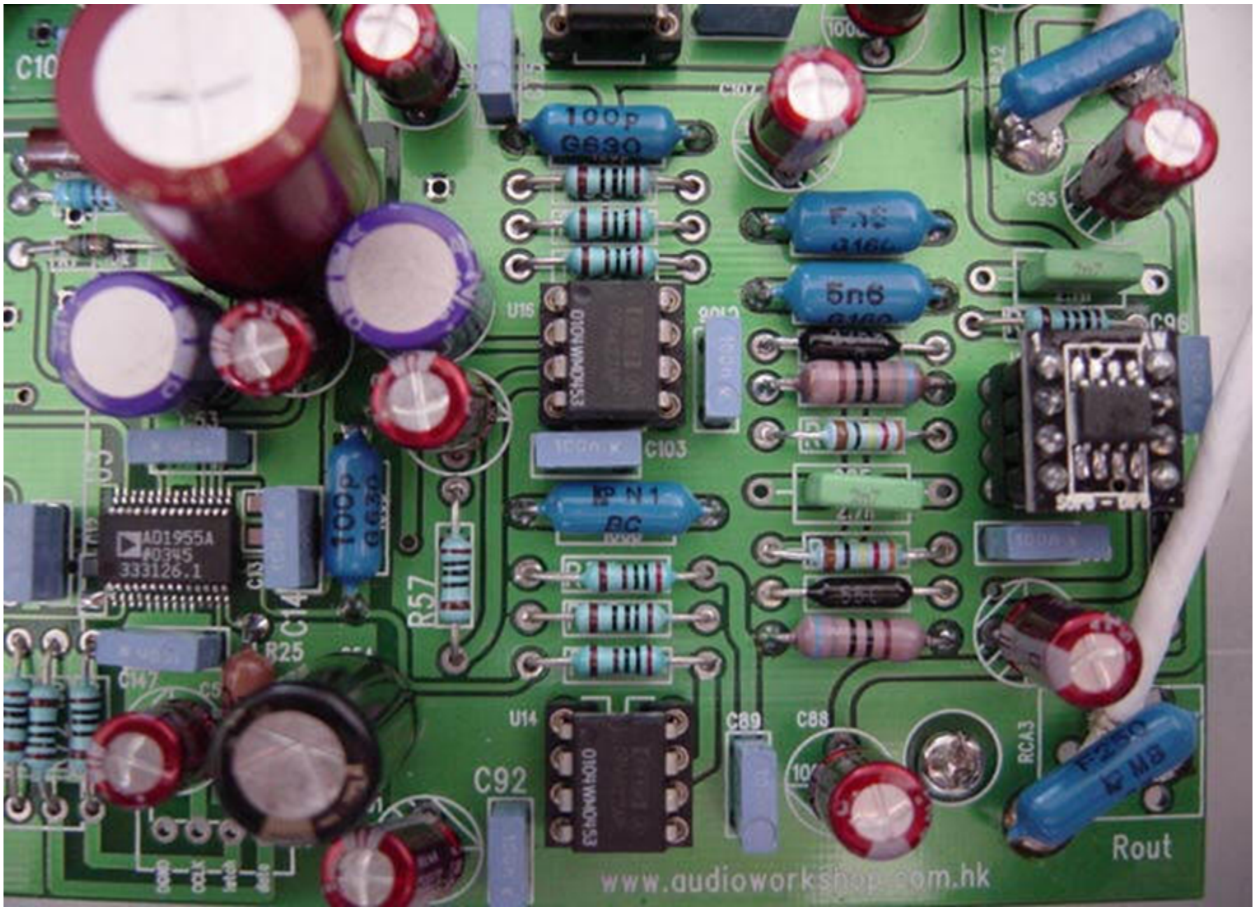


DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

EC133 – ELECTRONIC WORKSHOP LABORATORY

Syllabus

1. Use basic source and measuring instruments (Power supply, function generator, CRO, DMM), Familiarization of breadboard.
2. Measurement of Voltage and Frequency using CRO. Study of step down transformer. Measuring the secondary voltage.
3. Identify and test electrical/electronic active and passive components
4. Colour Coding of resistors and Capacitor Coding
5. Study of Series and Parallel circuits – Using Bread Board and DC power supply.
6. Si – diode Characteristics – Static resistance – Dynamic Resistance at various points on the curve.
7. Half Wave Rectifier and Full Wave Rectifier
8. Fixed Biasing and Voltage Divider Biasing. (Check whether the transistor in the circuit is in the active, cut off or saturation)
9. Study different types of logic gates
10. Solder and de-solder electronic components on different types of PCB. Assemble one electronic system on PCB, test and demonstrate its functioning

Abstract about the Lab

This manual is intended for the First year students of BTech in the subject of Electronics Workshop. Students are advised to thoroughly go through this manual rather than only topics mentioned in the syllabus as practical aspects are the key to understanding application of electronics.

Good Luck for your Enjoyable Workshop Sessions.

Table of Contents

Sl.No	Date	Description of Experiments	Page No	Marks	Sign of Faculty
1		Colour Coding of resistors. Familiarization of breadboard			
2		Study of Series and Parallel circuits – Using Bread Board and DC power supply.			
3		Measurement of Voltage and Frequency using CRO. Study of step down transformer. Measuring the secondary voltage.			
4		Study of different types of logic gates			
5		Si – diode Characteristics – Static resistance – Dynamic Resistance at various points on the curve.			
6		Half Wave Rectifier and Full Wave Rectifier			
7		Solder and de-solder electronic components on different types of PCB			
8		Fixed Biasing and Voltage Divider Biasing. (Check whether the transistor in the circuit is in the active, cut off or saturation)			

Ex.No.6	a) Study of Colour code of resistors b) familiarization of breadboard c) circuit connection practice using resistors only d) use of DMM
Date: 18-11-2021	

Aim:

To determine the value of resistors by their colour code and to study the usage of breadboard for circuit connections in laboratory.

Apparatus

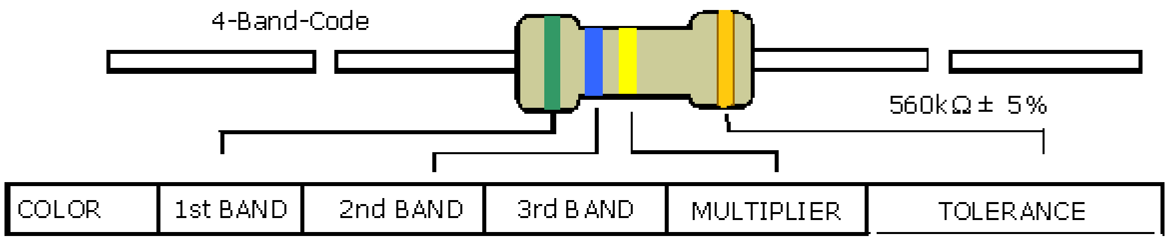
1. Breadboard
2. Set of wires – single strand
3. Set of resistors (any 3 values)
4. Digital Multimeter (DMM)

Theory

Since it is not practical to print the resistance values on the resistors due to its small size, a method called colour coding is adopted. Colour coding is standardized by Electronic Industries Assoication (EIA). Coloured bands are marked at the left end of the resistor to indicate the value of the resistance and another ring at the right end to indicate the tolerance value.

The values of resistors are derived from the standard set of two digit base numbers. Values are derived by assigning sufficient number of zeros or decimal points to these numbers :
10,12,15,18,22,27,33,39,47,56,68 and 82.

COLOUR	Ist Ring	IInd Ring	IIIrd Ring (multiplier)	IVth Ring (tolerance)
Black	0	0	1	-
Brown	1	1	10	-
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	-	-	-	+ or – 5%
Silver	-	-	-	+ or – 10%



Procedure

1. Hold the resistor such that the colour bands are at the left end of the resistor. Write down the numeric value of the first colour band.
2. Write down the numeric value of the second colour band .Read the numeric value of the third colour band and write down those many zeros at the right side of the first two numerics. This gives the value of the resistor in Ω.
3. Measure the resistance using a multimeter. Compare the theoretical value with this practical value. Repeat the procedure for various resistors.

Reading the value of resistors

Sl. No	**Band-1**	**Band-2**	**Band-3**	**Resistance**	**Multimeter reading**
Sample 1	colour	colour	colour	Theoretical value	Measured value
Sample 2					
Sample 3					

BREADBOARD

Theory

An electronics breadboard is a **solderless** breadboard. These are units for making temporary circuits and prototyping, and they require absolutely no soldering.

Apart from horizontal rows, breadboards usually have what are called power rails that run vertically along the sides.

These power rails are metal strips that are identical to the ones that run horizontally, except they are, typically, all connected. When building a circuit, we may need power supply connections in number of different places. The power rails give you easy access to power points wherever you need it in your circuit.

Ex.No.2	Series and parallel connection
Date:	

Aim :To study the properties of series and parallel connection.

Apparatus

1. Set of resistors
2. Set of wires and breadboard
3. DC Power supply
4. Digital Multimeter

Theory

1. The Series Circuit

A series circuit is a circuit having one current path. Since a series circuit has just one current path, it follows that all the components in a series circuit carry the same current I .In a series circuit, the total resistance, R_T that the dc power supply/battery sees is equal to the sum of the individual resistances. Thus, the dc power source sees a total resistance, $R_T = R1 + R2 + R3 + \ldots Rn$

By Ohm's law, it follows that the current I in a series circuit is equal to

$$I = \frac{V}{R_T} = \frac{V}{R_1 + R_2 + \cdots + R_n}$$

The potential difference between the terminals of a resistor is called the voltage drop across the resistor, and, ***is equal to the current I times the resistance R*** ; that is, the ''**voltage drop**'' across a resistance of **R** ohms carrying a current of *I* amperes is **IR** volts.

We have the important fact that in a series circuit, the applied voltage is equal to the sum of the voltage drops.

2. The Parallel Circuit

A parallel circuit is one in which the battery current divides into a number of ''parallel paths.''

The currents in the individual resistances are called the ''branch currents,'' and the battery current **I** is often called the ''line current.'' In a parallel circuit, the battery current I is equal to the sum of the branch currents.

$$I = I_1 + I_2 + I_3 + \cdots + I_n$$

The battery voltage V is applied equally to all n resistances; that is, the same voltage V is applied to all the parallel branches hence, by Ohm's law, the individual branch currents have the values:

$$I = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}\right)$$

By Ohm's law,

$$I = \frac{V}{R_T}$$

From equations above,

$$\boxed{\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}}$$

Procedure for Series connection

1. Connect the circuit as shown in Fig. 1, set V_S =15V
2. Measured the voltage across R1 , R2 & R3, then record it in table below.

3. By using Ohm's law, calculate the R_T

4. Verify that $V_S = V1 + V2 + V3$

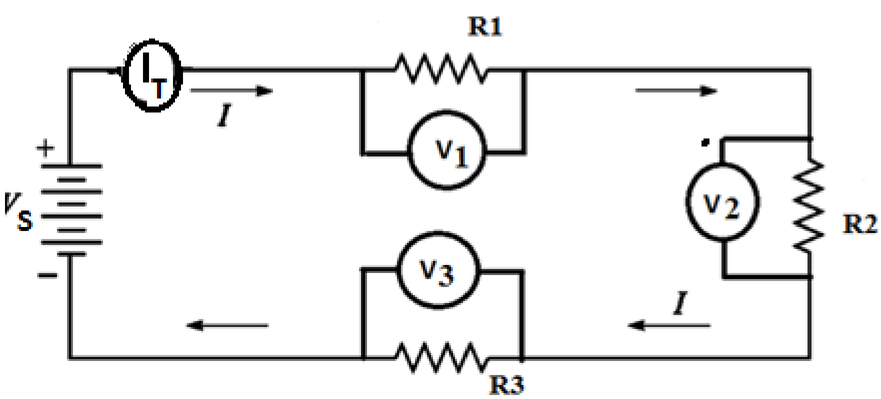


Fig. 1

	V_{R1}	V_{R2}	V_{R3}	
V(volt)				$V_S =$
I_T(mA)				$I_T =$

$R_T = V_S / I_T$

Procedure for Parallel connection

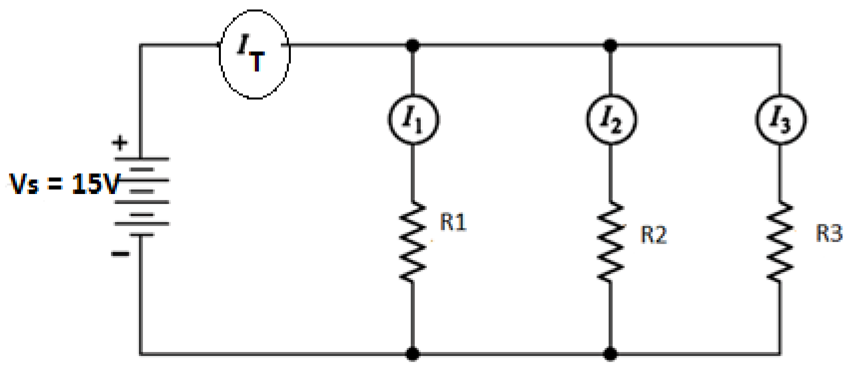


Fig. 2

1. Connect the circuit as shown in Fig.2, and measure the total current I_T and the current flowing in R1 , R2 & R3, then record it in table below.
2. Calculate $R_T = V_S / I_T$

3. Show that $I_T = I1 + I2 + I3$

	I_{R1} (I_1)	I_{R2} (I_2)	I_{R3} (I_3)	
I (mA)				**I_T =**
V (volts)				**V_S=**

Ex.No.3	**Measurement of voltage and frequency using DSO** **Study of step down transformer**
Date:	

AIM

To measure voltage and frequency using DSO and to study transformer action

APPARATUS

1. Step Down Transformer

2. Digital storage oscilloscope

THEORY

1. Step down transformer

Step down transformers are designed to convert electrical voltage from one level to a lower level. Their primary voltage is greater than their secondary voltage. This kind of transformer "steps down" the voltage applied to it.

Step down transformers work on the principle of mutual induction between coils to convert voltage levels.

Step down transformers are made from two or more coils of insulated wire wound around a core made of iron. When voltage is applied to one coil (called the primary or input) it magnetizes the iron core, which induces a voltage in the other coil, (called the secondary or output). The turns ratio of the two sets of windings determines the amount of voltage transformation.

If Vp = primary voltage and Vs = secondary voltage, then

$$V_s/V_p = N_s/N_p$$ where Ns = no. of turns of secondary and Np = no. of turns of primary

For a step down transformer, $N_s < N_p$.

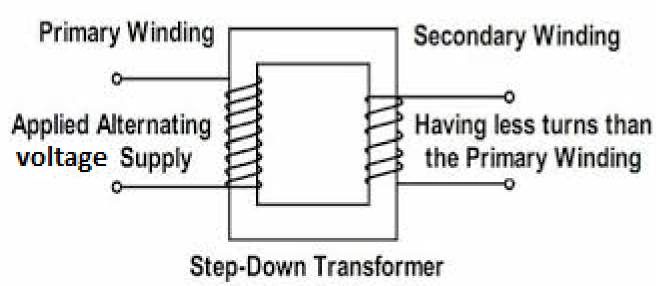


Fig.1

Procedure1: Connect the primary to 230V ac mains power supply. Connect oscilloscope probes across the secondary windings using the centre tapped terminal

i.e between 6-0- (6) / 9-0- (9). Observe the waveform of secondary.

Measure the peak value Vm. Then RMS value of secondary wave is Vm/√2 or approx. 0.707 V_m (fig.2)

Time period for 1 cycle = T

So, frequency of the a/c wave is f =1/T

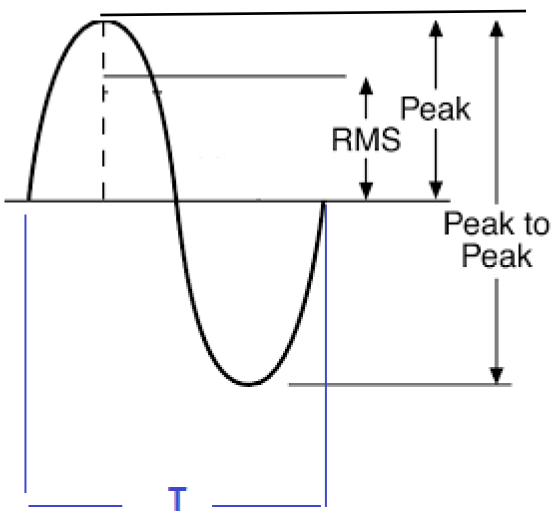


Fig. 2

TABULATION :

1) Draw the secondary sine waveform
2) Calculate and mark the RMS value.
3) Calculate the frequency and time period of ac wave across secondary.
4) Calculate the turns ratio from : A/C mains rms voltage is 230 volts (Vp)
   Measured rms voltage across secondary (Vs)
   Hence turns ration is : Vs/Vp

Ex.No.4	Verification of Truth Table of Logic Gates
Date:	

Aim of the experiment

This experiment will examine the operation of the OR, AND, NAND, NOT, NOR and XOR logic gates and compare the expected outputs to the truth tables for these devices.

Apparatus

1. IC Trainer Kit
2. Set of wire cables
3. ICs - 7408 AND Gate, 7432 OR Gate, 7400 NAND Gate, 7404 INV Gate, 7402 NOR Gate, 7486 XOR Gate

Theory

The NOT circuit or inverter performs the basic logic function of complementation.The inverter has one input and one output and the output is the complement of the input. Figure shows the truth table for the NOT function.

INPUT A	OUTPUT Y
1	0
0	1

All other logic gates have two or more inputs and one output. These logic gates accept digital logic levels on their inputs and will provide a digital logic level output which is dependent on the type of logic gate and the inputs applied to the gate.

Analysis of Basic Logic Gates

7408 AND Gate Truth Table:

A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

7432 OR Gate Truth Table:

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

7400 NAND Gate Truth Table:

A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

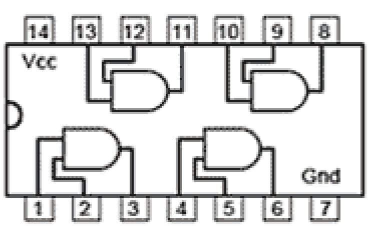
7402 NOR Gate Truth Table

A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

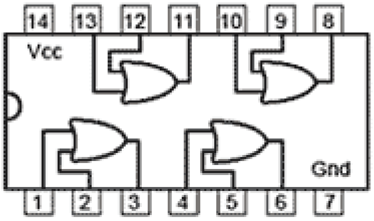
7486 XOR Gate Truth Table

A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

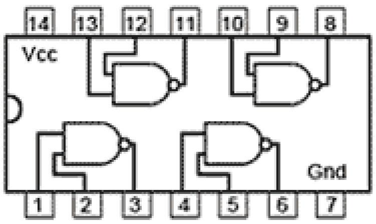
IC pin details



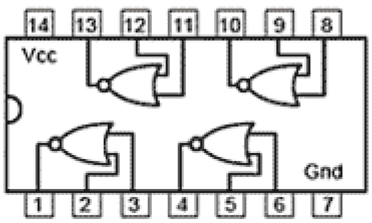
7408 Quad 2 input AND Gates



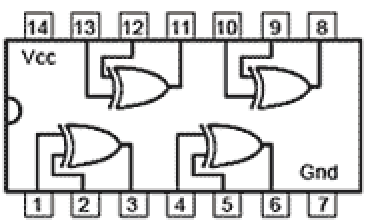
7432 Quad 2 input
OR Gates



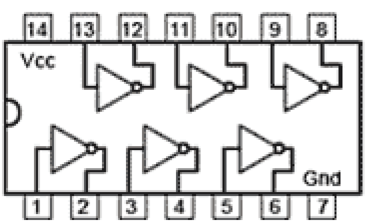
7400 Quad 2 input
NAND Gates



7402 Quad 2 input
NOR Gates



7486 Quad 2 input
XOR Gates



7404 Hex NOT Gates
(Inverters)

Procedure

Making use of the IC Trainer kit, verify the truth tables using appropriate input values.

Precaution : The IC pin holders are of 16 pin type whereas the 74 series ICs are of 14 pins. The pin numbers may be appropriately re-numbered depending upon the insertion of the ICs in the holder.

Ex.No.5	V - I CHARACTERISTICS OF PN JUNCTION DIODE
Date:	

AIM:

To plot the VI characteristics of a PN junction diode in both forward and reverse biased condition.

To calculate its cut- in voltage or threshold voltage, forward resistance and reverse resistance.

Components and Equipment required :

SL. NO.	NAME OF THE APPARATUS	RANGE	TYPE	QTY
1	Regulated power supply	0-30 V		1 No
2	Volt meter	0-30V		1 No
3	Ammeter	(0-50mA), (0-50μA)		Each1 NO
4	Diode	-	1N4007	1No
5	Breadboard	-	-	1 No

THEORY:

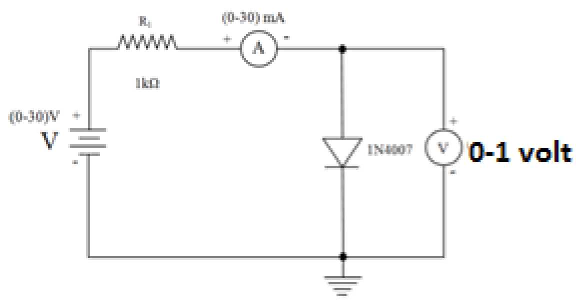
A PN junction diode is a one way device offering low resistance when forward biased and behaving as an insulator when reverse biased. A p-n junction diode conducts only in one direction.

When p-type (anode) is connected to +ve terminal and n- type (cathode) is connected to –ve terminal of the supply voltage, this is known as forward bias. The potential barrier is reduced when diode is in the forward biased condition. At a particular forward voltage, the potential barrier is altogether eliminated and current starts flowing through the diode and also in the circuit. The diode is said to be in ON state. The current increases with increasing forward voltage.

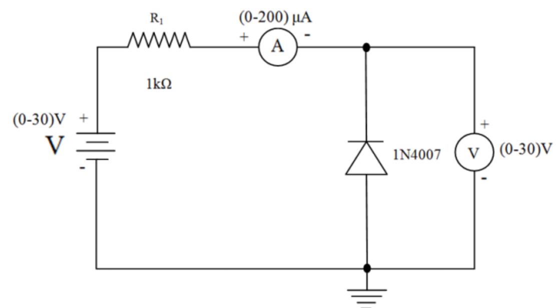
When n-type (cathode) is connected to +ve terminal and p-type (anode) is connected –ve terminal of the supply voltage is known as reverse bias and the potential barrier across the junction increases. Therefore, the junction resistance becomes very high and a very small current (reverse saturation current) flows in the circuit. The diode is said to be in OFF state. The reverse bias current is due to minority charge carriers.

CIRCUIT DIAGRAM:

FORWARD BIAS



REVERSE BIAS



PROCEDURE:

FORWARD BIAS:

1. The connections are made as shown in the circuit diagram.
2. For forward bias the positive terminal of power supply is connected to anode of the diode, negative terminal to cathode.
3. The power supply is switched on.
4. The forward voltage V_f across the diode is increased in small steps and the forward current is noted.
5. The readings are tabulated.
6. A graph is drawn between V_f and I_f by taking V_f along x-axis.
7. The inverse of the slope of the linear portion of the graph gives the forward resistance R_f of the diode $R_f=V_f/ I_f$.

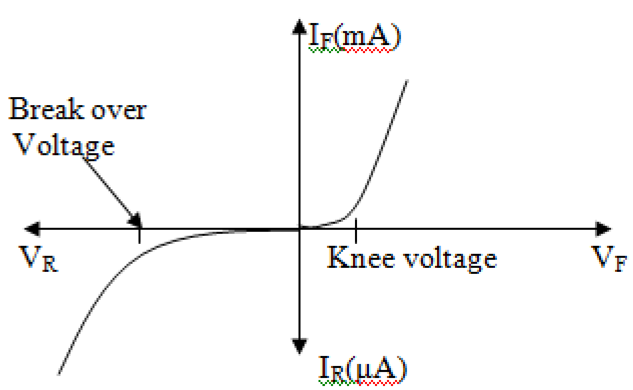
REVERSE BIAS:

1. For reverse bias the positive terminal of the power supply connected to cathode of the diode and the negative terminal to the anode of the diode.
2. The power supply is switched on.
3. The reverse bias voltage V_r is increased in steps and reverse current I_r is noted in each step.
4. The readings are tabulated.
5. A graph is drawn between V_r and I_r taking V_r on x-axis. The reverse characteristics curve is approximately a straight line .

TABULATIONS:

	FORWARD BIAS		REVERSE BIAS	
V_{supply}	V_f (V)	I_f(mA)	Vr (V)	Ir (μA)
0.1				
0.2				
0.3…..0.6				
0.7 V				
1 V				
2 V				
3V				
4V				
5V				
6V				
7 to 15v				

GRAPH:



RESULT:

The forward and reverse characteristics of the semiconductor diode has been plotted

The forward resistance of the diode = ---------

The cut-in voltage of the diode = ---------

PRECAUTIONS:

1. Always connect the voltmeter in parallel & ammeter in series as shown in figure.
2. Connection should be proper & tight.
3. Switch ‘ON the supply after completing the circuit.
4. DC supply should be increased slowly in steps.
5. Reading of voltmeter and ammeter should be accurate.

Ex.No.6	Half wave and Full wave Rectifier
Date:	

Aim of the experiment

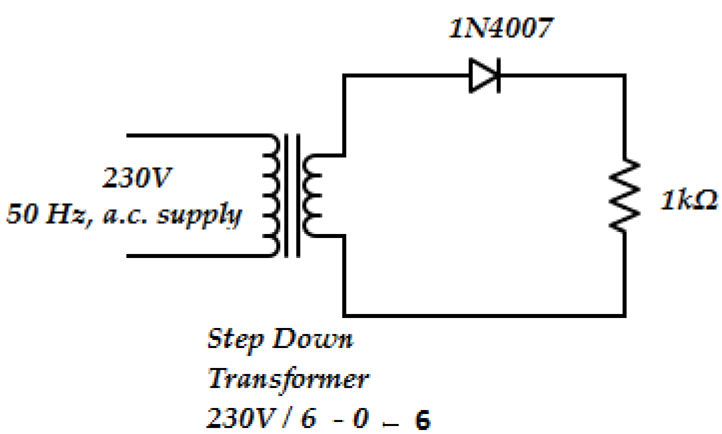
1. To set up a half wave rectifier and to find the dc value of rectified voltage
2. To set up a full wave rectifier and to find the dc value of rectified voltage

Apparatus

Sl. No	Equipment/ Component	No. Required
01.	DSO	01
02.	1N 4007	02
03.	Step Down Transformer 230V/ 6-0 – 6V	01
04.	Resistor 1k, 1/4W	01
05.	Bread Board	01
06.	Connecting Wires	Few Strands

Theory

1. The Half wave recifier



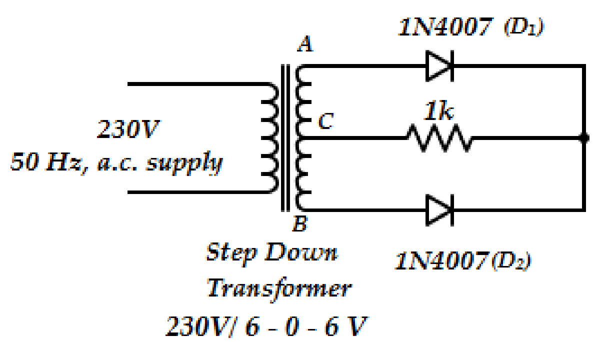
A rectifier is a circuit which converts the *Alternating Current* (AC) input power into a *Direct Current* (DC) output power.

Half Wave Rectifier is the simplest of all the rectifier circuits. The diode in a half wave rectifier circuit passes just one half of each complete sine wave of the AC supply in order to convert it into a DC supply. Then this type of circuit is called a "half-wave" rectifier because it passes only half of the incoming AC power supply.

During each "positive" half cycle of the AC sine wave, the diode is *forward biased* as the anode is positive with respect to the cathode resulting in current flowing through the diode. Since the DC load is resistive (resistor, R), the current flowing in the load resistor is therefore proportional to the voltage (Ohm´s Law), and the voltage across the load resistor will therefore be the same as the supply voltage, Vs (minus the diode drop of 0.7V), that is the "DC" voltage across the load is sinusoidal for the first half cycle only so Vout = Vs – 0.7V.

During each "negative" half cycle of the AC sinusoidal input waveform, the diode is *reverse biased* as the anode is negative with respect to the cathode. Therefore, no current flows through the diode or circuit. Then in the negative half cycle of the supply, no current flows in the load resistor as no voltage appears across it so therefore, Vout = 0.

2 FULL WAVE RECTIFIER



The full wave rectifier circuit consists of two *diodes* connected to a single load resistance (R_L) with each diode taking it in turn to supply current to the load. When point A of the transformer is positive with respect to point C, diode D_1 conducts in the forward direction as indicated by the arrows. When point B is positive (in the negative half of the cycle) with respect to point C, diode D_2 conducts in the forward direction and the current flowing through resistor R is in the same direction for both half-cycles.

<u>EXPERIMENT PROCEDURE:</u>

1. Connect circuit as shown in the circuit diagram

2. Connect one channel of the DSO to the secondary of the transformer and the other channel across the load resistor.
3. Observe the waveforms and note down the peak voltages Vm
4. Calculate the V_{DC}

Result : Value of full wave rectification (V_{DC}) will be twice that of half wave.

Ex.No.7	Soldering practice
Date:	

Aim of the experiment

To practice soldering and desoldering

Apparatus

1. Soldering iron
2. Solder lead
3. Flux
4. General purpose PCB
5. Desoldering pump, cutter, tweezer

Theory

Soldering is the process of joining two or more metal wires/leads using an alloy metal having low melting point to establish a permanent electrical connection. Hand soldering amd machine soldering (wave soldering) are the two types of soldering methods.

Solder lead : Solder is used for joining two or more metals at temperatures below their melting point. The popularly used solders are the alloys of tin (63%) and lead (47%) that melts at 183 C and solidifies when cools. Melting points of tin and lead are 232C and 327C respectively. When tin and lead are mixed in 63:47 ratio, it becomes molten at 180C. This is called eutectic point.

Soldering fluxes: In order to make the metallic surfaces accept the solder readily, the component terminals should be free from oxides and other obstructing film layers. Flux cleans the oxides from the surface of the metals. Zinc chloride, ammonium chloride and Rosin are the most commonly used fluxes. These are available in petroleum jelly as paste flux.

Soldering iron : It is the tool used to melt the solder and apply at the joints in the circuit. The normal power ratings of the soldering iron are 10W, 25W, 35W, 65W and 125W. 10W and 25W soldering irons are sufficient for light duty works. The iron bit at the tip gets heated up within a few minutes.

Desolderingpump : It is a vacuum pump used to remove the solder when melted by the soldering iron while desoldering the connections.

Procedure for soldering

1) Clean the component leads using a blade. Apply a little flux on the leads. Take a little solder on the soldering iron and apply molten solder on the leads. This process is called “tinning”

2) Clean the tip of the soldering iron . Keep the bit always clean from oxide formation while soldering.
3) Do not overheat the PCB and devices. Insert the component into the PCB holes designated for the component. Apply solder. Cut-off the excess lead lengths using a cutter.
4) Do not use excess solder or flux.

Ex.No. 8	Zener diode Regulator
Date:	

Aim : To study the regulation action of Zener diode

Apparatus

1. Resistor 1 k ohm
2. Set of wires and breadboard
3. DC Power supply (0 to 15 V)
4. Digital Multimeter
5. Zener diode 5.2 V

Theory

The *zener diode* is the simplest types of voltage regulator and the point at which a zener diode breaks down or conducts is called the "Zener Voltage" (Vz).

The **Zener diode** is like a general-purpose signal diode consisting of a silicon PN junction. When biased in the forward direction it behaves just like a normal signal diode passing the rated current, but as soon as a reverse voltage applied across the zener diode **exceeds the rated voltage** of the device, the diode breakdown voltage is reached. The current now flowing through the zener diode increases rapidly to the maximum circuit value (which is limited by a series resistor) and once achieved this reverse saturation current remains fairly constant over a wide range of applied voltages. The voltage point at which the voltage across the zener diode becomes constant is called the "zener voltage".

Procedure

1. Connect the circuit as shown in Fig. 1. Vary the supply voltage from 0V to 15 V.
2. Measured the voltage across Zener diode.
3. Tabulate the value of Vz for different values of V supply (0 to 15 V)

4. Verify that zener diode breakdown occurs around V_Z = 5.2 volts, after which it remains constant even if power supply is increased beyond 5.2 V.

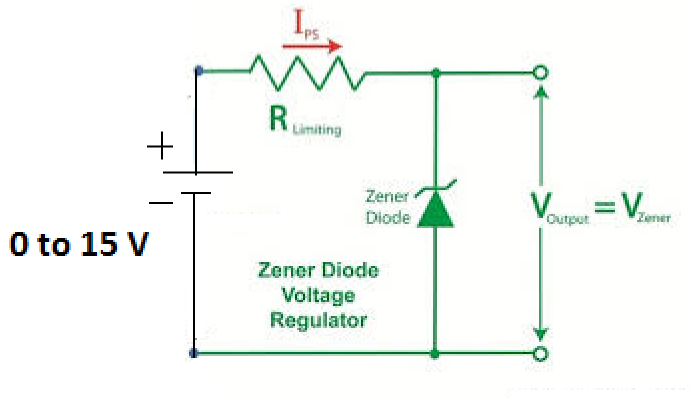


Fig. 1

Vsuppy	Voltage across Zener Vz
0 V	
1 V	
..	
..	
15 V	