TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. .... Date ....

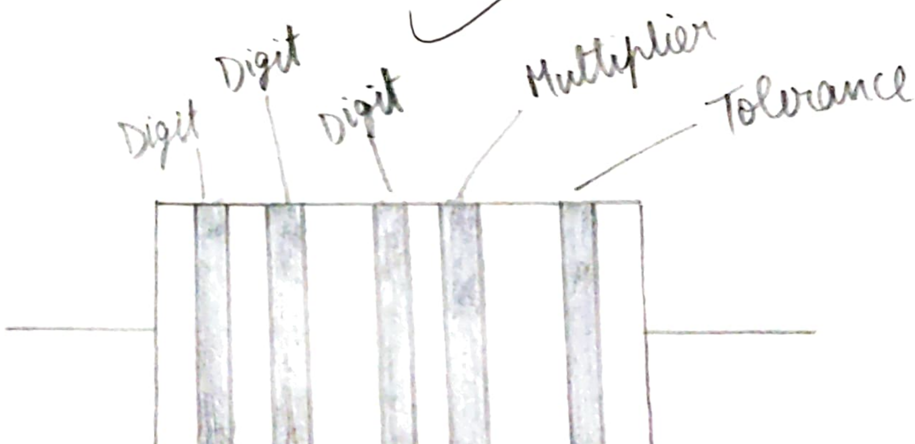
INDEX

Sr. No.	Name of experiment	Date of experiment	Date of submission	Sign. & Remark
1.	Study of Resistance.	26-11-21	3-12-21	Abheeny 3/12/21
2.	Study of Capacitors.	3-12-21	10-12-21	Rosom 10/12/21 A+
3.	Study of Inductor	17-12-21	17-12-21	Rosom 10/12/21 A+
4.	V-I characteristics of diode.	17/12/21	21/1/22	A+
5	Study of single, half wave rectifier uncontrolled rectifier	21/1/22	24/1/22	Abheey 24/01/22 A++
6.	Study & connection of Halogen lamp	24/1/22	24/1/22	A++
7.	Study of star-delta conn.	25/1/22	25-1-22	Rosom 25/1/22 A+
8.	L.T. switch gears	25/1/22	25/1/22	
9.	Buck converter	25/1/22	25/1/22.	Abheey 25/1/22 A+

Fixed resistance

variable resistance

4- Band Code



5- Band code

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. ____ Date ____

EXPERIMENT No. - 1

Objective - Study of Resistance

- Explain the function and unit of resistors.
- Measure the value of resistor.
- Measure the tolerance of a resistor.
- Explain the types of resistors.

Apparatus Required - Multimeter, resistor.

Theory - Types of resistors:

Fixed

- → Carbon film (Tolerance = ±5%), Metal film, wire wound resistors
- → Value of resistor is specified and cannot be changed.

Variable

- → Semi fixed, completely variable, potentiometer.
- → Can be changed by rotating the wiper.

Reading value : Step 1 -

If your resistor has four colour bands, turn the resistor so that the gold or silver band is on right hand side or the end with more bands should point left.

Step 2 -
The first band is now on the left hand side. This represents the first digit. Based on the colour make a note of the digit. In this case - 4 band its '5' and for 5 band its '2'.

Step 3 -
The second band represents the second digit. The colors represent the same no. as did the 1st digit. In this case - 4 band its '6' and for 5 band its '3'.

Step 4 -
The third band divulges how many zeros to add/divide to the first two no. for a 4 band resistor. In this case - 4 band its '4' zeros to be added. So value is 560 K.

Step 5 -
The 3rd band denotes the 3rd digit - for a 5 band resistor. In this case - 5 band its '7'. So the value of the 5 band resistor is 237 Ω as its multiplier digit is '0'.

Reading value of fixed resistors :
- Resistors are colour coded as they are too small for the value to be written on them.
- There are 4 or 5 bands of color. Value of a resistor is decoded from these band of colors.

Resistance - Resistance (also known as ohmic resistance or electrical resistance) is a measure of the opposition to current flow in an electrical circuit. Resistance is measured in ohms, symbolic by the greek letter omega (Ω).

Tolerance - The last band denotes the tolerance. So the value of the 4 band resistor it is ± 10 % while for the 5-band it is ± 1 %.

- Tolerance of a resistor is also an important property to consider.
- A 100 ohm resistor with a 10% tolerance can mean its value can be any fixed value b/w 90 to 100 Ω.
- A 120 ohm resistor with a 10% tolerance can mean its value can be any fixed value b/w 108 and 132 ohms.
- So, there is some overlap b/w 100 ohm and 120 ohm resistance in terms of its units.

Colour	Digit	Multiplier	Tolerance (1%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25

Calculations -

For observation 1 :-

$$C = \frac{x_2 - x_1}{x_1} \times 100$$

where, C = relative change
x_1 = initial value
x_2 = final value

here $x_1 = 2700\ \Omega$, $x_2 = 2700\ \Omega$

Percentage difference (%) , $C = \frac{2700-2700}{2700} \times 100$

$$C = 0\%$$

For observation 2 :-

here , $x_1 = 560\ \Omega$, $x_2 = 566\ \Omega$

Percentage difference , $C = \frac{566-560}{566} \times 100$

$$C = 1.071\%$$

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem:

Roll No. Date:

Violet	7	10^7	0.1	
Grey	8	10^8		
White	9	10^9		
Gold	~~9~~		5	
Silver			10	
(none)			20	

Observations -

Sr. No.	Colour Bands	Thoritical value (x_1) (Ω)	Practical value (x_2) (Ω)	Percentage difference $C = \frac{x_2 - x_1}{x_1}$
1.	Red Violet Red Gold	2700 ± 5%	2700	0%
2.	Green Blue Brown Gold	560 ± 5%	566	1.071 %

Result - We have studied the function and unit of resistors, measured the value of resistor using multimeter, percentage diff. b/w actual and theoritical value of resistor found out to be 0% and 1.071 %.

Dhruv
3/12/21

EXPERIMENT No.- 2

Objective - Study of capacitor :

- Provide a definition of capacitor and name its units.
- Explain how a capacitor can be constructed to give a particular value of capacitance
- Explain why a capacitor has a max. working voltage.
- Determine experimentally the energy stored in capacitor.
- Identify the value and type of capacitor.
- Identify the polarity of terminals.

Apparatus Required - Different types of capacitors.

Theory - Capacitor is one of the passive components like resistor. It is also known as condenser. Capacitor is generally used to store the charge. The charge is stored in the form of "electric field". Capacitors play a major role in many electrical and electronics circuits.

Construction - The basic construction of all capacitors is of two parallel metal plates separate by an insulating material (the dielectric). An insulator is a material which is non-conducting, i.e. it shows a high resistance to letting to

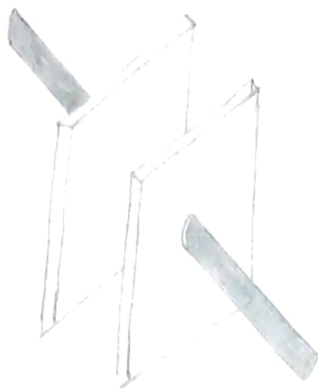
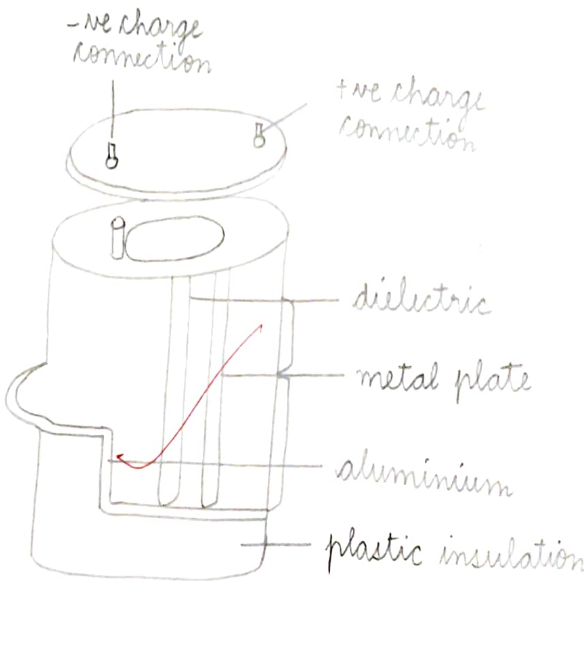


fig. a.



-ve charge connection
+ve charge connection
dielectric
metal plate
aluminium
plastic insulation

electric used is air, other types are oil or paper. Real capacitors are made by taking thin strips of metal foil and the appropriate dielectric material and sandwiching them together. Capacitors achieve large area (thus large capacitance) by doing something tricky, such as putting dielectric between 2 layers of metal foil and rolling it up like in a fig. b.

Capacitance - A capacitor is so called because it has the capacity to store charge - just like a beaker storing a liquid. Capacitors are marked with a value which indicates their capacitance - their ability to store charge. Capacitance can be thought of as the "electrical capacity" of that body. It is measured in Farads.

Maximum Working Voltage -
If the voltage across a capacitor is too high, the insulator between the plates fails to insulate and charge passes from one plate to the other. Capacitor are usually marked with the max. working voltage to help the user to avoid situation.
A good rule of thumb is to never place a voltage across the capacitor which exceeds about two thirds of this value, especially for alternating current circuits.

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. Date

→ Mathematical Notations -

- A static description of the way a capacitor behaves would be to say ~~$I = C\frac{dv}{dt}$~~. ~~This~~ $Q = C \times V$, where Q is the total charge, C is a measure of how big the capacitor is and V is the voltage across it.
- A dynamic description, i.e. one that changes with time would be to say $I = C\frac{dv}{dt}$. This is just the time derivative of the static description. C is constant wrt time, I is the rate at which charge flows. This essentially says - the bigger the current, the faster the capacitor's voltage changes.

Classification of Capacitors -

Unpolarized	Polarized
- Ceramic Multilayer Polystyrene film Polyster film Polypropylene Mica	- Electrolytic Tantalum Super
- They don't have +ve and -ve electrodes	- They have +ve and -ve electrodes.

Name Dhruv Bagora Branch CSE Sem 1st
Roll No. Date

Ceramic Capacitors -

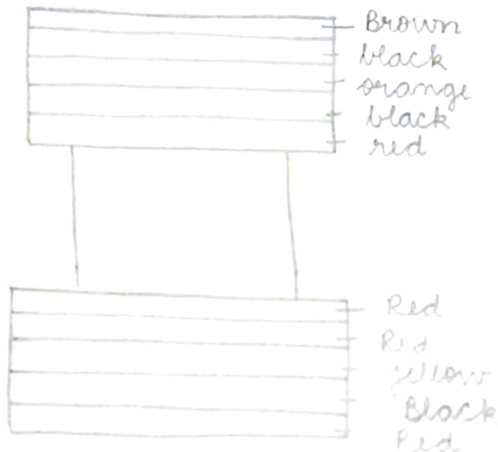
Ceramic capacitors are the most used capacitors in the electronics industry. These are fixed capacitance type capacitors and they are usually very small. The capacitance of ceramic capacitors is usually in the range of picofarads to few microfarads (less than 10 μF). They are non-polarised type capacitors and hence can be used in both DC as well as AC circuits.

Electrolytic Capacitors -

Electrolytic capacitors are polarized and they must be connected the correct way round, atleast one of their leads will be marked +ve or -ve. It is very easy to find the values of electrolytic capacitors because they are clearly printed with their capacitance and voltage rating!

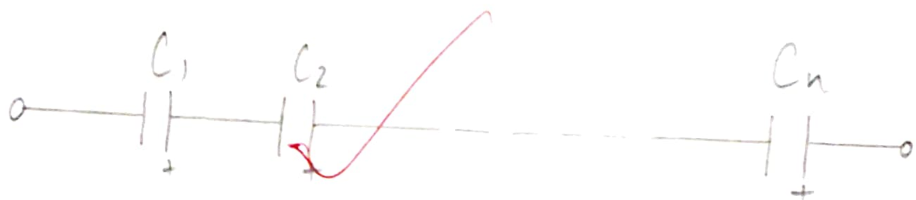
Tantalum Capacitors -

Tantalum bead capacitors are polarized and have low voltage ratings like electrolytic capacitors. Usually the "+" symbol is used to show the positive component lead. Modern tantalum bead capacitors are printed with their capacitance, voltage and polarity in full. However older ones are use a colour-code systems which lead has two strips (for the 2 digits) and a spot of colour for the no. of zeros to give the value in μF.



UNPOLARISED CAPACITOR

(colour code)



Capacitors connected in series

Unpolarised capacitors — small values (upto $1\mu F$) :-
The value printed but without a multiplier, so we need to use experience to work out what the multiplier should be! For eg - 0.1 means $0.1\mu F$. Sometimes the multiplier is used in place of the decimal point. For eg.- 4n7 means 4.7 nF.

Unpolarised capacitors - Capacitor number code :-
The no. code is often used on small capacitors where printing is difficult. The 1^{st} no. is the 1^{st} digit, the 2^{nd} no. is the 2^{nd} digit and 3^{rd} no. is the no. of zeroes to give the capacitance in pF. Ignore any letters — they just indicate tolerance and voltage rating. For eg.- 102 means 1000 pF (not 102 pF), eg.- 472 J means 4700 pF (J means 5% tolerance).

Capacitors in series -
Capacitors in series means two or more capacitors connected in a single line. Positive plate of the one capacitor is connected to the -ve plate of the next capacitor.

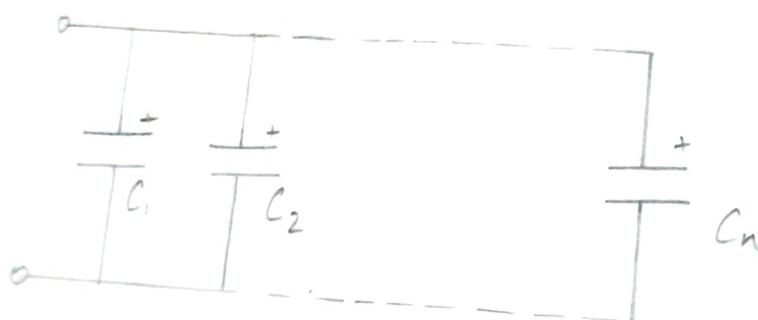
$Q_T = Q_1 = Q_2 = \ldots\ldots = Q$

$I_c = I_1 = I_2 = \ldots\ldots = I$

where, Q_T = total charge

I_c = capacitive current.

When the capacitors are connected in series, charge and current is same on all the capacitors.



Capacitors connected in parallel

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. Date

For series capacitors same quantity of e⁻ will flow through each capacitor because the charge on each plate is coming from the adjacent plate. So, coulomb charge is same. As current is nothing but flow of e⁻, current is also same. Eq. capacitance for two capacitors in series,

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$$

Capacitors in parallel -

When the capacitors are connected in parallel the total capacitance value is increased. There are some applications where higher capacitance value are required. All the capacitors which are connected in parallel have same voltage and is equal to the Vt applied between the input and output terminals of the circuit.

$$V_t = V_1 = V_2$$

Eq. capacitance for two capacitors in parallel,

$$C_{eq} = C_1 + C_2$$

Charging -

The plate on the capacitor that attaches to the -ve terminal of the battery accepts e⁻ that the battery is producing. The plate on the capacitor that attaches to the +ve terminal of the battery loses e⁻ to the battery. Once its charged, the capacitor has the same voltage as the battery.

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. Date

Discharging -

If we then remove the battery and replace it with a wire, current will flow from one plate of the capacitor to the other. The bulb will light initially and then dim as the capacitor discharges, until it is completely out.

Result - We have studied classification and identification of diff. types of capacitors.

Rasoni 10/12/21 A+

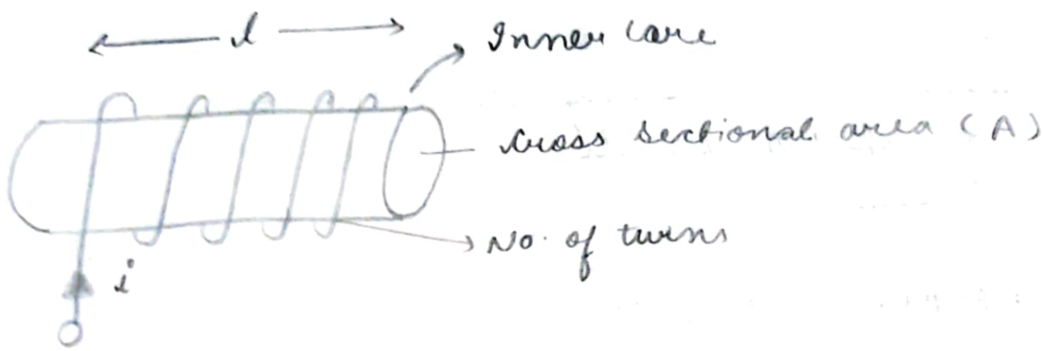
EXPERIMENT → 3

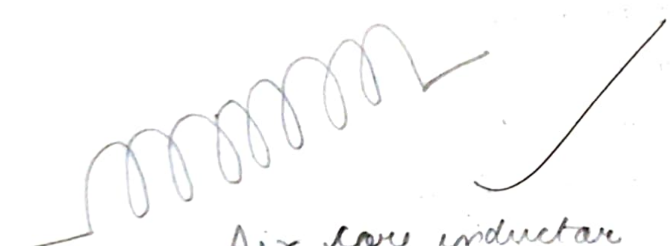
OBJECTIVE - study of inductor
- explain function of inductor
- explain the factors influencing inductance.

APPARATUS REQUIRED -
Inductor and LCR meter

THEORY - An inductor, also called a coil, choke or reactor, is a passive 2 terminal electrical component that stores energy in a magnetic field when electric current flows through it. An inductor typically consits of insulated wire wound into a coil around a core. An inductor is characterized by its inductance, which is the ratio of the voltage to the rate of change of current.
In the international system of units [SI], the unit of inductance is the Henry [H] named for 19th century. American scientist Josep Henry in the measurement of magnetic circuits, it is equivalent to ampere / weber.

The coil is the most recognizable form of an inductor. this tool is designed to calculate the inductance of a coil of wire given the length of the coil, the no. of turns, the loop radius, and the permeability of the core material.





Air core inductor

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagara Branch Sem

Roll No. Date

Equation:

$$L_{coil} - \mu_r \mu_0 N^2 A / l = \mu_r \mu_0 N^2 \pi r^2 / l$$

Where;

L_{COIL} - inductance of the coil in henries [H]

μ_r - Relative permeability of the core [dimensionless]

μ_0 - Permeability of free space $= 4\pi \times 10^{-7}$ [H/m]

N - number of turns

A - coil area (m^2)

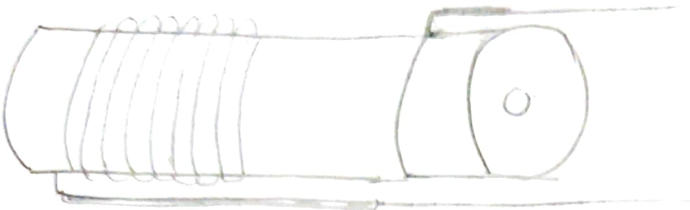
r - coil radius [m]

l - coil length [m]

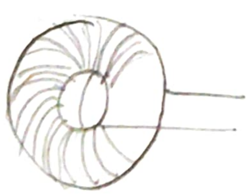
There are different types of insulators. Depending on their material type they are basically categorized as follows -

1) AIR CORE INDUCTOR -

Air ceramic core inductors are referred as "air core inductors". Ceramic is the most commonly used material for inductor cores. The main advantages of these inductors are very low core losses, High quality factor. These are mainly used in high frequency applications where low inductance values are required.



Iron core Inductor



Torroidal Inductor

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagara Branch Sem

Roll No. Date

2.) IRON CORE INDUCTOR-

In the areas where low space inductors are in mid then these iron core inductors are best options.
These inductors have high power and High inductance value but limited in High frequency capacity. These are applicable in audio equipments.

3.) LAMINATED CORE INDUCTOR-
These core material are formed by arranging many nos. of laminations on-top of each other. These lamination are made up of steel with insulating material between them. They have high power levels, so they are mostly used at power filtering devices for excitation frequencies above several

4.) TOROIDAL INDUCTOR-
wire wounded on core which has ring or donut shaped surface. These are generally made up of different materials like ferrite, powdered Iron and tape wound etc. It has High energy transferring efficiency and high inductance value at low frequency applications. These inductors mainly used in

medical devices, switching regulator, air conditioners, refrigerators, telecommunication & musical instruments etc.

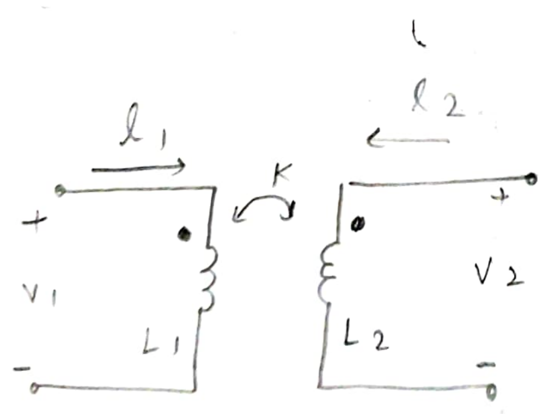
5.) MULTI-LAYER CERAMIC INDUCTORS -
The name itself indicates that it consists of multilayers of coiled simply by adding additional layers of coiled wire that is wound around the central core to the inductor gives multi-layer inductor. generally for more no's of turns in a wire, the inductance is also more. In these multi-layer inductors not only the inductance of the inductor increases but also the capacitance let the wires also increases

6.) FILM INDUCTOR -
These uses a film of conductor on base material thus according to the requirement this film is shaped for conductor application. Film inductors in thin size are suitable for DC to DC converters that serve a power supplies in smart phones and mobile devices. The RF thin film is shown.

7.) VARIABLE INDUCTOR - It is formed by moving the magnetic core in and outside of the inductor windings. By this magnetic core

Observation Table -

Sr. No	Inductor	Inductor value
1.	Primary inductor	3.296 H
2.	secondary inductor	19.51 mH = 0.0195 H



coupled Inductor

we can adjust the inductance value. when we consider a ferrite core inductor can be formed. These type of inductors are used in radio and High frequency applications where the turning is required. These inductor are typically ranged from 10nH to 100nH.

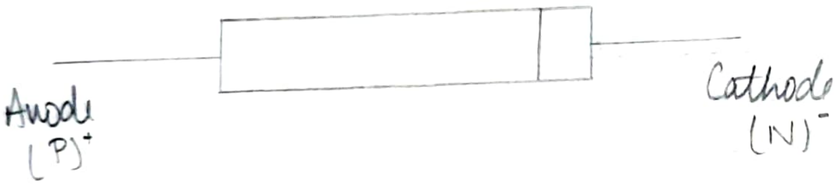
10) COUPLED INDUCTORS -

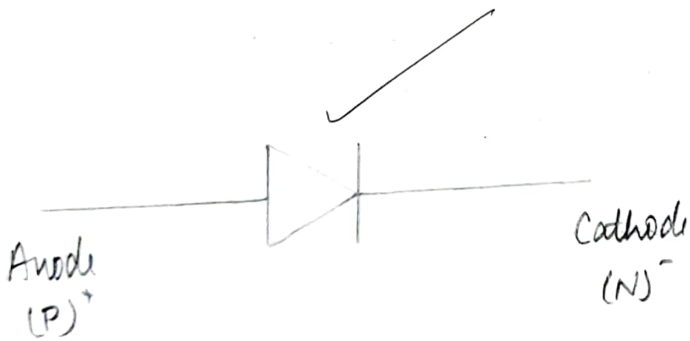
The 2 conductors connected by Electromagnetic inductor are generally referred as coupled inductors. we already seen that whenever the A C current is flowing in one inductor produces voltages in second inductor gives us manual inductance phenomenon. coupled inductors will work on this phenomenon only. These can isolate 2 circuits electrically by transferring impedance through the circuit. A transformer is one of the type of coupled inductor.

Result -

we have studied the construction of different types of inductor and also measured the inductance of inductor using L C R meter.

Poonam Soni
17/12/21


Anode
(P)+
Cathode
(N)-


Anode
(P)+
Cathode
(N)-

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. .... Date ....

Experiment - 4

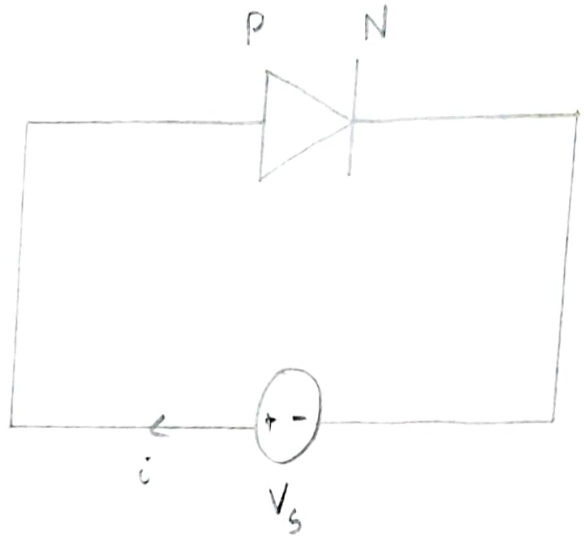
Objective -
- Explain the structure of a P-N junction diode.
- Explain the function of a P-N junction diode.
- Explain forward and reverse biased characteristics of a silicon diode.

Apparatus Required - Battery, voltmeter, Ammeter, resistance, diode (IN4007).

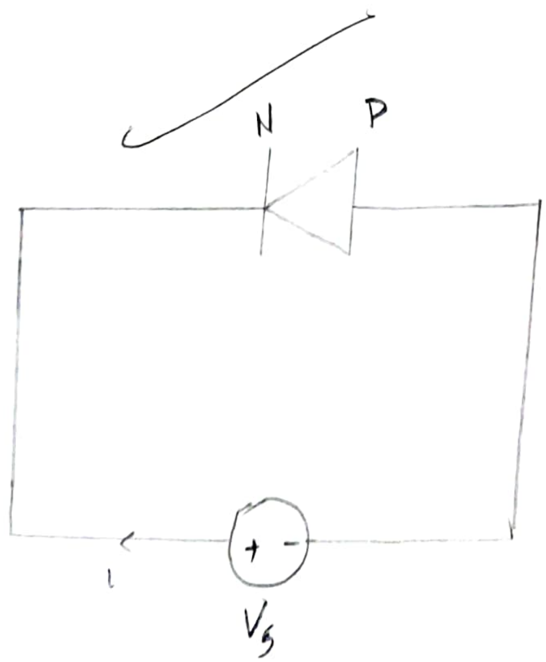
Theory -

- Structure of P-N junction diode:-
The diode is a device formed from a junction of n-type and p-type material. The lead connected to the p-type material is called the anode and the lead connected to the n-type material is the cathode. In general, the cathode of a diode is marked by a solid line on the diode.

- Function of a P-N junction diode in Forward Bias :-
The positive terminal of battery is connected to the P side (anode) and the negative terminal of battery is connected to the N-side (cathode) of a diode, the holes in the p-type region and the electrons in the n-type region are pushed towards the junction and start to neutralize the depletion zone, reducing its width. The positive potential applied to the p-type material repels the holes, while the -ve potential



Forward Bias



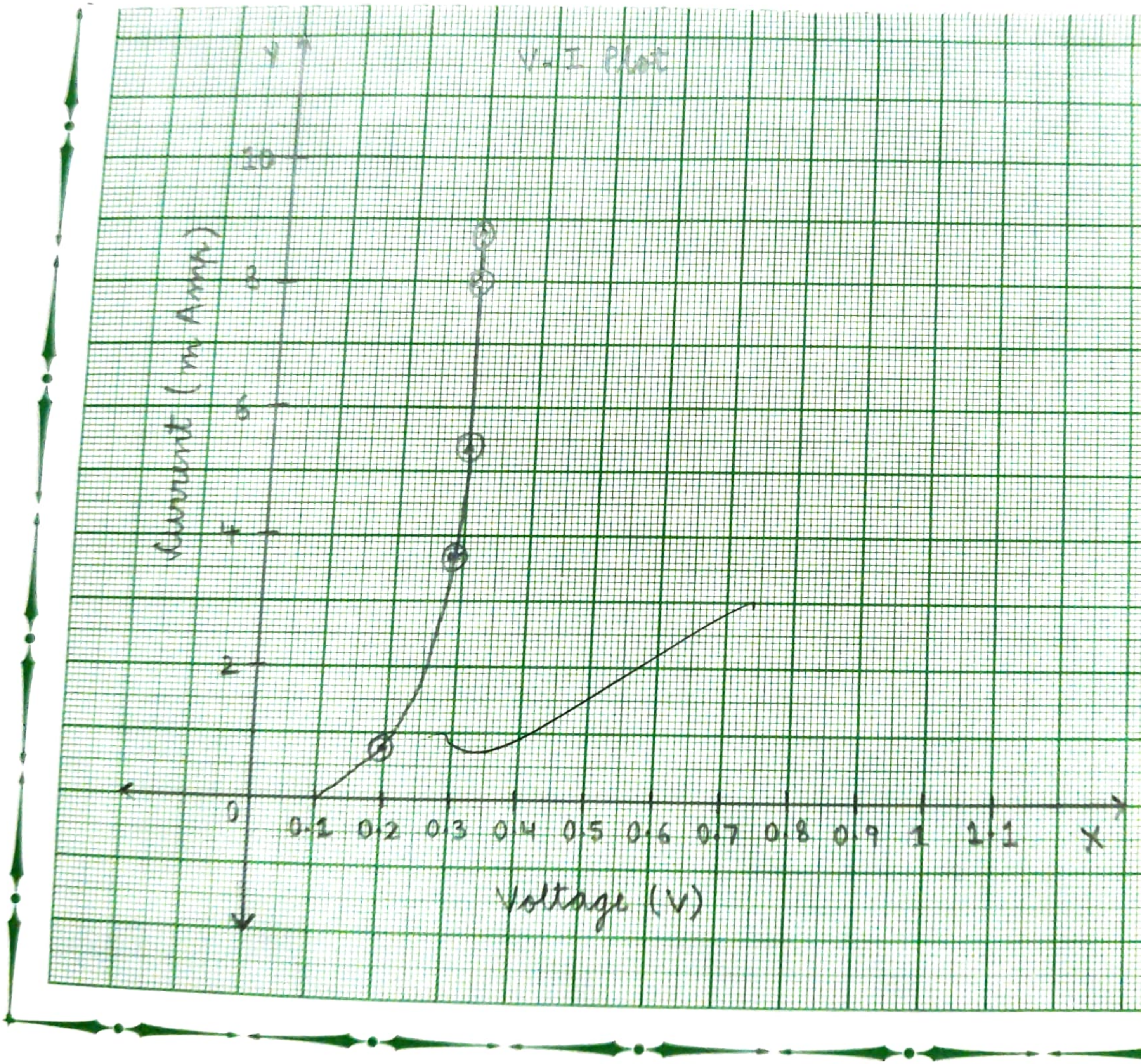
Reverse Bias

applied to the n-type material repels the e⁻. The change in potential between the p-side and the n-side decreases or switches sign. With increasing forward bias voltage, the depletion zone eventually becomes thin enough that the zone's electric field cannot counteract charge carrier motion across the p-n junctⁿ, which has a consequence reduces electrical resistance. The e⁻ that cross p-n junction into the p-type material will diffuse into the nearly neutral region. The amount of minority diffusion in the near-neutral zones determines the amount of current that may flow through the diode.

- Function of a P-N junction diode in Reverse Bias -

The +ve terminal of battery is connected to the N side (cathode) and the -ve terminal is connected to the P side (anode) of a diode. Therefore, very little current will flow until the diod break down.

The +ve terminal of battery is connected to the N-side (cathode) and the -ve terminal of battery is connected to P-side (anode) of a diode, the 'holes' in the p-type material are pulled away from the junctⁿ leaving behind charged ions and causing the width of the depletion region to increase. Likewise, because the n-type region is connected to the +ve terminal, the e⁻ will also be pulled away from the junction, with similar effect. This raises the voltage results in junction behaving as an insulator


V-I Plot
Y
10
8
6
4
2
0
Current (m Amp)
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
X
Voltage (V)

The strength of the depletion zone electric field increases as the reverse-bias voltage increases. Once the electric field intensity reases beyond a critical level, the p-n junction depletion zone breaks down and current begins to flow, usually these breakdown processes are non-distructive and are reversible, as long as the amount of current flowing does not reach levels that cause the semiconductor material to overheat and cause thermal damage.

- Forward and reverse biased characteristics of a silicon diode-

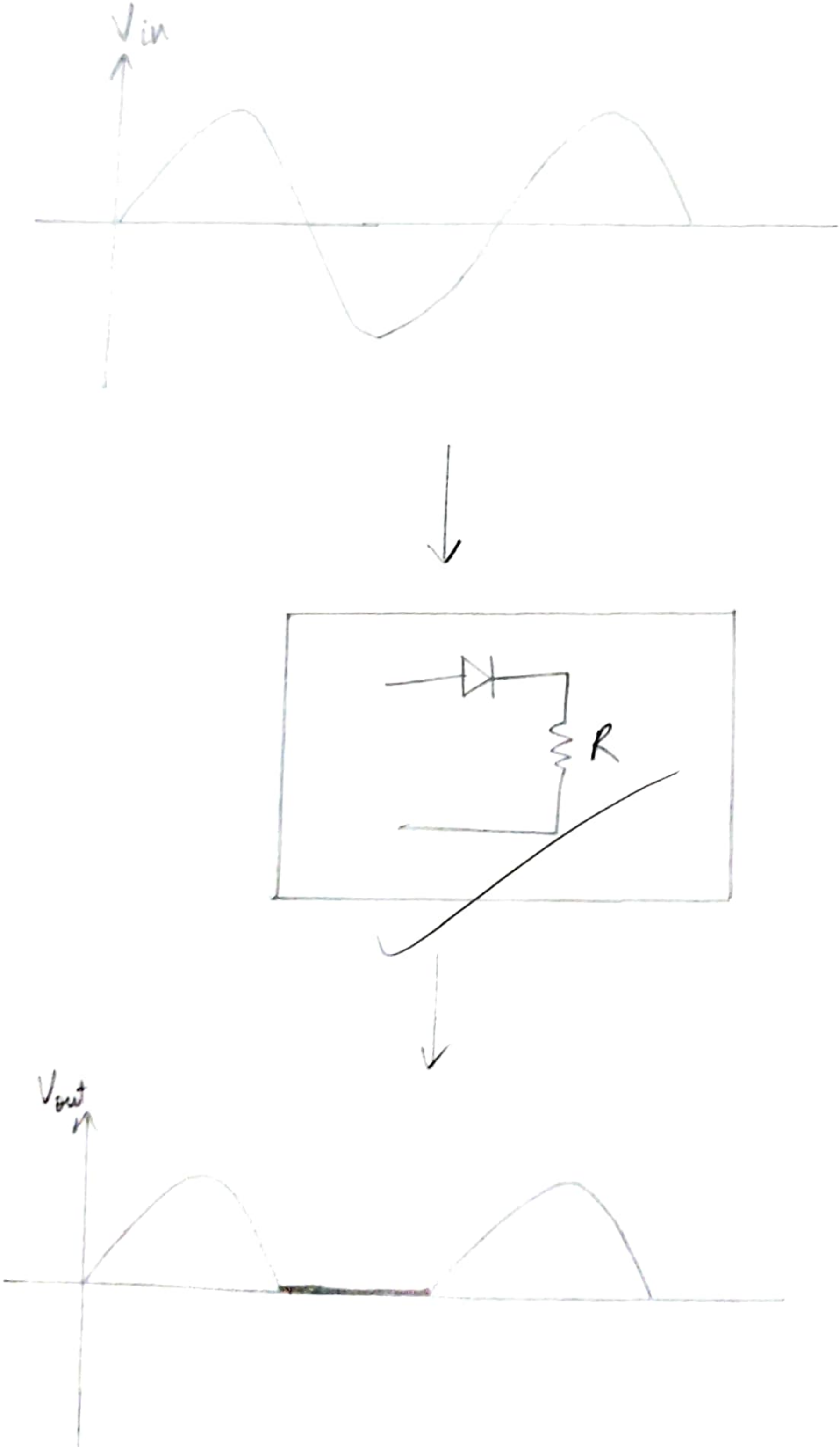
In forward biasing, the +ve terminal of battery is connected to the P side and the -ve terminal is connected to the N side of the diode. Diode will conduct in forward biasing because the forward biasing will decrease the depletion region width and overcome the barrier potential. In order to conduct, the forward biasing voltage should be greater than the barrier potential. During forward biasing the diode acts like a losed switch with a potential drop of nearly 0.6 V across it for a silicon diode. The forward & reverse bias characteristics of a silicon diode.

In reverse biasing, the +ve terminal of battery is connected to the N side & -ve terminal is to the P-side of a diode. In reverse biasing, the diode does not conduct electricity, since reverse biasing leads to an increase in the depletion region width, hence current charges find it more difficult to overcome the barriers potential. The diode will act like an open switch and there is no current flow.

Observation Table -

Sr. No.	Forward biasing (volt)	Forward Current (in mAmp.)
1.	0	0
2	0.557	0.790
3	0.567	1.78
4.	0.575	2.77
5	0.580	3.75
6	0.585	4.74
7	0.589	5.73
8	0.593	6.72
9	0.596	7.70
10	0.598	8.69

24/01/22


Vin
R
Vout

EXPERIMENT - 5

Objective - Study of single phase half wave uncontrolled rectifier.

(1.) Explain rectification.
(2.) Explain Half wave rectification
(3.) Explain Half wave rectification : For +ve half cycle.
(4.) Explain Half wave rectification : For -ve half cycle.

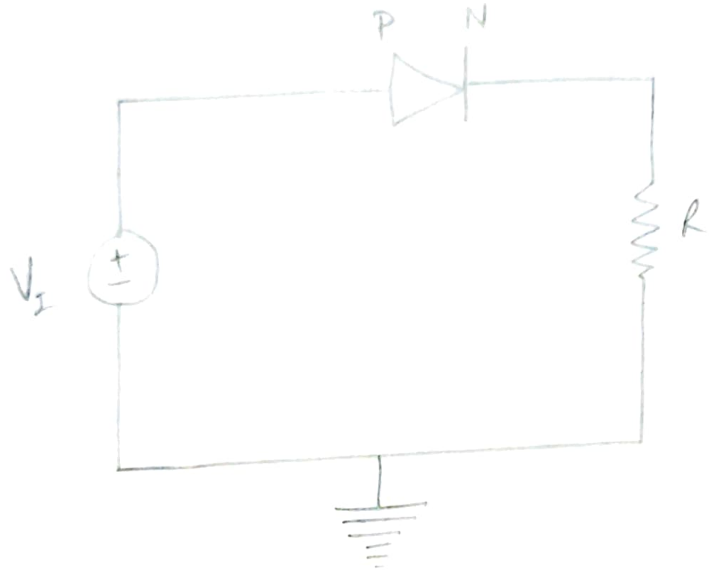
Apparatus Required - AC source, Resistive load, diode.

• **Rectification** -

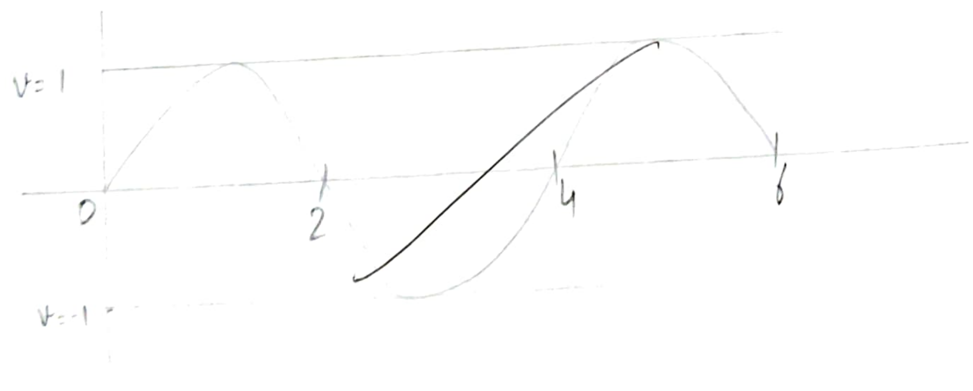
Alternating current → Rectifier → Direct current

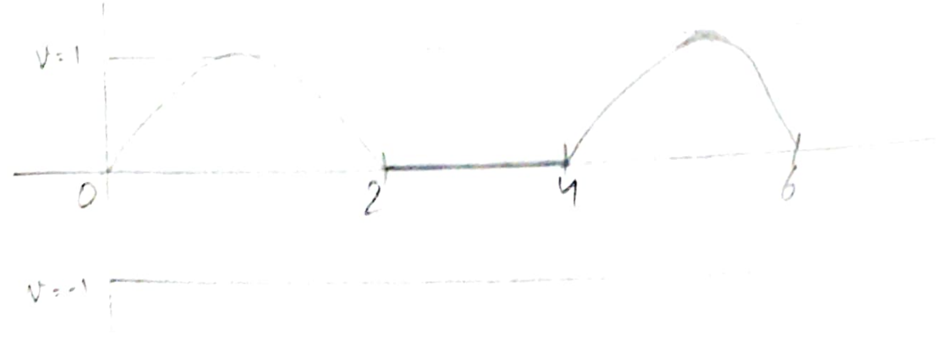
A rectifier is a device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers are essentially of two types - a half wave rectifiers and a full wave rectifier.

• **Half Wave Rectification** -
On the positive cycle the diode is forward biased. By using a diode we have converted an AC source into a pulsating DC source. In summary we have 'rectified' the AC signal.
The simplest kind of rectifier circuit is the half wave rectifier. The half wave rectifier is a circuit that allows only part of an input signal to pass.



Half Wave Rectifiers - Waveforms





TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagoria Branch: CSE Sem: 1st

Roll No. Date

The circuit is simply the combination of a signal diode in series with a resistor, where the resistor is acting as a load.

- Half wave Rectifiers -

The output DC voltage of a half wave rectifier can be calculated with the following two ideal equations.

$$V_{peak} = V_{rms} \times \sqrt{2}$$

$$V_{dc} = \frac{V_{peak}}{\pi}$$

where, V_I = Input voltage
V_b = bar

- Half wave Rectification - For +ve half cycle:

Diode is forward biased, acts as a short circuit passes the waveform through.

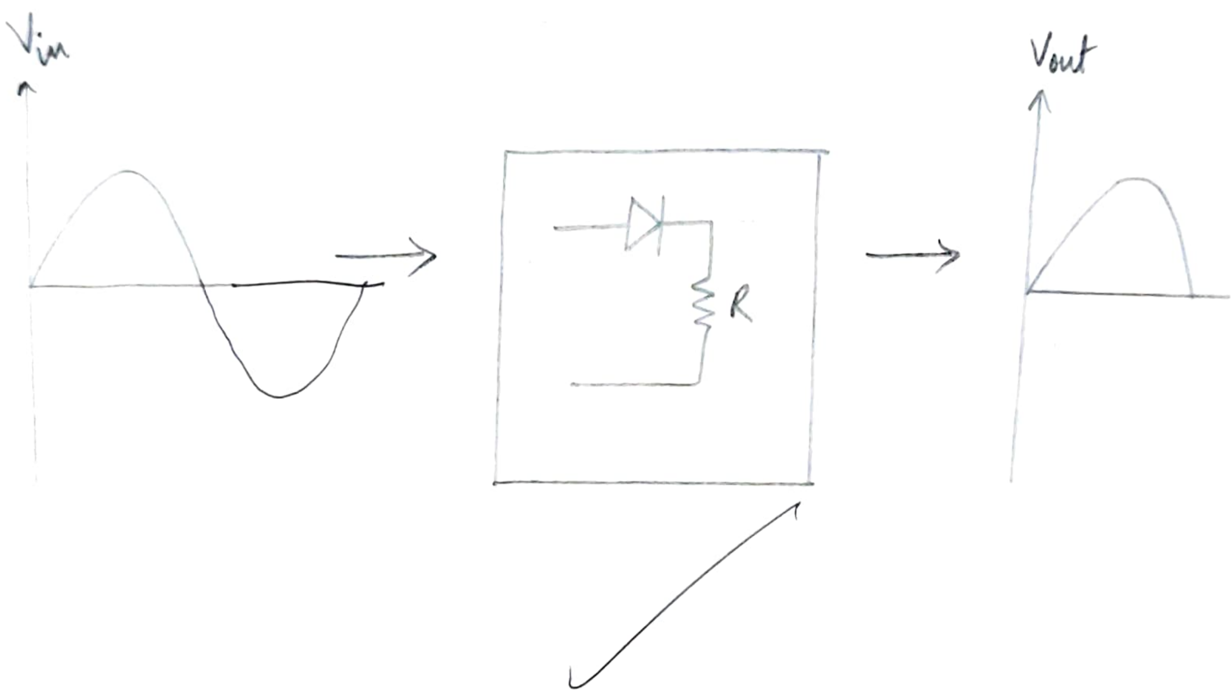
For +ve half cycle:

$$V_I - V_b - I r_d - IR = 0$$

where, V_I = input voltage
V_b = barrier potential
r_d = diode resistance
I = total current
R = resistance

$$I = \frac{V_I - V_b}{r_d + R}$$

for a line equation of,



Vin
R
Vout

$$V_o = IR$$

$$V_o = \frac{V_I - V_b}{r_d + R} \times R$$

for $r_d << R$

$$V_o = V_I - V_b$$

V_b is 0.3 for germanium.
V_b is 0.7 for silicon.

- For $V_I < V_b$:
  The diode will remain off. The output voltage will be

$$V_o = 0$$

- For $V_I > V_b$:
  The diode will remain on. The output voltage will be,

$$V_o = V_I - V_b$$

<u>Average output voltage</u>-

$$V_o = \cancel{V_m \sin \omega t} \quad , \forall \; 0 \le \omega t \le \pi$$

$$V_o = 0 \quad , \forall \; \pi \le \omega t \le 2\pi$$

$$V_{av.} = \frac{V_m}{\pi} = 0.318 \, V_m$$

Observation Table -

Max. Input V	Theoritical V_{rms}	Practical V_{rms}
10V	5V	5.09V

Calculations -

diff. percentage $= \frac{|\text{practical} - \text{Theo.}|}{\text{Theo.}} \times 100$

$= \frac{|5.09 - 5|}{5} \times 100$

$= \underline{18\%}$

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. ______ Date ______

- <u>RMS load voltage</u> -

$$V_{rms} = I_{rms} R = \frac{V_m}{2}$$

- <u>Average load current</u> -

$$I_{av} = \frac{V_{av}}{R} = \frac{\frac{V_m}{\pi}}{R}$$

$$I_{av} = \frac{V_m}{\pi R} = \frac{I_m}{\pi}$$

- <u>RMS load current</u> -

$$I_{rms} = \frac{I_m}{2}$$

- <u>Form factor</u> - It is defined as the ratio of rms load voltage and average load voltage

$$F.F. = \frac{V_{rms}}{V_{av.}}$$

$$F.F. = \frac{\frac{V_m}{2}}{\frac{V_{av}}{2}} = \frac{\pi}{2} = 1.57$$

$F.F. \geq 1$

$rms \geq avg.$

... for a time duration ΔT

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. Date

- Ripple Factor –

$$\gamma = \sqrt{F.F^2 - 1} \times 100\%$$

$$\gamma = \sqrt{1.57^2 - 1} \times 100\%$$

$$\gamma = 1.21\%$$

- Efficiency – It is defined as the ratio of dc power available at the load to the input ac power

$$\eta\% = \frac{P_{load}}{P_{in}} \times 100\%$$

$$\eta\% = \frac{I_{dc}^2 \times R}{I_{rms}^2 \times R} \times 100\%$$

$$\eta\% = \frac{\frac{I_m^2}{\pi^2}}{\frac{I_m^2}{4}} \times 100\%$$

$$\eta\% = \frac{4}{\pi^2} \times 100$$

$$= 40.56\%$$

Result – We have studied a single phase Half wave rectifier and wave forms are shown.

24/01/22

Name DHRUV BAGORA Branch CSE Sem 1st
Roll No. A-28 Date

Experiment - 6

* **Objective:** Study & prepare the connection of Halogen lamp & measure voltage, current and power in the circuit.

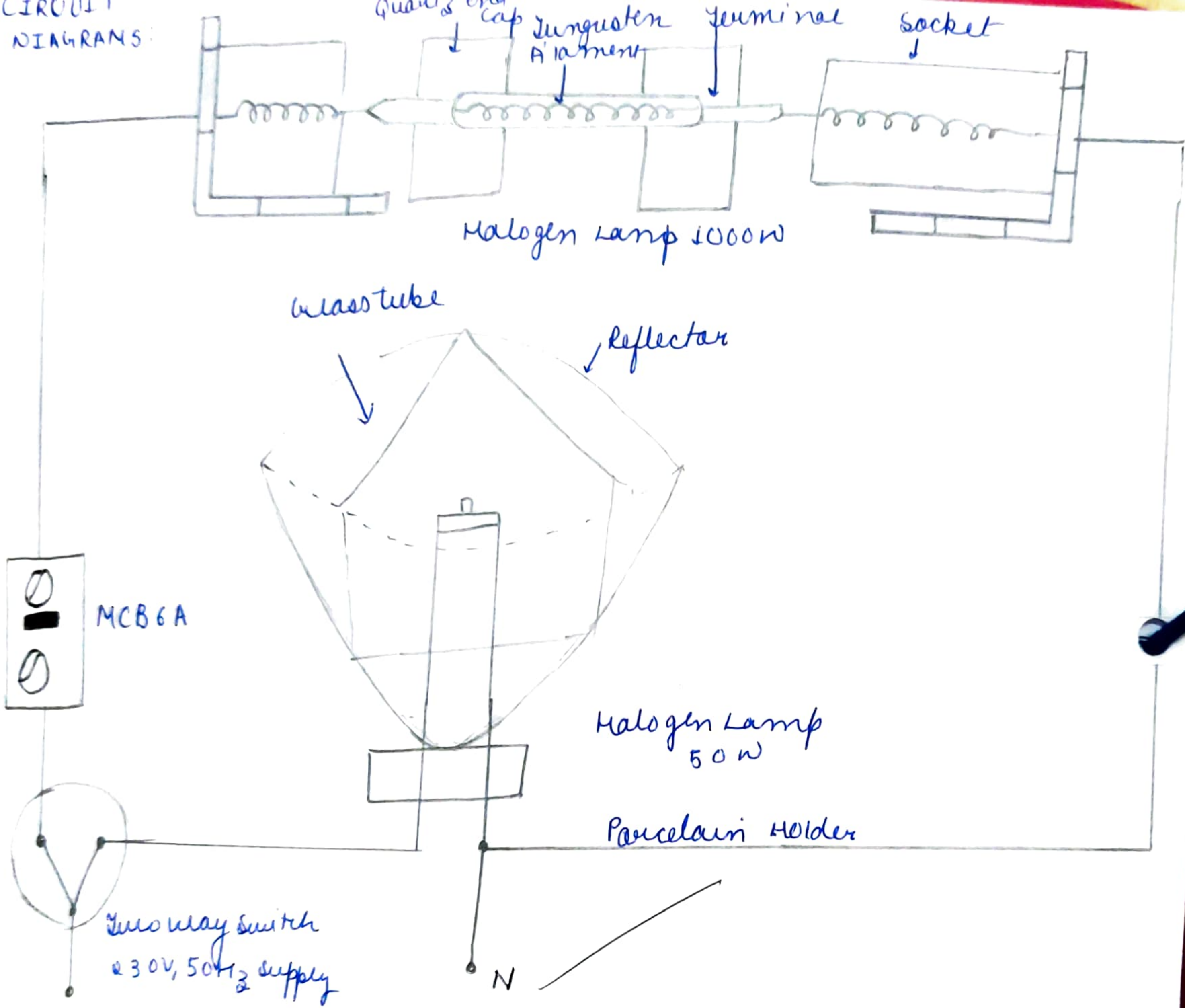
* **Apparatus required:**

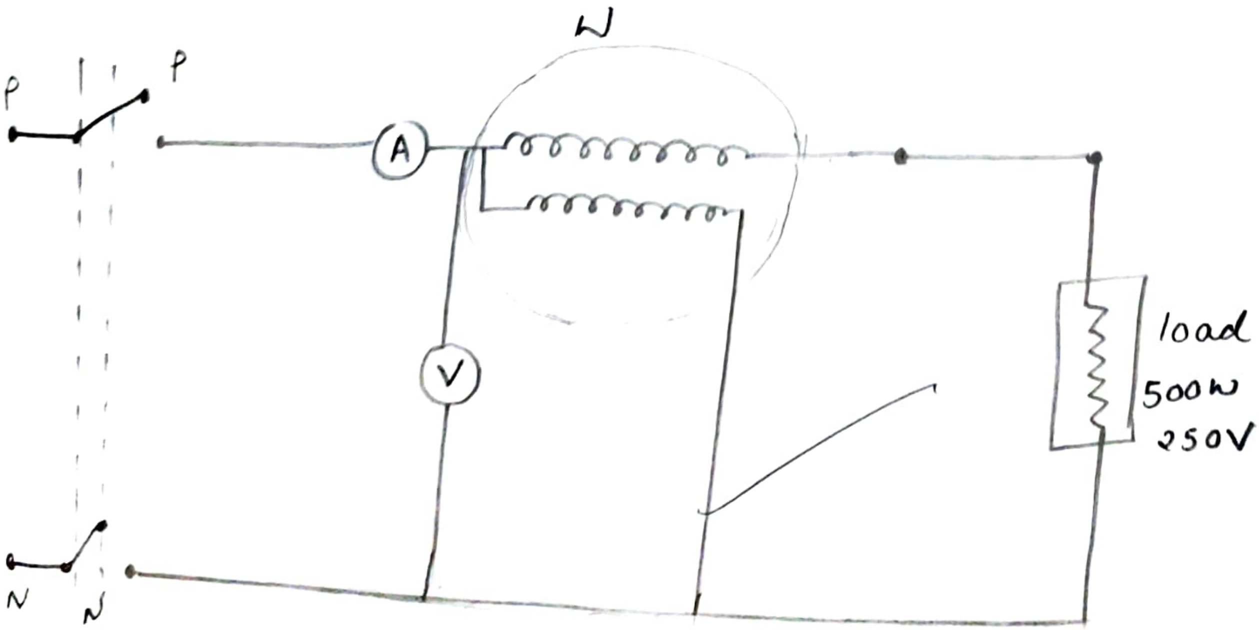
S. No.	Item	Rating	Quantity
1.	MCB	6 Amp, 250V, DPST type	1
2.	Halogen lamp	500 watt, 250 V	1
3.	connecting leads	PVC 1100V, 1 sq mm	As per req.

* **Theory:**

A Halogen lamp, also known as a Tungsten Halogen lamp or Quartz iodine lamp, is an incandescent lamp that has a small amount of a Halogen such as Iodine or bromine added. The combination of the Halogen gas and the tungsten filament. produces a Halogen cycle chemical reaction which redeposits evaporated tungsten back onto the filament, increasing its life and maintaining the clarity of envelope. Because of this, a halogen lamp can be operated at a higher temperature than a standard gas filled lamp of similar power and operating life, producing light of a higher luminous efficacy and color temperature.

CIRCUIT DIAGRAMS





TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: DHRUV BAMORA Branch: CSE Sem: 1st

Roll No.: A-28 Date:

In ordinary incandescent lamps, evaporated tungsten mostly deposits onto the inner surface of the bulb. The Halogen sets up a reversible chemical reaction cycle with the tungsten evaporated from the filament. The Halogen cycle keeps the bulb clean and the light output remains almost constant throughout life. At moderate temperatures the halogen reacts with the evaporating tungsten, the halide formed being moved around in the inert gas filling. The bulb must be made of fused silica (quartz) or a high-melting-point glass. Since quartz is very strong, the gas pressure can be higher which reduces the rate of evaporation of the filament, permitting it to run a higher temp. for the same average life. The tungsten released in hotter region does not generally redeposit where it came from, so the hotter parts of the filament eventually thin out & fail.

Application-

1. Automobile lights
2. desktop lamps
3. theatrical & studio.
4. floodlights for outdoor lighting systems.

Precaution-

1. Always connect phase wire with switch.

for a time duration DT,

Observation Table:

Load voltage	Load current	Rated load Power	Measured Power.
240V	2.07A	500W	488 W

Calculation -

$$\text{diff. percentage} = \frac{|\text{measured power} - \text{rated P}|}{\text{rated power}} \times 100$$

$$= \frac{|488 - 500|}{500} \times 100$$

$$\Rightarrow \underline{\underline{2.4\%}}$$

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. Date

2. All connection should be proper & right way.
3. All connection should be tight.

Result -

We have studied & prepare the connection of halogen lamp & measure voltage, current & power in the circuit.

24/01/22

INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora

Roll No. .... Branch: CSE .... Sem: 1st

Date ....

EXPERIMENT - 7

Objective - Observation of line voltage and phase voltage relation for 3-phase delta-star and delta-delta connected transformer at no load.

Apparatus Required -

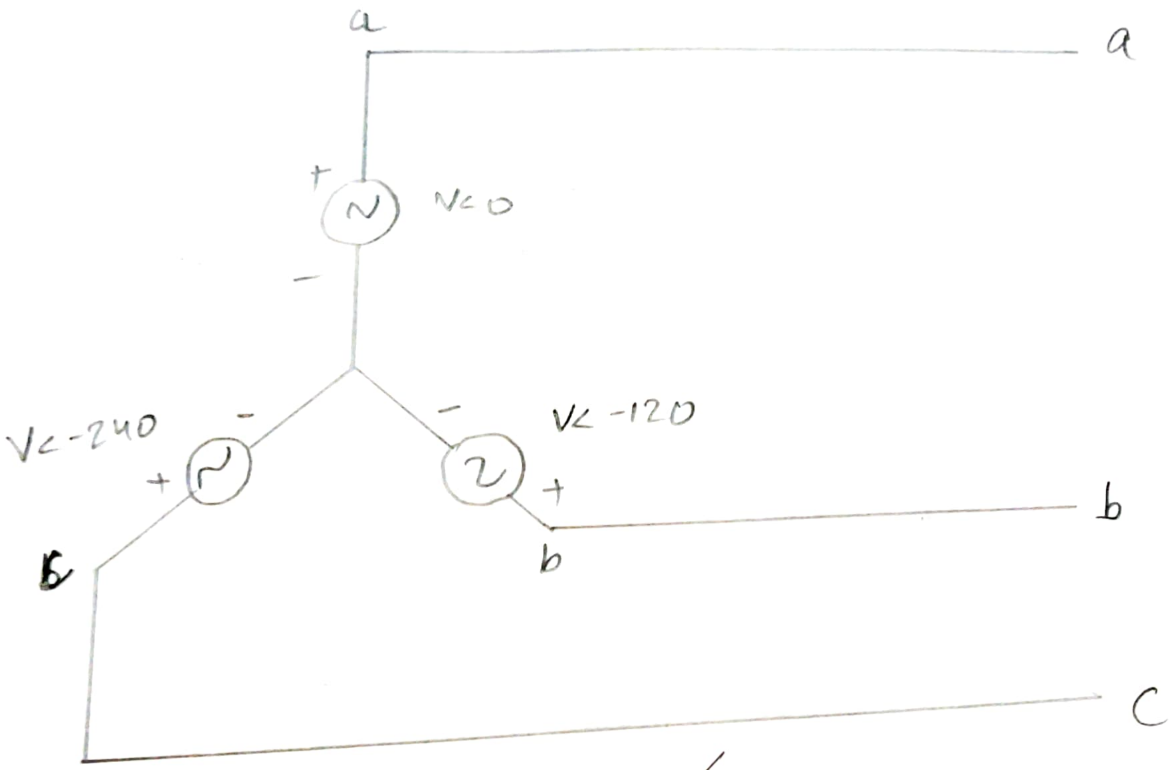
Sr. No.	Item	Rating	Quantity
1.	3-phase transformer	415/230V, 50 Hz	1
2.	voltmeter	0-500 V	4
3.	connecting leads	-	-

Theory -

There are two types of system available in electric circuit, single phase and three phase system. In single phase circuit, there will be one one phase, i.e., the current will flow through only one wire and there will be one return path called neutral line to complete the circuit.

Three phase circuit is a polyphase system where three phases are send together from the generator to the load. Each phase are having a phase difference of 120°, i.e., 120° angle electrically. So from the total 360°, three phases are equally divided into 120° each. The power in three phase system continuous as all the three phases are involved in generating the total power.

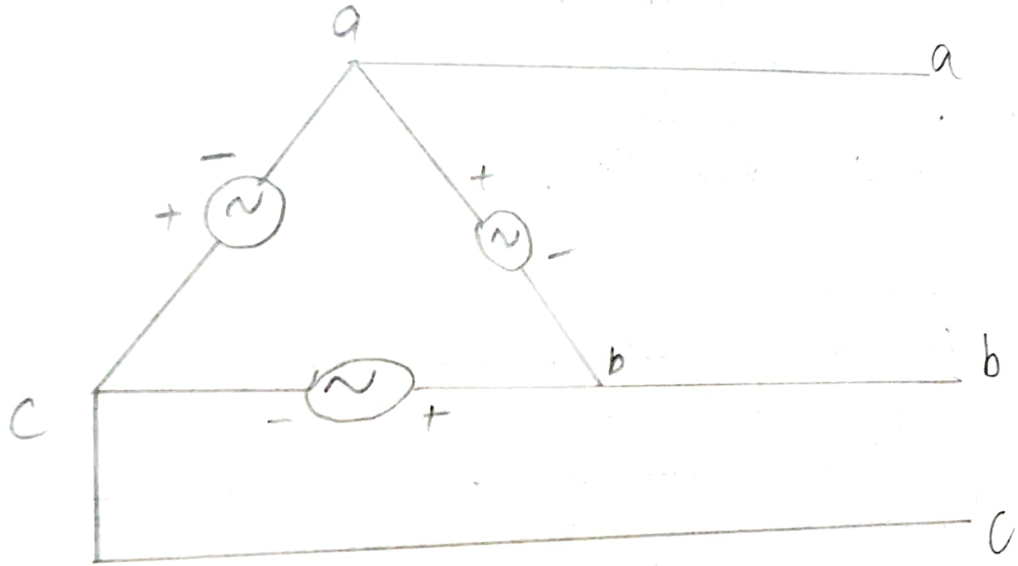
... for a time duration DT ...



Star connection

In three phase circuit, connection can be given in two types -
1. Star connection
2. Delta connection.

1. Star Connection -
In star connection, there are four wires, three wires are phase wire and fourth is neutral wire which is taken from the star point. Star connection is preffered for long distance power transmission because it is having the neutral point. In this we need to come to the concept of balanced & unbalanced current in power system.
When equal current will flow through all the three phases, then it is called as balanced current. And when the current will not be equal in any of the phase, then it is unbalanced current. In this case, during balanced condition there will be no current flowing through the neutral line & hence there is no ~~use~~ of the neutral terminal. But when there will be unbalanced current flowing in the three phase circuit, neutral is having a vital role. It will take the unbalanced current through to the ground and protect the transformer. Unbalanced current affects transformer and it may also cause damage to the transformer and for this star connection is preffered for long distance transmission.
In star connection the line voltage is $\sqrt{3}$ times of phase voltage. Line voltage is the voltage b/w



Delta connection

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. .... Date ....

two phases in three phase circuit and phase voltage is the voltage b/w one phase to the neutral line. And the current is same for both line and phase.

$$\Rightarrow E_{line} = \sqrt{3}\, E_{phase}$$

$$\Rightarrow I_{line} = I_{phase}$$

2. Delta connection -

In delta connection, there is three wires alone and no neutral terminal is taken. Normally delta connection is preferred for short distance due to the problem of unbalanced current in the circuit. In the load station, ground can be used as neutral path if required.

In delta connection, the line voltage is the same as that of phase voltage. And the line current is $\sqrt{3}$ times of phase current.

$$\Rightarrow E_{line} = E_{phase}$$

$$\Rightarrow I_{line} = \sqrt{3}\, I_{phase}.$$

In a three-phase circuit, star & delta connection can be arranged in four diff. ways:-

1. Star - star connection
2. Star - Delta connection
3. Delta - star connection

• Observation Table -

Connection type	Primary		Secondary	
	V_L	V_P	V_L	V_P
1. Delta - Delta	424	424	136	136
2. Delta - Star	424	423	240	137

INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. .... Date ....

4\. Delta - Delta connection.

But the power is independent of the circuit arrangement of the three phase system. The net power in the circuit will be same in both star and delta connection. ~~It~~

$$P_{Total} = 3 \times E_{phase} \times I_{phase} \times P.F.$$

Result -

We have observed the line voltage and phase voltage relation for 3-phase delta-star and delta-delta connected tranformers at no load.

Rosoni 25/1/22

EXPERIMENT - 8

Objective - To study construction (cut-section model), working principle of diff. components of LT switchgear.

Theory -

- Circuit Breaker -
An electrical circuit breaker is a switching device that can be operated manually or automatically for controlling and protecting the electrical power system. There are different types of circuit breakers which are based on voltage, installation location, external design and interrupting mechanism.

- Miniature Circuit Breaker -
There are two arrangements of operation of miniature circuit breaker. One due to thermal effect of over current and other due to electromagnetic effect of over current. The thermal operation of miniature circuit breaker is achieved with a bimetallic strip whenever continuous over current flows through MCB, the bimetallic strip is heated and deflects by bending. This deflection of bimetallic strip releases mechanical latch. As this mechanical latch is attached with operating mechanism, it causes to open the miniature circuit breaker contacts, but during short circuit

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: 1st

Roll No. Date

condition, sudden rising of current, causes electromechanical displacement of plunger associated with tripping coil or solenoid of MCB. The plunger strikes the trip lever causing immediate release of latch mechanism consequently open the circuit breaker contacts. 7

• Molded Case Circuit Breaker-

A molded case circuit breaker, abr. MCCB, is a type of electrical protection device that can be used for a wide range of voltages, and frequencies of both 50Hz and 60Hz. The main distinctions b/w molded-case and miniature circuit breaker are that the MCCB can have current ratings of up to 2500A, and its trip settings are normally adjustable. An additional diff is that MCCBs tends to be much larger than MCBs. As with most types of circuit breakers, an MCCB has 3 main funct^n:

(i) Protection ~~against~~ over load - currents above the rated value that last longer than what is normal for the application.

(ii) Protection against electrical faults - During a fault such as a short circuit or line fault, there are extremely high currents that must be interrupted immediately.

(iii) Switching a circuit on ~~and~~ off - This is a less common funct^n of circuit breakers, but they can be used for that purpose if there isn't an adequate manual switch.

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. Date

- Difference b/w MCB and MCCB -

The wide range of current ratings available from molded-case circuit breakers allows them to be used in a wide variety of applications. MCCBs are available with current ratings that range from low values such as 15 A, to industrial ratings such as 2500 A. This allows them to be used in both low-power and high-power applications.

The main diff. b/w the two is their capacity, with the MCB rated under 100 A with an interrupting rating of under 18000 A. Consequently, their trip characteristics may not be adjusted since they basically cater to low circuits.

On the other hand, an MCCB comes with an adjustable trip characteristics for the higher models. Usually, this type of circuit breaker would provide amps as high as 2500 or as low as 10, depending on what is necessary. Their interrupting rating ranges from around 10000 A to 20000 A.

- Earth Leakage Circuit Breaker (ELCB) -

An ELCB is one kind of safety device used for installation an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical device on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of earth leakage circuit

breaker (ELCB) is to stop damage to humans & animals due to electric shock.
An ELCB is a specific type of latching relay that has a structure's incoming mains power associated through its switching contacts so that the circuit breaker detaches the power in an unsafe condition. The ELCB notices fault currents of human or animal to the earth wire in the connection it guards. If ample voltage seems across the ELCB's sense coil, it will turn off the power, and remain off until manually rearrange. A voltage sensing ELCB doesn't detect fault currents from human or animal to the earth.

• earthing -
To connect metallic parts of electric appliance or installations to the earth is called earthing or grounding.
In other words, to connect the metallic parts of electrical machinery and devices to the earth plate or earth electrode through a thick conductor wire for safety purpose is known as earthing or grounding.

→ Types of earthing :-

1. Plate earthing -
In plate earthing system, a plate made up of copper or galvanized iron is buried vertical in the earth which should not be less than 3m (10ft) from ground level

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora   Branch: CSE   Sem: 1st

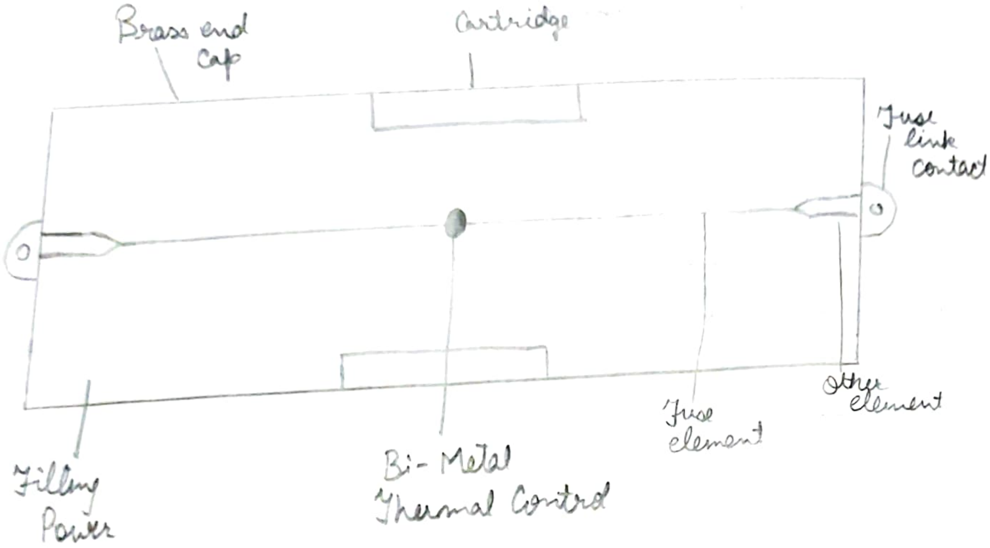
Roll No.:   Date:

2. Pipe earthing -
A galvanized steel and a perforated pipe of approval length & diameter is placed vertically in a wet soil in this kind of system of earthing. It is the most common system of earthing. The size of pipe depends on the magnitude of current and the type of soil.

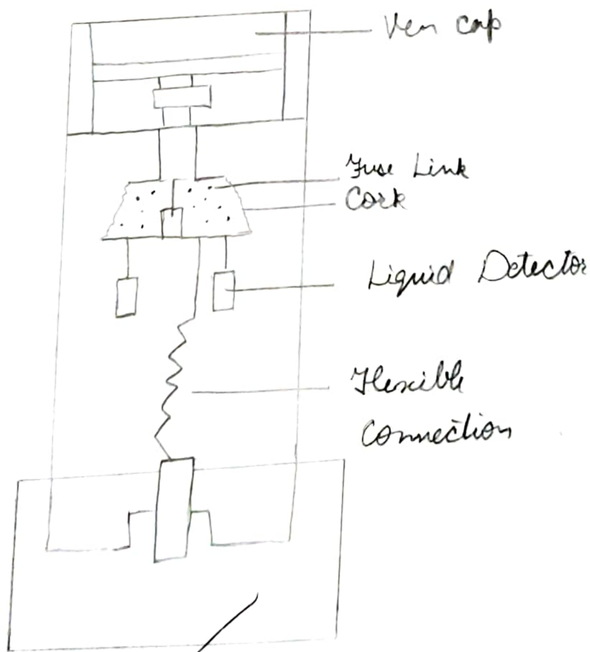
3. Rod earthing -
It is same method as pipe earthing. A copper rod or galvanized steel or hollow section of G I pipe are buried upright in the earth manually or with the help of pneumatic hammer. The length embedded electrodes in the soil reduces earth resistance to a desired value.

4. Strip or Wire earthing -
In this method of earthing, strip electrodes of cross section is buried in horizontal trenches of a min. depth of 0.5 m. If copper with a cross-section of 25 mm x 4mm is used and dimension of 3.0mm² if its a galvanized iron or steel.

- Fuses -
Fuses are the protectors, these are the safety devices which are used to protect the home appliances like TV, fridge, computers with damage by high voltage. The fuse is made up of thin strip or strand of metal, whenever the heavy amount of current or an excessive current flow in there an electrical



Cartridge Type HRC Fuses



Liquid Type HRC Fuse

circuit, the fuse melts and it opens the circuit and disconnects it from the power supply.

→ Types:-

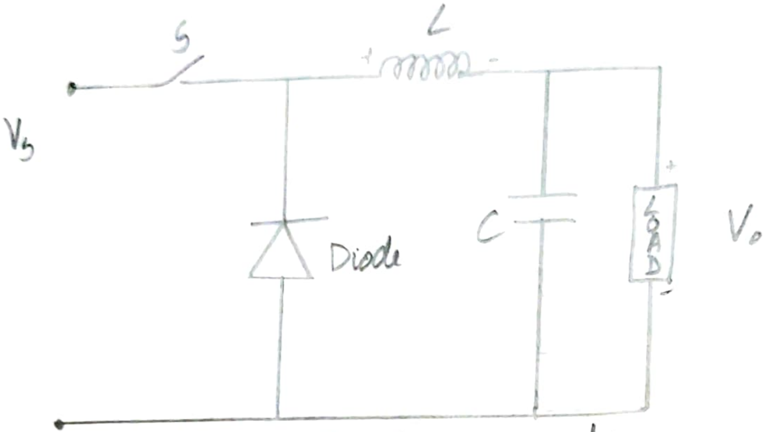
1. Rewirable / Kit-Kat Type -
In this type of fuse, the main advantage is that fuse carrier is easier to remove without having any electrical shock or injury. The fuse base acts as an incoming and outgoing terminal which is made up of porcelain & fuse carrier is used to hold the fuse element which is made up of tin, copper, lead etc. This is used in domestic wiring, small industries etc.

2. Cartridge Type HRC Fuses -
It is similar to low voltage type, only some designing features are different.

3. Liquid Type HRC Fuses -
These are used for circuit upto 100A rated current & systems upto 132 KV. These fuses have the glass tube filled with carbon tetrachloride. The one end of the tube is packed and another is fixed by phosphorous bronze wire. When fuse operations starts, the liquid uses in the fuse extinguish the arc. This increase the short circuit capacity.

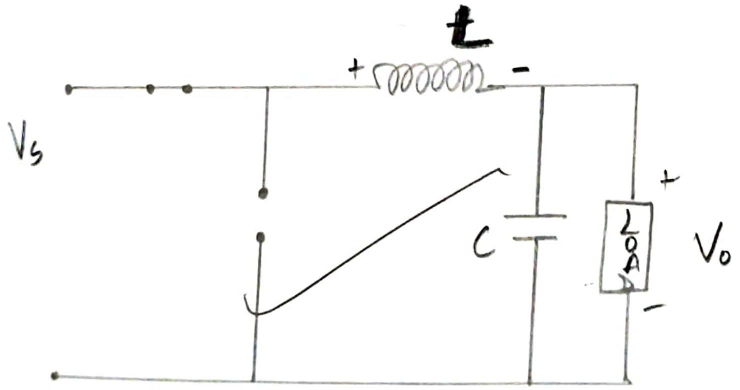
Result - We have studied diff. types of circuit breakers, earthing and fuses and their applications

... ... duration DT,

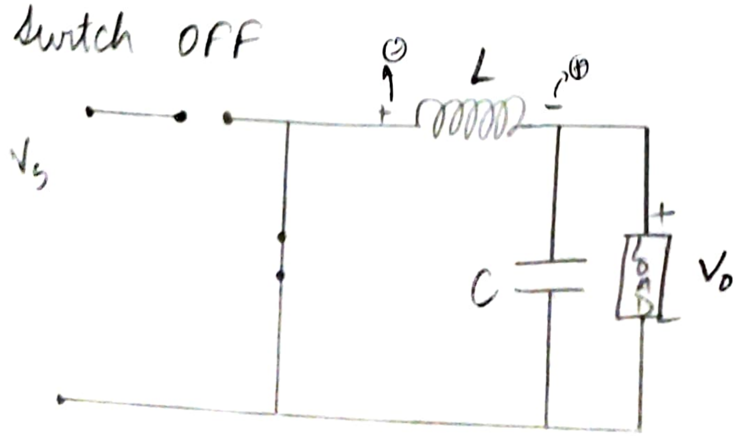


Buck converter

(i) Switch ON



(ii) Switch OFF



TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name: Dhruv Bagora Branch: CSE Sem: Ist

Roll No. Date

EXPERIMENT 9

Objective - Study of DC-DC Buck converter with R load and observed effect of duty ratio on converter output voltage.

Apparatus Required - DC-DC Buck converter, trainer kit, two channel DSO, connection leads.

Theory -

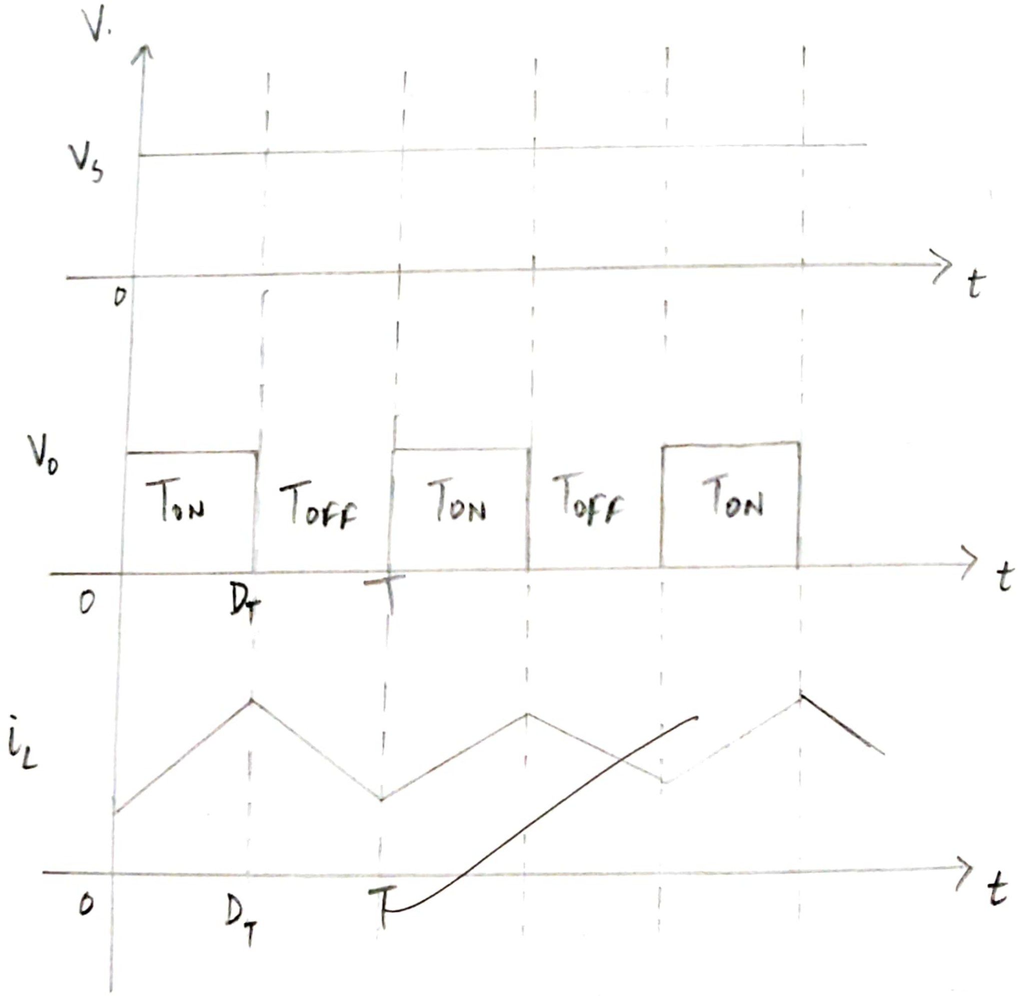
- **Circuit description** -

The three basic dc-dc converter use a pair of switches, usually one controlled (eg. MOSFET) and one uncontrolled (i.e. diode), to achieve unidirectional power flow from input to output. The converters also use one capacitor and one inductor to store and transfer energy from input to output. They also filter or smooth voltage and current.

The dc-dc converters can have two distinct modes of operation: Continuous conduction mode (CCM) and discontinuous conduction mode (DCM). In practice, a converter may operate in both modes, which have significantly diff. characteristics. Therefore, a converter and its control should be designed based on both modes of operation. However, for this course we only consider the dc-dc converters operated in CCM.

- **Circuit operation** -

When the switch is on for a time duration DT,



waveforms

the switch conducts the inductor current and the diode becomes reverse biased. This results in a +ve voltage $V_L = V_g - V_o$ across the inductor. This voltage causes ~~to~~ a linear increase in the inductor current i_L. When the switch is turned off, because of the inductive energy storage, i_L continues to flow. This current now flows through the diode, and $V_L = -V_o$ for a time duration $(1-D)T$ until the switch is turned on again.

- Volt second Balance equation -

Voltage upto time $DT = V_S - V_o$

Voltage for time $(T-DT) = 0 - V_o = -V_o$

$$\frac{(V_S - V_o)}{\cancel{L}} D\cancel{T} = -\left(-\frac{V_o}{\cancel{L}}\right) \cancel{T}(1-D)$$

$$V_S D - V_o D = V_o - V_o D$$

$$\boxed{V_o = V_S D}$$ volt second balance eqn.

V_o = output voltage

V_S = input voltage

D = Duty ratio / Duty cycle $= \frac{T_{ON}}{T} = \frac{T_{ON}}{T_{ON} + T_{OFF}}$

Observation Table -

Sr. No.	Input voltage (V_s)	Duty Ratio (D)	Output voltage (V_o)
1.	24V	15%	5.20V
2.	24V	20%	7.2 V
3.	24V	30%	10.4V
4.	24V	40%	12.8V
5.	24V	50%	14.8V
6.	24V	60%	16 V
7.	24V	70%	17.2V
8.	24V	80%	18.4V
9.	24V	90%	20.4V
10.	24V	95%	21.6V

For $R_L = 36.6\ \Omega$

Frequency = 2 KHz.

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Dhruv Bagora Branch CSE Sem 1st

Roll No. Date

Result - We have studied and observed the DC-DC buck converter with R load and observed effect of duty ratio on converter output voltage.

Ahuja 25/1/22