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INDEX

S.NO.	Name of Experiment	Date of Exp.	Date of Submission	Signature & remark
1.	Study of Resistance	26/11/21	2/12/21	Abeer 2/12/21 A++
2.	Study of Capacitor	2/12/21	}	Rabson 16/12/21 late sub. A+
3	Study of Inductor	9/12/21		
4.	V-I Characteristics of diode	10/1/22	13/1/22	Rabson 13/1/22 A+
5.	Study of single, half wave uncontrolled Rectifier	13/1/22	20/1/22	
6.	Study of Halogen lamp	24/1/22	24/1/22	Abeer 24/01/22 A++
7	Study of star delta connection	24/1/22	25/1/22	Rabson 25/1/22 A+
8	Study of LT Switch gear	25/1/22	25/1/22	} Rabson 25/1/22 A++
9.	Study of DC-DC Buck converter	25/1/22	25/1/22.	

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

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

Experiment NO : 1

Objective - Study of resistance
- Explain the function and unit of resistors
- Measure the value of a resistor
- Measure the tolerance of a resistor
- Explain the types of resistors

Apparatus Required - 1 Multimeter 2. Resistor

Theory - Type of Resistors:

Fixed

carbon film (Tolerance = +/- 5%)
Metal Film, wire
wound resistors

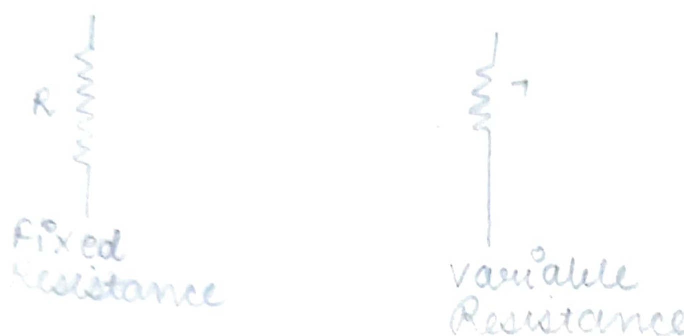
value of resistor
is specified &
cannot be changed

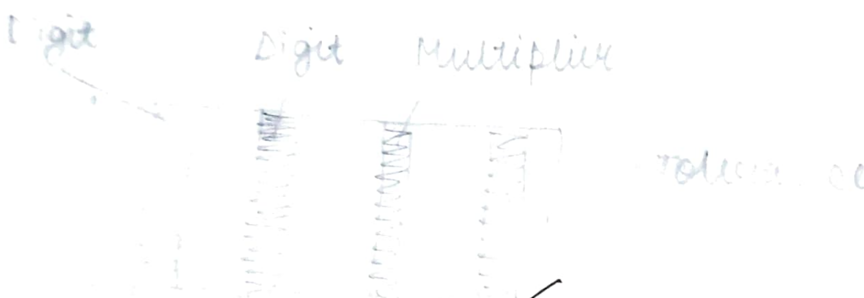
Variable

Semi fixed,
completely
Variable,
potentiometer

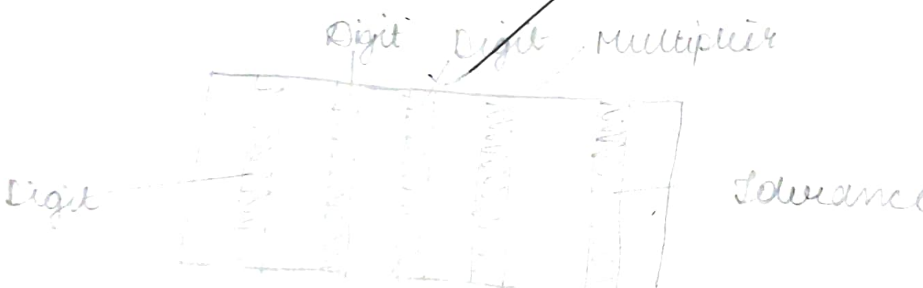
can be
changed by
rotating the
wiper

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





4-band code



5-band code

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Name ....

Roll No. .... Branch .... Sem ....

Date ....

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

Step - 3

The second band represents the second digit. The colours represent the same number as did the first digit. In this case - 4 band its '6' & for 5 band its '3'

Step - 4

The Third band ~~divulges~~ how many zeros to add / divide to the first two numbers for a 4 band Resistor. In this case - 4 band its '4' zeros to be added so value is 560K.

Step 5.

The Third 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 values to be written on them
- There are 4 or 5 bands of colour. Value of a Resistor is decoded from these band of color.

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 symbolised 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 resistor it +/- 1%

- Tolerance of a resistor is also an imp. property to consider -
- A 100 Ω resistor with a 10% tolerance can mean its value can be any fixed value b/w 90 to 110 Ω
- A 120 ohm resistor with a 10% tolerance can mean its value can be any fixed value b/w 108 to 132 Ω
- So there is same overlap b/w 100 Ω & 120 Ω resistance in terms of its units

Colour	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
yellow	4	10^4	[illegible]
green	5	10^5	0.85
blue	6	10^6	0.25

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

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

voilet	7	10^7	0.1
grey	8	10^8	
white	9	10^9	
gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

Observation

S.NO.	Colour Brands	Theoritical value $(x_1)\Omega$	Practical value $x_2(\Omega)$	Percentage difference $C = \frac{x_2 - x_1}{x_1}$
1	Red voilet Red gold	2700±5%	2700	0%
	Green Blue Brown Gold	560±5%	566	1.071%

Result

We have studied the function & unit of resistors measured the value of resistor using multimeter, percentage difference b/w actual & theortical value of resistor found out to be 0% & 1.071%.

2/12/21 A+

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

Percentage diff (x) $\quad c_1 = \frac{2700 - 2700}{2700} \times 100$

$c_1 = 0\%$

For observation '2'

Percentage difference

here

$x_1 = 560\,\Omega$

$x_2 = 566\,\Omega$

$c = \frac{566 - 560}{560} \times 100$

$c = 1.071\%$

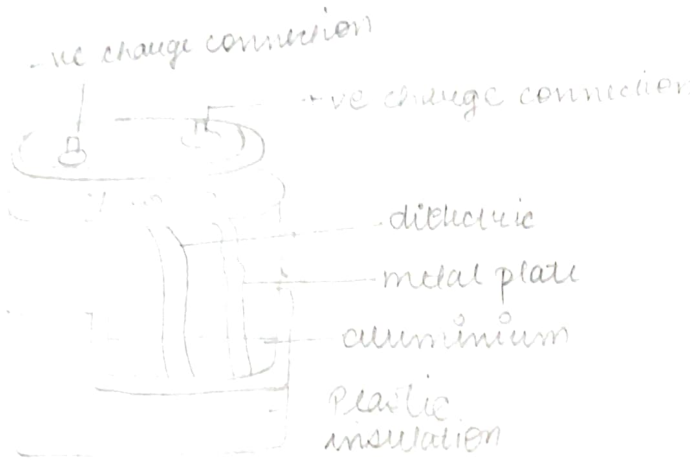
Experiment - 2

Objective - study of capacitor
• after the end of this module the student would be be able to
- provide a definition of capacitor & name its units
- explain how a capacitor can be constructed to give a particular value of capacitance
- explain way a capacitor has Max. working voltage
- determine experimentally the energy stored in a capacitor
- Identify the value & type of capacitor
- Identify the polarity of terminal

APPARATUS - different types of capacitors

Theory
capacitor - It is one of the passive components like resistor It is also known as condensor. capacitor is generally used to store the charge The charge is stored in the form of "electrical field" It plays a major role in many electrical & electronic circuits

Construction - The basic construction of all capacitors is of 2 parallel metal plates separated by an insulating material An insulator is



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

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Name .... Branch .... Sem ....

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

a material which is non conducting i.e. it show a high resistance to letting to electric used is air, other types are oil or paper. Real capacitor are made by taking thin strips of metal foil & the appropriate dielectric set 2 layers of metal foil & rolling it up like in this figure

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 let the plates fails to insulate & charge passes from, plate to another. capacitors are usually marked with the maximum working voltage to help the user avoid situation

A good rule of thumb is to never place a voltage across the capacitor which exceeds about 2/3rds of ~~their~~ its value especially says- the bigger the current, the faster the capacitor's voltage changes.

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Name .... Branch .... Sem ....

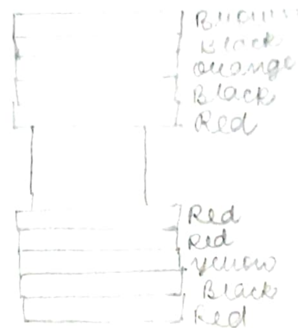
Roll No. .... Date ....

Classification of capacitors

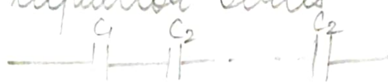
UNPOLARISED	POLARISED
Ceramic	Electrolytic
Multilayer	Tantalum
Polystyrene Film	Super
Polyster Film	They have +ve & -ve electrode
Polyproplene	
Mica	
They do not have +ve &-ve electrode	

Ceramic capacitors - They are most used capacitors in the electronic industry This are fixed capacitance ~~type~~ capacitors & they are usually very small, The capacitance of this is usually ~~in the~~ range of placofazadr to few micro farads (Less than 10 uF) They are non Polarized type capacitors & hence can be used in both DC as well as AC circuits

Electrolytic capacitor - This is polarized & they must be connected the correct way round, atleast of their leads will be marked + or -. It is very easy to find the values of ~~electricity~~ electrolytic capacitors because they are clearly printed with ~~this~~ their capacitance & voltage rating



capacitor series



$$Q_T = Q_1 = Q_2 = \dots = Q$$

$$I_C = I_1 = I_2 = \dots I$$

equivalent capacitance of 2 capacitors in series

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

Tantalum capacitor

Tantum lead voltage rating like electrolytic capacitors usually the "+" symbol is used to show the +ve component lead. Modern tantalum lead capacitors are printed with their capacitance voltage & polarity in full However older ones use a color code systems which has 2 ~~sml~~ stripes & a spot of colour for the of 0's to give the value in uF

UNPOLARISED CAPACITORS

- SMALL VALUES (upto 1uF) The value printed but without a multiplier so you need to use exp. to work out what the multiplier should be for eg. 0.1 means 0.1 pF Sometimes the multiplier is used in place of the decimal point for eg 4n7 means 4.7 nF

Capacitor NOS CODE - A NOS code is often used on small capacitors where printing is ~~different~~ difficult The 1st nos is the 1st digit, the 2nd nos is the 2nd digit, the 3rd is 0 to give capacitance in pF Ignore any letters - they just indicate tolerance & voltage rating for eg - 102 means 1000 pF (not 102 PF)

eg 472 J means 4700 PF (J means 5% tolerance

Capacitor in series - means 2 or more capacitor connected in a single line the plate of the of the I capacitor is connected to the -ve plate of the next capacitor

where

Q_T = Total charge

I_C = capacitive current.

when the capacitor are connected in series charge & current is same on all the capacitors

For series capacitor same quantity of $e^{\ominus}$ is will 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 $e^{\ominus}$'s current is also same

CAPACITOR in PARALLEL

when the capacitors are connected in parallel the total capacitance value is ↑ There are some application where higher capacitance values are req.

All the capacitors which are connected in parallel have the same voltage & is equal to the VT applied but the input & output terminal of the circuit

$$V_T = V_1 = V_2$$

Equivalent capacitance of 2 capacitor-Lo 25 in Parallel $C_{eq} = C_1 + C_2$

Charging & Discharging

The plate on the capacitor that attaches to the -ve terminal of the battery loses $e^{\ominus}$'s to

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

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

to the battery once it's charged, the capacitor has the same voltage as the battery charging

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

A colour code was used on polyster capacitors for many years The color should be read like the resistor code the top 3 color band giving the value in pF Ignore the 4th band & 5th for eg - Brown, Black, orange means 1000pF not that there is no gaps between the colour bands so 2 identical bands actually appear as a wide band for eg wide red yellow means 220F

Result - we have studied classification & identification of different types of capacitor.

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name Garvita Baya Branch .... Sem ....

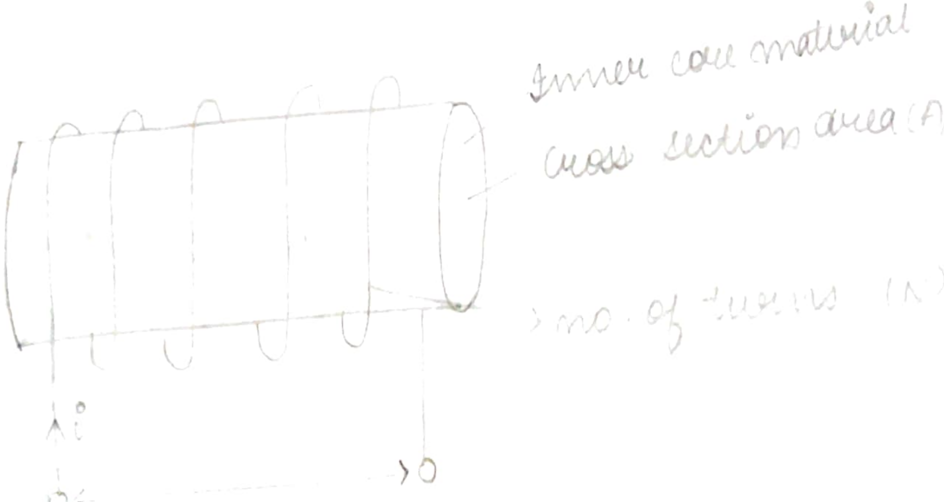
Roll No. .... Date ....

Experiment - 3

Objective - • Study of inductor & name its unit
• Provide a defination of inductor Explain how a inductor can constructed to give a particular value of inductor
• Indentify the value and type of inductor
• Measurement of inductor using LCR ~~Cer~~ meter

Apparatus Required
(i) Single Phase step down Transfer 230/12V @ 2A
(ii) 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 consists 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 units of Inductance is the Henry (H) named for 19th century American scientist Joseph Henry. In the measurement of magnetic circuits, it is equivalent to weber/ampere



L_{coil} = Inductance of coil in henries
μ_r = relative Permeability of core
μ_0 = Permeability of free space $= 4\pi \times 10^{-7}$
N = no. of turns
A = coil area (m^2)
r = coil radius (m)
l = coil length (m)

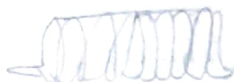
$$L_{coil} = \frac{\mu_r \mu_0 N^2 A}{l} = \frac{\mu_r \mu_0 N^2 \pi r^2}{l}$$

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

1) AIR CORE INDUCTOR
Ceramic core inductors are referred as "air core inductors" Ceramic is the most commonly used material for inductor cores. The main advantage of these inductors are very low core losses, high quality factor These are mainly used in high frequency application where low inductance values are req.

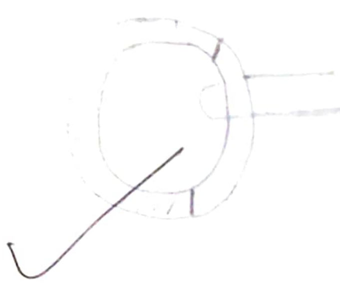
2) Iron Core Inductor
In the areas where low space inductors are in need then these iron core inductors are best option
These inductors have high power & high inductance value but limited in high frequency capacity these are applicable in audio equipments

3) LAMINATED CORE INDUCTOR.
These core materials are formed by arranging many no's of ~~on~~ laminations on top of each other These laminations are made up of steel with insulating material between them The have high power levels so they are mostly used as power filtering devices for

1) 

2) 

3) 

4) 

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

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

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 & high inductance values at low frequency application. These inductors mainly used in medical devices, switching regulators, air conditioners refrigerators, telecommunications & musical instrument etc.

5 Multi Layer ceramic Inductors

The name itself indicates that it consist of multilayers simply by adding additional layers of coiled wire that is wound around the central core to the inductor gives multi layers inductor Generally for more no:s of turns in a wire, the inductance is also more In these multi layer inductors not only in the inductance of the inductor ↑ but also the capacitance bet the wires as lo ↑s

6 Film Inductor

These uses a film of conductor on base materia Thus acc. to the req. this film is shaped for conductor application Film inductors in thin size are suitable for DC to DC converters

• Coupled Inductor

Measured of Inductance of 1-ϕ step up transformer (230/12 V @ 2 A)

i) Primary winding Inductor :- 3.300 H

ii) Secondary winding Inductance :- 20.34 mH

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Name .... Branch .... Sem ....

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

that serve as power supplies in smart phones & mobile devices. The RF thin film is shown.

4 Variable Inductor

it is formed by moving the magnetic core in & outside of the inductor winding By this magnetic core we can adjust the inductance value when we consider a ferrite core inductor can be formed. These type of inductors are used in radio & high frequency applications where the turning is required These inductors are typically ranged from 10 uH to 100 uH & in present days these are ranged from 10nH to 100mH

8. Coupled Inductance

The 2 conductors connected by electromagnetic inductors are generally referred. as coupled inductors we already seen that whenever the AC current is flowing in inductor produces voltage in 2nd inductor gives us mutual inductance in phenomenon The inductors work on this phenomenon only. These can isolate 2 circuit electrically by transfering impedence through the circuit A transformer is of the type of coupled inductor.

16/12/21

Result - we have studied construction of different type of inductors & also measure the Inductance of inductor using LRC circuit

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Name Garvita Baya Branch Sem

Roll No. Date

Experiment no. 4

Objective :-

1. explain the structure of a P-N junction diode
2. Explain the function of a P-N junction diode
3. Explain forward & reverse biased characteristics of a silicon diode

Apparatus Required - Diode (IN4001), battery, resistance, voltmeter, Ammeter

Theory

1. Structure of P-N junction diode - The diode is a device formed from a junction of n type & p-type semiconductor material. The lead connected to the p-type material is called the anode & 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.

2. Function of a P-N Junction in forward bias. The positive terminal of battery is connected to the P side (anode) & the negative terminal of battery is connected to the N side (cathode) of a diode, the holes in the p type region & the electrons in the n-type region are pushed toward the junction its width The positive potential applied to the p type material repels the holes, while the negative potential

Fig 1

Fig 2

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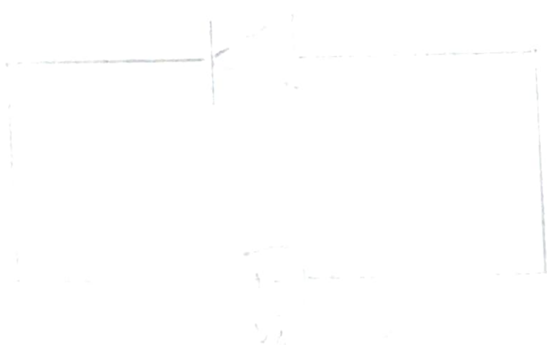
Name Gaurita Baya. Branch .... Sem ....

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

applied to the n type material repels the electrons. The change in potential b/w the p side & 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 junction, which as a consequence reduces electrical resistance The electrons that cross p-n junction into the p type material (or hole that cross into the n-type material) will diffuse into the nearby neutral region. The amount of minority diffusion in the near neutral zones determines the amount of current that may flow through the diode

Func^n of a p-n junction diode in Reverse Bias
The positive terminal of battery is connected to the N-side (cathode) & the negative terminal of battery is connected to the P side (anode) of a diode. Therefore very little current will flow until the current breaks down
The positive terminal of battery is connected to the N side & the negative terminal of the battery is connected to the p side of a diode; the 'holes' in the p-type material are pulled away from the junction, leaving behing charged ions & causing the width of the depletion region is connected to the +ve terminal, the e⁻ will also be pulled

Forward Bias



Reverse Bias

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

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

away from the junction, with similar effects This increases the voltage barrier causing a high resistance to the flow of charge carriers thus allowing minimal electric current to cross the p-n junction The increase in resistance of the p-n junction results in the junction behaving as an insulator

The strength of the depletion zone electric field ↑ as the reverse bias voltage increases Once the electric field intensity increases beyond a critical level, the p-n junction depletion zone breaks down & current begins to flow, usually by either the zener or the avalanche ~~usually~~ breakdown processes Both of these breakdown processes are non destructive & are reversible as long as the amount of current flowing does not reach levels that cause the semiconductor material to overheat & cause thermal damage

Forward & Reverse biased characteristics of Si diode-

The forward biasing, the +ve terminal of the battery is connected to the P side of the diode & the negative terminal of the battery is connected to the N side of the diode & the -ve terminal of battery is connected to the N side of the diode Diode will conduct in forward biasing because the forward biasing

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

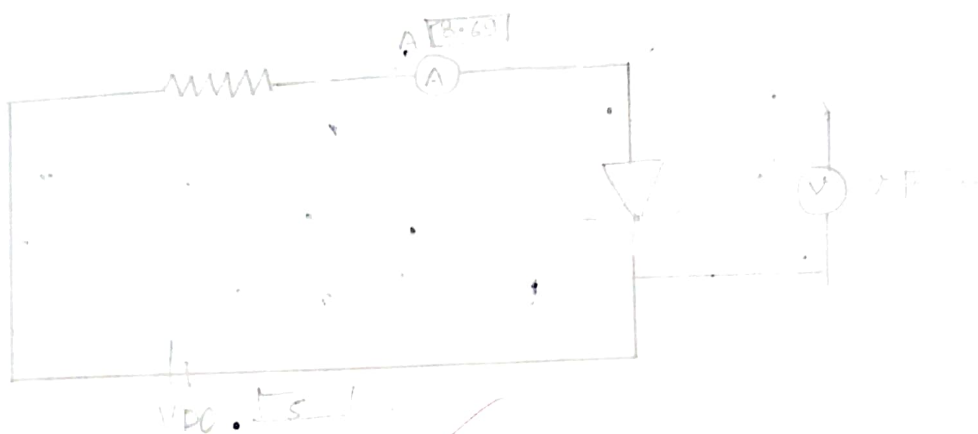
Roll No. .... Date ....

will ↓ the depletion region width & 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 closed switch with a potential drop of nearly 0.6 V across it for a silicon diode The forward & reverse bias characteristics of a si diode from the graph the diode starts conducting when the forward bias voltage exceed around 0.6 V (for si diode) This voltage is called cut in voltage

In reverse biasing, the +ve terminal of the battery is connected to the N side & -ve terminal of the battery is connected to 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 carrier charges find it more difficult to overcome the barrier potential The diode will act like an open switch & there is no current flow

Observation Table

S.NO.	Forward Voltage (volt)	Forward Current (m Amp)



Experimental setup

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

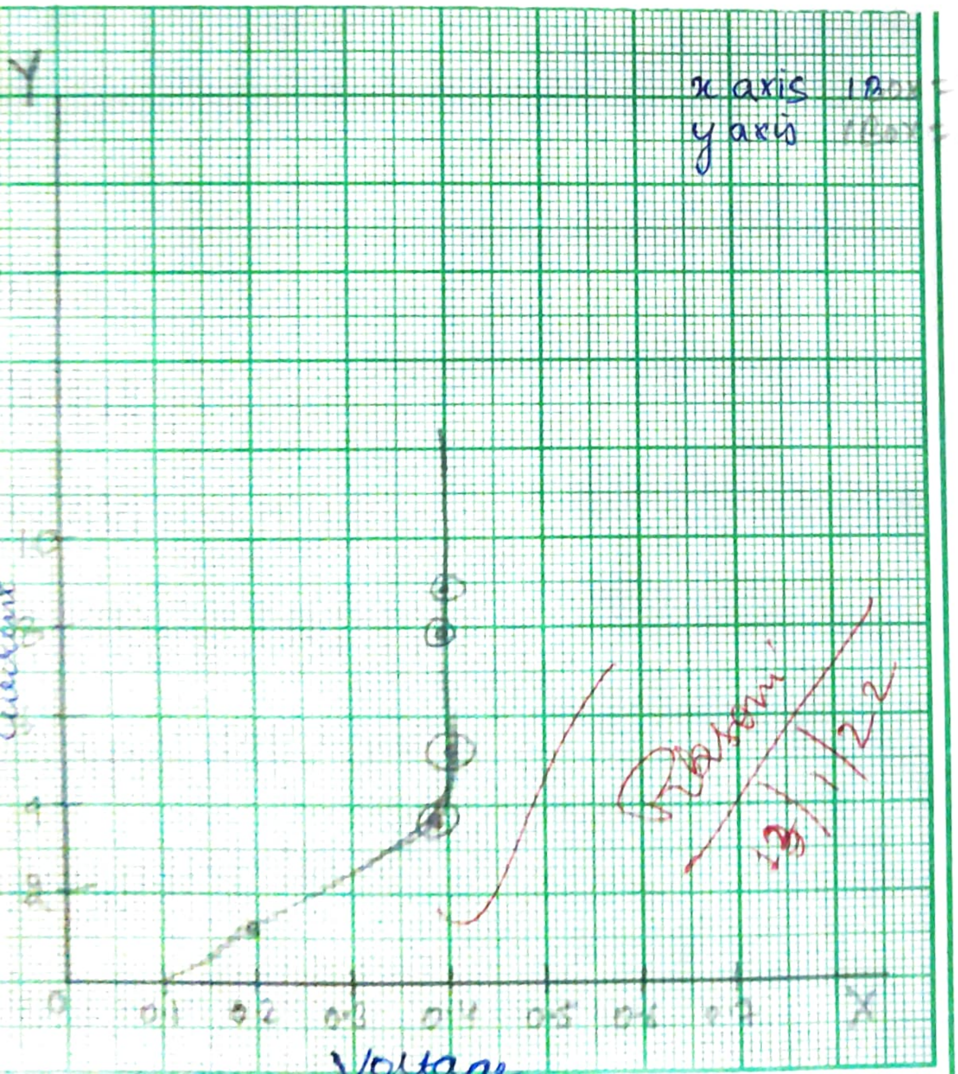
Name .... Branch .... Sem ....

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

1	0	0
2	0.557	0.790
3	0.567	1.78
4	0.573	2.57
5	0.580	3.75
6	0.584	4.54
7	0.589	5.73
8	0.593	6.72
9	0.596	7.70
10	0.598	8.69.

Result - we have studied the V-I characteristics of diode

13/1/22
Ex+



x axis 1 Box = 0·1 cm
y axis 1 Box = 2 cm
Y
X
Voltage

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY

Name .... Branch .... Sem ....

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

Experiment - 5

★ Objective - study of single phase half wave uncontrolled rectifier

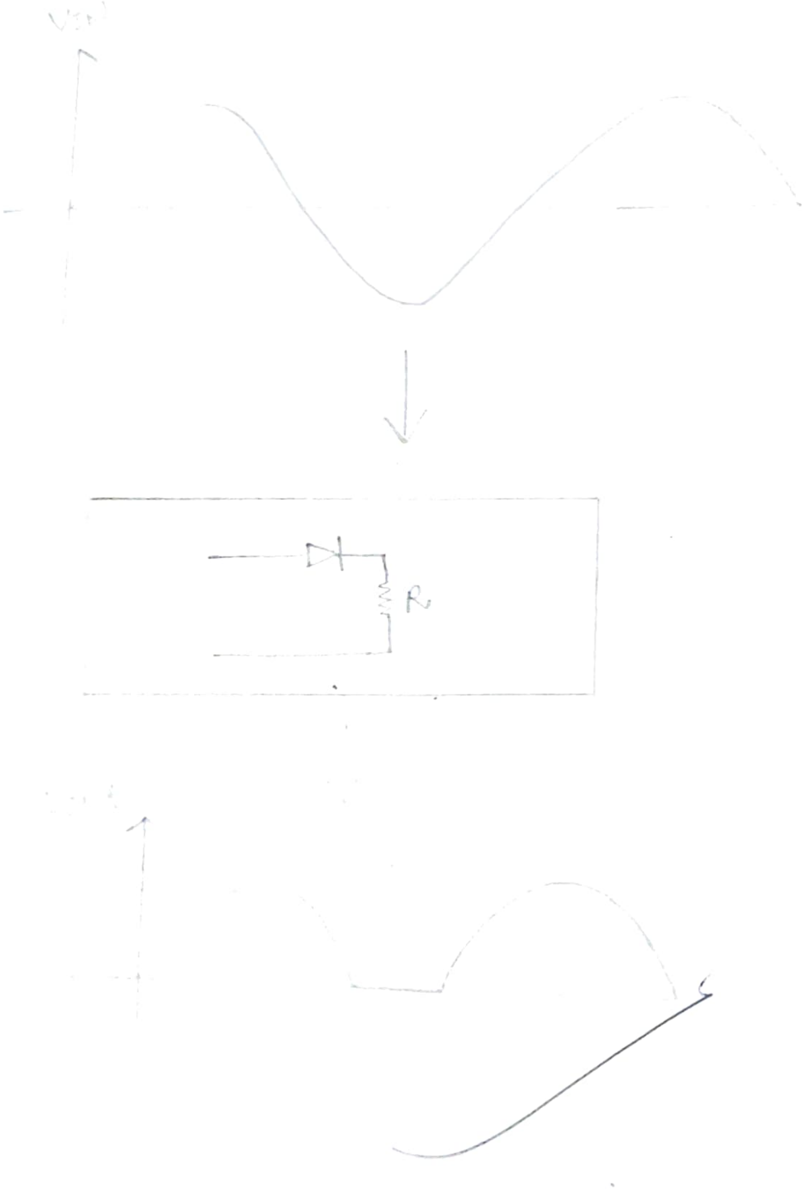
1. explain Rectification
2. explain half wave Rectification
3. explain half wave Rectification for positive half cycle

★ Rectification
Alternate current → Rectifier → Direct current.

A rectifier is a device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifier are essentially of 2 types - a half wave rectifier or a full wave rectifier

Half wave rectifier - On the +ve cycle is forward biased & on the -ve cycle the diode is reverse 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 The circuit is simply the combinati


R

of a 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 ~~set~~ two ideal eq^n

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

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

Half wave Rectification - For positive half cycle Diode is forward biased, acts as a short circuit passes the waveform through

For +ve half cycle:

$$V_I - V_b - I \times r_d - I \times R = 0$$

where,

V_I is the input voltage,

V_b is barrier potential,

r_d is diode resistance,

I is total current

R is resistance

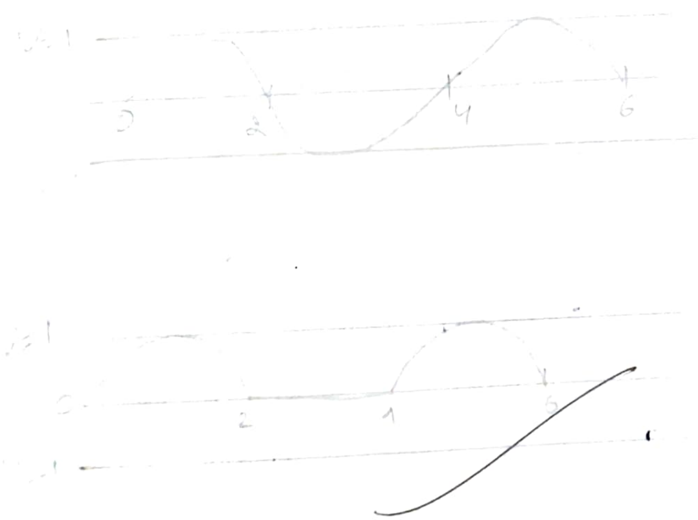
$$I = \frac{V_I - V_b}{r_d + R}$$

$$V_o = I \times R$$

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

for $r_d << R$

Half wave rectifier - Waveforms



$V_0 = V_I - V_b$

V_b is 0.3 for germanium

V_f is 0.7 for silicon

For $V_I > V_b$

The diode will remain off. The output voltage will be $V_0 = 0$

For $V_I > V_b$

The diode will be ON. The output voltage will be $V_0 = V_I - V_b$

Average output voltage

$V_0 = V_m \times \sin \omega t$ for $0 \leq \omega t \leq \pi$

$V_0 = 0$ for $\pi \leq \omega t \leq 2\pi$

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

RMS load voltage

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

Average load current

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

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

RMS load current

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

Form factor - It is defined as the ratio of r... load voltage & 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. >1

rms > avg

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

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

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

$$\eta\% = \frac{\frac{I_m^2}{\pi^2}}{\frac{I_m^2}{4}} \times 100\% = 40.56\%$$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Vout

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Name Gaurita Baya Branch Sem

Roll No. Date

Experiment - 6

Object - Study & prepare the connection of halogen lamp & measure voltage, current & power in the circuit

Apparatus Required

S.NO	ITEM	RATING	QUATITY
1	MCB	6 Amp, 250V, DPST type	1
2	Halogen lamp	500 watt, 250V	1
3	connecting leads	PVC 1100V, 1.00 sq mm	As per req.

Theory

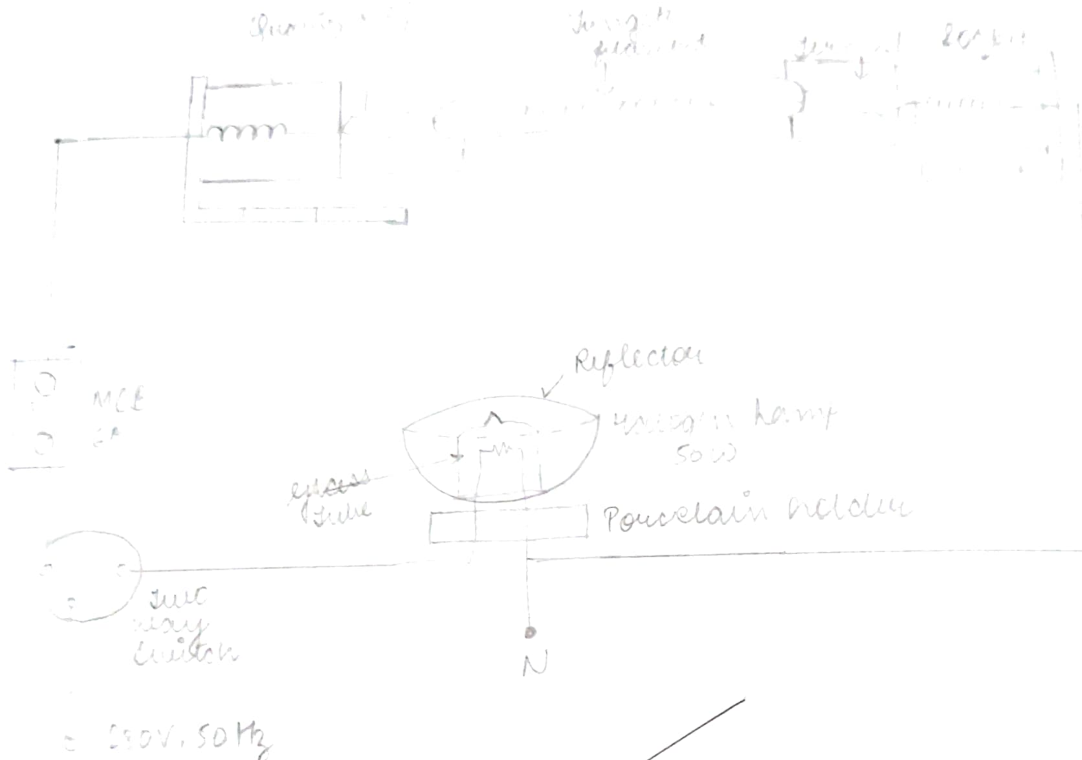
A halogen lamp, also known as a tungsten halogen lamp or quartz iodine lamp, is an incandescent lamp that has a small amount of a halogen such as iodine or bromine added. The combination of the halogen gas & the tungsten filament produces a halogen cycle chemical reac^n which ~~redo~~ redeposit's evaporated tungsten back onto the filament increasing its life & maintaining the clarity of the envelope. Because of this, a halogen lamp can be operated at a higher temperature than a standard gas filled lamp of similiar power & operating life, producing light of a higher luminous efficacy & colour temperature

In ordinary incandescent lamps, evaporated tungsten mostly deposits onto the inner surface of the bulb. The halogen sets up a reversible chemical reac^n cycle with the tungsten evaporated tungsten evaporated from the filament The halogen cycle keeps the bulb clean & the light output remains almost constant throughout life At moderate temps the halogen reacts with the evaporating tungsten, the halide formed being moved around in the inert gas filling At some time it will reach higher temperature regions, where it dissociates, releasing tungsten & freeing the halogen to repeat the process The overall bulb envelope temperature must be higher than in conventional incandescent lamps for the reacn to work.

The bulb must be made of fused (quartz) or a high melting point glass (such as aluminosilicate glass). Since quartz is very strong, the gas pressure can be higher, which reduces the rate of evaporation of the filament, permitting to run a higher temperature for the same average life The tungsten released in hotter regions does not generally ~~d~~ deposit where it came from so hotter parts of the filament ~~eventually~~ thin out & fail. Regeneration of the filament is also possible with flourine but its chemical activity is so great that other parts of the lamp are attacked.

Observation Table

S.NO.	Load voltage ~~[illegible]~~	Load Power ~~[illegible]~~	Measured Power
1	~~[illegible]~~ 235	500W	437.7
~~2~~	~~[illegible]~~		


Reflector
Halogen lamp
tube
Porcelain holder
MCB
Two way switch
N
230V, 50Hz

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Application

The major application of halogen lamp are

i) automobile lights

ii) floodlights for outdoor lighting system

iii) Desktop

iv) Theatrical & studio (film & television) fixture

Result

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

24/01/22

Calculation Table

$$\text{Difference \%} = \frac{|\text{Measured Power} - \text{Rated Power}|}{\text{Rated Power}} \times 100$$

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

2.40%.

Exp-7

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

Apparatus Required - 3 phase Transformer, voltmeter, Conn. Lead

S.No.	Item	Reading	Quantity
1	3 Phase Trans.	415/230V, 50 Hz	1
2.	voltmeter	0-500V	4
3.	Connection Leads	-	-

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

Three phase circuit is the polyphase system where ~~there~~ three phase wire & fourth is neutral which is taken from the start ~~poes~~ The power in three phase system is continuous as all the three phases are involved in generating the total power.

In three phase circuit, connections can be given in 2 types

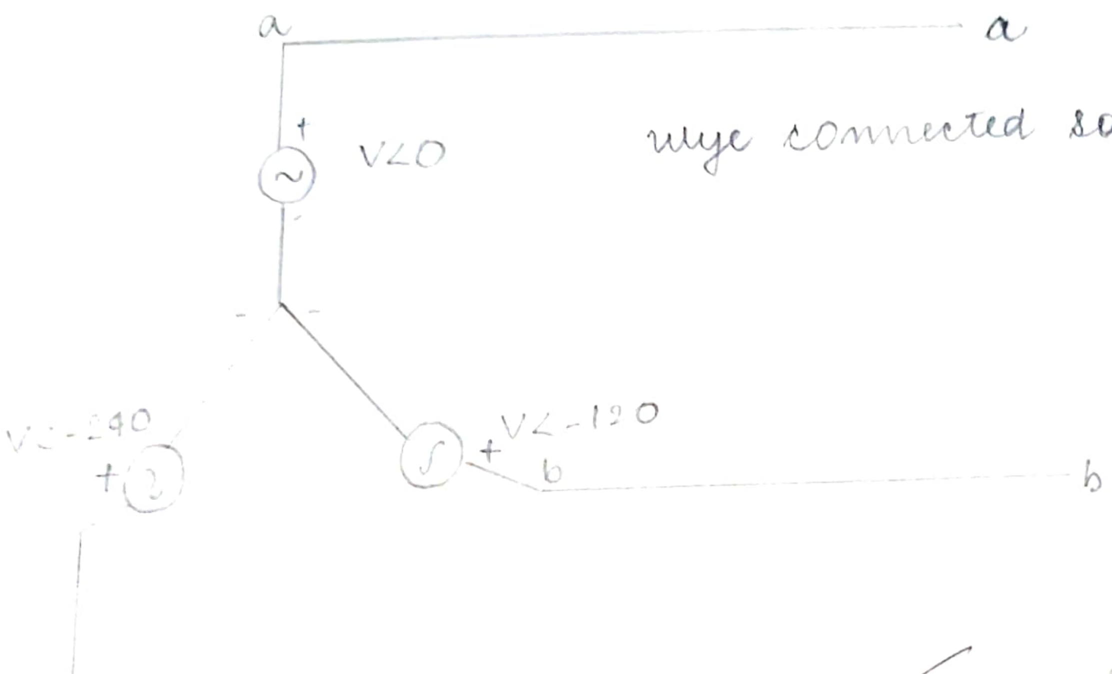
1. Star connection
2. Delta connection

10 STAR CONNECTION

In star connection, ~~three~~ there is four wire, three wire are phase wire & forth is neutral which is taken from the star point star connection is preferred 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 3 phases, then it is called as balanced current & when the current will not be equal in any of the phase then it is unbalanced current. In this case, during balanced condn 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 & protect the transformer Unbalanced current affects transformer & it may also cause damage to the transformer & for this star connection is preferred for long distance transmission

In star connection, the line voltage is $\sqrt{3}$ times of phase voltage & line voltage is the voltage b/w one phase to the neutral line And the current is same for both line & phase It is shown as expression below.



wye connected source

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

2. Delta connection

In Delta connection there is three wires along & no neutral terminal is taken Normally delta connection is preferred for short distance due to the problem of unbalanced current in the circuit The figure is shown below for delta connection In the load station, ground can be used as neutral path if required

In delta connection, the line ~~ratio~~ voltage is the same as that of phase voltage And the line current is $\sqrt{3}$ times of phase current It is shown as below

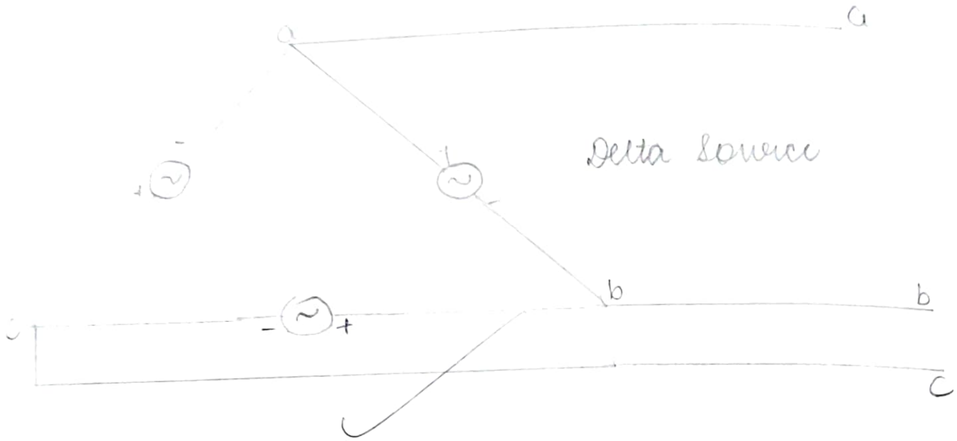
$E_{line} = E_{phase}$ & $I_{line} = \sqrt{3} I_{phase}$

In a three phase circuit star & delta connection can be arranged in four different ways

1.) star - star connection
2) star Delta connection
3) Delta ~~Delta~~ star connection
4) Delta - Delta connection

But the power is independent of the circuit arrang. of the 3 phase system The net power in the circuit will be same in both star & delta connection The power in 3 phase circuit can be calculated from the equation below

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



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Observation Table

	Primary		Secondary	
Connective Type	V_L	V_P	V_L	V_P
1 Delta Delta	424	423	136	136
Delta Star	424	423	240	137

Result

We have observed the line voltage & phase voltage relation for 3-phase delta-star & Delta-delta connected transformer at no load.

Rsoni
25/1/22

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Name: Garvita Baya Branch .... Sem ....

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

Experiment - 8

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

Theory

Circuit Breaker:

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

Miniature Circuit Breaker.

There are 2 arrangements of operation of miniature circuit breaker. One due to thermal effect of over current & other due to electromagnetic effect of over current. The Thermal operation of miniature circuit breaker is achieved with a bimetallic strip whenever continous over current flows through MCB, the bimetallic strip is heated & deflects by bending. This deflection of bimettallic strip releases mechanical latch. As this mechanical latch is attached with operating mechanism it causes to open the miniature circuit beaker contacts. but during short circuit condn, 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 This was a simple explanation of of miniature circuit breaker working principle

Molded case circuit Breaker

A Molded case circuit breaker, abbreviated MCCB is a type of electrical protection device that can be used for a wide range of voltages & frequencies of both 50 Hz & 60 Hz The main distinctions b/w molded case & miniature circuit breaker are that the MCCB can have current ratings of up to 2500 amperes & its trip settings are normally adjustable An additional difference is that MCCBs tend to be much larger than MCBs As with most types of circuit breakers, an MCCB has 3 main function

- Protection against overload. Currents above the rated value that last longer than what is normal for the application
- Protection against electrical faults - During a fault such as short circuit or line fault, there are extremely high currents that must be interrupted immediately
- Switching a circuit on & off - This is a less common function of circuit breakers, but they can be used for that purpose if there isn't an

an adequate manual switch

D/f b/w MCB & MCCB
The wide range of current ratings available from molded case circuit breaker allows them to be used in ~~an~~ wide variety of applications. MCCBs are available with current ratings that range from low values such as 15 amphere to industrial ratings such as 2500 amphere. This allows them to be used in both low power & high power application

The main difference b/w the 2 in their capacity with the MCB rated under 100 amps with an interrupting rating of under 18,000 amps. 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 characteristic for the higher models. Usually, this type of circuit breaker would provide amps as high as 2500 or a low as 10 depending on what is necessary. Their interrupting rating ranges from around 10,000 amps to ~~200~~ 200,000 amps

Earth Leakage Circuit Breaker (ELCB)
An ELCB is one kind of ~~safe~~ safety device used for installing an electrical device with high earth impedance to avoid shock. These devices identify small stray voltages of the electrical devices

on the metal enclosures and intrude the circuit if a dangerous voltage is identified. The main purpose of Earth leakage circuit breaker to stop damage to human & 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 faults 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, & remain off until manually rearrange. A voltage sensing ELCB doesn't detect fault currents from human or animal to the earth.

Earthing
To connect the metallic (conductive) parts of an electric appliance or installations to the earth (ground) is called Earthing or Grounding.

Types of Earthing
Earthing can be done in many ways. The various methods employed in earthing are discussed below.

i) Plate Earthing
In plate earthing system, a plate made up of either copper with dimension $60 \times 60 \times 3.18$ (cm) (cm) (mm) is buried vertical in the earth which should not be less

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

than 3m (10 ft) from the ground level

2) Pipe earthing

A galvanized steel & a perforated pipe of approved 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 to use depends on the magnitude of current & the type of soil. The dimension of the pipe is usually 40mm (1.5 in) in diameter & 2.7m in length for ordinary soil or greater for dry & rocky soil. The moisture of the soil will determine the length ~~than~~ of the pipe to be buried but usually it should be 4.75m.

3) Rod Earthing

It is the same method as pipe earthing. A copper rod of 12.5mm diameter of the ~~pipe is usually 40mm in dia~~ galvanized steel or hollow section 25 mm of GI pipe of length above 2.5m are buried upright in the earth manually or with the help of a pneumatic hammer. The length of 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 not less than 25 mm × 1.6 mm is buried in a horizontal trenches of a min. depth of 0.5m of copper with a cross section of 25x4 mm

Fuses

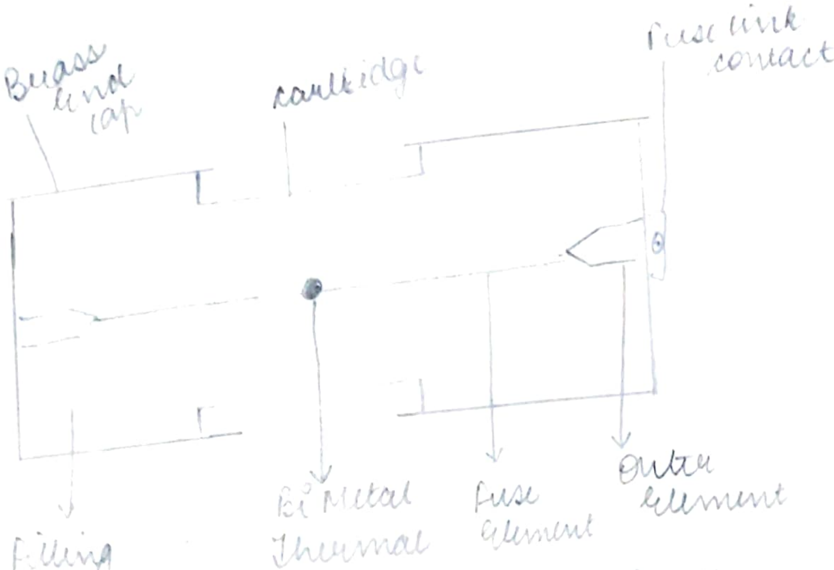
Fuses are the protectors ~~that~~ these are the safety devices which are used to protect the home appliances like T.V., refridgerator, computer with damage by high voltage. The fuse is made up of thin strip or strand of metal, whenever the heavy amount of current or an ~~exp~~ excessive current flow is there is an electrical circuit, the fuse melts & it opens the circuit & disconnects it from the power supply

Types

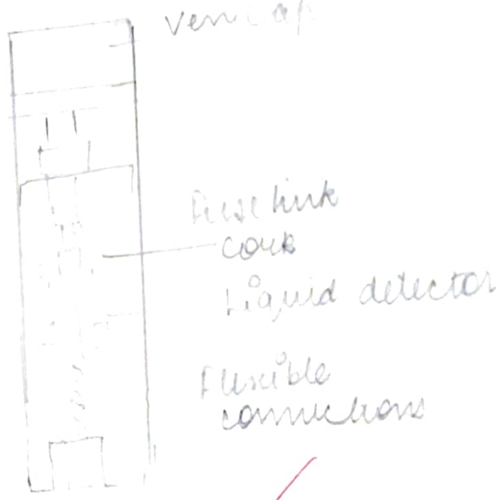
1. Rewireable / Kit kat type - In this type of fuse, the main advantage is that the fuse carrier is easier to remove without having any electrical shock or injury. The fuse base acts as an incoming & outgoing terminal which is made up of porcelain & fuse carrier is used to hold the fuse elements which is made up of tin, copper, aluminium, lead etc.

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

3. ~~Ca~~ Liquid Type HRC fuses - These are used for circuit up to 100 A rated current & system up to 132 kV. These fuses have the glass tube filled with C tetrachlor-



Cartridge type HRC fuses



Liquid type HRC Fuse.

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

The one end of the tube is packed & another is fixed by phosphorus bronze wire when fuse operation starts, the liquid uses in the fuse entry the arc. This ↑ the short circuit capacity

Result - we have studied different types of circuit breakers, earthing & fuses & their application

Rasoni
25/1/22

Experiment - 9

Objective
Study of DC-DC buck converter with R load & observe & observe effect of duty ratio on converter output voltage

Apparatus Required
DC-DC buck converter trainer kit, 2 channel DSO, connection leads.

Theory

For $R_L = 36.6\Omega$
$f = 2\,KHz$

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

The DC-DC converter can have two distinct modes of operations continuous conduction mode (CCM) & discontinuous conduction mode (DCM) In practice a converter may operate in both modes which have significantly different characteristics

Therefore, a converter & its control should be designed based on both modes of operation. However for this course we only consider the DC-DC converter operated in CCM.

Circuit operation

When the switch is on for a time duration DT, the switch conducts the inductor currents & the diode becomes reverse biased this results in a positive voltage $V_L = V_g - V_o$ across the inductor. This voltage cause a linear increase in the inductor current when the switch is turned off because of the inductive energy storage, ie continuous to flow this current ~~m~~ now flows through the diode & $V_L = -V_o$ for a time duration $(1-D)T$ until the switch is turned on again.

Voltage second balance eq.

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

$$V_s D - V_o D = V_o - V_o D$$

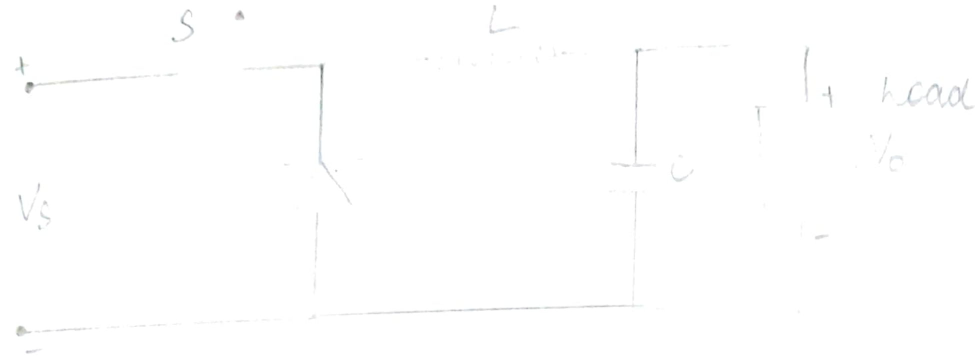
$$V_s = \frac{V_o}{D}$$

$$V_o = V_s D$$

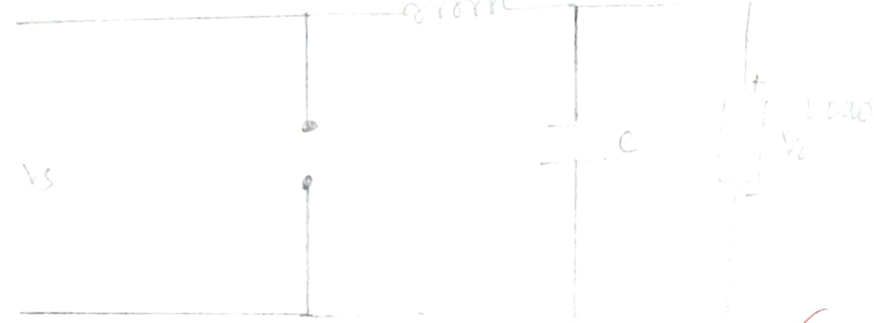
V_o = Output voltage

V_s = Input voltag

D = Duty Ratio



i) Switch ON



ii) Switch off.

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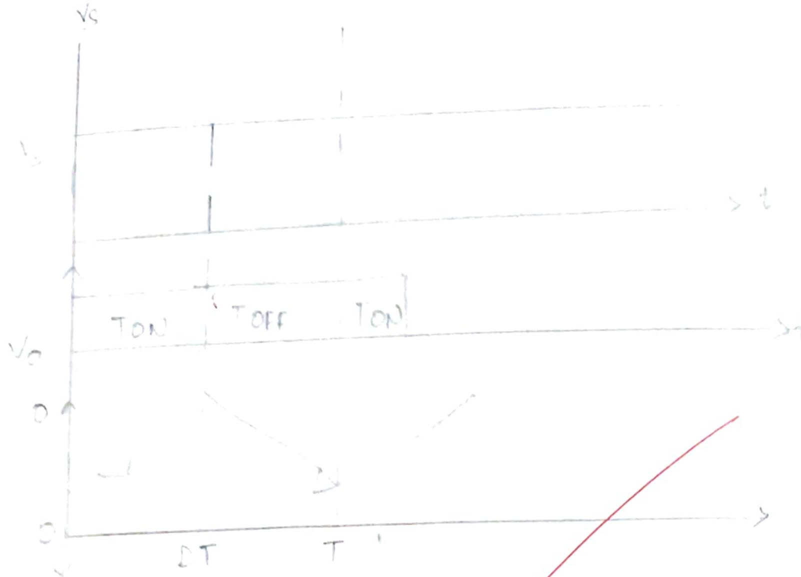
Observation Table

SNO	Supply voltage (Vs)	Duty Ratio (%) (D)	Output voltage (Vo)
1	24V	15%	4
2	24V	20%	5.2
3	24V	30%	7.2
4	24V	45%	9.6
5	24V	50%	11.2
6	24V	60%	13.2
7	24V	70%	15.6
8	24V	80%	18.4V
9	24V	90%	20.4V
10	24V	95%	21.2V

Result - we have studied DC-DC buck converter with 'R' Load & observe effect of Duty ratio on converter output voltage

Rashmi 25/1/22


Vs
TON
TOFF
TON
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DT
T