RUSHIK RATHOD
20DCS103_DEPSTAR CSE - 2

EE145
PRACTICAL 1 TO 10

Charotar University of Science & Technology
Faculty of Technology & Engineering
M & V Patel Department of Electrical Engineering

AY 2020-21

List of Experiments

Exp. No	Aim of Experiment
1.	To Study various electrical and electronics components..
2.	To study and perform about KVL and mesh analysis.
3.	To study and perform about KCL and Node analysis.
4.	To perform of charging and discharging of a capacitor.
5.	To study and perform V-I characteristics of PN junction Diode.
6.	To study and perform zener diode as voltage regulator.
7.	To study and perform half wave rectifier.
8.	To study and perform full wave rectifiers.
9.	To study the input and output characteristics of a Transistor in Common Base(CB) configuration.
10.	To perform resonance in series R-L-C circuit.

EXPERIMENT NO: 1	DATE: 14 /02/ 2021

AIM: To study various electronics and electrical symbols.

THEORY:

Graphic symbols are used to denote electrical, electronic and mechanical components and devices. They are used to portray complex schematic and wiring circuit diagrams in a simple manner for conserving space. In order to make the diagrams easier to read, the graphic symbols, in many cases, resemble the actual component or its element. Thus, the graphic symbols serve as effective & precise means of communication, particularly in situations, which involve complex diagrams and devices.

We have selected a few commonly used symbols and have explained them first and the symbols are drawn in the latter part.

FUSE:

Many circuits have a fuse in series as a protection against over load from a short circuit. Fuses are fabricated from low melting point alloys. Under normal load conditions, the current through the fuse will not produce excessive heat. If the circuit is overloaded or if a fault occurs, leading to a heavy rush of current, the fuse element melts due to high heat generated by this increased current. This blowing-up of the fuse thus opens the series circuit. The objective is to let the fuse blow before the components are damaged. A new fuse element can easily replace the blown fuse after the overload has been eliminated. Fuses are manufactured in a wide variety of shapes & current ratings. Fuse elements are made of tin-coated copper or nickel and aluminium. They are available in current ratings of 2 mA to hundreds of ampere.

CELL & BATTERY:

A voltaic chemical cell is a combination of materials, which produce direct current (DC) from its internal chemical reactions. Each cell has two terminals +ve terminal & –ve terminal.

An electric battery consists of a number of electro-chemical cells, connected either in series or parallel. The voltage rating of battery depends upon voltage rating of group of cells (either connected in series or parallel). The voltage rating of cell is given by its open circuit voltage i.e. voltage it can produce when not connected to a load circuit. This voltage depends on the type of materials used and not the physical size of the cell.

SWITCHES:

A switch is a device for opening and closing a circuit. They are manufactured in hundreds of sizes and types. Some of the more common ones are discussed below:

i. **Single pole Single – throw (SPST) Switch:**

Such switch has one lever or arm (i.e. Single pole). It can connect or disconnect one side of a line or a single wire circuit.
Example: Tumbler switch, piano switch using in house wiring, etc.

ii. **Single pole Double – throw (SPDT) Switch:**

Such switch has two ON positions. It is OFF when in the centre. As schematically shown in fig. it has one are (hence Single Pole) but can be moved into either one of the two positions. Obviously, it can close either one of the two circuits.
Example: blunder switch OFF & ON (Low speed, High Speed).

iii. **Double pole Single throw (DPST) Switch:**

Such a switch has only one position of closure but completes two contacts simultaneously. It fact it is similar to SPST switch except that it switches both sides of a wire line at once. It may also be used as two single pose switches acting together.

iv. **Double pole Double throw (DPDT) Switch:**

Such a switch has two poles and can be moved either to the right (Position A) or to the left (Position B).

v. **Rotary Switches:**

The best example of such a switch is the switch used in ceiling fan regulator. The symbol drawn is for a single pole rotary switch.

vi. **Push Button:**
Symbol is shown in fig. It is like a switch with a spring return system i.e. when button is pressed it makes contact or release contact as the case may be. When released it comes back to its normal position. [NC or NO]

RESISTOR:

It is passive element. A resister is an electrical component with a known specified value of resistance. It is probably the most common component in all kinds of electronic equipment ranging from a small radio to a colour television receiver. As its name suggests, a resistor opposes the flow of current through it. Resistance is necessary for any circuit to do useful work. In fact without resistance, every circuit would be a short circuit.

Some of the common uses of resistors are: -
(1) To establish proper value of circuit voltages due to IR drops.
(2) To limit current.
(3) To provide load.

Resistor can be connected in the circuit in either direction because they have no polarity. The types of resistor are:

i. **Fixed Resistor:**
   It is such resistor, where we cannot change its resistance value.

ii. **Variable Resistor:**
   It is such resistor, where we can change its resistance value.

iii. **Rheostat:**
   One type of variable resistor which has two fixed terminal & one variable terminal or known as wire wound resistor they are constructed from a long fine wire i.e. high resistance wire (Nickel chromium wire) wound on a ceramic core. The advantage with a rheostat is that it can be used as a fixed resistor as well as a variable resistor.

INDUCTORS:

It is another passive element commonly used in electrical/electronic circuit It is nothing but coil wound on a core or former of some suitable material. It opposes any change in current. There are mainly two types of inductors on basis of their construction

i. **Air Core Inductor:**
   It consists of number of turns of wire wound on a former made of ordinary cardboard. Since, there is nothing but air inside the coil it is termed as an air-cored inductor. It has the least inductance for a given number of turns & core length.

ii. **Iron-Core Inductor:**
   It is that inductor in which a coil of wire is wound over a solid or laminated iron core. This construction leads to increase in its inductance as many times as the relative permeability (μr) of Iron.

CAPACITORS:

A capacitor has two plates separated by dielectric medium. It is also passive element commonly used in electric circuit. It is a device which

- Has the ability to store charge which neither a resistor nor an inductor can do.
- Opposes any change of voltage in the circuit in which it is connected.
- Block the passage of direct current through it.

They are mainly of two types:

- Fixed Capacitor
- Variable Capacitor

TRANSFORMER:

Basically transformer is power transformation device. It transfers power from one circuit to other either by increasing voltage level (decreasing current level) or by decreasing voltage level (increasing current level) i.e. It makes it possible to step up a relatively low generated voltage level to the possible most desirable high voltage (Step up transformer $N_p < N_s$) or lower the voltage level for most convenient utilization level [esp. in home] (step down transformer $N_p > N_s$).
Its principle's based on mutual inductance principle. Normally transformer has two windings, which are electrically isolated & magnetically coupled.

AUTO TRANSFORMER:

It is also one type of transformer but in this there is only one winding, which works as primary as well as secondary winding. It is also known, as variac.

TRANSISTORS:

Basically consists of two back-to-back P-N junctions manufactured in a single piece of a semiconductor crystal. These two Junctions give rise to three regions called emitter, base and collector. In fig, the arrowhead is always at the emitter (not at the collector) and in each case its direction indicate the conventional direction of current flow. For a PNP transistor, arrowhead points from emitter to base meaning that emitter is positive with respect to base (and also with respect to collector). For NPN transistor, it points from base to emitter meaning that base (and collector as well) is positive with respect to emitter.

I. **N-P-N Transistor**:
In this P-type material is sandwiched between two layers of N-type material. Normally used for voltage Amplification in amplifier. The symbols employed for PNP is shown in fig.

II. **P-N-P Transistor**:
In this N-type material is sandwiched between two layers of P-type material. The symbols employed for NPN is shown in fig.

III. **FET**:
Nowadays field effect transistors are rapidly replacing both Vacuum tubes and junction transistor, in applications requiring high input impedance.

SEMICONDUCTOR DIODE:

Known as PN junction diode two terminal devices consisting of P-N Junction formed either in Ge or Si crystal. PN Junction diode is one-way device offering low resistance when forward biased and behaving almost as an insulator when reverse biased. So used for rectifier for converting alternating current into direct current. It cannot work in reverse bias condition.

ZENER DIODE:

It is also a P-N Junction but its doping (impurities level) is high as compared to PN Junction diode. So during junction formation in reversed biased condition, its depletion region gets decreased and so at low value of break down voltage it will break and work as constant voltage source. Also, its junction is formed at very high temp so it can withstand large heat produced during reverse biasing without damage. It can work in reverse bias while PN junction does not work in reverse bias. Its uses are:

- As a voltage regulator.
- As a fixed reference voltage in a network for biasing and comparison purposes and for calibrating voltmeters.

WATTMETER:

It measures electric power. They are of AC type & DC type
AC Power = VICosΦ Watt [Cos Φ – Power factor]
DC Power = VI Watt

It has two coils - one, which is known as current coil designated with M. & L. Second coil known as potential coil designated with C.V.

- Current coil always connected in series with circuit, as it measures current of Circuit.
- Voltage coil or potential coil is connected in paralleled to circuit as it measures Voltage of coil.

Combined it measures power of circuit.

CROSSOVER:

Symbol is as shown in fig. It means two wires are not meeting at a point.

JUNCTION:

Symbol is shown in fig. It means two wires are meeting at a point.

DC GENERATOR:

Function of generator is to convert mechanical energy into electrical energy. DC generator is based on dynamically induced e.m.f. principle. In this generator output electrical energy is in term of DC so it is called DC generator.

AC GENERATOR:

Converts mechanical energy into electrical energy. Electrical energy produced is an alternating quantity and hence called an AC generator. It operates on statically induced e.m.f. principle.

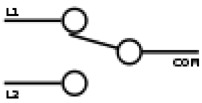
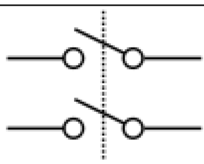
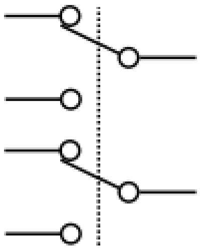
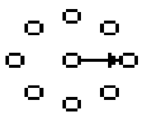
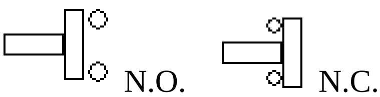
DC MOTOR:

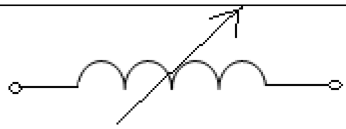
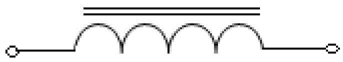
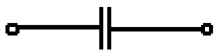
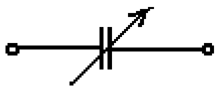
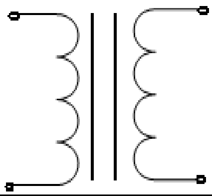
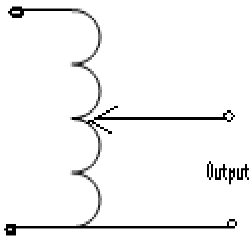
Function of motor is to convert electrical energy into mechanical energy. Its input electrical energy is in form of direct quantity so it is called DC Motor.

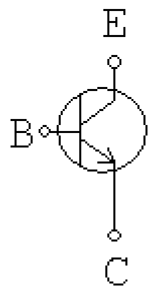
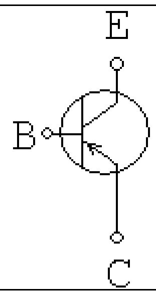
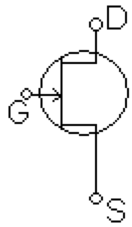
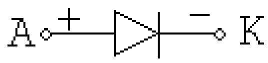
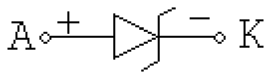
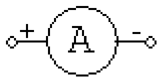
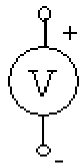
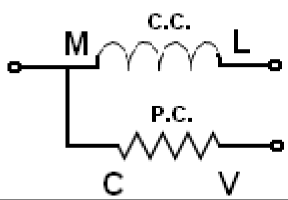
AC MOTOR or INDUCTION MOTOR:

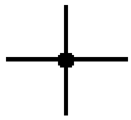
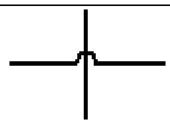
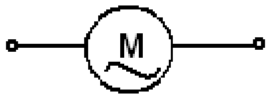
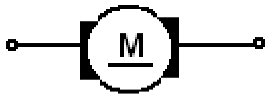
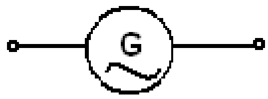
Converts AC electrical energy into mechanical energy.

SYMBOLS:

DESCRIPTION	SYMBOLS
Fuse	
Cell/Battery	
Switches	
i. Single pole single throw [SPST]	
ii. Single pole double throw switch [SPDT]	
iii. Double pole single throw switch [DPST]	
iv. Double pole double throw switch [DPDT]	
v. Rotary switch	
vi. Push button switch [NO & NC]	
Resistors	
i. Fixed resistors	

ii. Variable resistors	
iii. Rheostat	
Inductors	
i. Fixed inductor or air core inductor	
ii. Variable inductor	
iii. Iron core inductor	
Capacitors	
i. Fixed capacitors	
ii. Variable capacitors	
Transformers	
i. Iron core transformer	
ii. Auto transformer	
Transistors	

i. N-P-N transistor	
ii. P-N-P transistor	
iii. FET [Field Effect Transistor]	
Diodes	
i. P-N junction diode	
ii. Zener Diode	
Meters	
i. Ammeter	
ii. Voltmeter	
iii. Wattmeter	

Network	
i. Junction	
ii. Crossover	
Motor / Generators	
i. AC Motor	
ii. DC Motor	
iii. AC Generator [alternator]	
iv. DC Generator	

Conclusion: In this practical, we study various electronics and electrical symbols.

EXPERIMENT NO: 2	DATE: 14 /02/ 2021

AIM: To perform Kirchhoff's Voltage Law [KVL]

APPARATUS: Network theorem kit, DMM, connecting wires

THEORY:

KVL- KIRCHOFF'S VOLTAGE LAW:

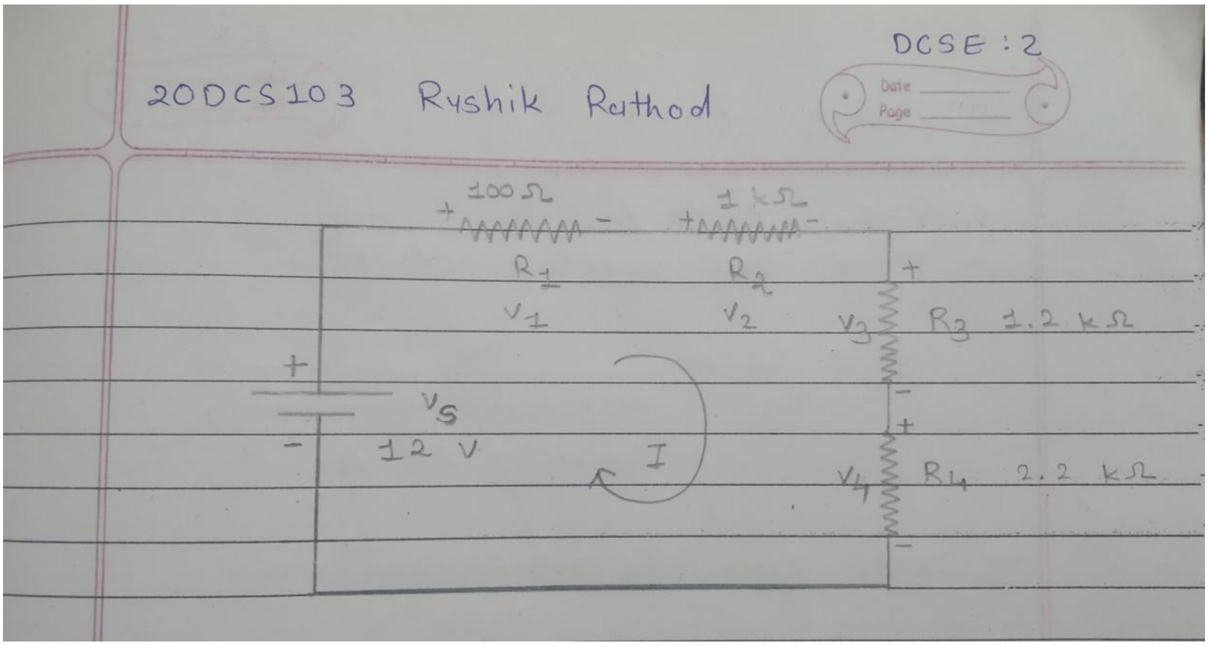
Kirchhoff's voltage law states that algebraic sum of all branch voltages around any closed loop of a network is a zero at all instant of time or we may say that around any closed loop, at any instant of time, the sum of the voltage drops must equal the sum of the voltage rises.

PROCEDURE:

KVL

1. Once the current is measured as directed, measure the voltage across each resistor with the help of multi-meter.
2. Verify the KVL for close loop.
3. Find out the values of voltage drops theoretically and compare the same with practical values.
4. Note down the values as required in the observation table.

CIRCUIT DIAGRAM:



KVL

Theoretical Readings:

Supply Voltage V_S Volts	Voltage across R_1, R_2, R_3 & R_4				$V_S = V_{R1} + V_{R2} + V_{R3} + V_{R4}$
	V_{R1} Volts	V_{R2} Volts	V_{R3} Volts	V_{R4} Volts	
12	0.266	2.66	3.2	5.86	11.986

Practical Readings:

Supply Voltage V_S Volts	Voltage across R_1, R_2, R_3 & R_4				$V_S = V_{R1} + V_{R2} + V_{R3} + V_{R4}$
	V_{R1} Volts	V_{R2} Volts	V_{R3} Volts	V_{R4} Volts	
12.23	0.271	2.708	3.22	6.01	12.209

CALCULATION:

DCSE : 2

20DCS103 Rushik. Rathod

Date
Page

→ Here, $V = 12$ V.

→ From the equation $V = IR$,

$$I = \frac{V}{R_{eq}} = \frac{12}{100 + 1000 + 1200 + 2200}$$

$$= 0.266 \times 10^{-2} \text{ A.}$$

→ NOW, $V_{R_1} = IR_1 = 0.266 \times 10^{-2} \times 100$

$= 0.266$ V.

$V_{R_2} = IR_2 = 0.266 \times 10^{-2} \times 1000$

$= 2.66$ V

$V_{R_3} = IR_3 = 0.266 \times 10^{-2} \times 1200$

$= 3.2$ V

$V_{R_4} = IR_4 = 0.266 \times 10^{-2} \times 2200$

$= 5.858 \approx 5.86$

→ Finally, $V_S = V_{R_1} + V_{R_2} + V_{R_3} + V_{R_4}$

$= 11.986$ V

CONCLUSION: The perpose of this experiment was to verify Kirchchoff's voltage law and the law state that the voltage across the circuit add upto zero.

EXPERIMENT NO: 3	DATE: 14 /02/ 2021

AIM: To perform Kirchhoff's Current Law [KCL]

OBJECTIVE: To verify KCL practically.

APPARATUS: Network theorem kit, DMM, connecting wires

THEORY:

KCL – KIRCHOFF'S CURRENT LAW:

Kirchhoff's current law states that **algebraic sum of all branch currents leaving or entering a node is zero at all instant of time** or we may say that sum of current entering a node must equal the sum of the current leaving the node.

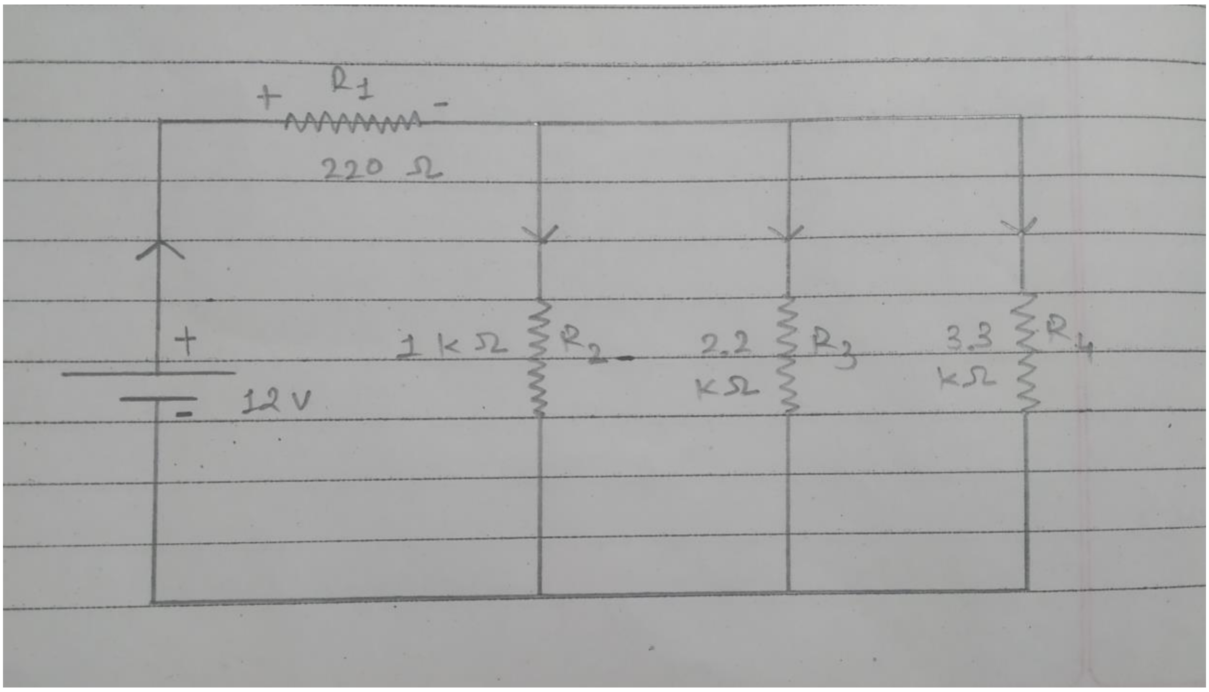
.

PROCEDURE:

KCL

1. Connect the circuit as per shown in the diagram.
2. Switch on the supply and set the value of supply voltage to 12 volts.
3. Take the readings of three ammeters i.e. the total current and branch currents in each branch respectively.
4. Check that for practical readings at node A, KCL is verified or not.
5. Find out the values of current theoretically and compare the same with practical values.
6. Note down the values as required in the observation table

CIRCUIT DIAGRAM:



OBSERVATION TABLE:

KCL

Theoretical Readings:

Supply Voltage V_S Volts	Supply Current I_{R1} (mA)	Branch Current I_{R2} (mA)	Branch Current I_{R3} (mA)	Branch Current I_{R4} (mA)	Sum of current at node A $I_{R1} = I_{R2} + I_{R3} + I_{R4}$ (mA)
12 V	15.2 mA	8.65 mA	3.93 mA	2.62 mA	15.2 mA

Practical Readings:

Supply Voltage V_S Volts	Supply Current I_{R1} (mA)	Branch Current I_{R2} (mA)	Branch Current I_{R3} (mA)	Branch Current I_{R4} (mA)	Sum of current at node A $I_{R1} = I_{R2} + I_{R3} + I_{R4}$ (mA)
12.23 V	15 mA	8.6 mA	3.9 mA	2.65 mA	15.15 mA

CALCULATION:

DCSE : 2

20DCS103 Rushik. Rathod

Date ______ Page ______

→ Here, $R_1 = 220\ \Omega$ $R_3 = 2200\ \Omega$

$R_2 = 1000\ \Omega$ $R_4 = 3300\ \Omega$

→ Now, $\frac{1}{R_{eq}(P)} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

$= 568.96\ \Omega.$

$R_{eq} = R_1 + R_{eq}(P)$

$= 220 + 568.96\ \Omega = 788.96\ \Omega$

$I = \frac{V_1}{R_{eq}} = \frac{12}{788.96} = 15.2\ mA$

$\therefore I_{R_1} = 15.2\ mA.$

and $V_p = I \cdot R_{eq}(P)$

$= 15.2 \times 10^{-3} \times 568.96$

$= 8.65\ V$

→ $I_{R_2} = V_P / R_2 = 8.65\ mA$

→ $I_{R_3} = V_P / R_3 = 3.93\ mA$

→ $I_{R_4} = V_P / R_4 = 2.62\ mA$

→ $I_P = I_{R_2} + I_{R_3} + I_{R_4}$

$= 8.65 + 3.93 + 2.62\ mA$

$= 15.2\ mA$

CONCLUSION:

The purpose of this experiment was to verify kirchhoff's current law and the law state that the current through the circuit add upto zero.

EXPERIMENT NO: 4	**DATE: 14 /02/ 2021**

AIM: To study and perform charging and discharging of a capacitor.

APPARATUS: kit, Stopwatch, DMM and connecting wires.

THEORY:

CHARGING OF A CAPACITOR:

Figure shows a capacitor of capacitance C connected in series with a non-inductive resistor R & is connected to a D.C supply of V volts through a switch ‘S’ at position ‘b’. At the instant of closing the switch to a position ‘b’ there is no charge on the capacitor and therefore no potential difference across it. As a result, the whole of the applied voltage must momentarily act across resistor R. As a result, initial value of charging current becomes equal to V/R, which is the maximum possible current. The charging current gradually decreases from its maximum value till it becomes zero. This happens when the potential difference across the capacitor plates becomes equal & opposite to the supply voltage V.

Let us understand the charging of capacitor. After closing the switch to charge position ‘b’, the capacitor starts charging & voltage across it increases gradually

Let at any instant during charging.

V_C = potential difference across the capacitor
I = charging current
q = charge on the capacitor

Charging voltage $V_C = V[1-e^{-t/RC}]$
Charging current $i = I_m e^{-t/RC}$

Where
$I_m = V/R$ = initial value of charging current.
I_m = Maximum value of charging current

DISCHARGING OF A CAPACITOR:

Consider the above circuit having a capacitor C & R connected in series across a supply volt through the switch. When switch is connected to position ‘b’, then the capacitor is charged to a voltage of V volts. Now, for discharging the switch is moved to a position ‘a’,

Hence capacitor is disconnected from D.C. supply and the circuit is completed through the resistor R. As a result, capacitor starts getting discharged through the resistor R. The moment the switch is thrown to ‘a’ position, discharge current is maximum initially and then decreases gradually till it becomes zero when the capacitor is fully discharged.

Let at any instant during discharging.

V_C= potential difference across the capacitor
I= discharging current
q= charge on the capacitor =C V_C
Discharging voltage $V_C=Ve^{-t/RC}$
Charging current i= -Im $e^{-t/RC}$
where I_m = V_C/R = initial value of discharging current.
I_m = Maximum value of discharging current

TIME CONSTANT:
The increases or rise in potential difference across the capacitor is given by the equation

$$Vc=V[1-e^{-t/RC}]$$

In this equation the exponent of 'e' is t / RC. The exponent of 'e' must be a number. Therefore the quantity RC should have the dimension of time. Hence the quantity RC is called time constant of the circuit. It affects the charging rate and charging time. It is generally denoted by 'λ' (or T)

Time constant λ= RC seconds

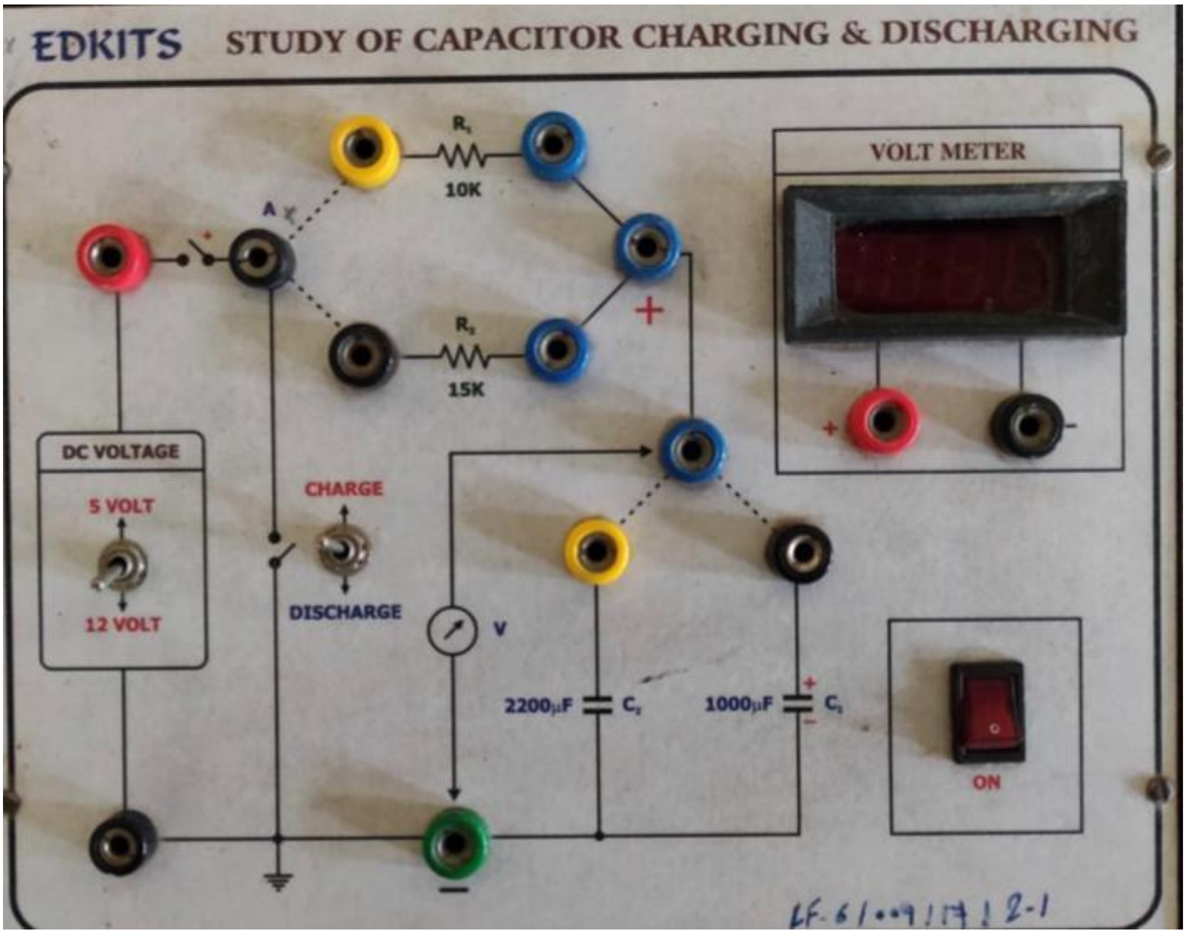
The time constant will be in seconds if R and C are in ohms and farad respectively. Time constant affects the time period of the charging process of a capacitor. The larger the time constant, the longer is the charging period and vice-versa. In fact the time constant indicates the rate at which a capacitor is charged.

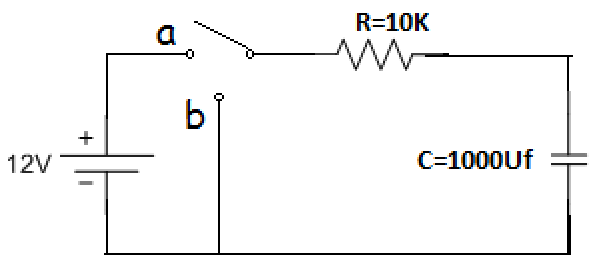
PROCEDURE:

1. First connect the circuit as shown in figure with appropriate value of capacitor and resistor.
2. Keep charge-discharge switch at '**charging**' position.
3. Give supply of 12 V DC to the kit and at the same time start the stopwatch simultaneously.
4. Read values of charging current and voltage at the interval of 5 sec.
5. Write the readings until capacitor gets charged i.e. the voltage drop across C is same as supply voltage
6. Now, take readings for discharging of capacitor.
7. Change the switch to **'discharging'** position and simultaneously start stopwatch. Note that the last reading for charging is the first reading for discharging of the capacitor.
8. The readings for discharging have to be taken at an interval of 5 sec.
9. Take readings until capacitor gets discharged i.e. the voltage drop across the capacitor becomes nearly zero.
10. Now, calculate time constant, Maximum current I_m for charging and Maximum current I_m for discharging.
11. Plot the graphs for **voltage v/s time** and **current v/s time** for charging of capacitor and **voltage v/s time** and **current v/s time** for discharging of capacitor.

12. Find the time constant from the graph. To obtain this, in the graph for Voltage v/s time, draw a tangent from origin to the point obtained from first reading for charging of capacitor. Now, draw a line for the maximum charged voltage Vc. Where, the tangent and Vc intersect, project that point on the time axis. The achieved value on tine axis is
13. the time constant λ for given R-C circuit. Similarly, this can also be achieved from the current v/s time graph also.

CIRCUIT DIAGRAM:





If switch is connected to ‘a’, charging of capacitor takes place.
If switch is connected to ‘b’, discharging of capacitor takes place.

OBSERVATION TABLE:

CHARGING OF CAPACITOR				DISCHARGING OF CAPACITOR			
Sr. No.	**Time t Sec.**	**Voltage V_c Volt**	**Current I mA**	**Sr. No.**	**Time t Sec.**	**Voltage V_c Volt**	**Current I mA**
1.	5	2.1	0.36	1.	5	8.9	0.36
2.	15	4.8	0.24	2.	15	6.9	0.24
3.	25	6.4	0.16	3.	25	4.8	0.16
4.	35	7.5	0.16	4.	35	3.4	0.12
5.	45	8.2	0.12	5.	45	2.4	0.08
6.	55	8.7	0.08	6.	55	1.8	0.04
7.	65	9.0	0.08	7.	65	1.3	0.04
8.	75	9.2	0.08	8.	75	0.09	0.04
9.	85	9.4	0.04	9.	85	0.07	0.0
10.	95	9.5	0.04	10.	95	0.05	0.0
11.	105	9.5	0.04	11.	105	0.04	0.0
12.	115	9.6	0.04	12.	115	0.03	0.0
13.	125	9.6	0.04	13.	125	0.02	0.0

CALCULATION:

20DCS103 Rushik. Rathod

Date ______
Page ______

* Charging :-

$\rightarrow V_C = V\left[1 - e^{-t/RC}\right]$

$\rightarrow V = 12\ V, \quad t = 45, \quad R = 10 \cdot K$

$C = 1000\ \mu F$

$\rightarrow V_C = V\left[1 - e^{\frac{-t}{RC}}\right]$

$= 12\left[1 - e^{-45/10}\right]$ at $t = 45$ sec

$= 12\left[1 - \frac{1}{e^{4.5}}\right]$

$= 12\left[1 - \frac{1}{90}\right]$

$= 12 \frac{\lambda.89}{90}$

$\therefore V_C = 11.86\ V$

* Dis-charging :-

$\rightarrow V_C = V \cdot e^{\frac{-t}{RC}}$

$\rightarrow V = 12\ V, \quad t = 45, \quad R = 10K, \quad C = 1000\ \mu F$

$\rightarrow V_C = 12 \cdot e^{\frac{-t}{RC}}$

$= 12 \cdot e^{\frac{-45}{10K}}$

$= 12 \cdot \frac{1}{90}$

$\therefore V_C = 0.13\ V$

CONCLUSION:

During the charging of the capacitor the voltage across capacitor increases and current across capacitor decreases. While during discharging of the capacitor the voltage across capacitor decreases and the current across capacitor also decreases but in the negative direction.

EXPERIMENT NO: 5	DATE: 14/02/2021

AIM: To study the I-V characteristics of a p-n junction diode

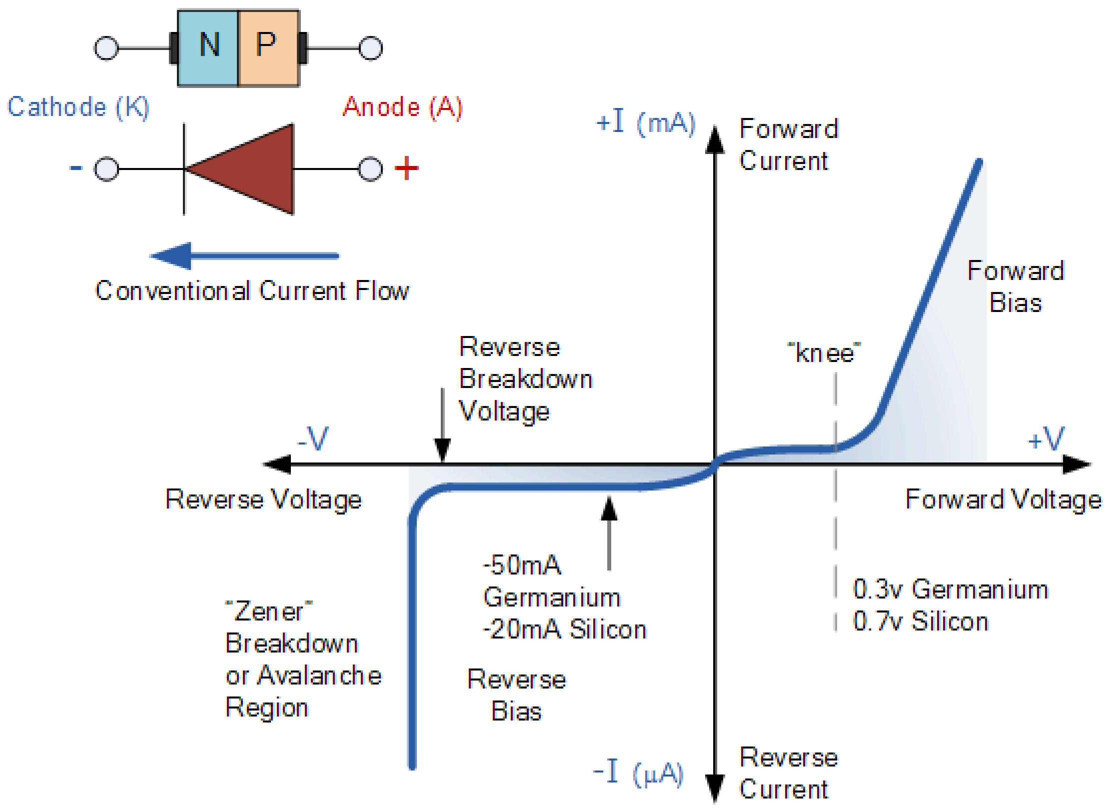
COMPONENTS: Power Supply (0-20V), Voltmeter (0-30V), Ammeter (µA & mA range), Kit of EDkits, connecting wires.

THEORY:

A PN Junction Diode is one of the simplest Semiconductor Devices around, and which has the characteristic of passing current in only one direction only. However, unlike a resistor, a diode does not behave linearly with respect to the applied voltage as the diode has an exponential current-voltage (I-V) relationship and therefore we cannot described its operation by simply using an equation such as Ohm's law.

If a suitable positive voltage (forward bias) is applied between the two ends of the PN junction, it can supply free electrons and holes with the extra energy they require to cross the junction as the width of the depletion layer around the PN junction is decreased.

By applying a negative voltage (reverse bias) results in the free charges being pulled away from the junction resulting in the depletion layer width being increased. This has the effect of increasing or decreasing the effective resistance of the junction itself allowing or blocking current flow through the diode.



CIRCUIT DIAGRAMS:

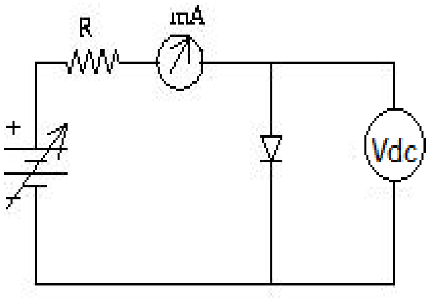


Fig: 5.1 forward biased diode

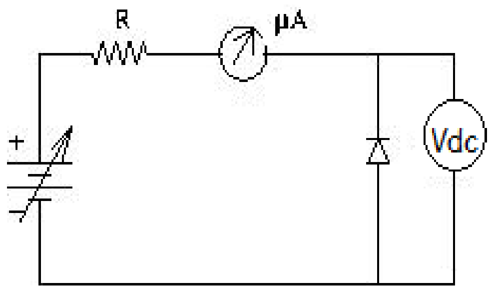


Fig: 5.2 Reverse biased diode

PROCEDURE:

1. Wire up the circuit shown in figure 5.1
2. Record the voltage across the diode (V) and current (I) through it as a function of input voltage.
3. Repeat the experiment of the reverse biased diode (fig 5.2).
4. Plot I-V characteristics of diode.

OBSERVATION TABLE:

Forward bias		
SR NO	Voltage Across Diode Vdc(V)	Current through Diode Idc(mA)
1	0.1	0
2	0.2	0.4
3	0.3	1.4
4	0.4	2.4
5	0.5	4.0
6	0.6	5.8
7	0.7	7.6
8	0.8	7.6
9	0.9	7.6
10	1.0	

Reverse Bias		
SR NO	Voltage Across Diode Vdc(V)	Current through Diode Idc(µA)
1	1	0
2	2	0.1
3	3	0.2
4	4	0.3
5	5	0.4
6	6	0.5
7	7	0.7
8	8	0.8
9	9	0.9
10	10	

CONCLUSION:

After the knee voltage the current increases exponentially i.e. in mA in forward bias. While in reverse bias by increasing the voltage the current decrease which is small i.e. in µA.

EXPERIMENT NO: 6 **DATE: 14/02/202**

AIM: To study and perform Zener diode as voltage regulator.

APPARATUS: Zener diode as voltage regulator kit, connecting wires, Digital multimeter.

THEORY:

Zener diode will continue to regulate the voltage until the diodes current falls below the minimum $I_{Z(min)}$ value in the reverse breakdown region. It permits current to flow in the forward direction as normal, but will also allow it to flow in the reverse direction when the voltage is above a certain value - the breakdown voltage known as the Zener voltage. The Zener diode specially made to have a reverse voltage breakdown at a specific voltage. Its characteristics are otherwise very similar to common diodes.

The purpose of a voltage regulator is to maintain a constant voltage across a load regardless of variations in the applied input voltage and variations in the load current. The resistor is selected so that when the input voltage is at $V_{IN\ (min)}$ and the load current is at $I_{L(max)}$ that the current through the Zener diode is at least $I_{z(min)}$. Then for all other combinations of input voltage and load current the Zener diode conducts the excess current thus maintaining a constant voltage across the load.

CIRCUIT DIAGRAMS:

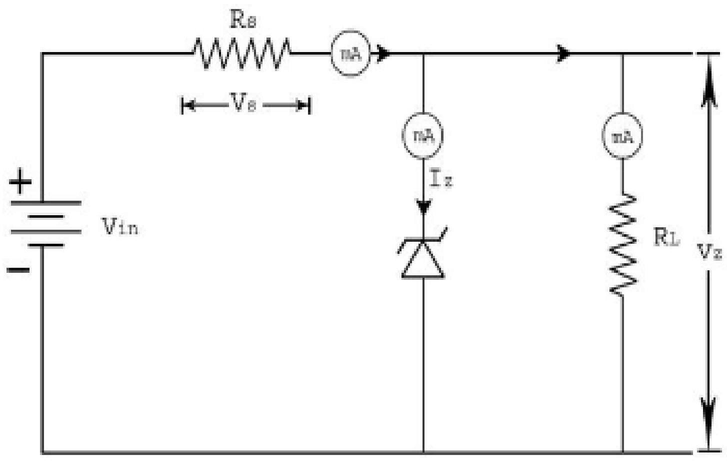


Fig:7.1 zener diode as voltage regulator

PROCEDURE:

1. Wire up the circuit shown in figure 7.1
2. Record the voltage across the Zener diode (V) and current (I) through it as a function of input voltage. Find Zener Voltage
3. Keep the load resistance R_L constant. Vary the input voltage in short steps and record the voltage across the Zener diode and current flowing through the R_L.
4. Repeat the above step for various Vin values.

OBSERVATION TABLE:

SR NO	Voltage Across Zener Diode Vz(V)	Current through R_L I (mA)
1	1	0
2	2	0.1
3	3	0.2
4	4	0.3
5	5	0.4
6	6	0.4
7	6.2	0.5
8	6.4	0.5
9	6.6	2.0
10	6.8	10.0

CONCLUSION:

In this experiment, we studied and perform Zener diode as voltage regulator.

EXPERIMENT NO: 7	DATE: 14 /02/2021

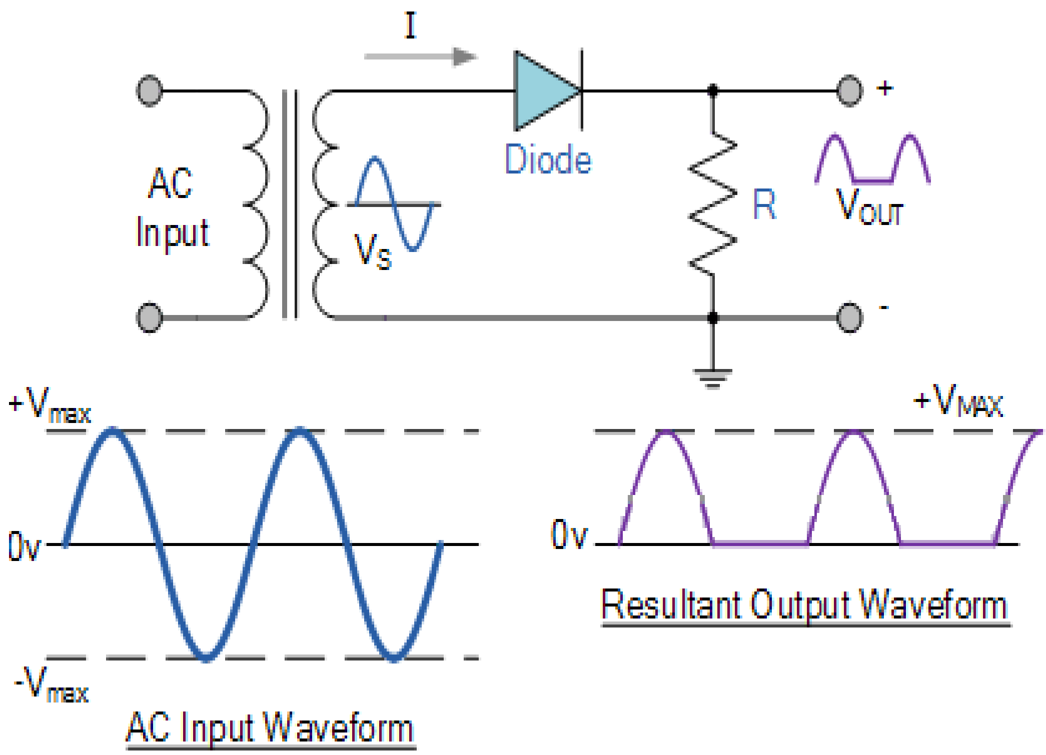
AIM: To study and perform half wave rectifiers.

APPARATUS: Bread board, power supply, PN diode, resisters, connecting wires, CRO

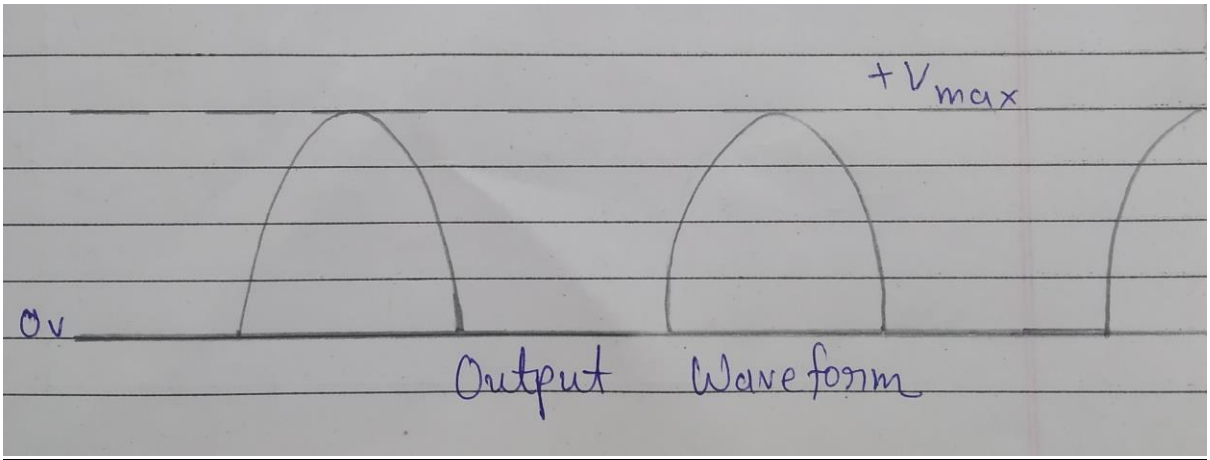
THEORY:

A rectifier is a circuit which converts the Alternating Current (AC) input into a Direct Current(DC) output . The input supply may be either a single-phase or a multi-phase supply with the simplest of all the rectifier circuits being that of the **Half Wave Rectifier**. 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.

HALF WAVE RECTIFIER CIRCUIT:



OUTPUT Waveforms:



CONCLUSION:

Output power of half wave rectifier is less. Also the theoretical efficiency of half-wave rectifier is 40% while practical efficiency is even less then that. Due to this pulsating nature of output power the load may get damaged. It produces high ripple because of which the size of filter also increases.

EXPERIMENT NO: 8 **DATE: 14/02/2021**

AIM: To study and perform Full wave rectifiers.

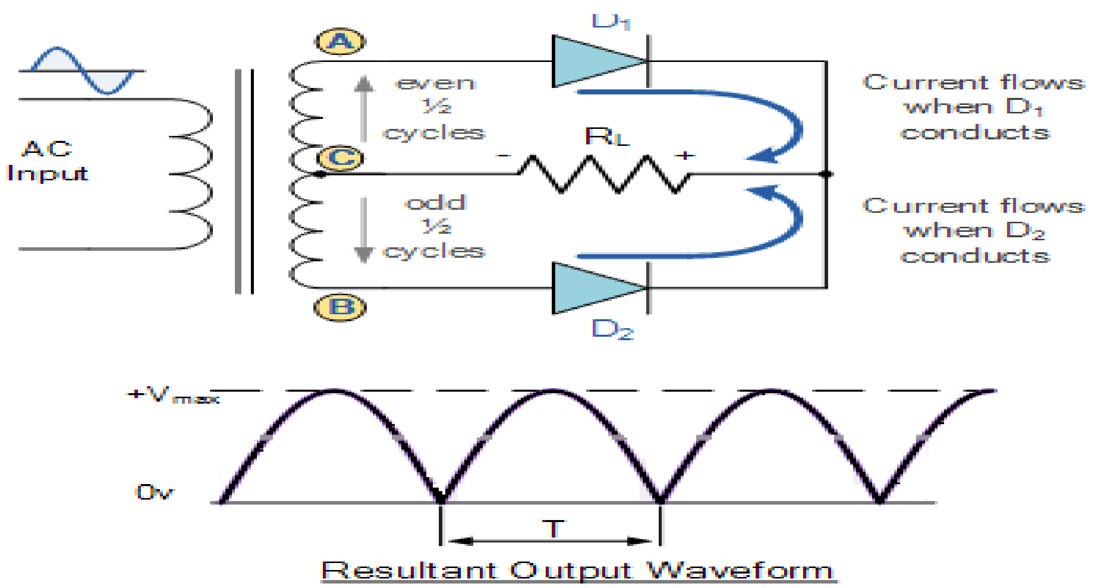
APPARATUS: Bread board, power supply, PN diode, resisters, connecting wires, CRO

THEORY:

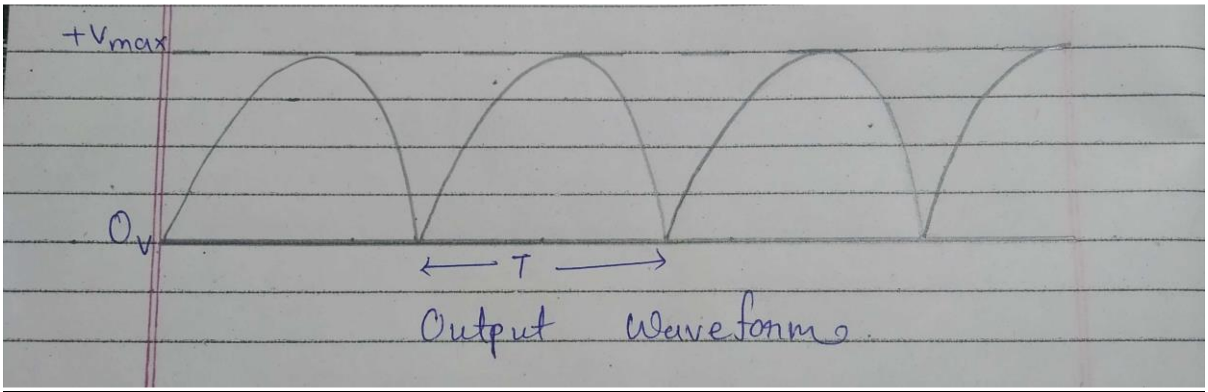
The full wave rectifier circuit consists of two *diodes* connected to a single load resistance (R_L) with each diode taking it in turn to supply current to the load. When point A of the transformer is positive with respect to point C, diode D_1 conducts in the forward direction as indicated by the arrows.

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. As the output voltage across the resistor R is the phasor sum of the two waveforms combined, this type of full wave rectifier circuit is also known as a "bi-phase" circuit.

FULL WAVE RECTIFIER CIRCUIT:



OUTPUT Waveforms:



CONCLUSION:

Output power of Full-Wave rectifier is more with compare to half-wave rectifier. By the circuit diagram it is clear that the load in fullwave rectifier always gets positive power.

EXPERIMENT NO: 9	DATE: 14/02/2021

AIM: To study the input and output characteristics of a transistor in Common Base Configuration.

APPARATUS: Transistor, Resistors, Bread Board, Multi meter, Connecting wires and Power Supply

THEORY:

Bipolar Junction Transistor (BJT) is a three terminal (emitter, base, collector) semiconductor device. There are two types of BJTs, namely NPN and PNP. It consists of two PN junctions, namely emitter junction and collector junction. The basic circuit diagram for studying input characteristics is shown in the circuit diagram. The input is applied between emitter and base, the output is taken between collector and base. Here base of the transistor is common to both input and output and hence the name is Common Base Configuration. Input characteristics are obtained between the input current and input voltage at constant output voltage. It is plotted between VEE and IE at constant VCB in CB configuration. Output characteristics are obtained between the output voltage and output current at constant input current. It is plotted between VCB and IC at constant IE in CB configuration.

PROCEDURE:

Input Characteristics:

- Connect the circuit as shown in the circuit diagram.
- Keep output voltage VCB = 0V by varying VCC.
- Varying VEE gradually, note down emitter current IE and emitter-base voltage(VEE).
- Step size is not fixed because of nonlinear curve. Initially vary VEE in steps of 0.1 V. Once the current starts increasing vary VEE in steps of 1V up to 30V.
- Repeat above procedure (step 3) for VCB = 5V.

Output Characteristics:

- Connect the circuit as shown in the circuit diagram.
- Keep emitter current IE = 0mA by varying VEE.
- Varying VCC gradually in steps of 1V up to 30V and note down collector current IC and collector-base voltage (VCB).
- Repeat above procedure (step 3) for IE = 5mA.

OBSERVATION TABLE:

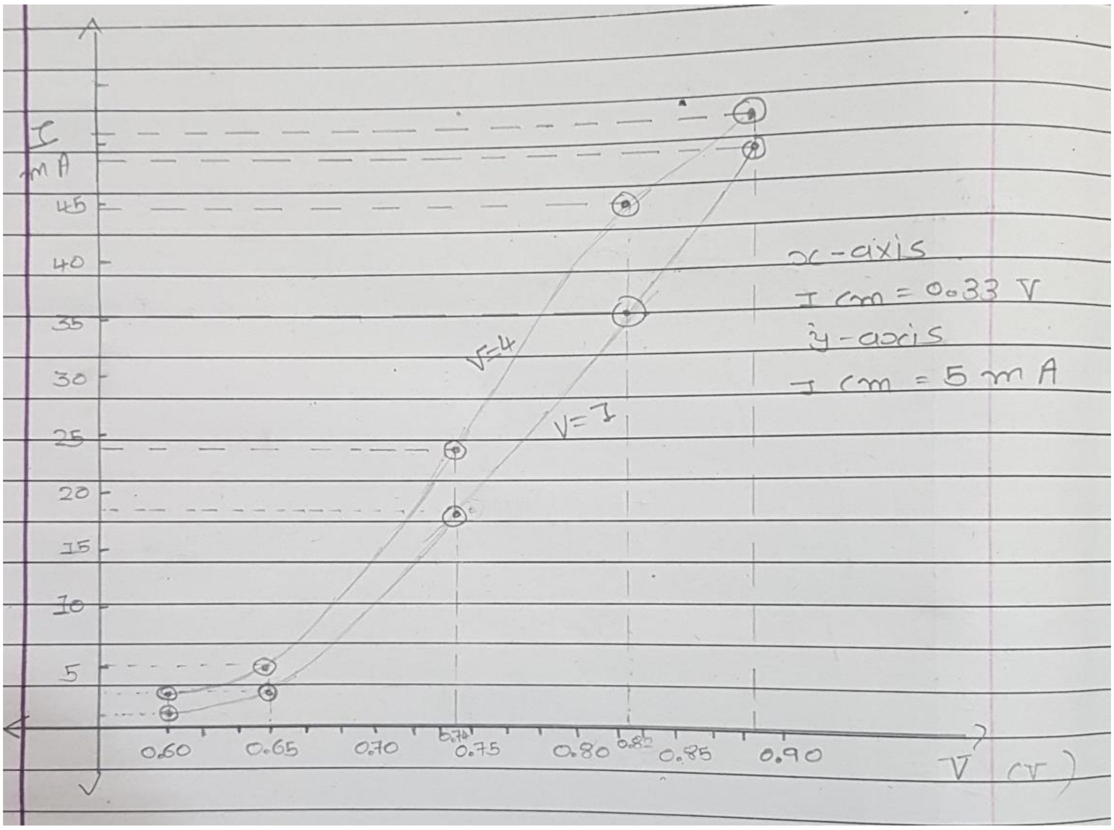
Input Characteristics

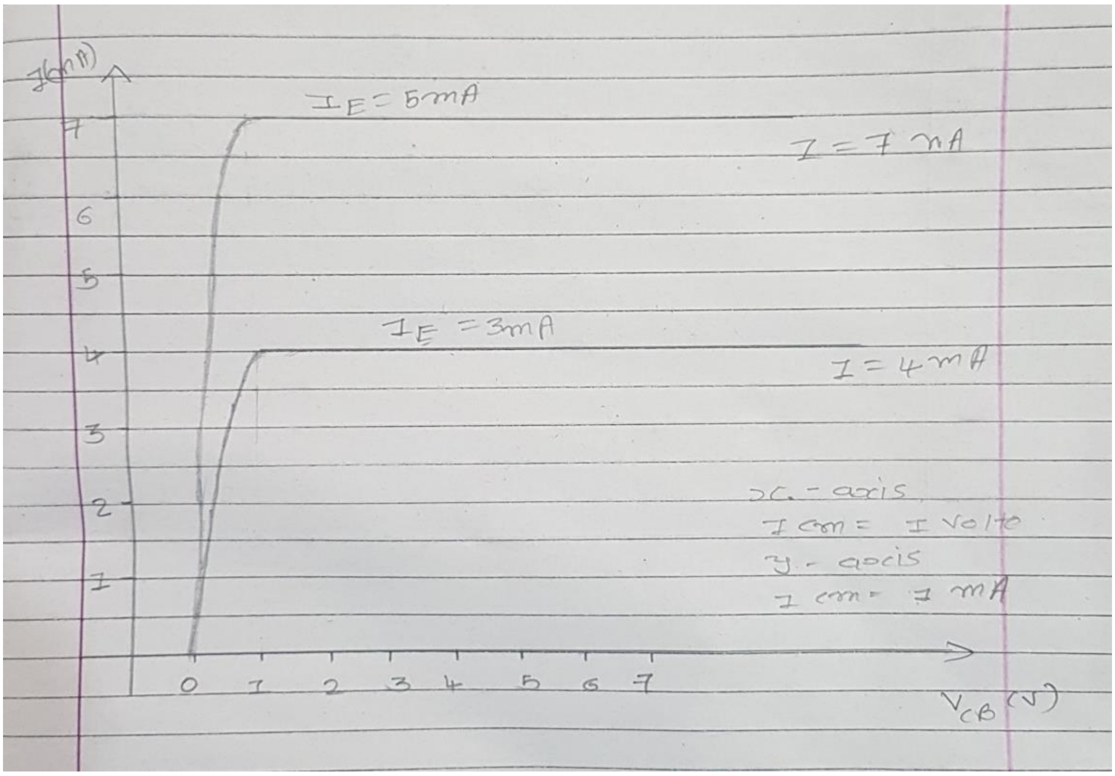
V_{EE} (Volts)	V_{CB} =		V_{CB} =	
	V_{EB} (Volts)	I_E (mA)	V_{EB} (Volts)	I_E (mA)
0.60	0.60	1	0.60	2
0.64	0.64	3	0.64	5.5
0.74	0.74	18	0.74	23
0.82	0.82	35	0.82	44
0.88	0.88	49	0.84	50

Output Characteristics

V_{CC} (Volts)	I_E =		I_E =	
	V_{CB} (Volts)	I_C (mA)	V_{CB} (Volts)	I_C (mA)
1	1	4	1	7
2	2	4	2	7
3	3	4	3	7
4	4	4	4	7
5	5	4	5	7
6	6	4	6	7

GRAPH OF CHARACTERISTICS:





EXPERIMENT NO: 10	**DATE: 14/02/2021**

AIM: To perform resonance in series R-L-C circuit.

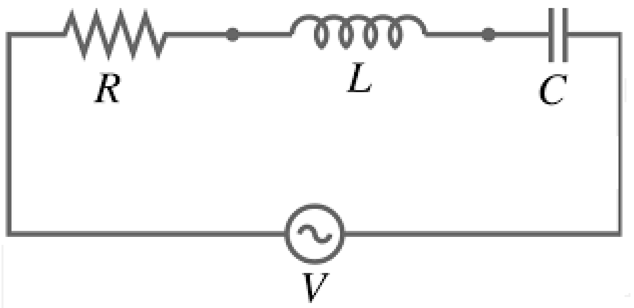
APPARATUS: kit, function generator, connecting wires, Digital Multimeter.

THEORY:

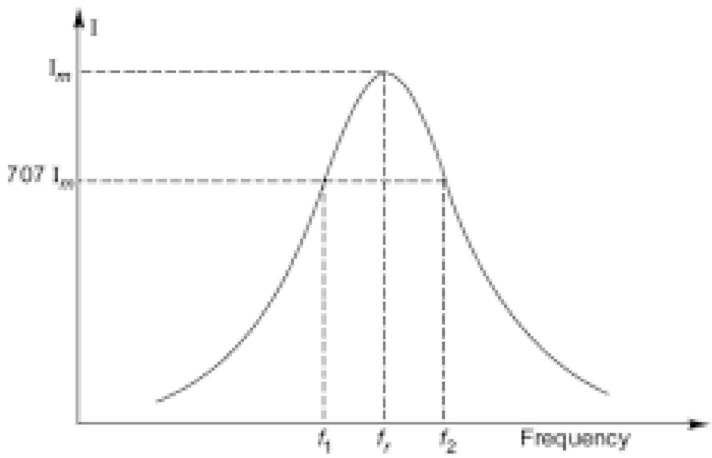
Resonance condition of an RLC series circuit can be obtained by equating X_L and X_C, so that the two opposing phasors cancel each other. At resonance, the effects of the inductor and capacitor cancel, so that Z=R, and I_{rms} is a maximum. Resonance is the tendency of a system to oscillate with greater amplitude at some frequencies than at others. Frequencies at which the response amplitude is a relative maximum are known as the system's resonance frequencies. The voltage through an RLC series circuit will be measured as a function of frequency for a fixed applied voltage. The frequency for which the rms voltage attains a maximum value is the resonance frequency. The expected resonance frequency is given by equation,

$$f_0 = \frac{1}{2\pi} \cdot \frac{1}{\sqrt{LC}}$$

R-l-C SERIES CIRCUIT:



RESONANCE CURVE



PROCEDURE:

1. Wire up the circuit as shown in circuit diagram.
2. Connect function generator output at the input of kit.
3. Vary the frequency in short steps and record the current flowing through series elements.
4. Repeat the above step until reaches to resonant frequency.
5. Plot the relevant graph.

OBSERVATION TABLE:

Sr.No	Frequency	Current
1	29 kHz	0.221 mA
2	30 kHz	0.226 mA
3	31 kHz	0.233 mA
4	32 kHz	0.241 mA
5	33 kHz	0.245 mA
6	34 kHz	0.244 mA
7	35 kHz	0.231 mA
8	36 kHz	0.213 mA
9	37 kHz	0.196 mA
10	38 kHz	0.177 mA

CALCULATION:

20DCS103 - Rushik Rathod.

→ Here, $c = 0.001$

→ Here, $C = 0.01\ \mu F = 0.01 \times 10^{-6}\ F$

$L = 2\ mH = 2 \times 10^{-3}\ H$

$$f_0 = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2 \times 3.14 \times \sqrt{2 \times 10^{-3} \times 0.01 \times 10^{-6}}}$$

$\therefore f_0 = 34\ kHz.$

CONCLUSION:

In this practical we perform resonance in series R-L-C circuit.

Thank you :)