.Observe the waveform on CRO.

FWR Without Capacitor Filter:

1. Connections are made as per the circuit diagram of the rectifier without filter.
2. Connect the primary side of the transformer to ac mains and the secondary side to the rectifier input.
3.Observe the waveform on CRO

Observation:Waveform

HWR Without Filter:

HWR with capacitor filter:

FWR without Filter:

FWR with capacitor Filter

CONCLUSION :

Teacher's Sign

REFFRENCE: 1. Linear integrated circuits by Ramakant Gaikwad
2. Electronics Devices & circuits by L.Floyd

Q. 1. Answer the following Questions.

1. What is rectifier?
2. Define Ripple factor. What is filter?
3. What is Peak inverse voltage?
4. How capacitor acts as filter.
5. What are the applications of rectifiers?

Experiment No: 5
Title: FREQUENCY RESPONSE OF MOSFET
Date of Performance:
Name of the student:
Roll No: **Division:**
Signature of Teacher:

Experiment No: 5

FREQUENCY RESPONSE OF MOSFET:

TITLE Study of Frequency response of Transistor:
a) To plot frequency response of BJT amplifier.(Simulation)
b) To plot frequency response of MOSFET amplifier.(Simulation).

OBJECTIVE :

1. Simulate Single stage RC coupled CE amplifieand plot its frequency response.
2. Simulate Single CS MOSFET amplifier and to plot its frequency response.

Software Requirement : Multisim

THEORY :

1. Common Emitter Amplifier:

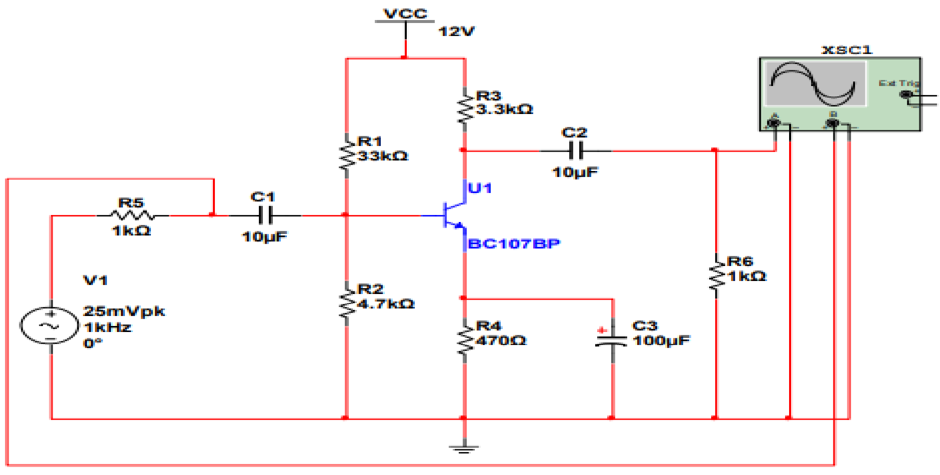
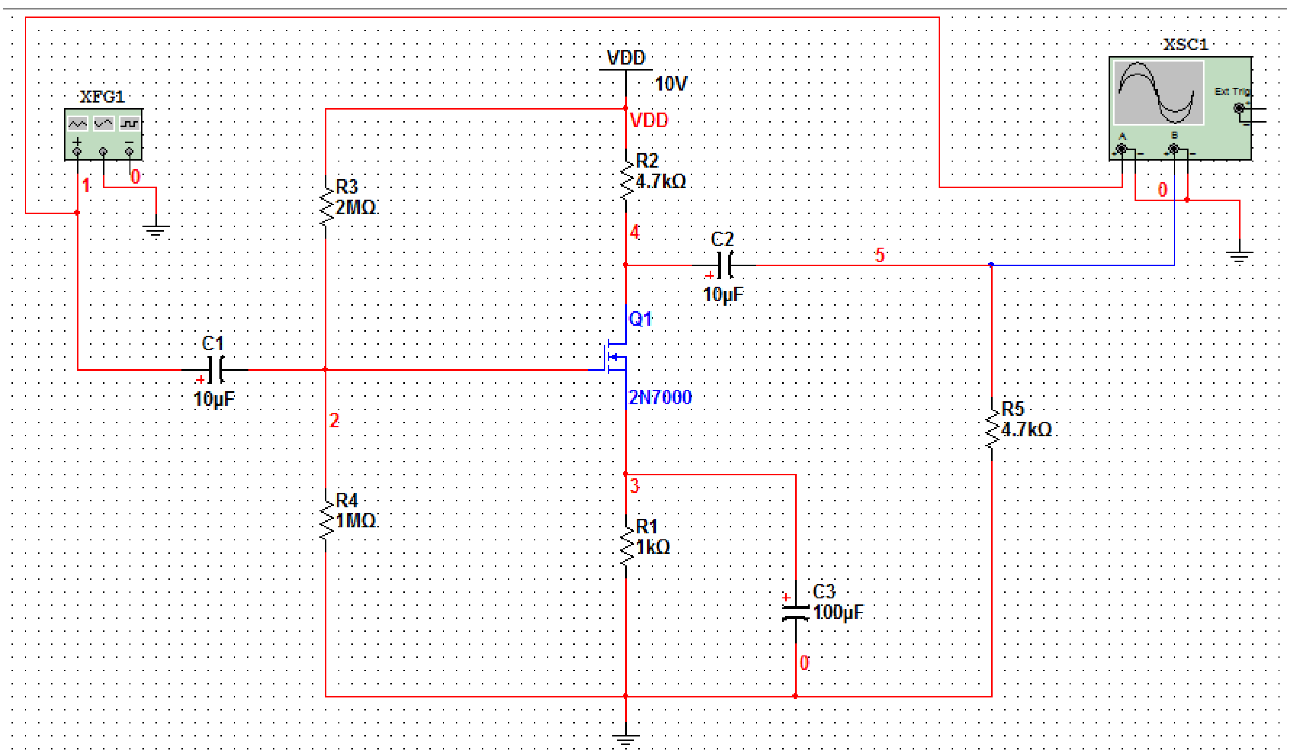


Figure 1: Circuit diagram of CE amplifier

The single stage common emitter amplifier circuit shown above uses what is commonly called "Voltage Divider Biasing" or “self biasing”. This type of biasing arrangement uses two resistors as a potential divider network and is commonly used in the design of bipolar transistor amplifier circuits. This type of biasing arrangement greatly reduces the effects of varying Beta,(β) by holding the Base bias at a constant steady voltage. This type of biasing produces the greatest stability.

The Common Emitter Amplifier circuit has a resistor in its Collector circuit. The current flowing through this resistor produces the voltage output of the amplifier. The value of this resistor is chosen so that at the amplifiers quiescent operating point, Q-point this output voltage lies half way along the transistors load line. In Common Emitter Amplifier circuits, capacitors C1 and C2 are used as Coupling Capacitors to separate the AC signals from the DC biasing voltage. This
ensures that the bias condition set up for the circuit to operate correctly is not affected by any additional amplifier stages, as the capacitors will only pass AC signals and block any DC component. The output AC signal is then superimposed on the biasing of the following stages. Also a bypass capacitor, CE is included in the Emitter leg circuit. This capacitor is an open circuit component for DC bias meaning that the biasing currents and voltages are not affected by the addition of the capacitor maintaining a good Q-point stability. However, this bypass capacitor short circuits

B. Single CS MOSFET amplifier



A field-effect transistor (FET) is a type of transistor commonly used for weak-signal amplification (for example, for amplifying wireless (signals). The device can amplify analog or digital signals. It can also switch DC or function as an oscillator. In the FET, current flows along a semiconductor path called the channel. At one end of the channel, there is an electrode called the source. At the other end of the channel, there is an electrode called the drain. The physical diameter of the channel is fixed, but its effective electrical diameter can be varied by the application of a voltage to a control electrode called the gate. Field-effect transistors exist in two major classifications. These are known as the junction FET (JFET) and the metal-oxide semiconductor FET (MOSFET). The junction FET has a channel consisting of N-type semiconductor (N-channel) or P-type semiconductor (P-channel) material; the gate is made of the opposite semiconductor type. In P-type material, electric charges are carried mainly in the form of electron deficiencies called holes. In N-type material, the charge carriers are primarily electrons. In a JFET, the junction is the boundary between the channel and the gate. Normally, this P -N junction is reverse-biased (a DC voltage is applied to it) so that no current flows between the channel and the gate. However, under some conditions there is a small current through the junction during part of the input signal cycle.

PROCEDURE:

Following procedure is applicable to both BJT and MOSFET

1. Open the Multisim icon in the system.
2. Place all the necessary components required for the design of the CE amplifier or CS FET amplifier i.e. Resistors, Capacitors, Transistors, Voltage sources, Power sources, Ground etc on the design window.
3. Connect all the components by proper wiring and also assure that nodes are formed at the interconnection points.
4. Connect the two channels of the Oscilloscope to input and output of the circuit and by using the simulation switch and check the input and output waveforms simultaneously to see phase difference on CRO.
5. Assign net numbers to input and output wires by double clicking on the particular wire and clicking on the show option.
6. Observe the output (Vo) by setting cursor to maximum and minimum peak of the output waveform and calutalte voltage gain using Av=Vo/Vin

7. To observe the frequency response, go to simulate-----► analysis-----►ac analysis and select the start and stop frequencies, select vertical scale as decibels, specify the output variables and click on simulate.

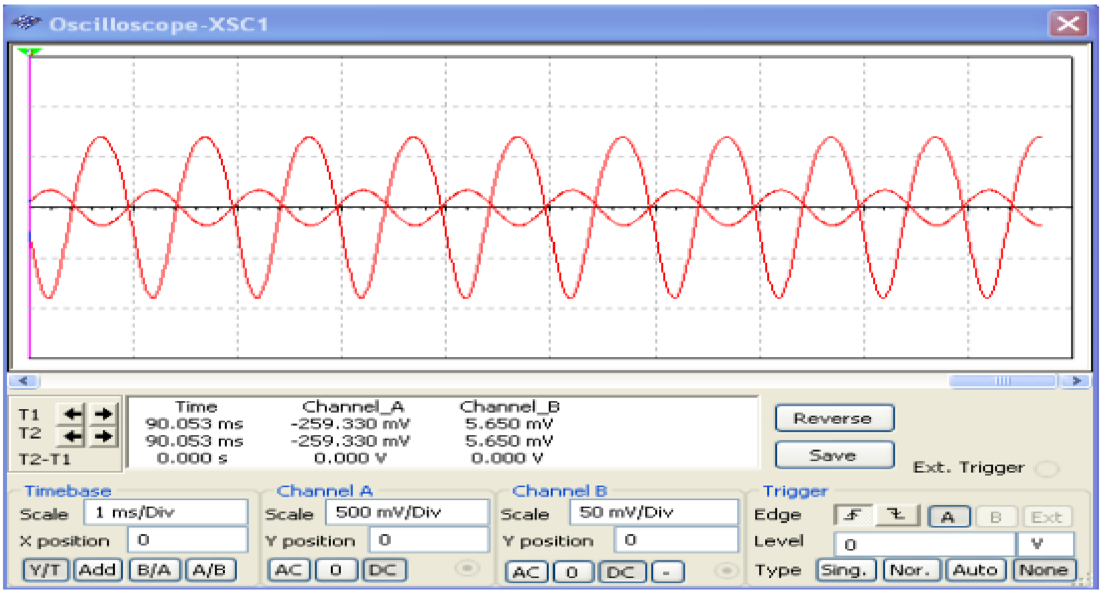
8. A window opens showing the frequency response on the top and phase response at the bottom.

9. From the frequency response, observe the bandwidth of the Amplifier.

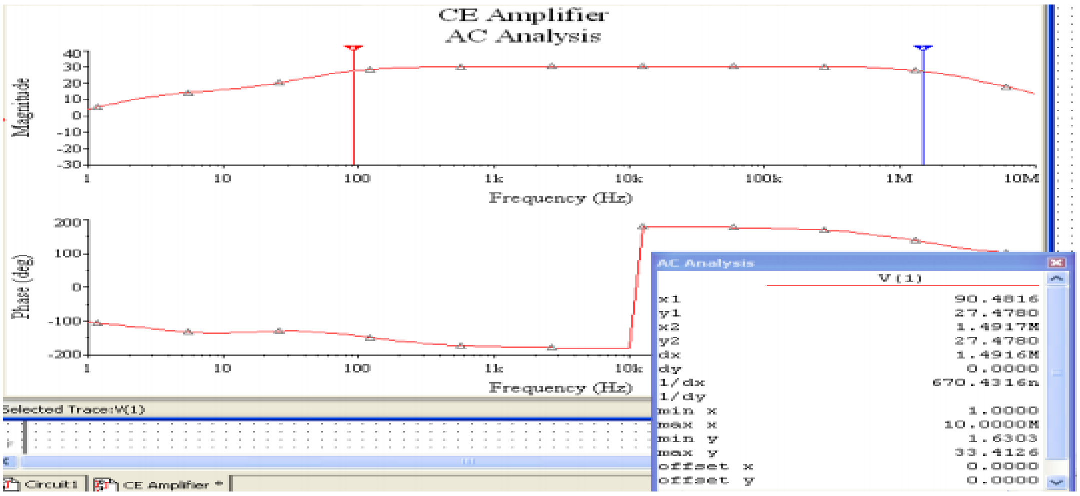
10.To obtain the netlist, go to transfer-----►export netlist and save the netlist in a text file. On opening the text file from the saved location, a netlist is obtained containing the specifications of all the used components used in the design of the circuit.

OBSERVATIONS:

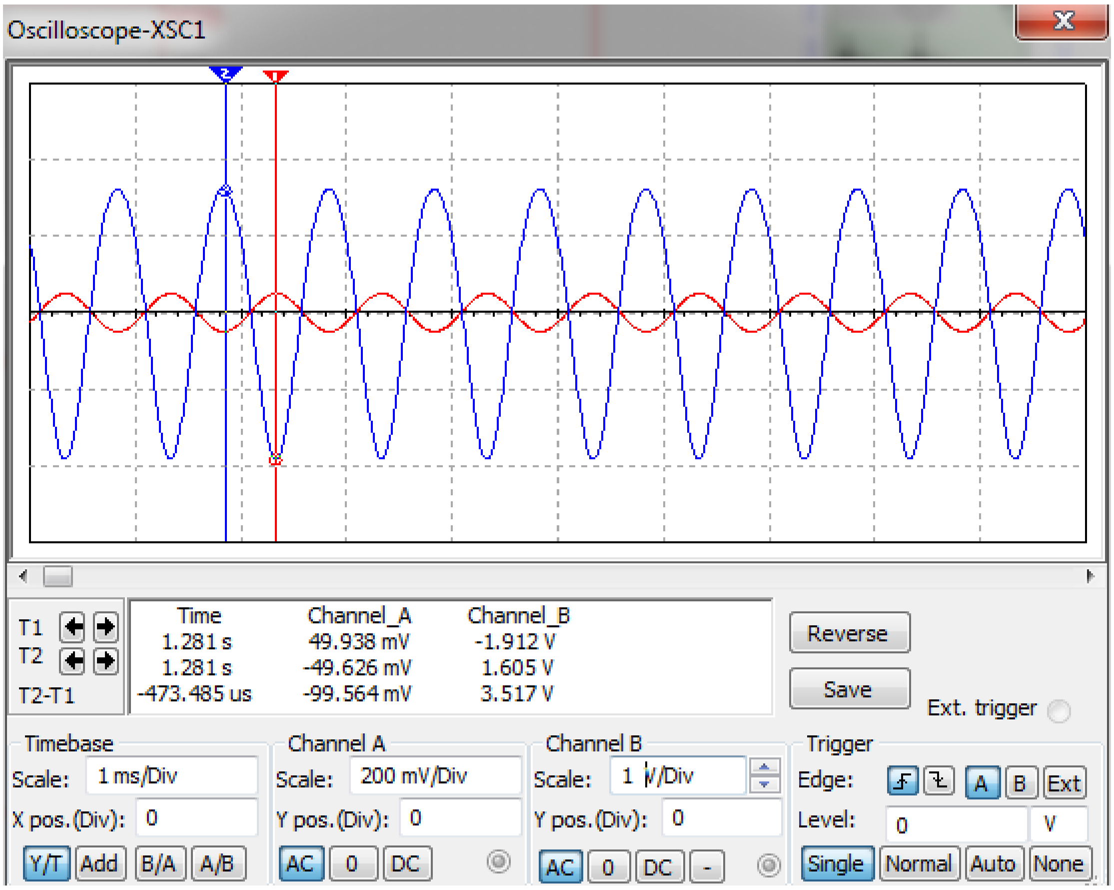
INPUT Vs OUTPUT WAVEFORM

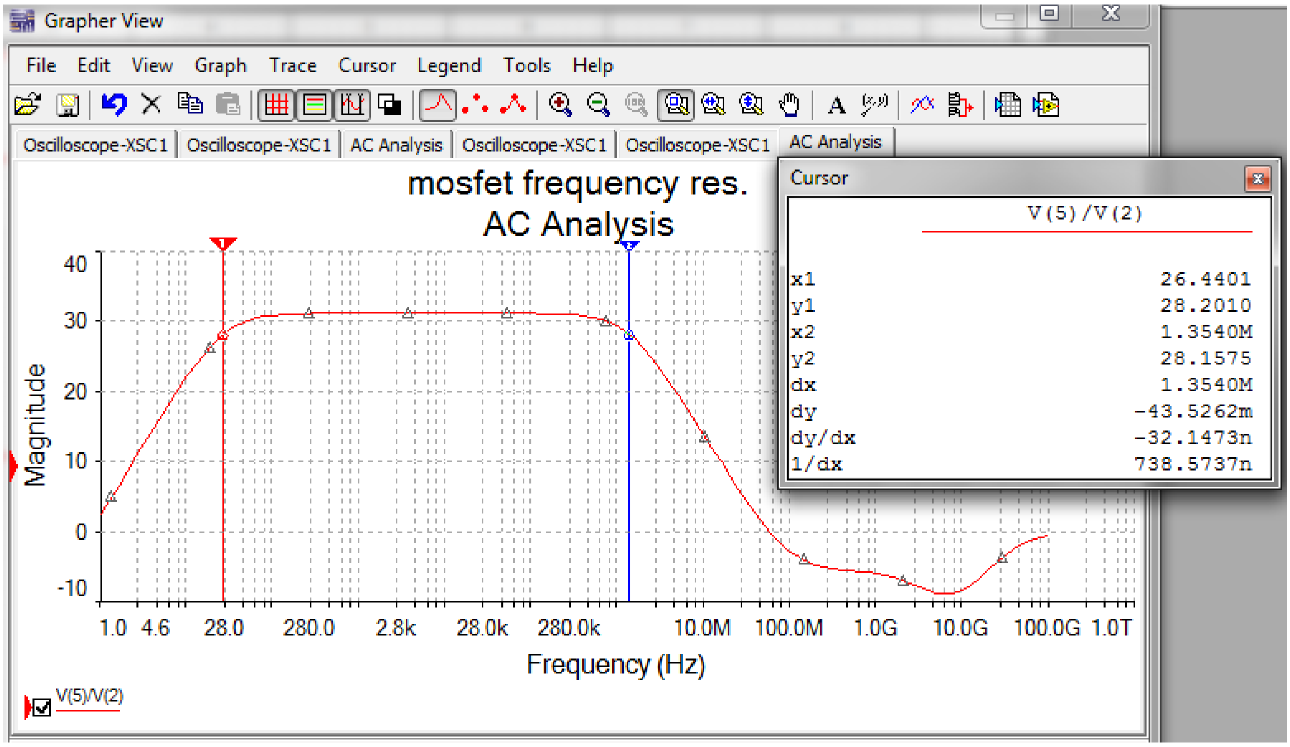


FREQUENCY RESPONSE AND PHASE RESPONSE GRAPHS



A] Single CS MOSFET amplifier





CONCLUSION :

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Teacher's Sign

Assignment questions:

1. What is the phase difference between input and output waveforms of CE amplifier?Justify.
2. What type of biasing is used in the given circuit?
3. What is the effect of emitter bypass capacitor on frequency response?
5. What is the effect of coupling capacitor?
6. What is the region of transistor so that it operates as an amplifier?
7. How does transistor acts as an amplifier.
8. Mention the characteristics of CE amplifier.

Exercise Question:

1. Find the frequency response of CE Amplifier by changing the bypass capacitor value.
2. Find the frequency response of CE Amplifier by removing the bypass capacitor

1.How does FET acts as an amplifier?
2. What are the parameters of a FET?
3. What is an amplification factor?
4. Draw the h-parameter model of the FET.
5. What are the advantages of FET over BJT?
6. What is the region of FET so that it acts as an amplifier?
7. What are the differences between JFET and MOSFET?
8. What type of biasing is used in the given circuit?

Exercise Question:

1. Find the frequency response of CS Amplifier by changing the bypass capacitor value.
2. Find the frequency response of CS Amplifier by removing the bypass capacitor.

REFFRENCES:

1. Electronics Devices & circuits L.Floyd
2. Electronic Devices and circuit theory Boylestad N

Experiment No: 6
Title: Inverting and Non-inverting amplifier
Date of Performance:
Name of the student:
Roll No: Division:
Signature of Teacher:

EXPT. NO. : 6

INVERTING AND NON-INVERTING AMPLIFIER

TITLE : **Inverting and Non-inverting amplifier**

PRE REQUISITES : OP-AMP amp configurations, Op-amp µA 741 parameters, Concept of virtual ground in inverting amplifier virtual short in non- inverting amplifier, gain of Inverting and Non-inverting amplifier

OBJECTIVE : **a.** To verify pin configuration of an OP-AMP(such as LM741)
b. To study the important parameters of LM741
c. To Implement Inverting and Non-Inverting amplifier.

APPARATUS :

Componets	Op-Amp IC-741, Resistors	
Instrument/s or components	Range	Quantity
Circuit board	--	01
Power supply	0-30V, 1A	03
Multimeter (Voltmeter)	0-30V	01
Bionet connector	--	02
Connecting wires	Banana pin	--
CRO	24MHz	01

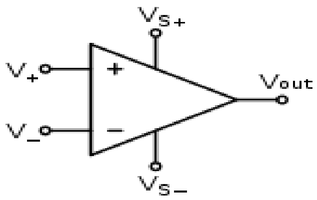
THEORY :

<u>Operational amplifier :</u>

An **operational amplifier**, which is often called an **op-amp**, is a DC-coupled high-gain electronic voltage amplifier with differential inputs and, usually, a single output. Typically the output of the op-amp is controlled either by negative feedback, which largely determines the magnitude of its output voltage gain, or by positive feedback, which facilitates regenerative gain and oscillation. High input impedance at the input terminals and low output impedance are important typical characteristics.

The op-amp is basically a differential amplifier having a large voltage gain, very high input impedance and low output impedance. The op-amp has an "Inverting" or (-) input and "Non-inverting" or (+) input and a single output. The op-amp is usually powered by a dual polarity power supply in the range of +/- 5 volts to +/- 15 volts. Op-amps are among the most widely used electronic devices today, being used in a vast array of consumer, industrial, and scientific devices.

Circuit notation:



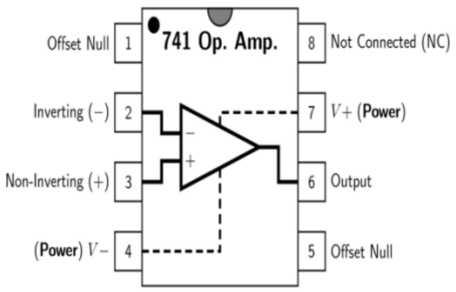
The circuit symbol for an op-amp is shown in above Figure.
where:

- V_+ : non-inverting input
- V_- : inverting input
- V_{out}: output
- $_{S+}$: positive power supply
- V_{S-} : negative power supply

The power supply pins (V_{S+} and V_{S-}) can be labeled in different ways. Despite different labeling, the function remains the same. Often these pins are left out of the diagram for clarity, and the power configuration is described or assumed from the circuit. For any input voltages the ideal op-amp has

- Infinite open-loop gain,
- Infinite bandwidth,
- Infinite input impedances.
- Zero offset voltage,
- Infinite slew rate,
- Zero output impedance,
- zero noise.

Internal circuitry of 741 type op-amp



Though designs vary between products and manufacturers, all op-amps have basically the same internal structure, which consists of three stages:

1. Differential amplifier
   - Input stage — provides low noise amplification, high input impedance, usually a differential output
2. Voltage amplifier
   - Provides high voltage gain, a single-pole frequency roll-off, usually single-ended output
3. Output amplifier
   - Output stage — provides high current driving capability, low output impedance, current limiting and short circuit protection circuitry

A.Inverting amplifier An inverting amplifier is an amplifier in which the amplified output signal is 180° out of phase with the input signal

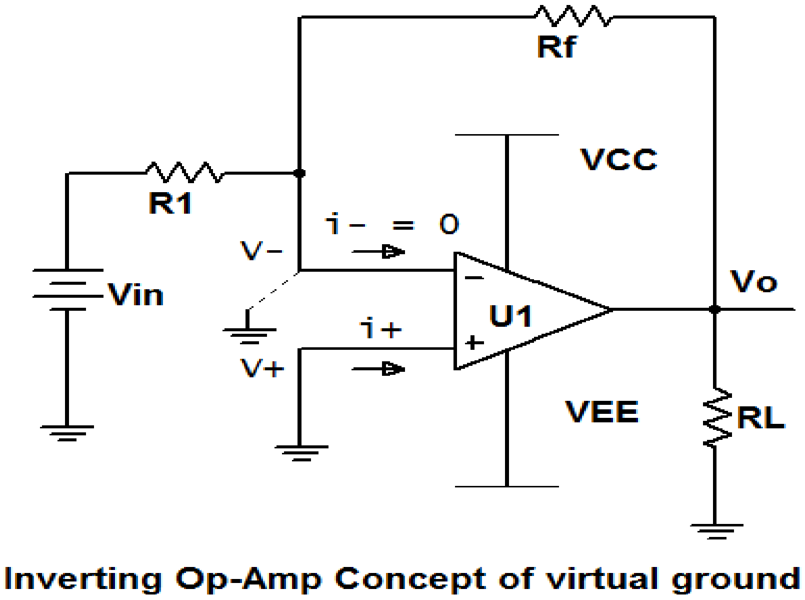


Fig.1. Inverting amplifier

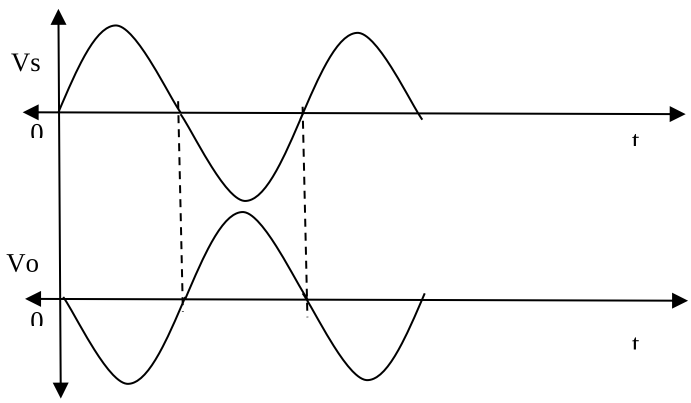


Fig.2 Input Output Waveforms of Inverting amplifier

APPLICATIONS :

NON- INVERTING AMPLIFIER:

An amplifier in which the amplified output signal is in phase with the input signal is known as a non- inverting amplifier

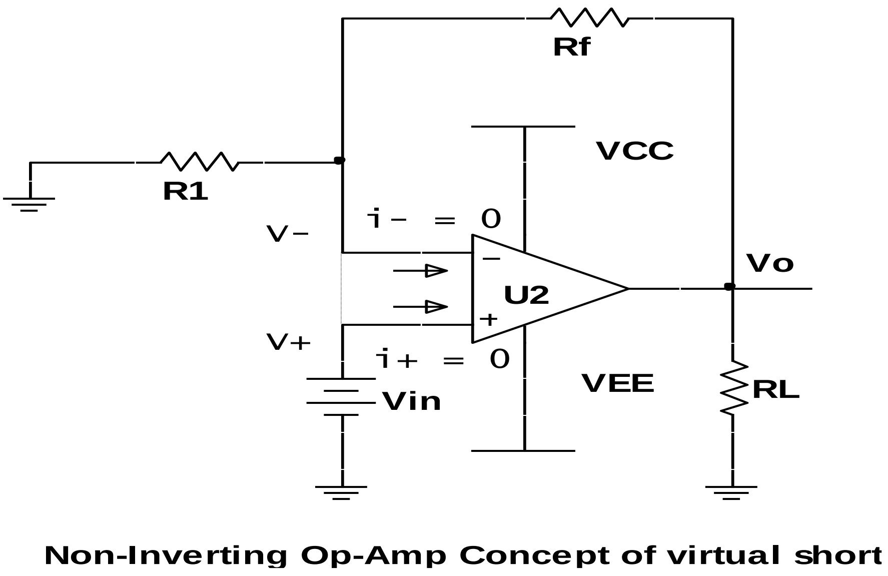


Fig.3. Non inverting amplifier

Inverting Amplifier(With offset null adjust facility)

Non-Inverting Amplifier(With offset null adjust facility)

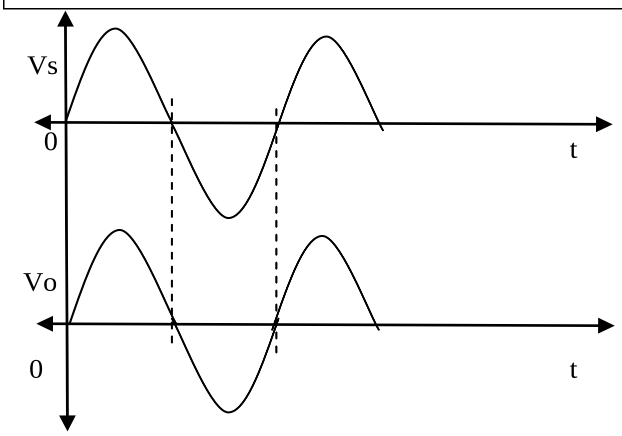


Fig. 4 Input output waveforms of Non inverting amplifier

PRACTICAL CIRCUIT DIAGRAM

OBSERVATIONS :

A. Practical observations					
R1= R_f=					
NON-INVERTING AMPLIFIER			**INVERTING AMPLIFIER**		
	TH	**PR**		**TH**	**PR**
V_{in}			V_{in}		
V_O			V_O		
A_{vf}			A_{vf}		

B. PHASE SHIFT	
NON INVERTING AMPLIFIER	**INVERTING AMPLIFIER**

CONCLUSION :

Teacher's Sign

REFFRENCE: 1. Linear integrated circuits by Ramakant Gaikwad
2. Electronics Devices & circuits by L.Floyd
3. S. Salivahanan, "Linear Integrated Circuits", TMH
4. Jacob Millman, "Integrated Electronics Analog and digital circuits and systems "any available edition.

Q. 1. Answer the following Questions.

1. Explain the Virtual ground concept of OP-AMP.
2. Draw and explain the block diagram of OP-AMP.
3. Explain different parameter of OP-AMP. State the different application of OP-AMP.
4. What is meant by negative feedback? What are the advantages and disadvantages of negative feedback?
5 State different application of OP-AMP

Experiment No: 7	
Title: **STUDY OF DIGITAL CIRCUITS**	
Date of Performance:	
Name of the student:	
Roll No:	**Division:**
Signature of Teacher:	

EXPT. NO. : 07

STUDY OF DIGITAL CIRCUITS

TITLE : Study Of Digital Circuits

PRE-REQUISTITES **:** Truth tables of logic gates. K-map techniques.
Half adder & Full adder circuit,Different types of Flip Flop (RS,JK,T,D etc).

OBJECTIVE : a) To identify pins and study the data sheet of basic and universal Digital logic gate IC's such as AND, OR, NOT, ExOR, ExNOR, NAND,NOR.
b) To implement Half & Full adder circuits with basic logic gate IC's**.**
c) To implement RS,JK,T,D with basic logic gate IC's.

APPARATUS **:** Digital-Board, Patch-Cords, IC-74LS32, IC-74LS08, IC-74LS86, IC-7404, IC7400, IC7402.

THEORY **:**

Types of IC Logic Gates:

The most common form of logic Gate ICs are listed. To identify and use The Integrated circuits
some sort of identification code has tobe usedwhich is printed on the IC package.logic Gate s are identified by the codes. The prefix 74 is used to identify a commercial version of the device from the military version of the device identified by the prefix 54. Military versions are designed to withstand harsh and severe environmental conditions.

D.C supply voltage:
The supply voltage at which the gate operates.

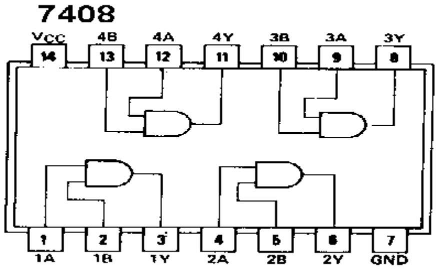
Noise margin:
The maximum and minimum voltages that represent binary 0 and 1 respectively. The voltages ranges determine the suitability of the gate to work in noisy environments.

Power Dissipation:
Gates consume power during their operation. The power dissipation varies with the frequency at which these gates operate.

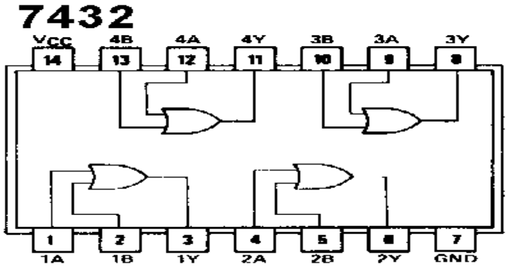
Frequency Response and Propagation Delay:
Gates do not instantaneously switch to a new output state after the inputs are changed. The delay between the input and output limits the frequency at which the inputs to a logic gate can be changed and the logic circuit can operate.

Fan out:
The number of gates that can be connected to the output of a single gate.

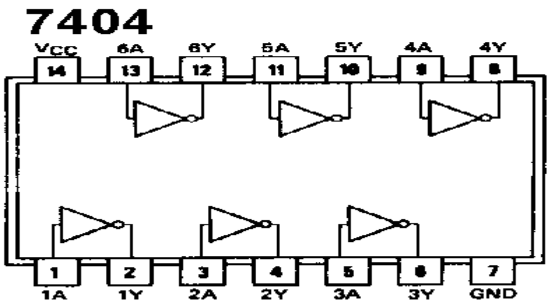
7408 AND GATE IC:
The 7408 14-pin chip has 4 or Quad, 2-input AND gates. This IC package contains four independent positive logic AND GATES. Pins 14 and 7 provide power for all four logic gates. Pins 7 and 14 are connected to ground and supply voltage respectively.
AND gate Logic rule:
The output is HIGH when both inputs are HIGH, otherwise output is LOW.



7432 OR GATE IC:
The 7432 14-pin IC package has 4 or Quad, 2- input OR gates. Connections to the OR gates are identical to those of the 7408 AND gate IC. Pins 14 and 7 provide power for all four logic gates. **OR Gate Logic Rule:**
If one or both the inputs are high, then the output will be high. Otherwise output will be low.

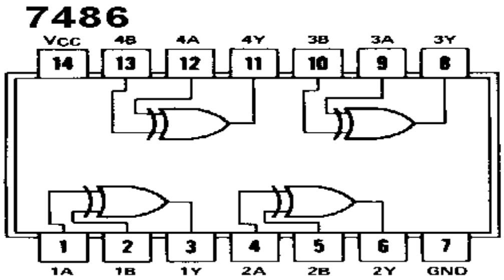


7404 NOT GATE IC:
The 7404 14 pin chip has 6 or hex inverters. The 7404 IC package contains six independent positive logic NOT GATES (INVERTERS). Pins 14 and 7 provide power for all six logic gates. Pins 7 and 14 are used for ground and supply voltage respectively.
NOT Gate Logic rule:
The output is the inverse of the input, in other words if the input is HIGH then the output is LOW and if the input is LOW the output is HIGH.

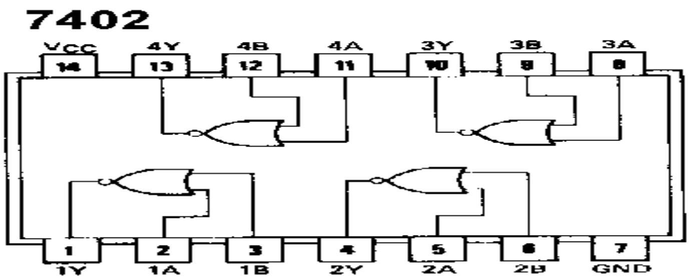


7486 Ex-OR GATE IC:
The 7486 IC package contains four independent positive logic XOR GATES. Pins 14 and 7 provide power for all four logic gates. Outputs of one gate can be connected to inputs of another within the same chip or to another chip as long as they share the same ground.

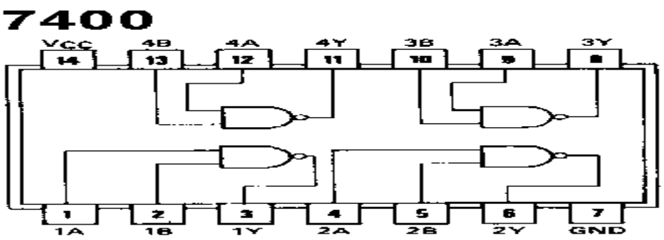
XOR GATE Logic-Rules:
The output is HIGH when one OR the other input is HIGH, but NOT both. If both inputs are high output will be LOW



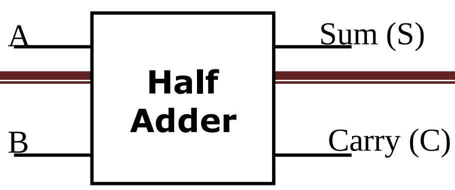
7402 NOR GATE IC:
The 7402 IC package contains four independent positive logic NOR GATES. Pins 14 and 7 provide power for all four logic gates.
NOR GATE Logic-Rules:
If one or both inputs are HIGH, then the output will be LOW. Otherwise, output will be HIGH.



7400 NAND GATE IC:
The 7400 IC package contains four independent positive logic NAND GATES. Pins 14 and 7 provide power for all four logic gates. Outputs of one gate can be connected to inputs of another within the same chip or to another chip as long as they share the same ground.
NAND GATE Logic-Rules: If both inputs are HIGH then the output will be LOW, otherwise output will be HIGH.



Half adder is a combinational logic circuit, which can be used to add two 1-bit numbers. While **Full adder** is a combinational logic circuit, which can be used to add two 1-bit numbers with carry.



Half Adder:

Half adder circuit can be designed using logic gates that add two 1 bit binary numbers. The addition of two 1-bit binary numbers A and B. is S=A+B with C, where C is the carry bit. The truth table for all combinations of A and B with input& output voltage levels is as shown.

A	B	Sum (S)	Carry (C)
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Logic diagram of half adder circuit::

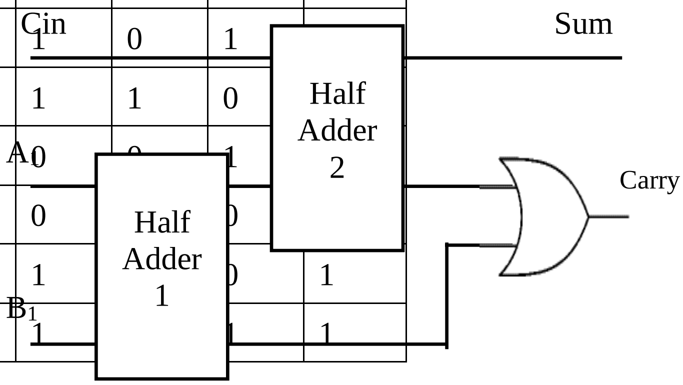
Design of Full adder:

In the half adder, it cannot handle the addition of any two arbitrary numbers because it does not allow the input of a carry bit from the addition of two previous digits. A circuit that can handle these three inputs can perform the addition of any two 1 bit binary numbers with carry provision is called as full adder.

The truth table for three input variables is shown.

A_1	B_1	C_{in}	Sum	Carry
0	0	0	0	0

0	0	1	1	0
0	1	0	1	[illegible]
0	1	1	0	[illegible]
1	0	0	1	[illegible]
1	0	[illegible]	0	[illegible]
1	1	[illegible]	0	1
1	1	[illegible]	1	1



Block Daigram

Logic diagram of full adder circuit:

Flip- Flops

A flip flop is an electronic circuit with two stable states that can be used to store binary data. The stored data can be changed by applying varying inputs. Flip-flops and latches are fundamental building blocks of digital electronics systems used in computers, communications, and many other types of systems.

Flip flop v/s Latch

The basic difference between a latch and a flip-flop is a gating or clocking mechanism. For example, let us talk about SR latch and SR flip-flops. In this circuit when you Set S as active the output Q would be high and Q' will be low. This is irrespective of anything else.

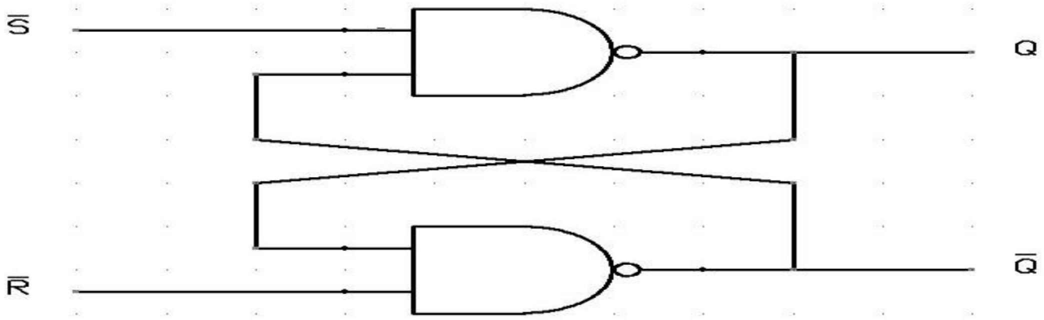


Fig SR Latch

A flip flop, on the other hand, is synchronous and is also known as gated or clocked SR latch.

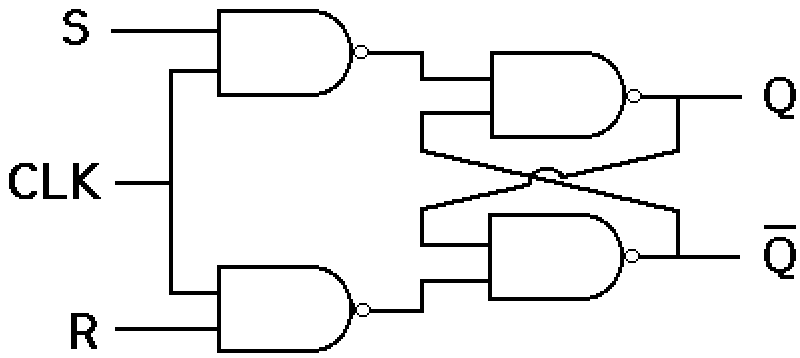


Fig SR Flip-Flop

In this circuit, the output is changed (i.e. the stored data is changed) only when you give an active clock signal.

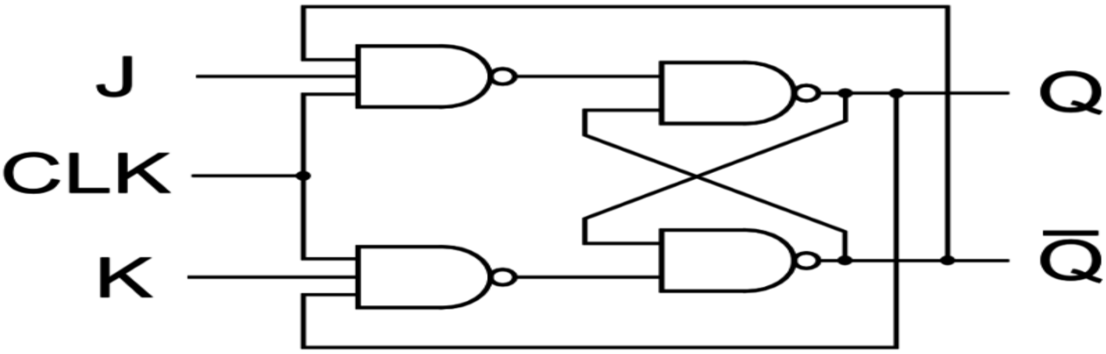
1] SR Flip Flop

There are majorly 4 types of flip flops, with the most common one being SR flip flop. As shown above, it is the simplest and the easiest to understand. The two outputs as shown above are the inverse of each other. The outputs of an SR flip flop are highlighted in the table below.

S	**R**	**Q**	**Q'**
0	0	0	1
0	1	0	1
1	0	1	0
1	1	∞	∞

2]JK Flip-flop

Due to the undefined state in the SR flip flop, another is required in electronics. The JK flip flop is an improvement on the SR flip flop where S=R=1 is not a problem.



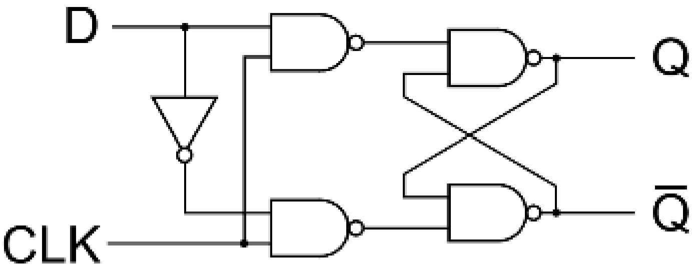
JK Flip-Flop

The input condition of J=K=1, gives an output inverting the output state. However, the outputs are the same when one tests the circuit practically.

J	K	Q	Q’
0	0	0	0
0	1	0	0
1	0	0	1
1	1	0	1
0	0	1	1
0	1	1	0
1	0	1	1
1	1	1	0

3]D Flip Flop

D flip flop is a better alternative that is very popular with digital electronics. They are commonly used for counters and shift-registers and input synchronisation.



D Flip-Flop

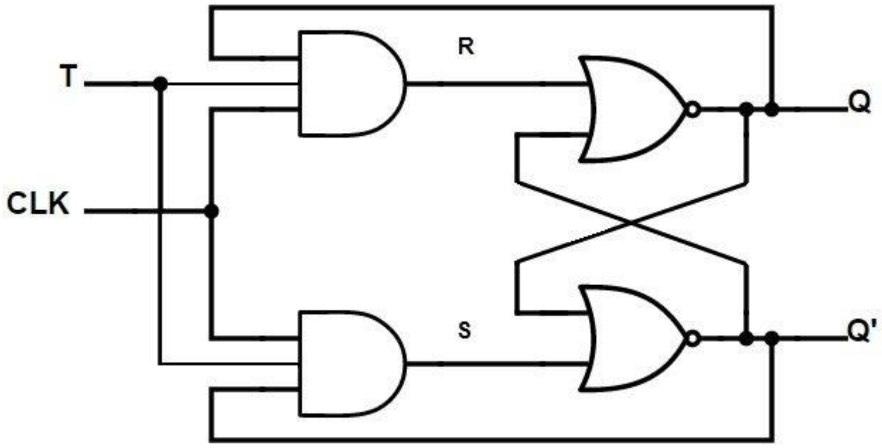
In a D flip flop, the output can be only changed at the clock edge, and if the input changes at other times, the output will be unaffected.

Clock	D	Q	Q’
↓ » 0	0	0	1
↑ » 1	0	0	1
↓ » 0	1	0	1
↑ » 1	1	1	0

The change of state of the output is dependent on the rising edge of the clock. The output (Q) is same as the input and can only change at the rising edge of the clock.

4] T Flip Flop

A T flip flop is like JK flip-flop. These are basically a single input version of JK flip flop. This modified form of JK flip-flop is obtained by connecting both inputs J and K together. This flip-flop has only one input along with the clock input.



T Flip-Flop

These flip-flops are called T flip-flops because of their ability to complement its state (i.e.) Toggle, hence the name Toggle flip-flop.

T	Q	Q (t+1)
0	0	0
1	0	1
0	1	1
1	1	0

Applications of Flip-Flops

These are the various types of flip-flops being used in digital electronic circuits and the applications of Flip-flops are as specified below.

- Counters
- Frequency Dividers
- Shift Registers
- Storage Registers

CONCLUSION:

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Teacher's Sign

REFFRENCE:

1. Modern Digital Electronics R.P.Jain
2. Digital System Morris Mano

Q.1. Answer the following Questions.

1. Implement EX-OR gate using NAND Gate.
2. Realize Full Adder using Half Adder.
3. Mention the IC’s used for AND, OR, NOT, NOR, NAND, EX-OR and EX-NOR gates,
4. Write truth tables of RS,JK,D,T Filp flop
5 Sate and explain Demoargan’s theorem .

Experiment No: 08	
Title: Transducers Circuits	
Date of Performance:	
Name of the student:	
Roll No:	**Division:**
Signature of Teacher:	

EXPT. NO. : 8

STUDY OF DIFFERENT TYPES OF TRANSDUCERS

TITLE : Study of different types of transducers (e.g. Thermistor, LDR, LVDT etc)

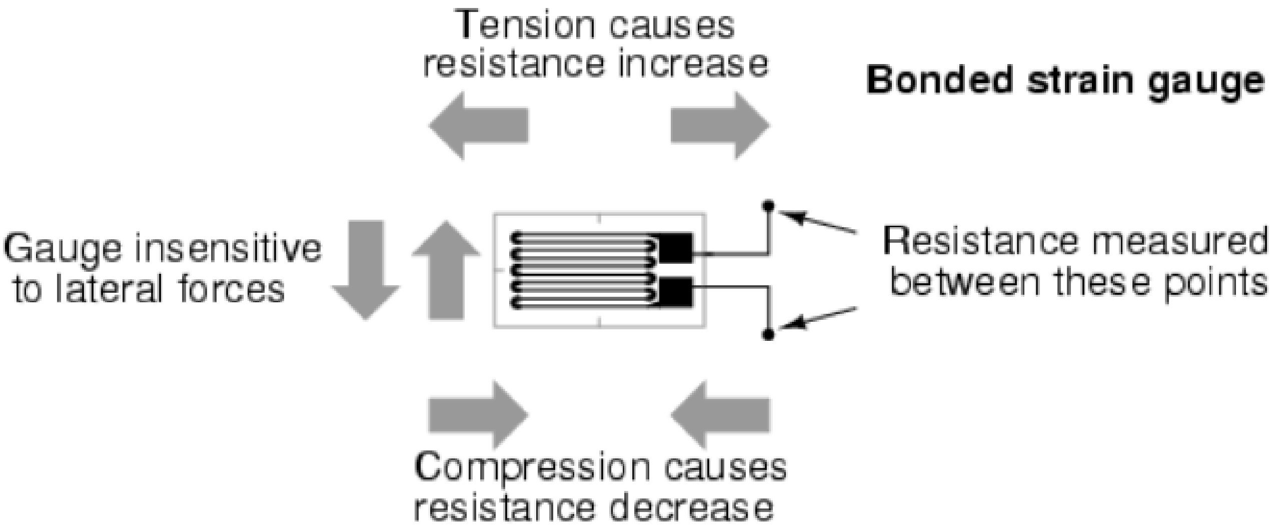
OBJECTIVE : 1. To Acquaint with transducer characteristics
2 .To understand applications of Transducer.

THEORY :

A]Strain Gauge

 Strain gauge is one of the prime transducer widely used in industry for measurements of weight,
load force, pressure, displacement, indirectly for torque, stress and strain.
 Strain gauge is nothing but a non-conductive paste clad on a high-grade plastic strip in such a way
that it can be easily bent and stressed/strained.
 The property of material is it change it's resistance when expose to mech./physical change in it's
shape.
 The strain gauge foils are available with different resistance valves, different size and different
gauge factors. (Gauge factor is the ratio of change in resistance with elongation or strain).
 Normally strain gauges are available with 120Ω, 240Ω, and 350Ω resistance values. Resistance
wire stain gauges are transducers applied to the surface of structural members under test in order
to sense the elongation or strain due to applied loads.
 The setup consists of mild steel structural strip duly ground from both the side ensuring smooth
surface rigidly mounted on a sturdy solid square bar supported on heavy stable base structure. The
sturdy structure stand ensure better result.
 Strain gauge sensor of plastic foil type with 120Ω resistance and 8mm gauge length, 5mm width,
compensated for mild steel type are pasted to steel strip. The pasting procedure is very important
as it is directly related to elongation of strain gauges when load is applied. Perfect surface contact
shall give better and consistent change in resistance linear to load applied to it.
 The strain gauges changes it's resistance with variation of temp. Hence gauge are selected are
mild steel compensated. The change in resistance is too small in value which makes it difficult in

sensing the change in view of this the strain gauges are used in the form of bridge circuitry and
electronic signal generated is processed by instrumentation amplifier.

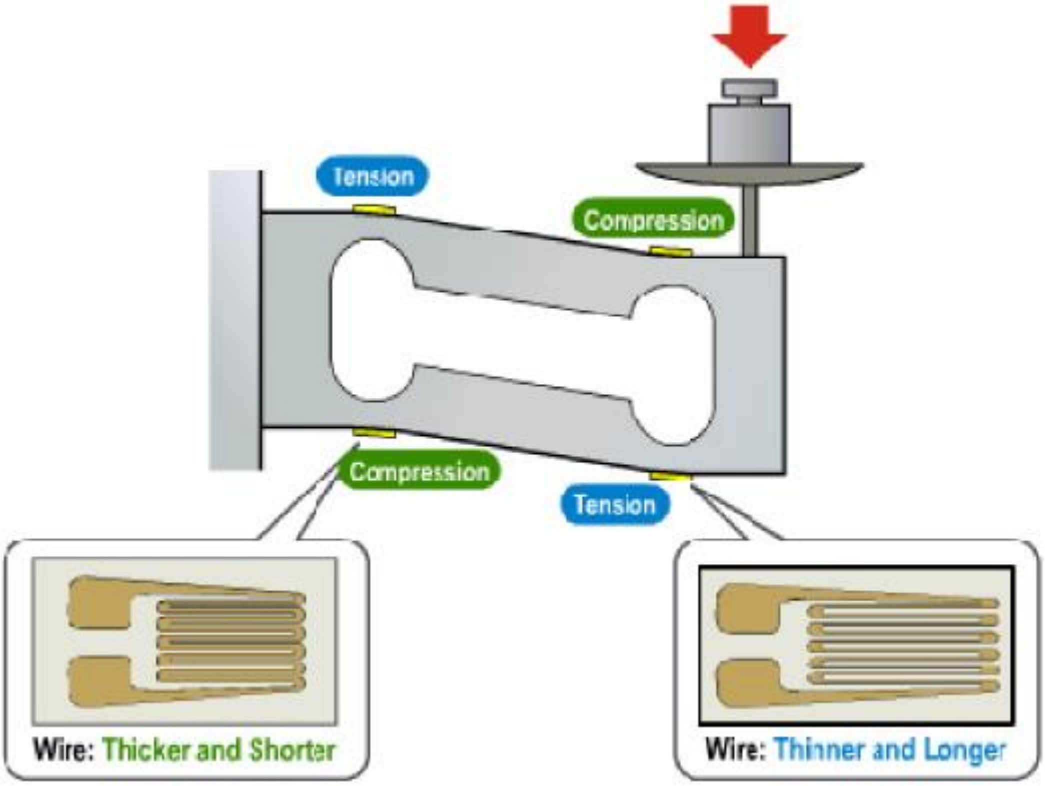


Load Cell/ Cantilever Beam Load Cell

 Bridge may have only one arm or two arm or four-arm strain gauge as active element and balance resistance as passive element.

 The 4-arm strain gauge bridge is the most preferred on performance basis. Load cell uses 4 strain gauges as active bridge element. The strain gauge are pasted to steel strip in such a way two strain gauge sensor are compressed while other elongated, resulting differential change in resistance increasing (doubles) sensitivity.

 Two strain gauges pasted from top to the strip and another exactly below from bottom all the 4 strain gauges are wired in the form of bridge and terminated at bottom plate on a connector makes it easy for connection. Small pan hooked up to the dead end cantilever with weights.



CONCLUSION :

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Teacher's Sign

Experiment No: 09	
Title: **BUILD AND TEST SIMPLE ELECTRONICS APPLICATION**	
Date of Performance:	
Name of the student:	
Roll No:	**Division:**
Signature of Teacher:	

EXPT. NO. : 09

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BUILD AND TEST SIMPLE ELECTRONICS APPLICATION CIRCUIT

TITLE : Build And Test Simple Electronics Application Circuit

OBJECTIVE : Build and Test any Circuit using

1) ***OP-AMP LM-741.***
2) BJT/MOSET
3) Any Digital Logic Gate IC
4) Sensor

APPARATUS : As per your application Circuit.

1. Digital Multimeter
2. CRO
3. Function Generator

THEORY : Following points to be covered**:-**

1) INTRODUCTION

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2) WORKING PRINCIPLE

3) SPECIFICATION OF COMPONENTS

Sr. No.	Name of the Component	Parameter/values

4) CIRCUIT DIAGRAM WITH COMPONENT VALUE

5) APPROXIMATE COST:

Sr. No	Components	Cost
Total Cost		

PROCEDURE :

Result:

Teacher's Sign

Experiment No: 10
Title: CASE STUDY OF ANY ONE ELECTRONICS APPLIANCES
Date of Performance:
Name of the student:
Roll No: Division:
Signature of Teacher:

EXPERIMENT NO: 10
CASE STUDY OF ANY ONE ELECTRONICS APPLIANCES

TITLE : Case Study of any one electronics appliances with block diagram, specification etc.

OBJECTIVE :

APPARATUS :

THEORY :

SPECIFICATION:

BLOCK DIAGRAM

CONCLUSION :

Teacher's Sign