ECE132: Basic Electrical and Electronics Engineering Lab

Experiment 1: The verification of Kirchhoff's voltage law and Kirchhoff's current law

Introduction

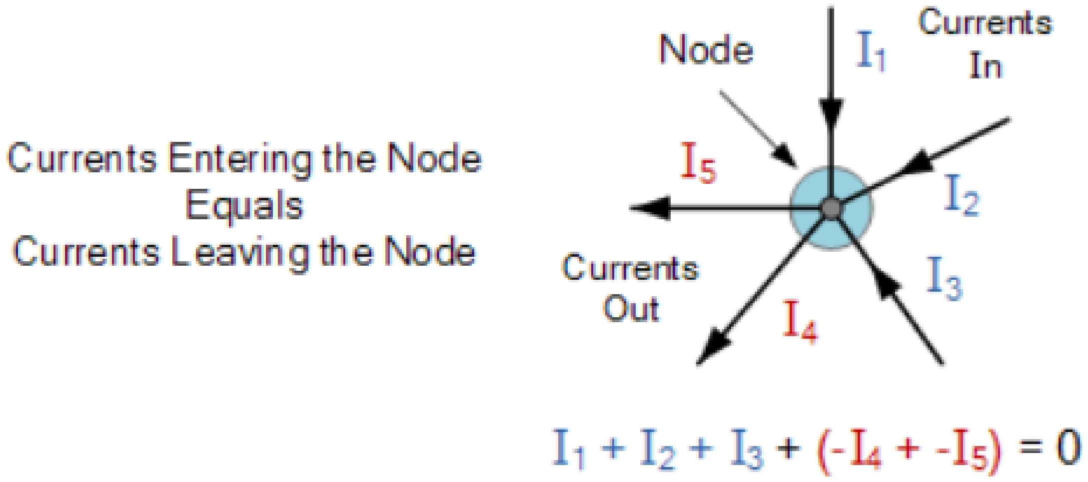
In complex circuits such as bridge or T networks, we can not simply use Ohm’s Law alone to find the voltages or currents circulating within the circuit. For these types of calculations we need certain rules which allow us to obtain the circuit equations and for this we can use **Kirchhoffs Circuit Law**.

It states that, "In any network of conductors, the algebraic sum of currents meeting at a point (or junction) is zero".

In other words the algebraic sum of ALL the currents entering and leaving a node must be equal to zero, I(exiting) + I(entering) = 0

Kirchhoffs Circuit Law

Kirchhoffs Current Law

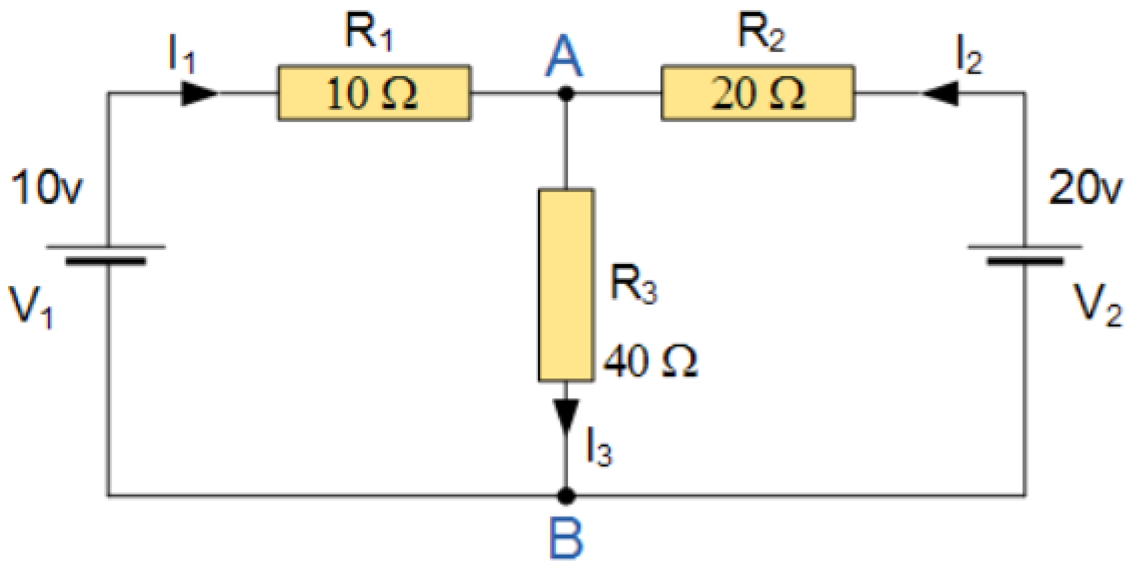


Kirchhoffs Circuit Law

Using **Kirchhoffs Current Law, KCL** the equations are given as:

At node A : $I_1 + I_2 = I_3$

At node B : $I_3 = I_1 + I_2$



Kirchhoffs Circuit Law

$$I_1 + I_2 = I_3$$

$$I_1 = \frac{V_1 - V_A}{R_1} \qquad I_3 = \frac{V_A - V_B}{R_3}$$

$$I_2 = \frac{V_2 - V_A}{R_2} \qquad \text{Assume } V_B = 0$$

$$\frac{V_1 - V_A}{R_1} + \frac{V_2 - V_A}{R_2} = \frac{V_A}{R_3}$$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} - V_A\left[\frac{1}{R_1} + \frac{1}{R_2}\right] = \frac{V_A}{R_3}$$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} = \frac{V_A}{R_3} + V_A\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} = V_A\left[\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right]$$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} = V_A\left[\frac{R_2R_3 + R_1R_3 + R_1R_2}{R_1R_2R_3}\right]$$

$$\frac{10}{10} + \frac{20}{20} = V_A\left[\frac{800 + 400 + 200}{8000}\right]$$

$$2 \times \frac{8000}{1400} = 11.428 = V_A$$

$$I_1 = \frac{10 - 11.428}{10} = -0.1428$$

$$I_2 = \frac{20 - 11.428}{20} = 0.4286$$

$$I_3 = \frac{11.428}{40} = 0.2857$$

Kirchhoffs Circuit Law

Using **Kirchhoffs Current Law, KCL** the equations are given as:

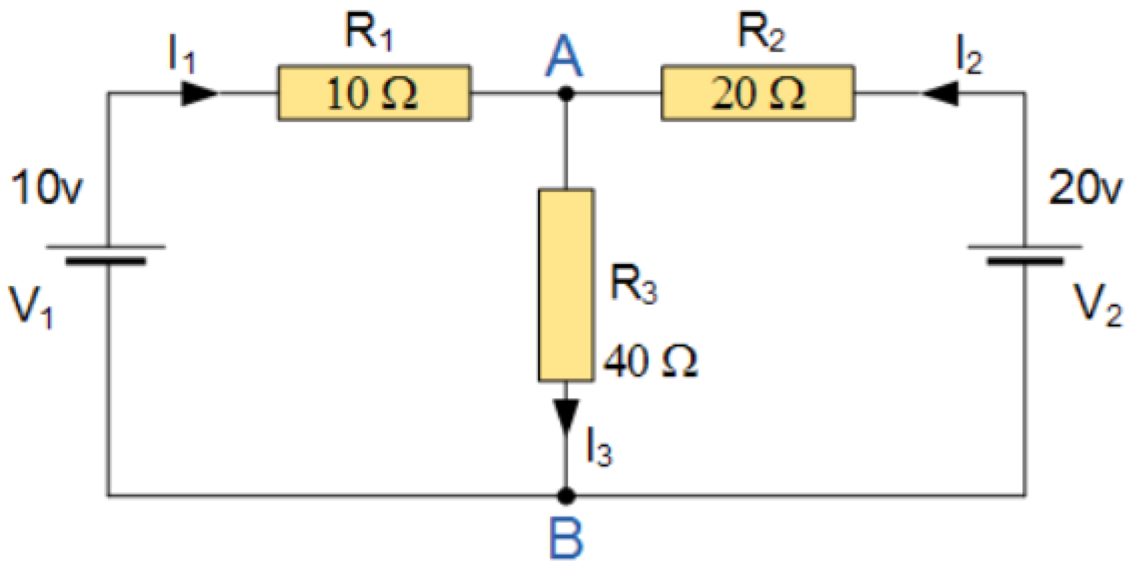
At node A : $I_1 + I_2 = I_3$

At node B : $I_3 = I_1 + I_2$

I_1 = -0.1428 amp

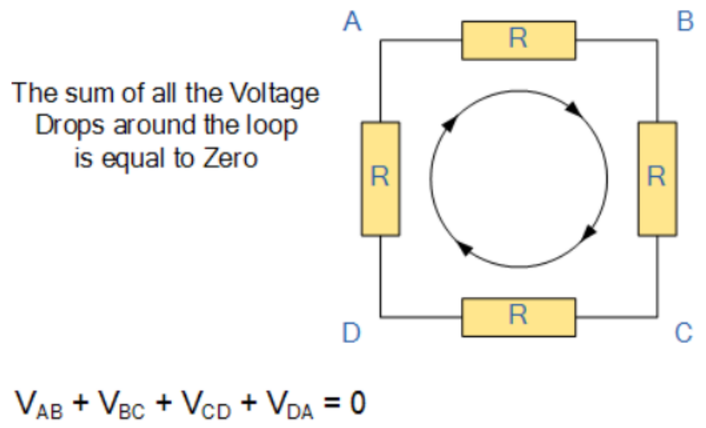
I_2 = 0.4286 amp

I_3 = 0. 2857 amp



Kirchhoffs Voltage Law

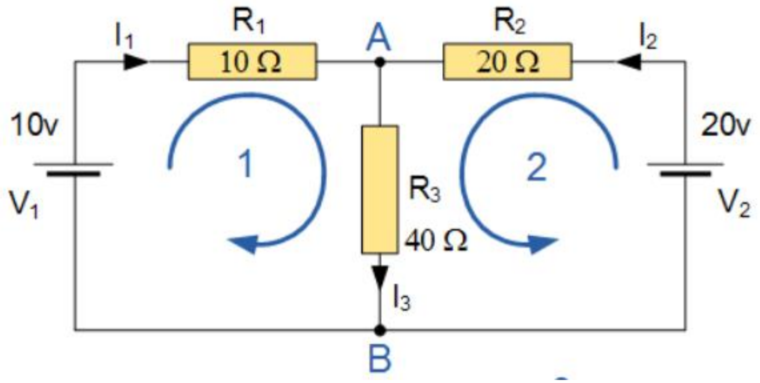
Kirchhoffs Voltage Law or KVL, states that "*in any closed loop network, the total voltage around the loop is equal to the sum of all the voltage drops within the same loop*" which is also equal to zero. In other words the algebraic sum of all voltages within the loop must be equal to zero.



Kirchhoffs Voltage Law

Using **Kirchhoffs Voltage Law**, **KVL** the equations are given as:

- Loop 1 is given as : $10 = R_1\, I_1 + R_3\, I_3 = 10I_1 + 40I_3$
- Loop 2 is given as : $20 = R_2\, I_2 + R_3\, I_3 = 20I_2 + 40I_3$



Kirchhoffs Voltage Law

$10 = R_1 I_1 + R_3 I_3$

$10 = 10 I_1 + 40 I_3 \qquad (I_3 = I_1 + I_2)$

$10 = 50 I_1 + 40 I_2$ --- (1)

$20 = R_2 I_2 + R_3 I_3$

$20 = 20 I_2 + 40 I_3 \qquad (I_3 = I_1 + I_2)$

$20 = 60 I_2 + 40 I_1$ --- (2)

$10 = 50 I_1 + 40 I_2 \qquad \times 60$

$20 = 40 I_1 + 60 I_2 \qquad \times 40$

$600 = 3000 I_1 + 2400 I_2$

$800 = 1600 I_1 + 2400 I_2$

$-200 = 1400 I_1 \div 0$

$\frac{-200}{1400} = I_1 = -0.1428$

$I_2 = 0.4286$

$I_3 = 0.2857$

$V_{R_1} = R_1 I_1 = -1.428$

$V_{R_3} = R_3 I_3 = 11.428$

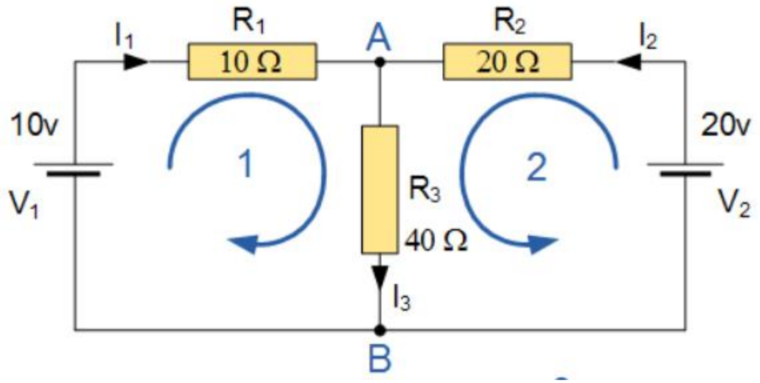
$V_{R_2} = R_2 I_2 = 8.572$

Kirchhoffs Voltage Law

Using **Kirchhoffs Voltage Law**, **KVL** the equations are given as:

- Loop 1 is given as : $10 = R_1 I_1 + R_3 I_3 = 10I_1 + 40I_3$
- Loop 2 is given as : $20 = R_2 I_2 + R_3 I_3 = 20I_2 + 40I_3$

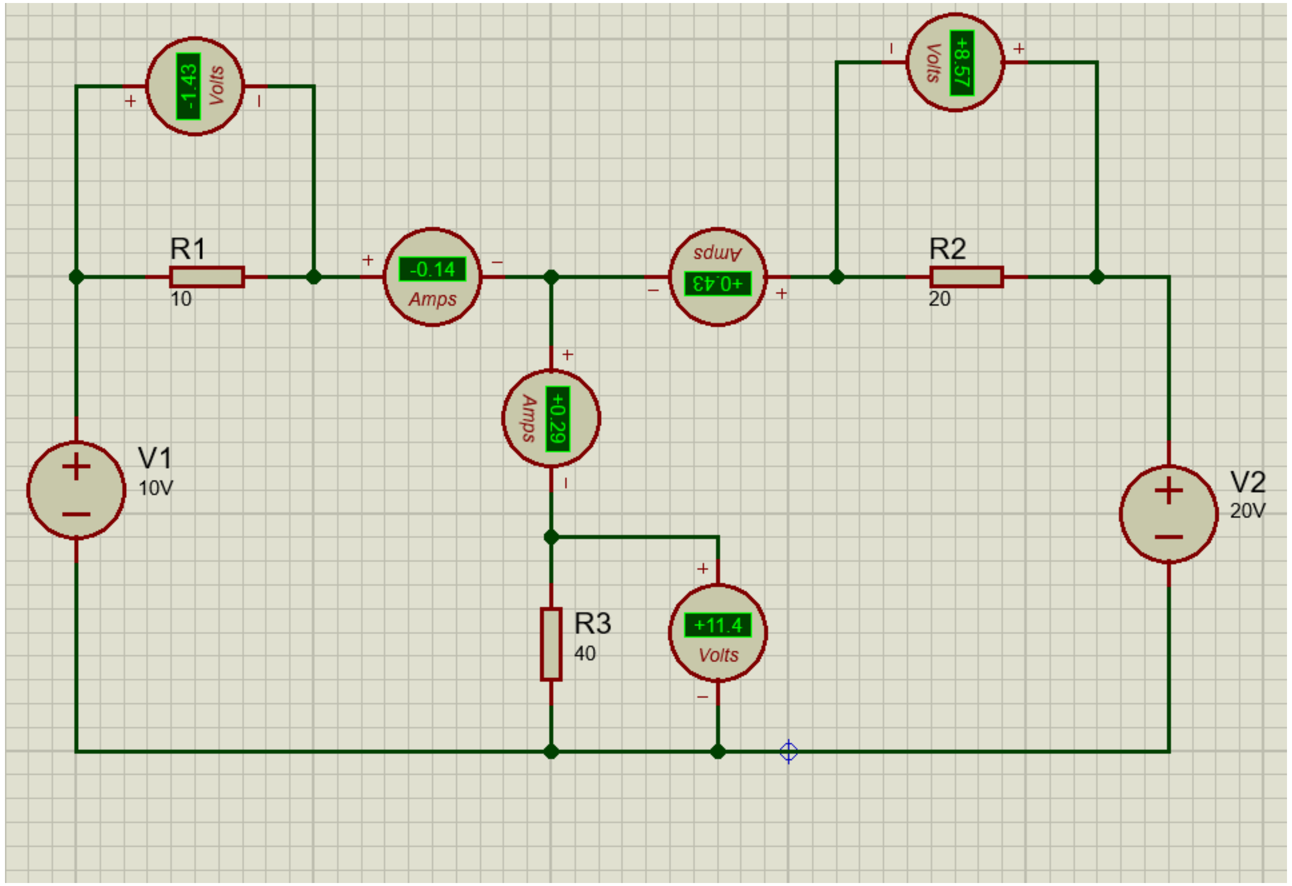
- VR1 = -1.428
- VR2 = 8.572
- VR3 = 11.428



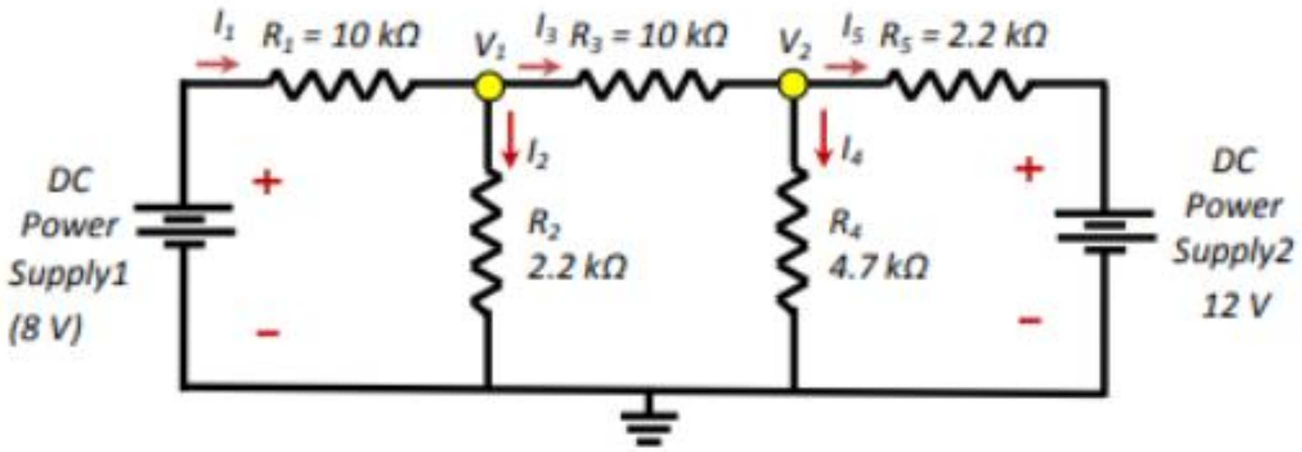
Let Verify using Proteus

- I_1 = -0.1428 amp
- I_2 = 0.4286 amp
- I_3 = 0. 2857 amp

- VR1 = -1.428
- VR2 = 8.572
- VR3 = 11.428



Problem to be solved



Thanks You

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Experiment 2: To understand the principle of turn ratio of a transformer

Introduction

A transformer is a static device which transfers electrical energy from one circuit to another with no direct electrical connection between the two but they are magnetically coupled. It transforms power from one circuit to another without changing its frequency and KVA. A transformer can increase or decrease the voltage with corresponding decrease or increase in current. It helps in providing isolation of the secondary side from the primary side and hence provides safety for the person handling it on the load side.

Turn Ratio

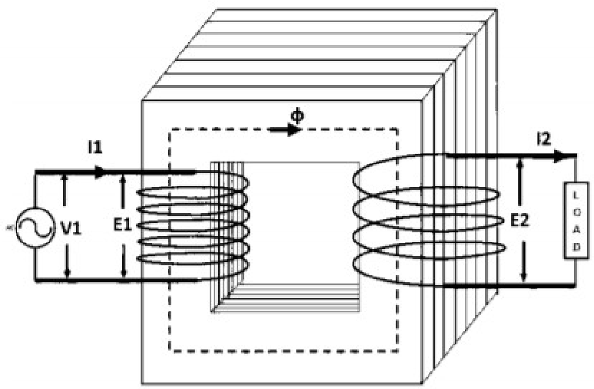
It is defined as the ratio of primary to secondary turns.

Turns Ratio = N1 / N2

If N2> N1 the transformer is called Step up transformer

If N2< N1 the transformer is called Step down transformer

If N2 =N1 the transformer is called Isolation transformer

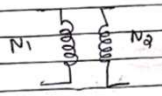


Transformer setting calculation

As you know that

In Ideal T/F

$$\frac{V_2}{V_1} = \frac{N_2}{N_1}$$



$$V_2 = V_1 \times \frac{N_2}{N_1}$$

But actually there is a coupling factor

and $N \propto \sqrt{L}$

$$V_2 = V_1 \times C_p \times \frac{N_2}{N_1}$$

$$V_2 = V_1 \times C_p \times \sqrt{\frac{L_2}{L_1}}$$

For stepup t/F $V_2 = 100V$, $V_1 = 50V$

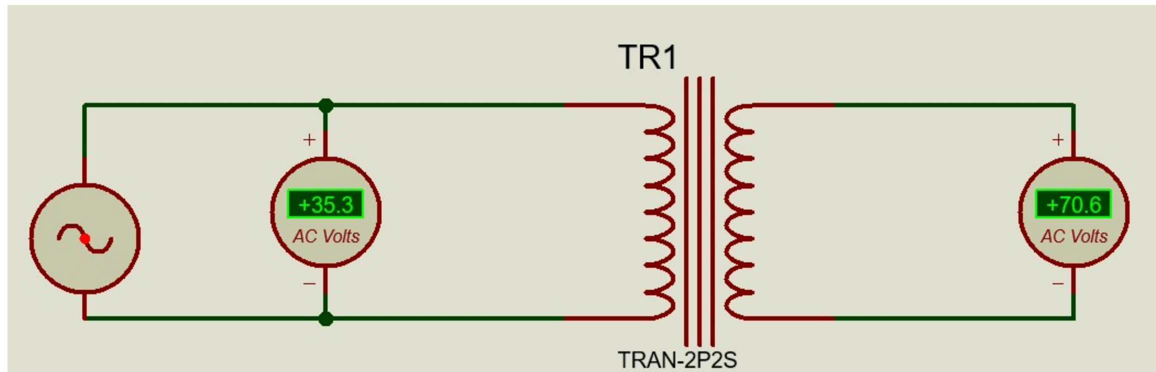
$$V_2 = V_1 \times C_p \times \sqrt{\frac{L_2}{L_1}}$$

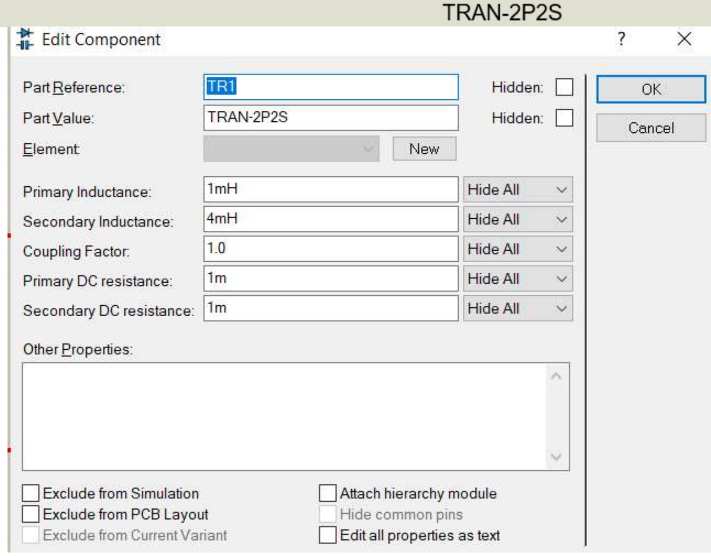
$$\sqrt{\frac{L_2}{L_1}} = 2$$

$L_2 = 4mh$

$L_1 = 1mh$

$$\sqrt{\frac{4}{1}} = 2$$





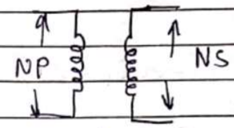
Transformer setting calculation

If T/f is with tapping and $C_p = 100\%$

at 100% tapping $N_p = N_s$

let assume $N_p = 100$

$N_s = 100$



We have four tapping at secondary

$N_{s1} = N_{s2} = N_{s3} = N_{s4} = \frac{100}{4} = 25$

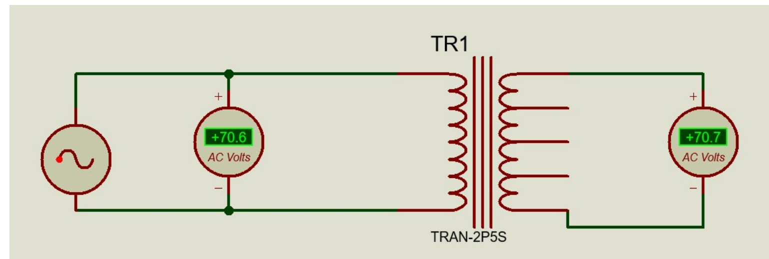
Now calculate inductance b/w each tapping

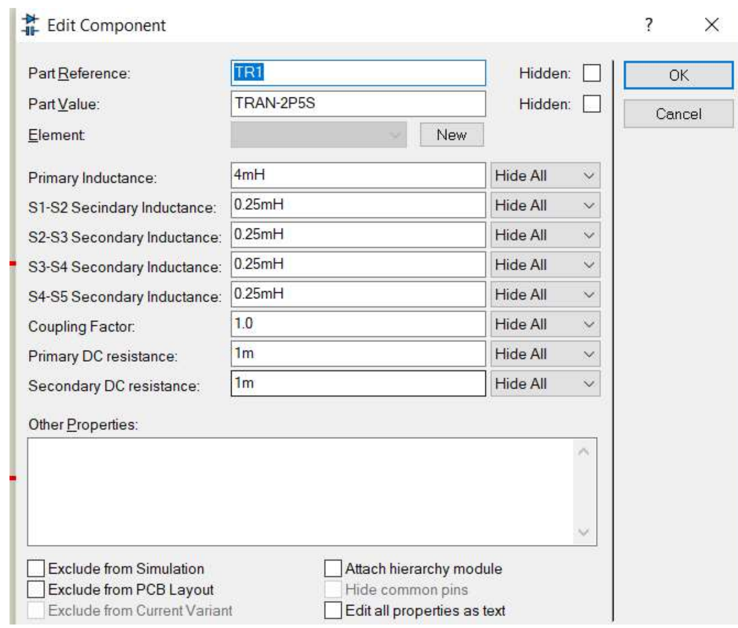
$$\frac{L_{s1} + L_{s2} + L_{s3} + L_{s4}}{L_p} = \frac{N_{s1}^2 + N_{s2}^2 + N_{s3}^2 + N_{s4}^2}{N_p^2}$$

$$= \frac{(25)^2 \times 4}{(100)^2} = \frac{1}{4}$$

If $L_p = 4\,mh$

then $L_{s1} = 1/4\,mh = 0.25\,mh$

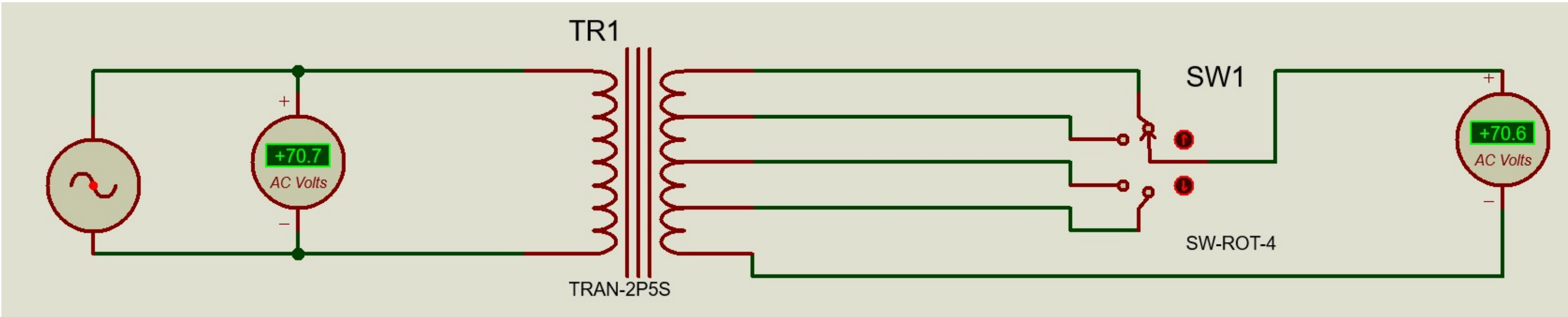




Observation and Calculation

S.No.	V1	V2	N1	N2	Turns ratio

Simulation Diagram



Thanks You

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Experiment 3: verification of Thevenin's and Norton's theorems in DC circuits.

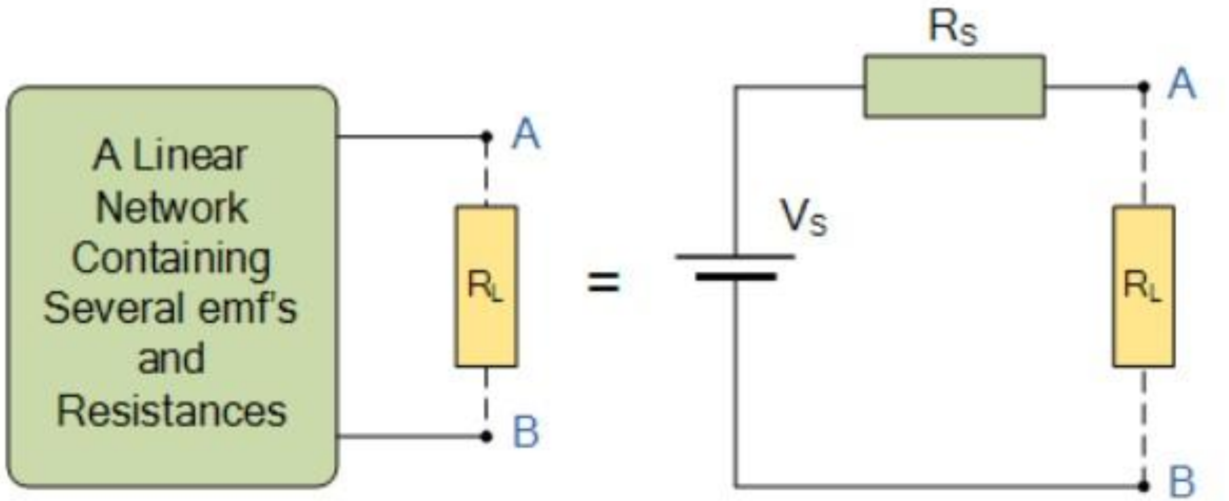
Introduction

Thevenin's Theorem

It states that "*Any linear circuit containing several voltages and resistances can be replaced by just one single voltage in series with a single resistance connected across the load*". In other words, it is possible to simplify any electrical circuit, no matter how complex, to an equivalent two-terminal circuit with just a single constant voltage source in series with a resistance (or impedance) connected to a load as shown below.

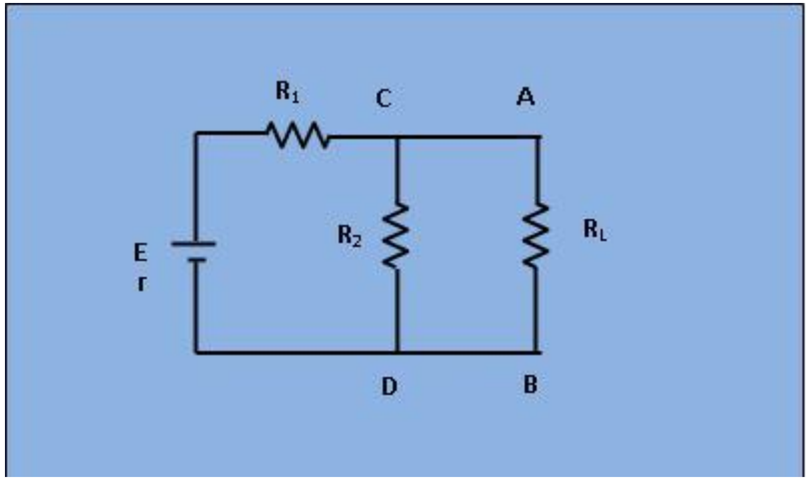
Introduction

Thevenin’s Equivalent Circuit



An Example

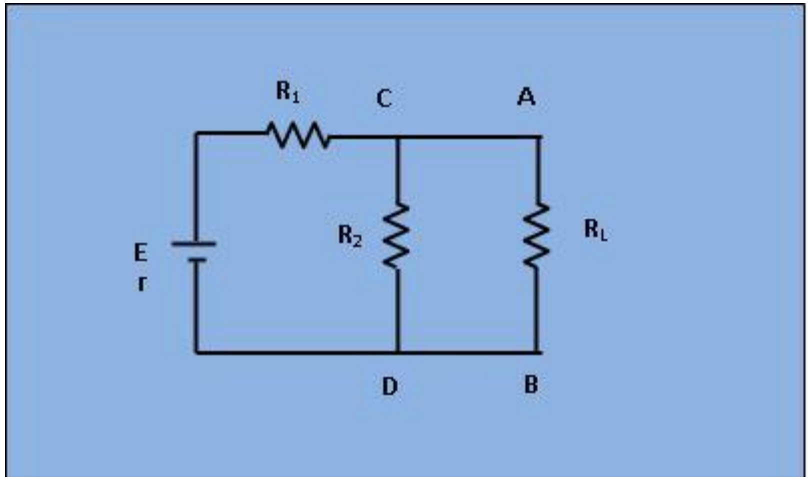
Find the current across the load resistor by applying the Thevenin’s theorem.



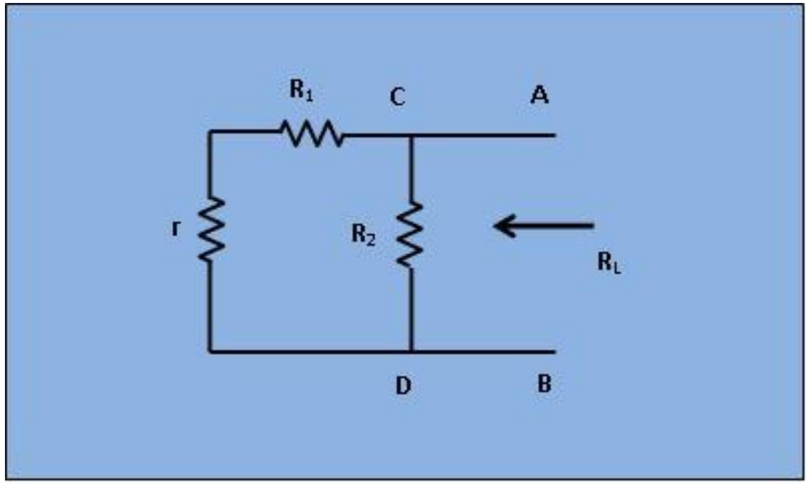
An Example

Find Equivalent Resistance, Rs

Step 1: Firstly, we have to remove the RL load resistor connected across the terminals A-B



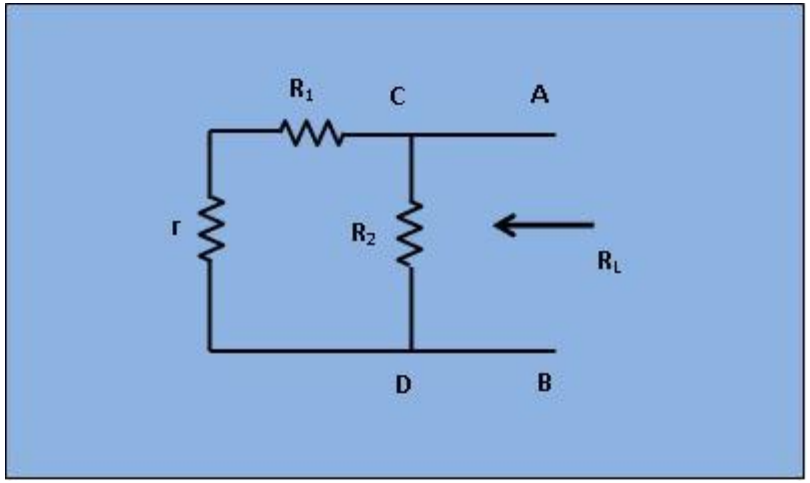
Step 2: Remove any internal resistance associated with the voltage source(s). This is done by shorting out all the voltage sources connected to the circuit with their internal resistance r.



An Example

Find Equivalent Resistance, Rth

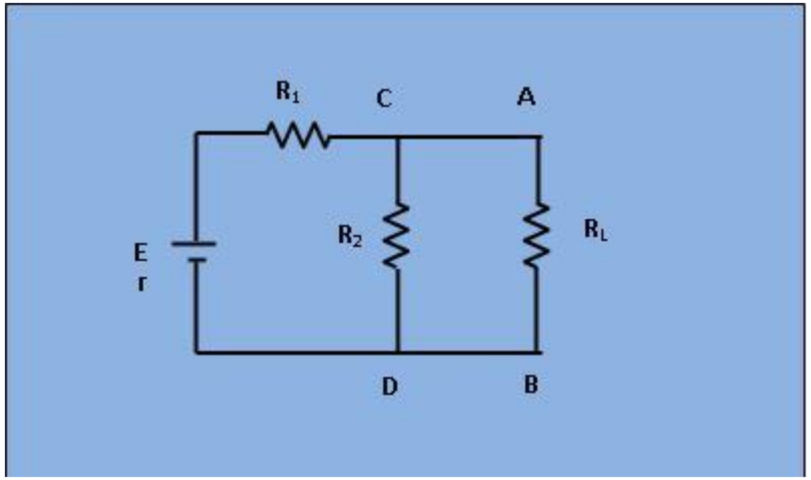
Step 3: The value of the equivalent resistance, Rth is found by calculating the total resistance looking back from the terminals A and B with all the voltage sources shorted.

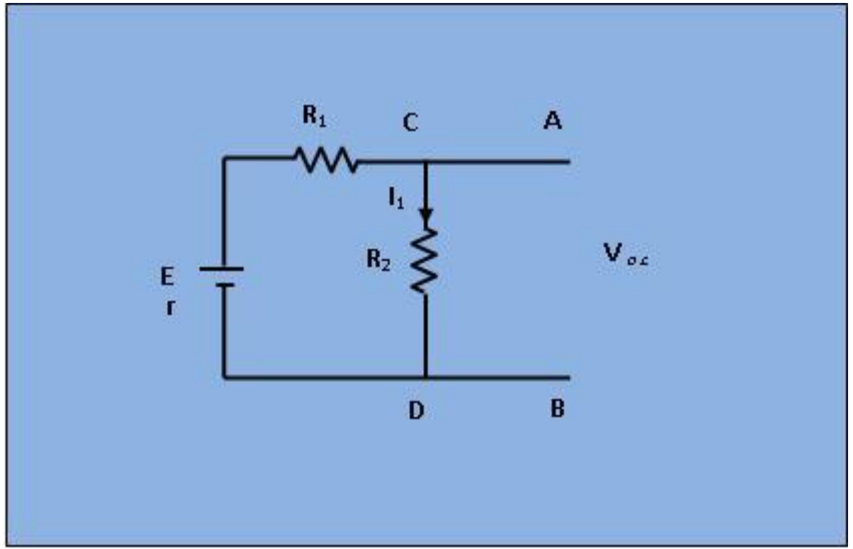


An Example

Find Equivalent Voltage, Vs

Step 4: We now need to reconnect the two voltages back into the circuit, and find the $V_{th} = V_{OC}$ by applying the KVL law

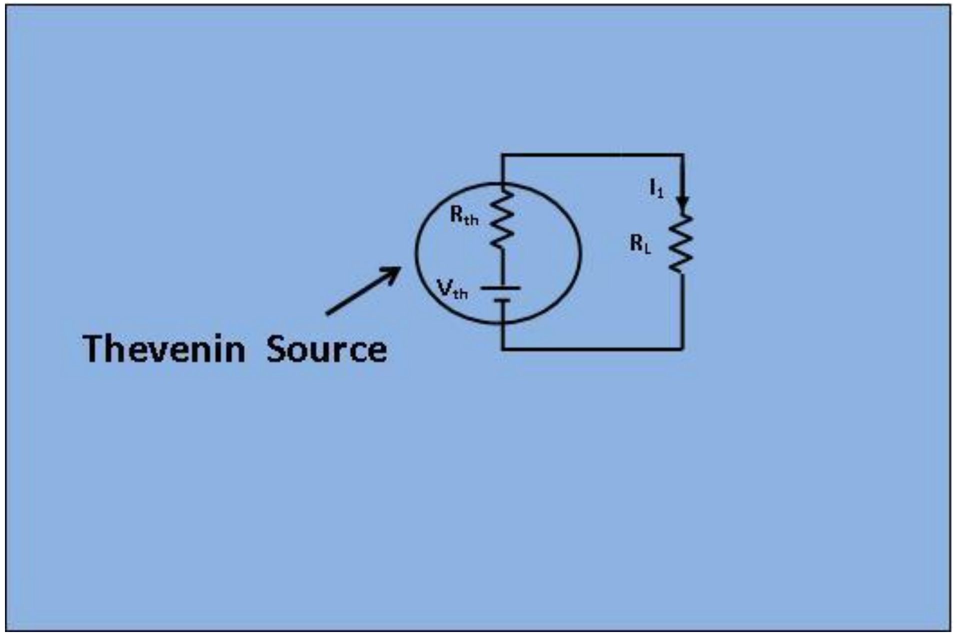




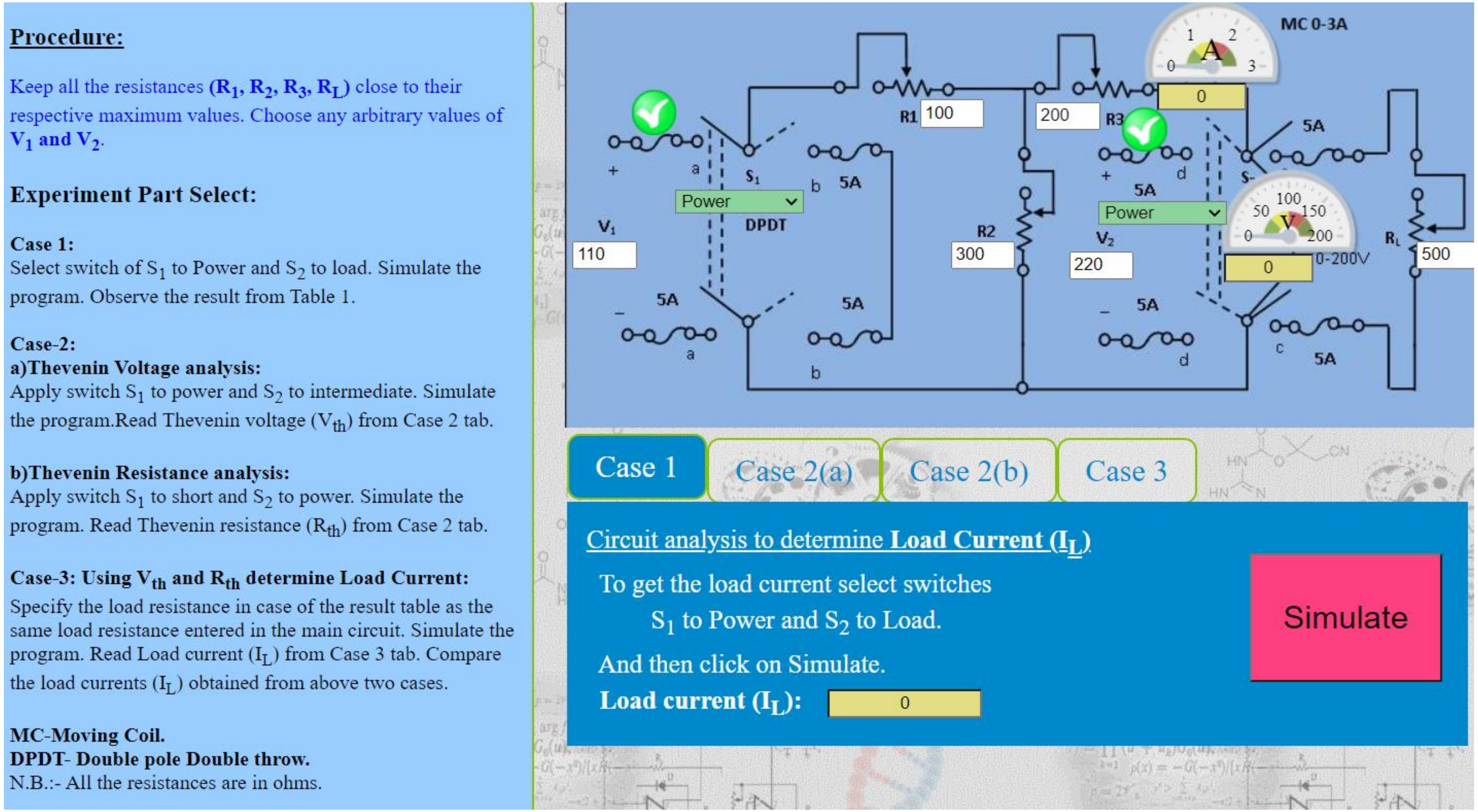
An Example

Step 5:. Consequently, as viewed from terminals A and B, the whole network (excluding RL) can be reduced to single source (called thevenin's source) whose e.m.f equal to VO.C. and whose internal reistance equal to Rth as shown in figure.

RL is now connected back across terminals A and B from where it was temporaily removed earlier. Current flowing through RL is given by,



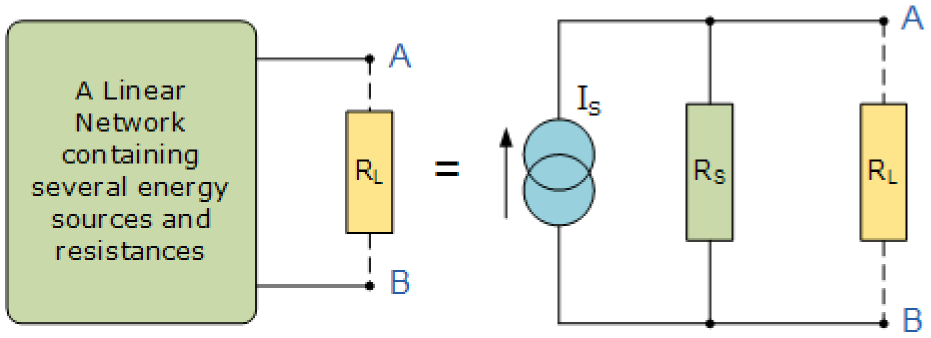
Let Verify using Virtual Lab



Introduction

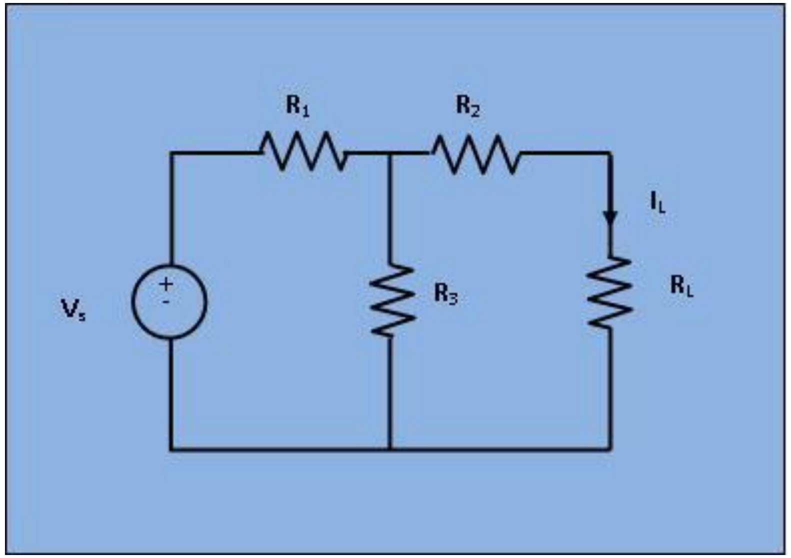
Norton's Theorem

It states that *"Any linear circuit containing several energy sources and resistances can be replaced by a single Constant Current generator in parallel with a Single Resistor"*.



An Example

Find the current across the 40Ω load resistor by applying the Norton's theorem.



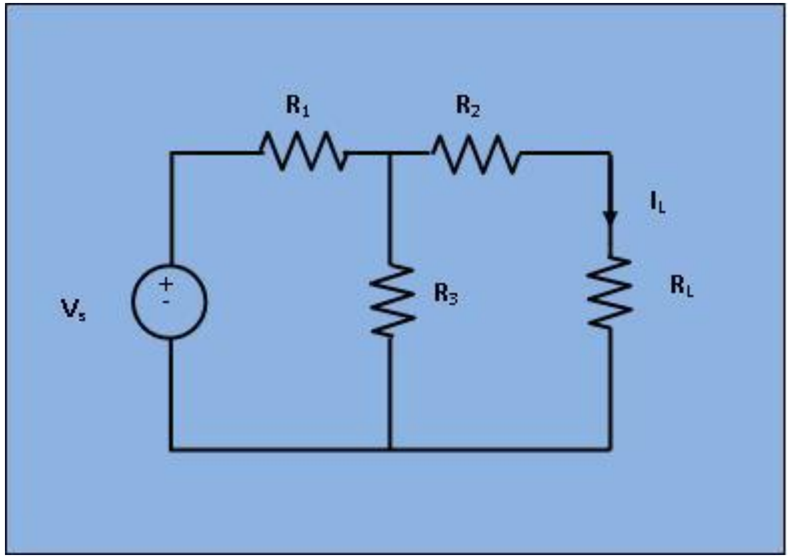
Find Equivalent Resistance, Rth

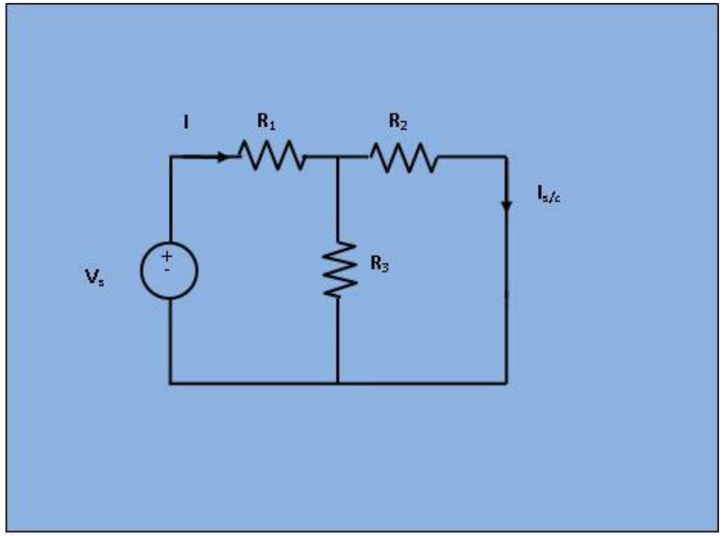
Step 1-3

An Example

Find Short circuit Current, Is

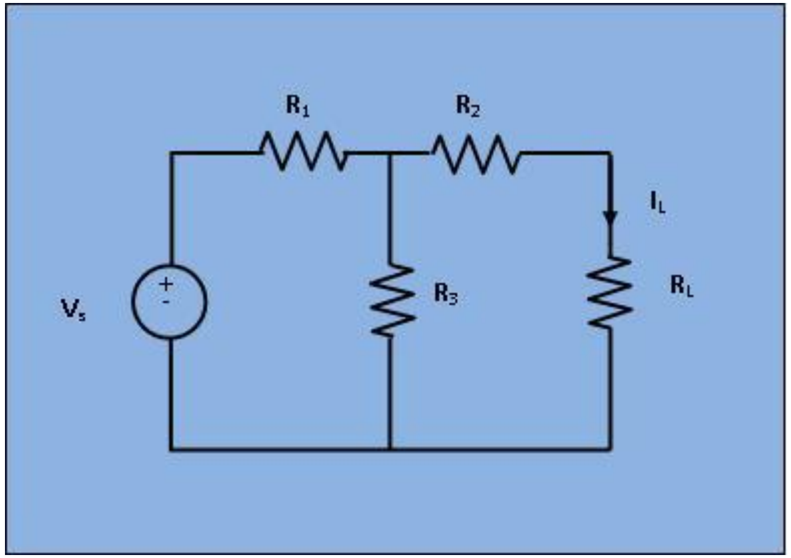
Step 4: To find the Norton’s equivalent of the above circuit we firstly have to remove the centre oad resistor and short out the terminals A and B to give us the following circuit and find the short circuit current by applying the KCL.

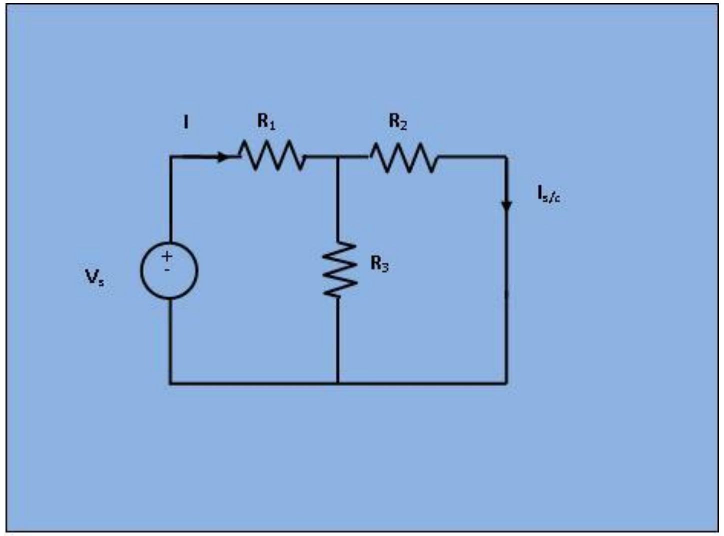




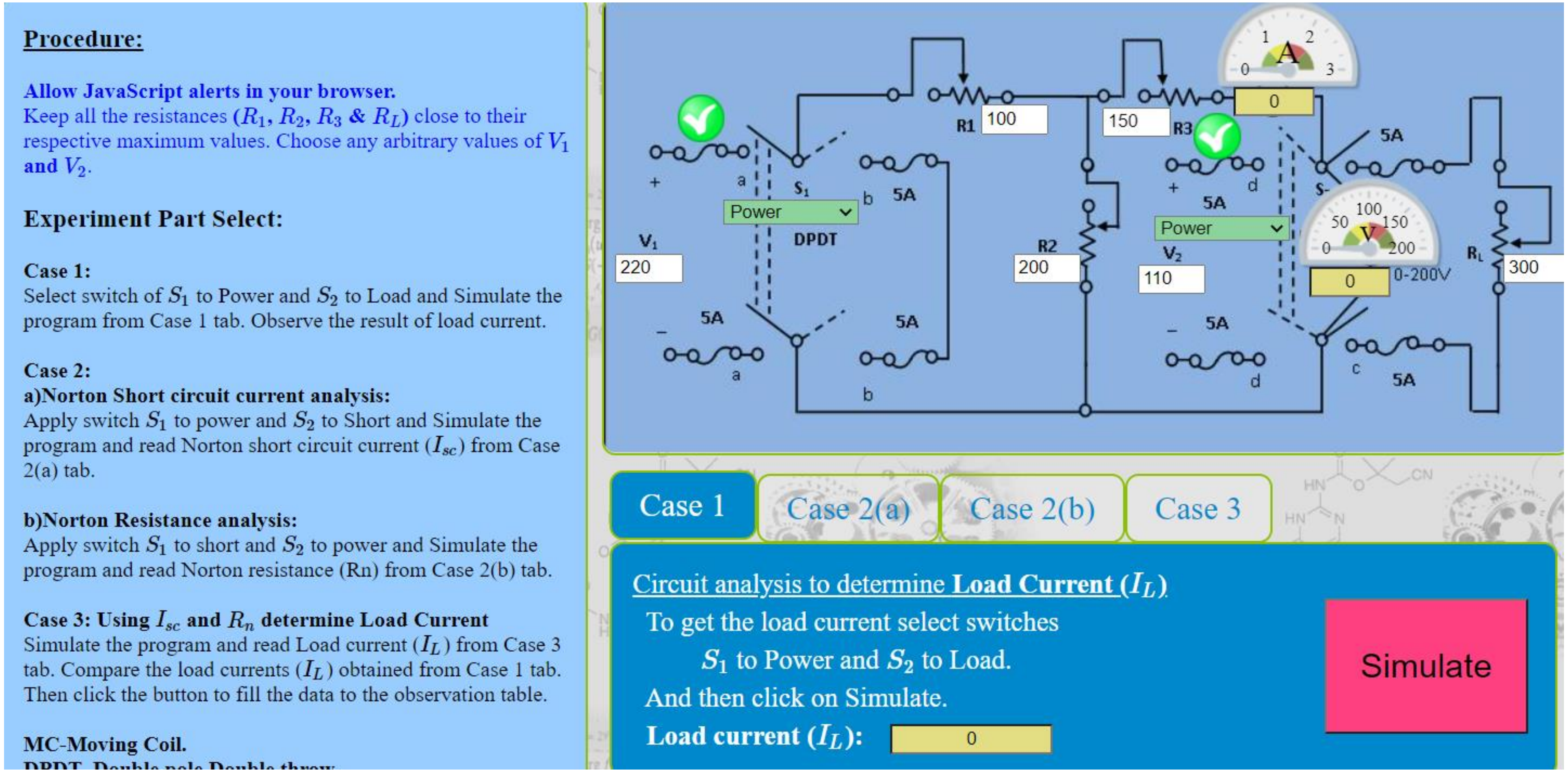
An Example

Step 5: As per Norton's theorem , the equivalent circuit as shown in figure, would contain a current source in parallel to the internal resistance, the current source being the short circuited current across the shorted terminals of the load resistor.





Let Verify using Virtual Lab



Thanks You

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Experiment 3:

a) To compare incandescent lamp, fluorescent lamp, CFL and LED based light source for its efficiency

b) Switching control of single lamp by using four 2 way switches.

Comparison of different lighting sources

Over the last few years, advances in technology have brought about innovations in how to light our homes and commercial buildings. In the beginning, all we had was the standard, incandescent light bulb. Now we have compact fluorescent lamps (CFL) and light emitting diodes or LED for short. We are going to tackle the question… which light bulb type reigns supreme

Comparison of different lighting sources

Comparison of different lighting sources

Lumens (Brightness)	LED Watts (Viribright)	CFL Watts	Incandescent Watts
400 – 500	6 – 7W	8 – 12W	40W
650 – 850	7 – 10W	13 – 18W	60W
1000 – 1400	12 – 13W	18 – 22W	75W
1450-1700+	14 – 20W	23 – 30W	100W
2700+	25 – 28W	30 – 55W	150W

Comparison of different lighting sources

Calculate the efficiency

1) First convert the lumen in to the output watts using the formula 1Lumen=0.00147W

2) Calculate the efficiency, Output watts/ Inputs watts

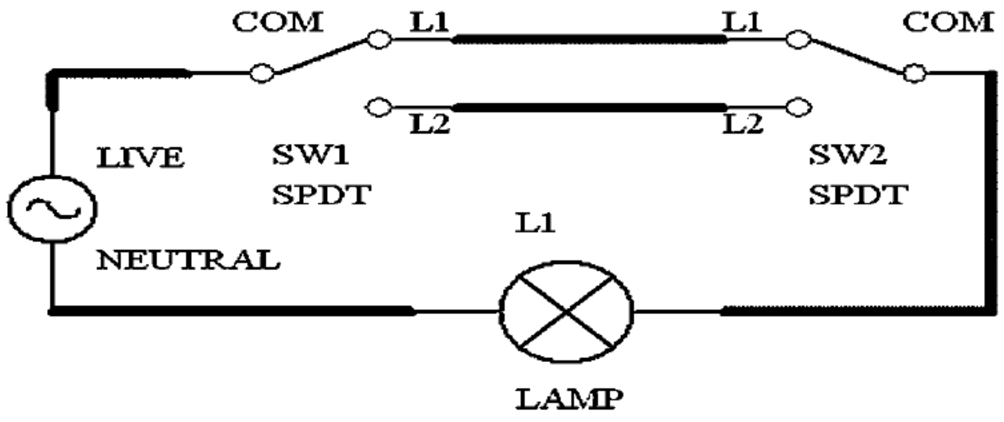
Comparison of different lighting sources

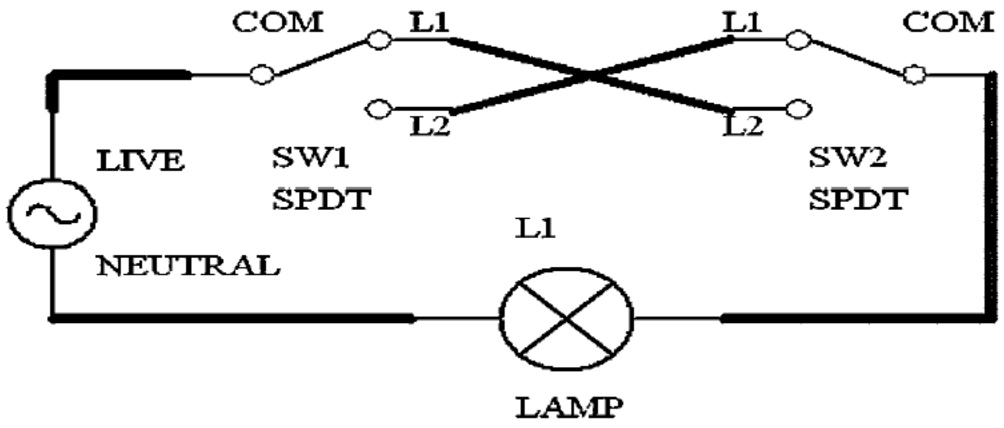
Observation Table

Sr. No	Type of Bulb	Power Input(W) P=VI	Power Outage Rating(W) Conversion Factor 1Lumen=0.00147W	Percentage Efficiency (%)

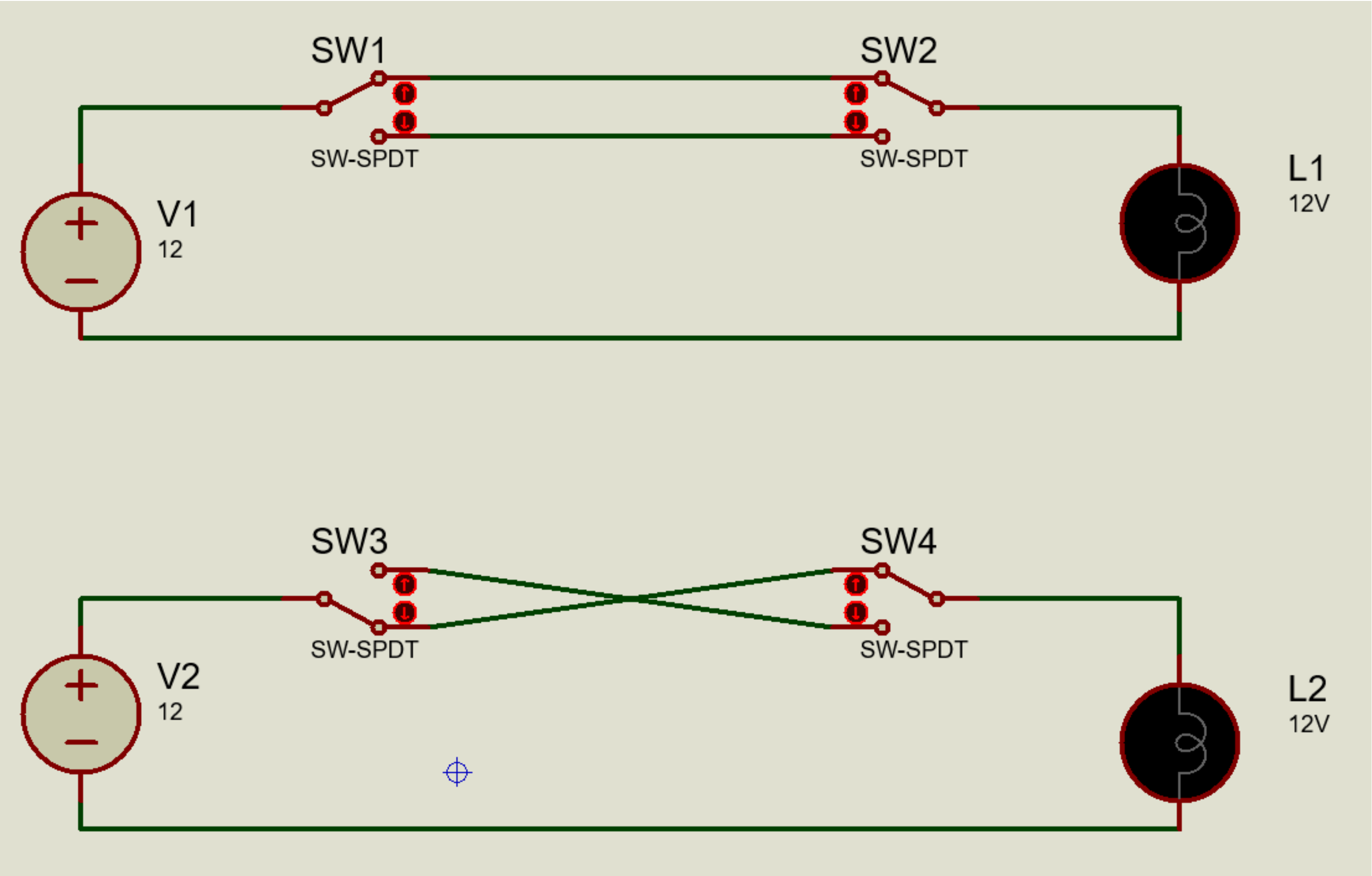
Two Way Switching

2 way switching means having two or more switches in different locations to control one lamp. They are wired so that operation of either switch will control the light. This arrangement is often found in stairways or in long hallways with a switch at either end. The switches can be connected either in cross or parallel in order to have different switching conditions.





Two Way Switching



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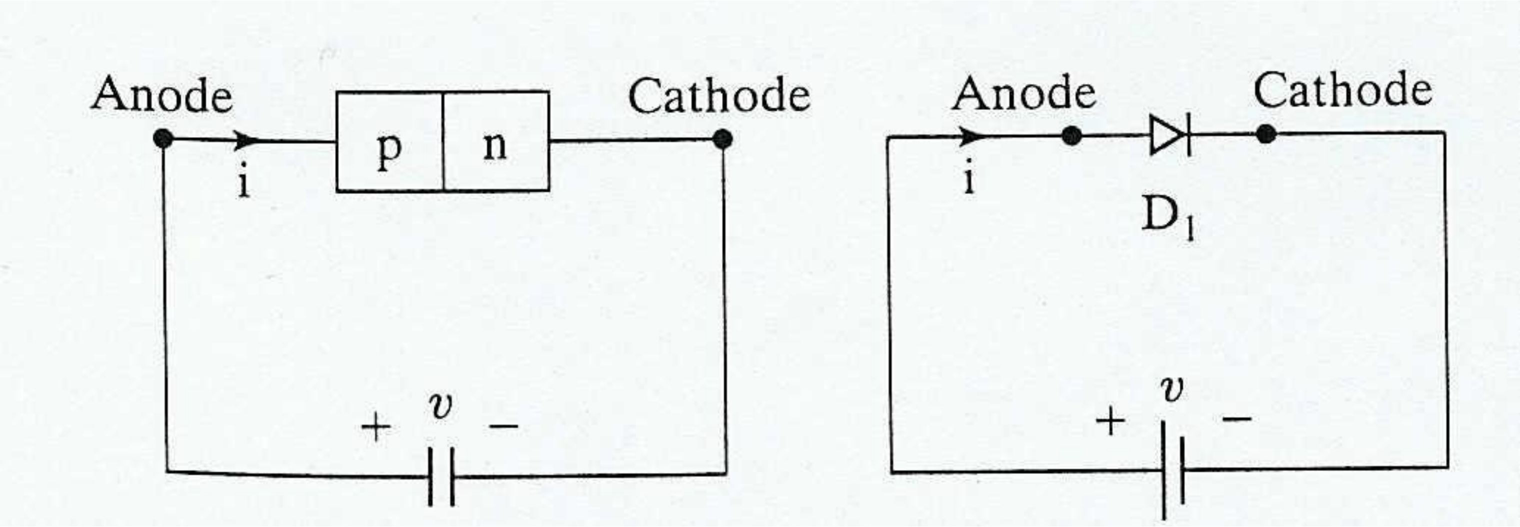
Experiment 5: VI Characteristics of Diode

PN-Junction Diode Characteristics

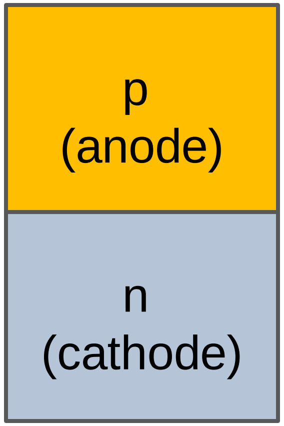


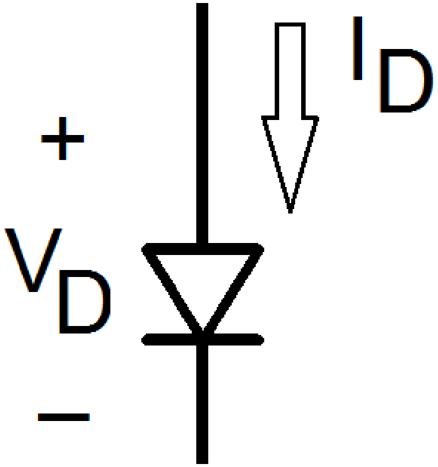
Forward Bias --- External battery makes the Anode more positive than the Cathode --- Current flows in the direction of the arrow in the symbol.

Reverse Bias --- External battery makes the Cathode more positive than the Anode --- A tiny current flows opposite to the arrow in the symbol.

Definition of Diode Current and Voltage

- **Forward Bias**
  - When $I_D > 0mA$ and $V_D > 0V$
- **Reverse Bias**
  - When $I_D < 0mA$ and $V_D < 0V$





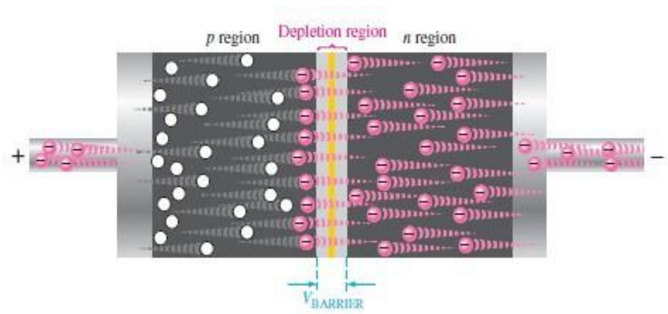
Forward Biased

Forward bias is a condition that allows current through pn junction.

A dc voltage (V bais) is applied to bias a diode.

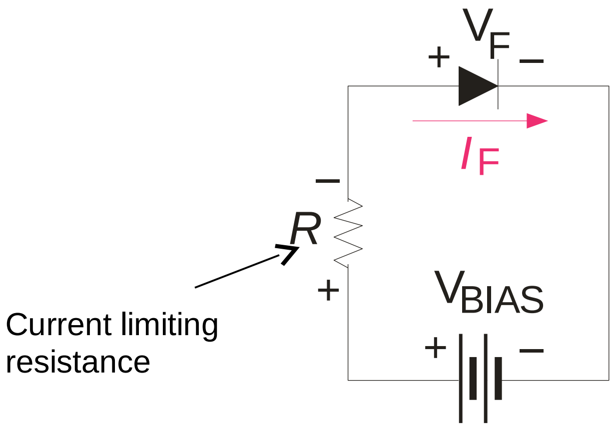
Positive side is connected to p-region (anode) and negative side is connected with n-region.

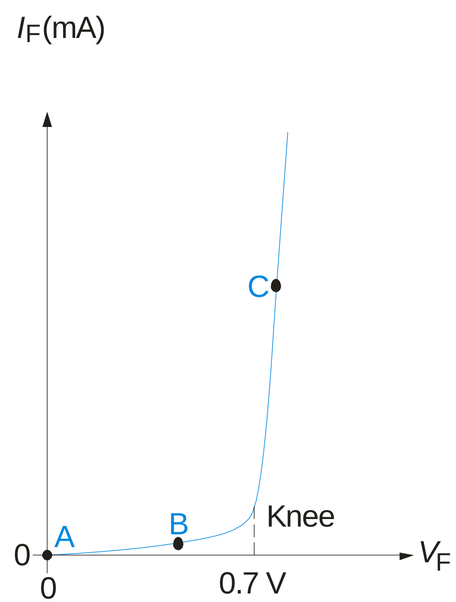
V bais must be greater than ‘barrier potential’



As more electrons flow into the depletion region reducing the number of positive ions and similarly more holes move in reducing the positive ions.

This reduces the width of depletion region.

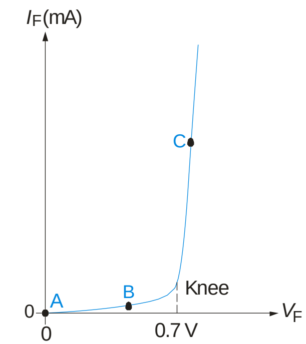


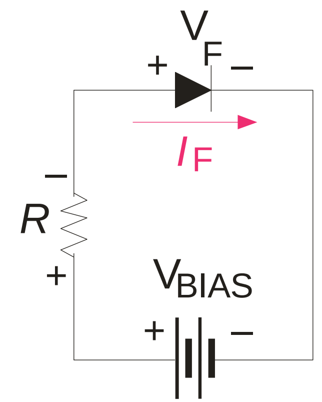


Diode V-I Characteristic

VI Characteristic for forward bias.

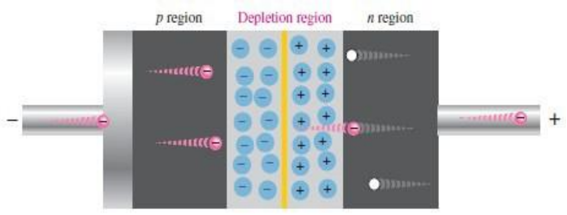
- The current in forward biased called *forward current* and is designated I_f.
- At V (V_{bias}) across the diode, there is no forward current. With gradual increase of V_{bias}, the forward voltage and forward current increases.
- A resistor in series will limit the forward current in order to protect the diode from overheating and permanent damage.
- Continuing increase of V_f causes rapid increase of forward current but only a gradual increase in voltage across diode





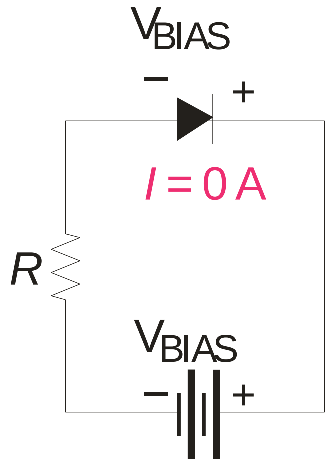
Reverse Biased

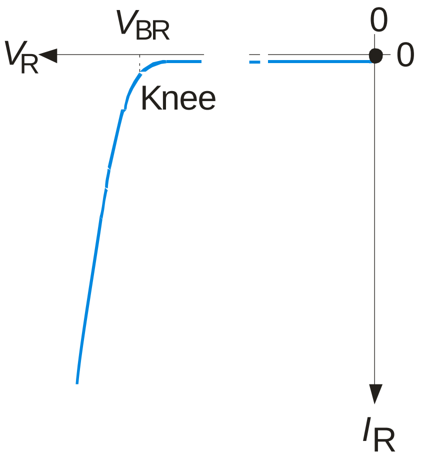
- Reverse bias is a condition that prevents current through junction.
- Positive side of Vbias is connected to the n- region whereas the negative side is connected with p-region.
- Depletion region get wider with this configuration.



The positive side of bias voltage attracts the majority carriers of n-type creating more positive ions at the junction.

This widens the depletion region.

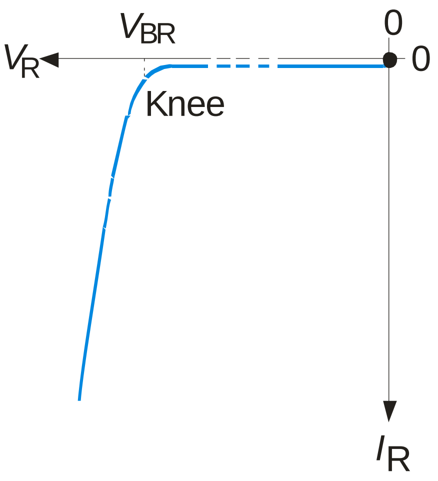




Diode V-I Characteristic

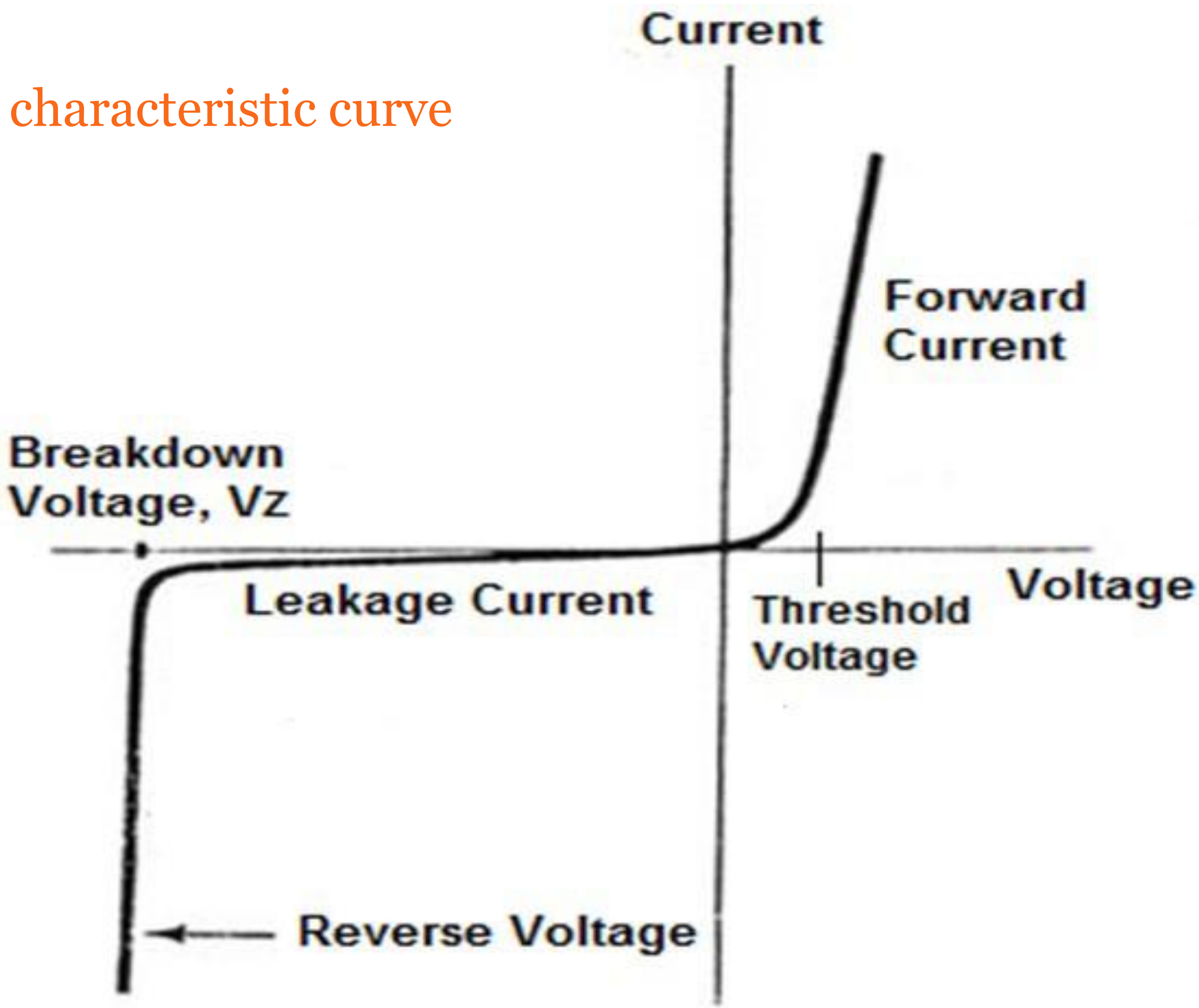
VI Characteristic for reverse bias.

- With 0V reverse voltage there is no reverse current.
- There is only a small current through the junction as the reverse voltage increases.
- At a point, reverse current shoots up with the break down of diode. The voltage called break down voltage. This is not normal mode of operation.
- After this point the reverse voltage remains at approximately VBR but IR increase very rapidly.
- Break down voltage depends on doping level, set by manufacturer.



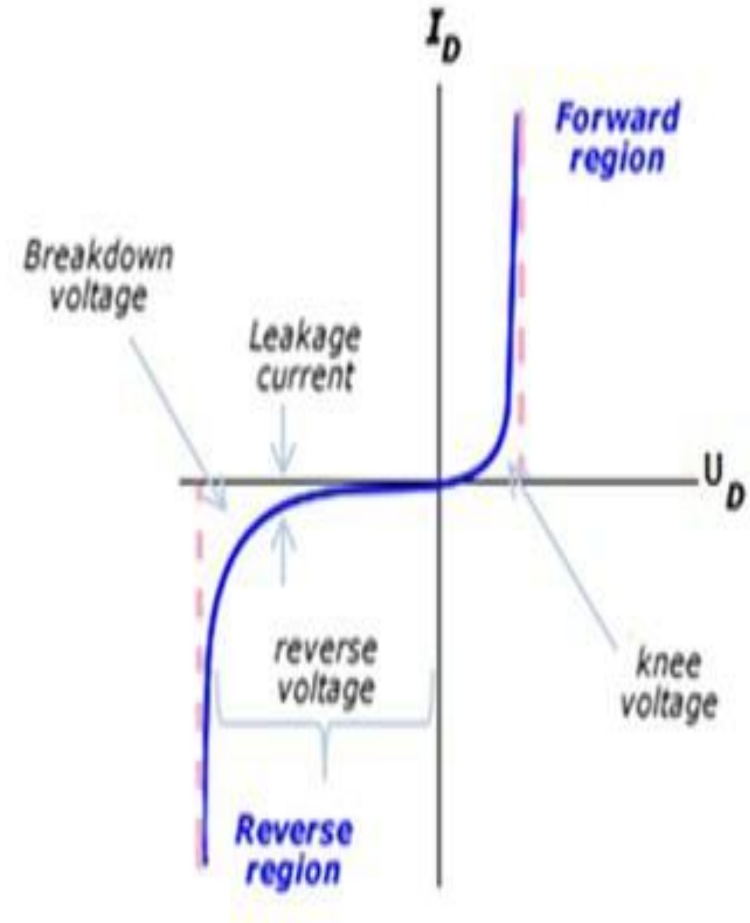
Diode V-I Characteristic

The complete V-I characteristic curve



Knee voltage

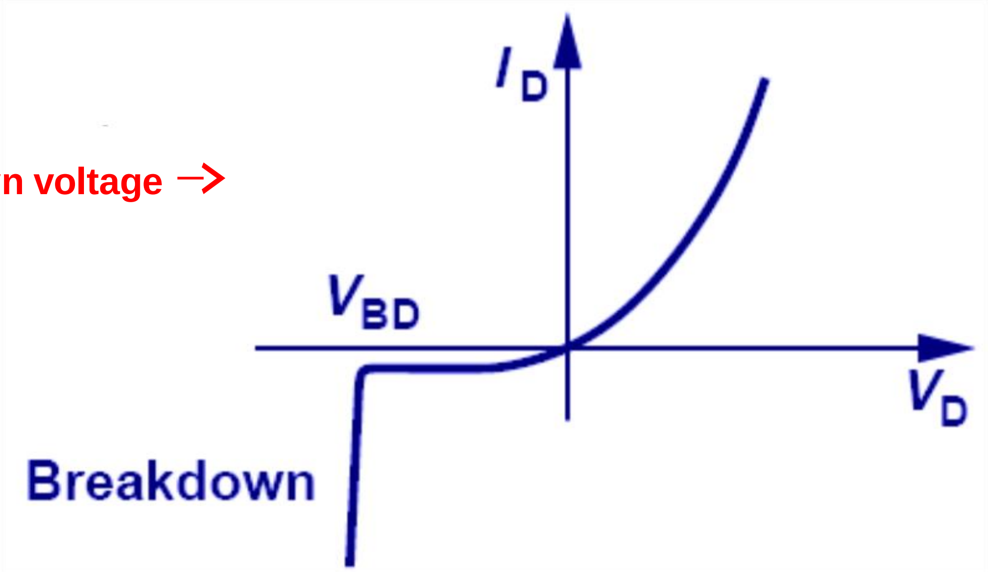
- The minimum amount of voltage required for conducting the diode is known as "knee voltage" or "threshold voltage" , "cut-in-voltage".
- The forward voltage at which the **current** through PN junction **starts increasing rapidly is known as knee voltage.**
- Knee voltage of "**germanium**" diode is-0.3volts
- Knee voltage of "**silicon**" diode is -0.7volts



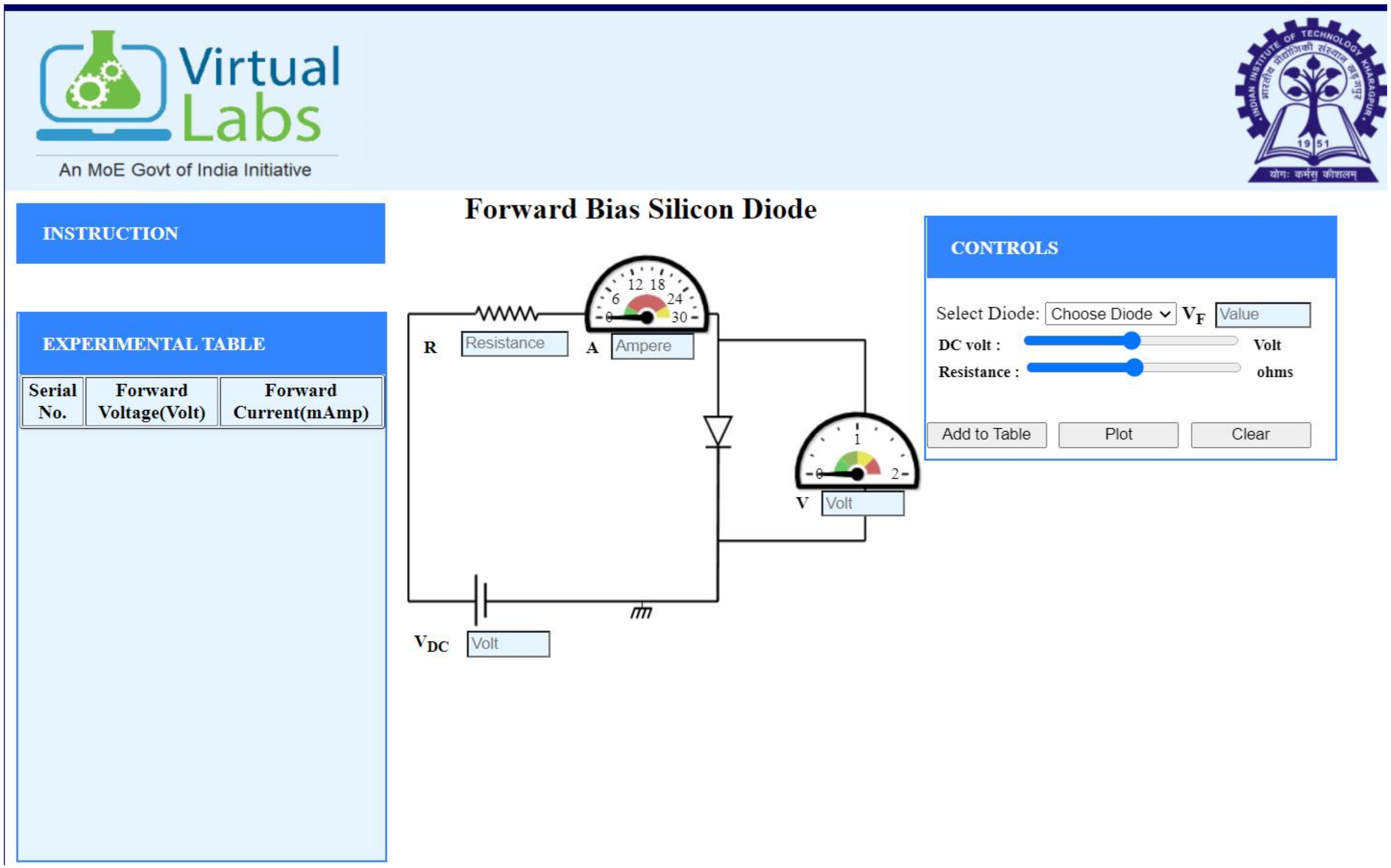
Reverse Breakdown

- As the reverse bias voltage increases, the electric field in the depletion region increases. Eventually, it can become large enough to cause the junction to break down so that a large reverse current flows:

breakdown voltage →



Let plot that on Virtual Lab



Thank you

ECE132: Basic Electrical and Electronics Engineering Lab

Experiment 6:

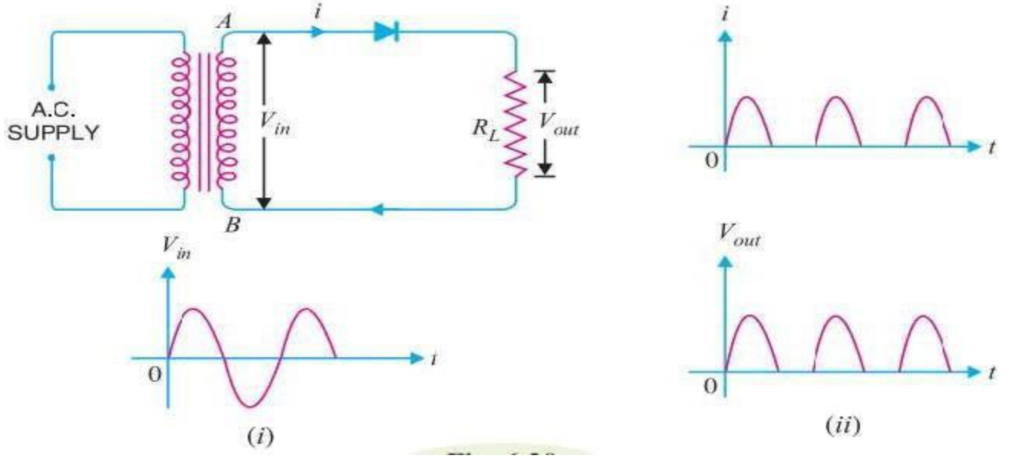
To understand use of diodes for half wave and full wave rectifiers

Introduction

- A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which is in only one direction, a process known as rectification.
- We can classify rectifiers into two types:
  - Half Wave Rectifier
  - Full Wave Rectifier

Half Wave Rectifier

- In half wave rectification, either the positive or negative half of the AC wave is passed, while the other half is blocked.
- Because only one half of the input waveform reaches the output, it is very inefficient if used for power transfer.



Half Wave Rectifier

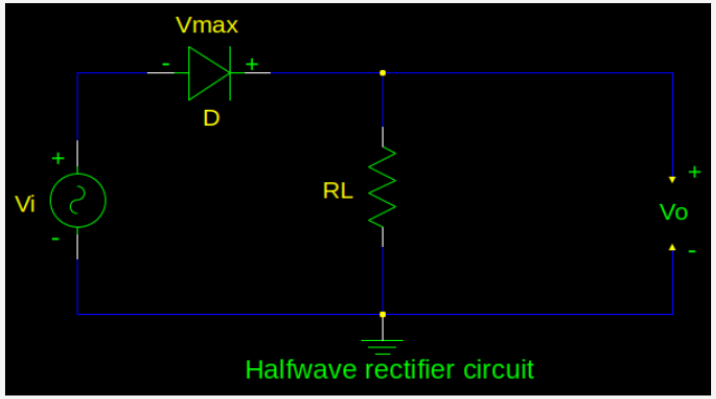
- The output DC voltage of a half wave rectifier can be calculated with the following two ideal equations

$$V_{rms} = \frac{V_{peak}}{2}$$

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

Half Wave Rectifier

Halfwave Rectifier Experiment



Halfwave rectifier circuit

Instructions

1. Observe the circuit diagram of the fullwave rectifier
2. Click on the **Power** Button.
3. Select the Amplitide(A) of the input sine wave signal(V_i).
4. Select the frequency of the signal(f) for the input signal(V_i).
5. Select the "Channel 1" to observe the input signal on graph
6. Select the "Channel 2" to observe the rectified output signal on graph
7. Select the "Dual" to observe the input signal and rectified output signal on graph
8. Change the values of A, f to observe the variation in the input and output signals.
9. Hover on the graph to observe the value of the V_i and V_o at that instatnt of time T.
10. Save the graph if you are done with your experiment.
11. **Note:**
    - **Ideal diode is considered**
    - **Make sure always Input Signal Amplitude>0 v**
    - **Make sure always Input Signal Frequency>0 Hz**
    - **Load resistance** $R = 1k\Omega$
    - **To change the values just scroll by hovering on it.**

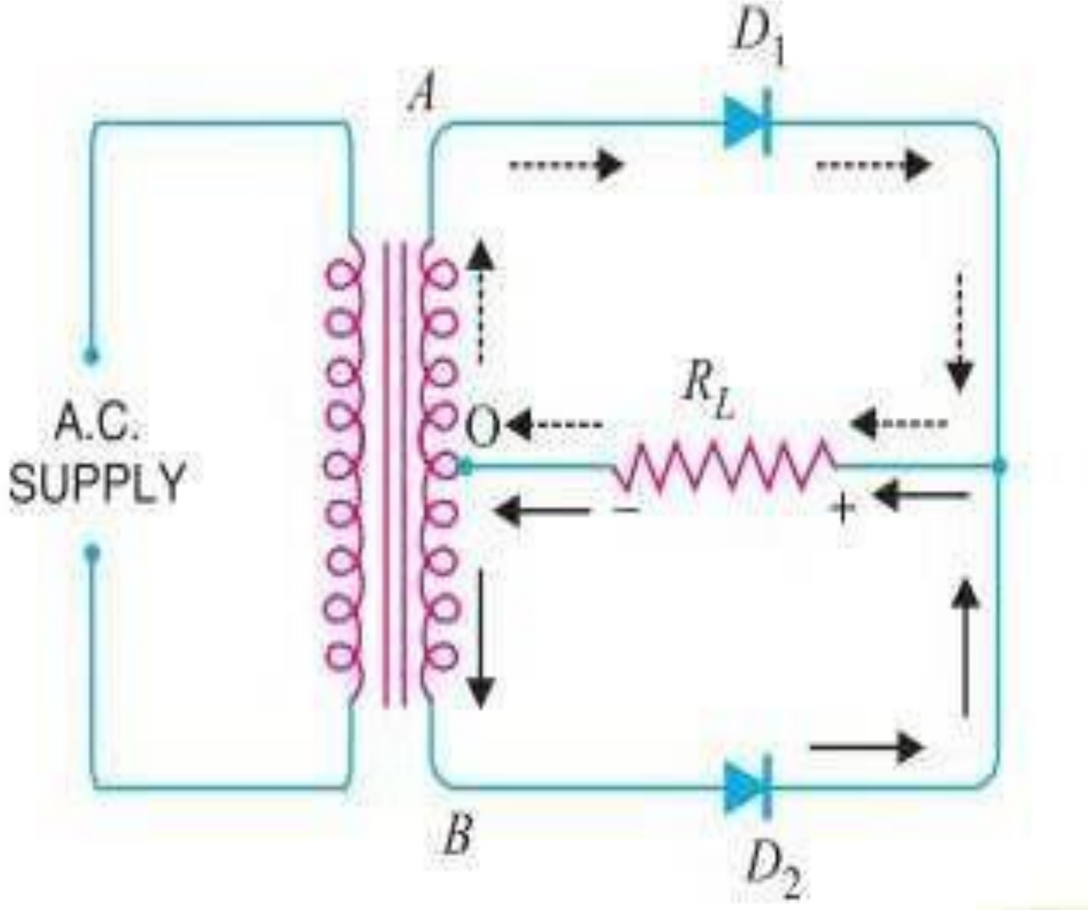
Full Wave Rectifier

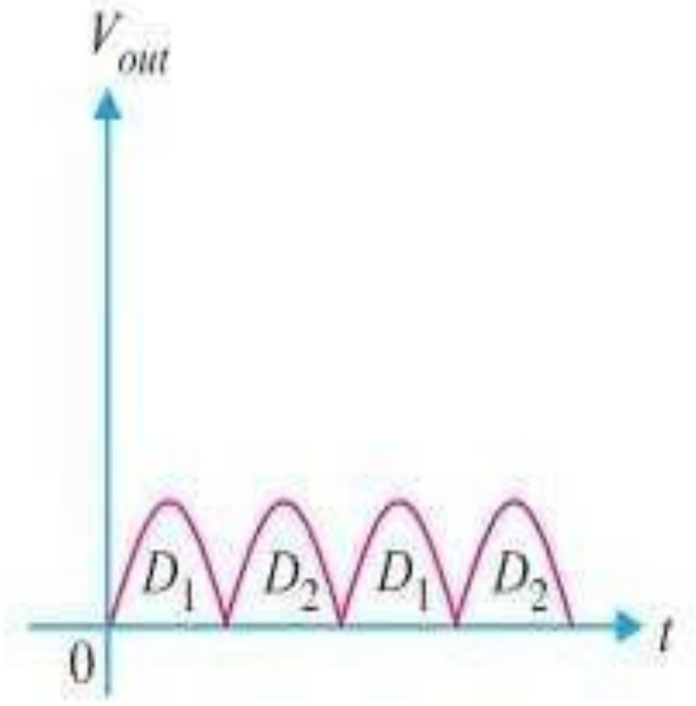
- In Full wave rectification current flow through the load in same direction for both half cycle of input ac.
- This can be achieved with two diodes working alternatively.
- For one half cycle one diode supplies current to load and for next half cycle another diode works

Full Wave Rectifier

- For single-phase AC, if the transformer is **center-tapped**, then two diodes back-to-back (i.e. anodes-to-anode or cathode-to-cathode) can form a full-wave rectifier.
- In a circuit with a **non - center tapped** transformer, four diodes are required instead of the one needed for halfwave rectification, it is also known as bridge rectifier.

Full Wave Rectifier – Center Tapped T/F





Full Wave Rectifier – Center Tapped T/F

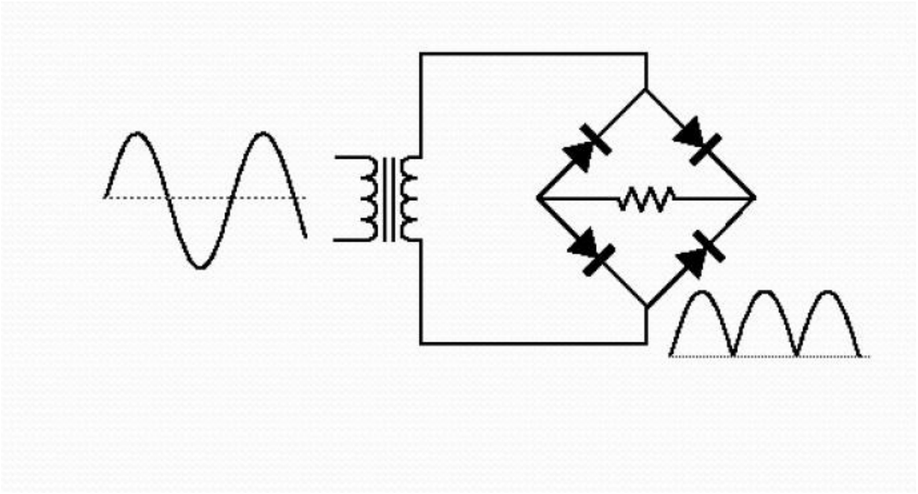
- The average and root-mean-square output voltages of an ideal single phase full wave rectifier can be calculated as:

$$V_{dc} = V_{av} = \frac{2V_p}{\pi}$$

$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

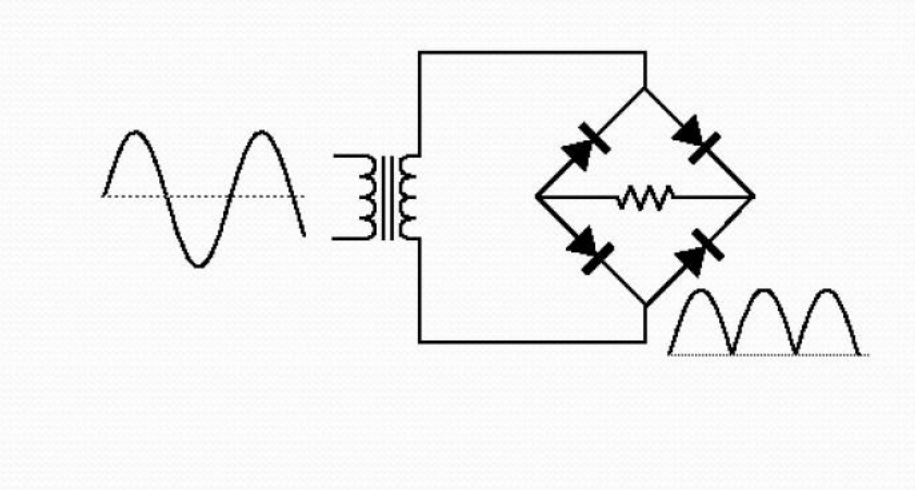
Full Wave Rectifier – Bridge Rectifier

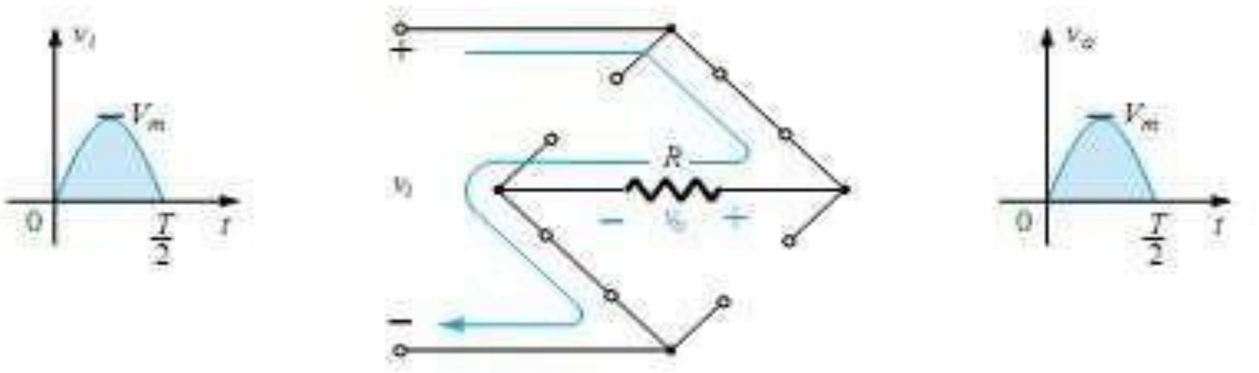
- A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification.



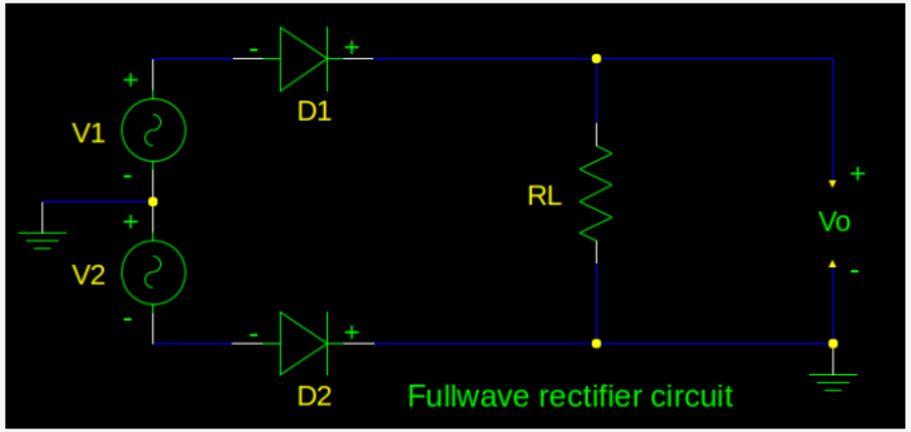
Full Wave Rectifier – Bridge Rectifier

- A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full-wave rectification.





Full Wave Rectifier



Instructions

1. Observe the circuit diagram of the fullwave rectifier
2. Click on the **Power** Button.
3. Select the Amplitide(A) of the input sine wave signal(V_i).
4. Select the frequency of the signal(f) for the input signal(V_i).
5. Select the "Channel 1" to observe the input signal on graph
6. Select the "Channel 2" to observe the rectified output signal on graph
7. Select the "Dual" to observe the input signal and rectified output signal on graph
8. Change the values of A, f to observe the variation in the input and output signals.
9. Hover on the graph to observe the value of the V_i and V_o at that instatnt of time T.
10. Save the graph if you are done with your experiment.
11. **Note:**
    - **V_2 is 180° in phase to V_1**
    - **Ideal diode is considered**
    - **Make sure always Input Signal Amplitude>0 v**
    - **Make sure always Input Signal Frequency>0 Hz**
    - **Load resistance $R = 1k\Omega$**
    - **To change the values just scroll by hovering on it.**

THANKS TO ALL

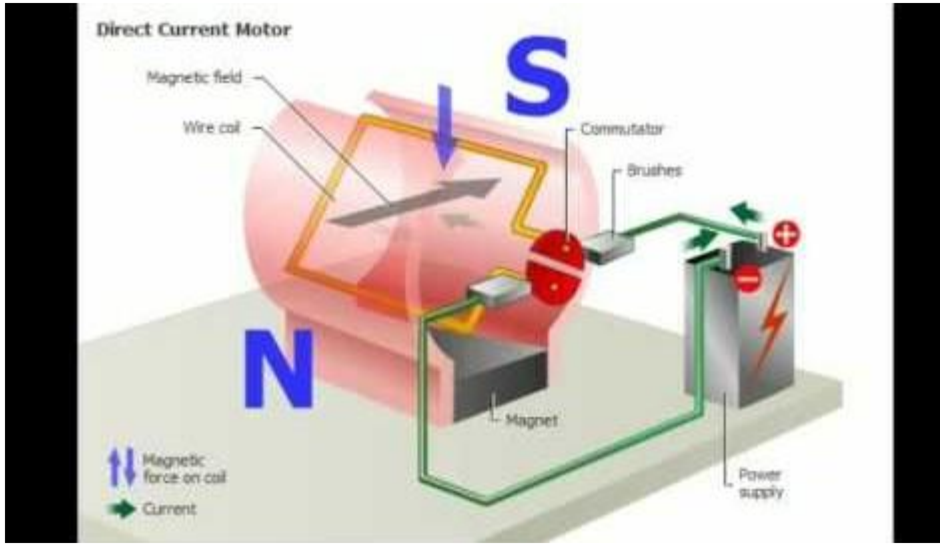
ECE132: Basic Electrical and Electronics Engineering Lab

Experiment 7:

To understand principle of speed control of a DC motor Proteus software.

Introduction to DC Motor

- A motor is an electrical machine which converts electrical energy into mechanical energy. The principle of working of a DC motor is that "whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left hand rule and it's magnitude is given by F = BIL. Where, B = magnetic flux density, I = current and L = length of the conductor within the magnetic field.



Introduction to DC Motor

- Back Emf: When the armature of the motor is rotating, the conductors are also cutting the magnetic flux lines and hence according to the Faraday's law of electromagnetic induction, an emf induces in the armature conductors. The direction of this induced emf is such that it opposes the armature current (Ia) .
- With increasing back emf armature current will start decreasing. Torque being proportional to the armature current, it will also decrease until it becomes sufficient for the load. Thus, speed of the motor will regulate.
- On the other hand, if a dc motor is suddenly loaded, the load will cause decrease in the speed. Due to decrease in speed, back emf will also decrease allowing more armature current. Increased armature current will increase the torque to satisfy the load requirement. Hence, presence of the back emf makes a dc motor ‘self-regulating’.

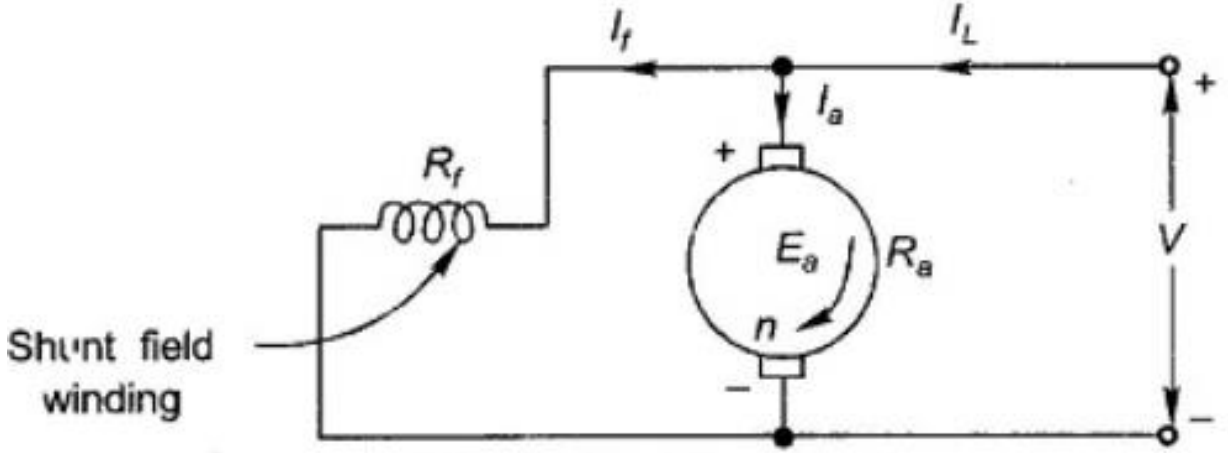
Introduction to DC Motor

Modelling Equation

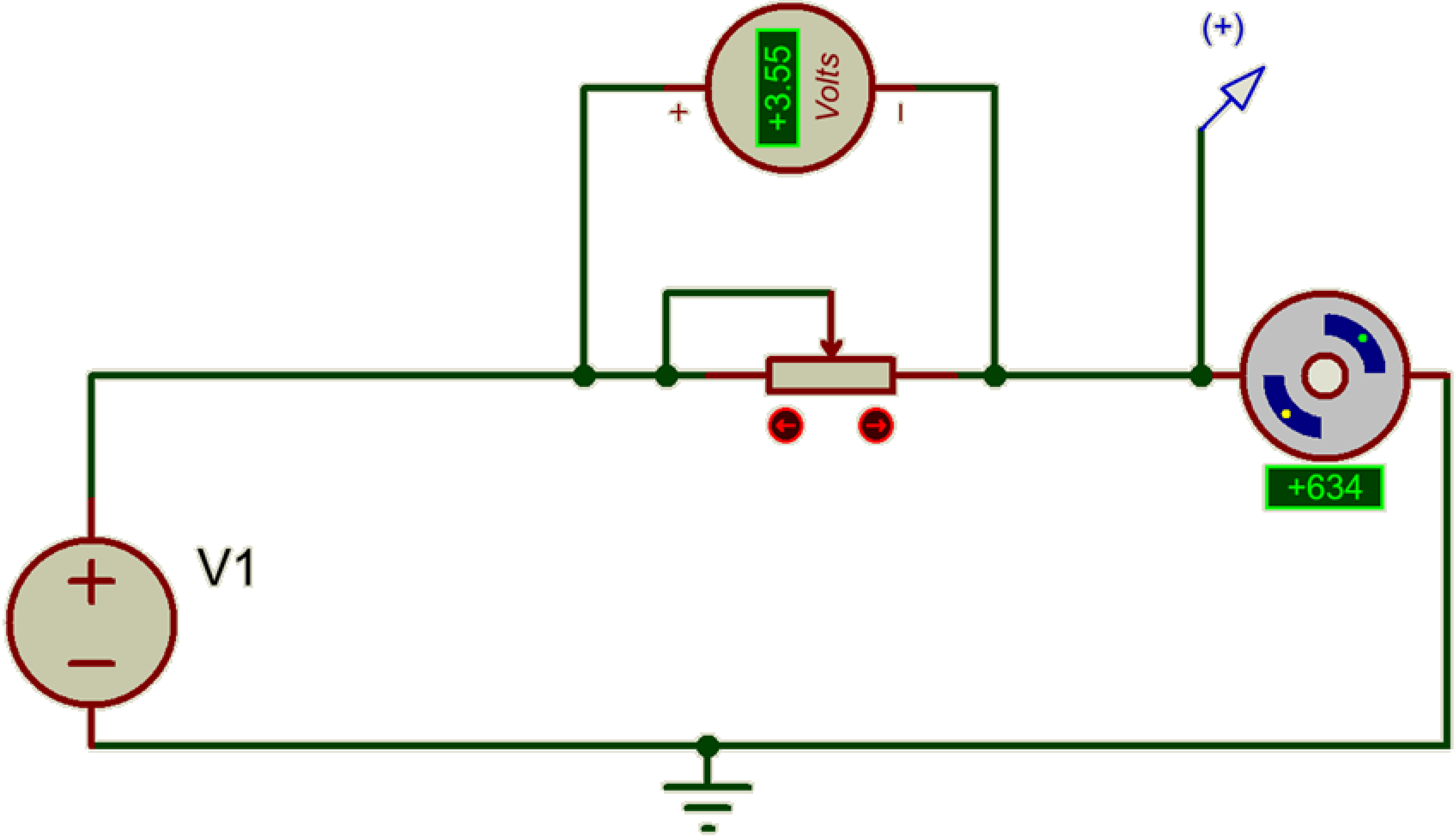
$$E_a = V - l_a R_a$$

$$n = K_N \left(\frac{V - I_a R_a}{\Phi} \right)$$

$$T = K_T \Phi I_a$$



Simulation



Observation and Calculation

S.No	Vs (in Volts)	Ia (in Amp)	N (RPM)	T (%age)

From Roll No 1 to 9:
Plot a graph between Vs and N

From Roll to 10 to 18:
Plot a graph between I and T

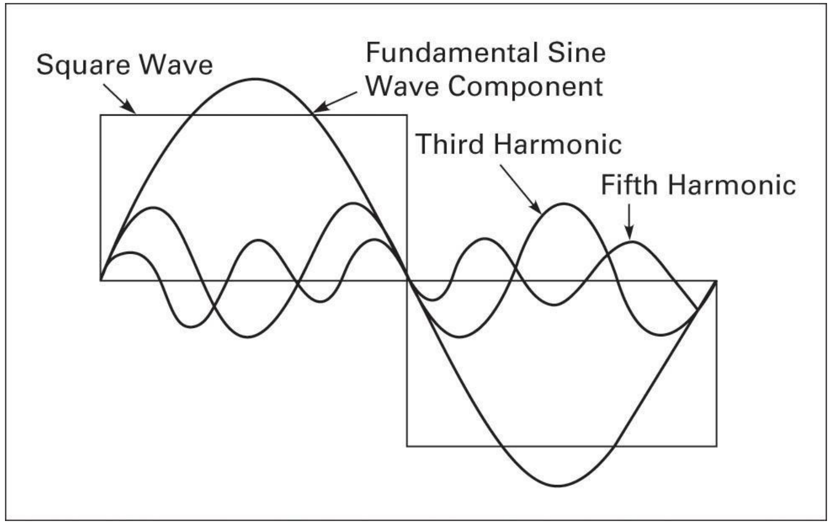
ECE132: Basic Electrical and Electronics Engineering Lab

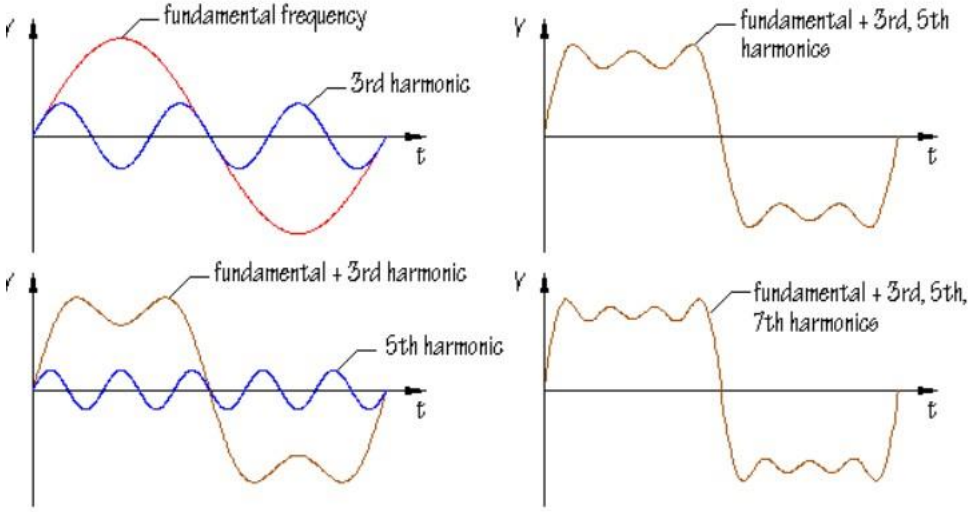
Experiment 8:

To study the effect of frequency on the output voltage in low-pass and high-pass filters

Introduction

A filter is a device or process that removes some unwanted components or features from a signal. The defining feature of filters being the complete or partial suppression of some aspects of the signal.





Introduction

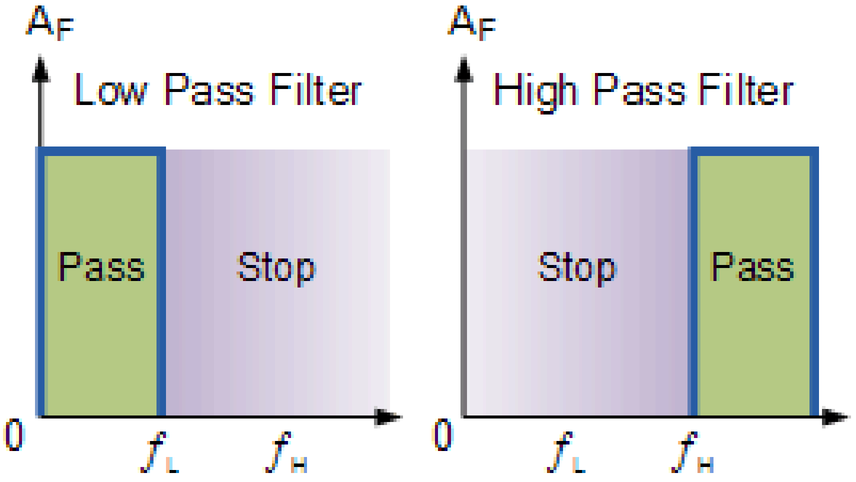
Depending on the type of element used in their construction, filters are classified into two types, such as:

- **Passive Filters:** A passive filter is built with passive components such as resistors, capacitors and inductors.
- **Active Filters:** An active filter makes use of active elements such as transistors, op-amps in addition to resistor and capacitors.

Introduction

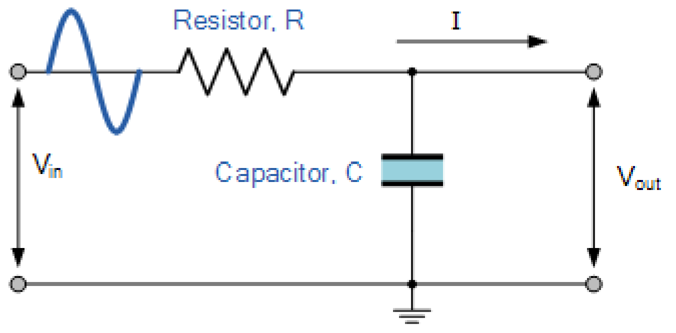
According to the operating frequency range, filters may also be classified as:

1. **Low Pass Filter:** The low pass filter only allows low frequency signals from 0 Hz to its cut-off frequency, f_L point to pass while blocking any higher frequency signals.
2. **High Pass Filter:** The high pass filter only allows high frequency signals from its cut-off frequency, f_L point and higher to infinity to pass through while blocking those any lower.



Low Pass filter

A simple passive RC Low Pass Filter or LPF, can be easily made by connecting together in series a single Resistor with a single Capacitor as shown below. In this type of filter arrangement the input signal (V_{IN}) is applied to the series combination (both the Resistor and Capacitor together) but the output signal (V_{OUT}) is taken across the capacitor only.



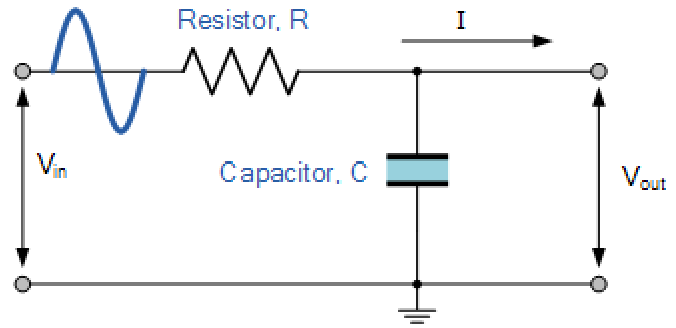
Low Pass filter

$$V_{out} = V_{in} \times \frac{R_2}{R_1 + R_2}$$

where: $R_1 + R_2 = R_T$, the total resistance of the circuit

$$X_C = \frac{1}{2\pi f C} \text{ in Ohm's}$$

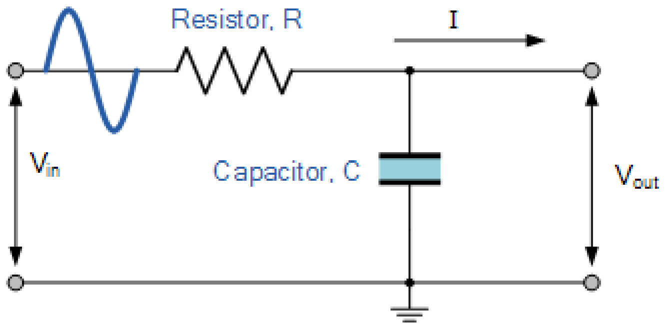
$$Z = \sqrt{R^2 + X_C^2}$$



$$V_{out} = V_{in} \times \frac{X_C}{\sqrt{R^2 + X_C^2}} = V_{in} \frac{X_C}{Z}$$

Low Pass filter

A Low Pass Filter circuit consisting of a resistor of 4.7kΩ in series with a capacitor of 47nF is connected across a 10v sinusoidal supply. Calculate the output voltage (VOUT) at a frequency of 100Hz and again at frequency of 10,000Hz or 10kHz.

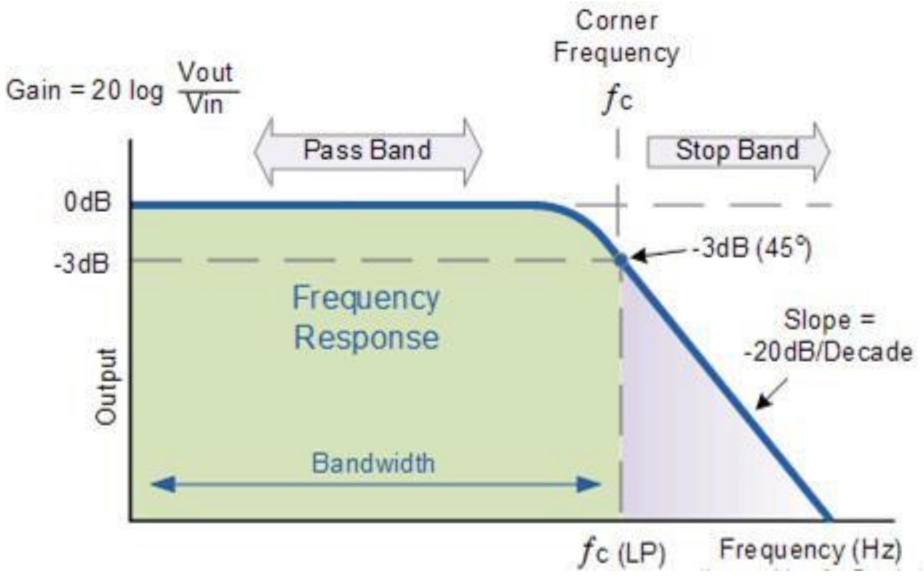


$$Xc = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 100 \times 47 \times 10^{-9}} = 33{,}863\Omega$$

$$V_{OUT} = V_{IN} \times \frac{Xc}{\sqrt{R^2 + X_C^2}} = 10 \times \frac{33863}{\sqrt{4700^2 + 33863^2}} = 9.9v$$

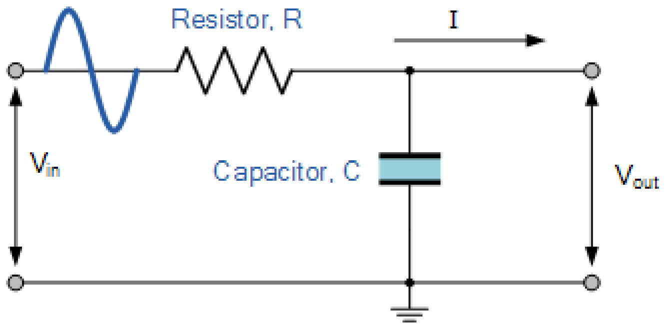
$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 10{,}000 \times 47 \times 10^{-9}} = 338.6\Omega$$

$$V_{OUT} = V_{IN} \times \frac{X_C}{\sqrt{R^2 + X_C^2}} = 10 \times \frac{338.6}{\sqrt{4700^2 + 338.6^2}} = 0.718v$$

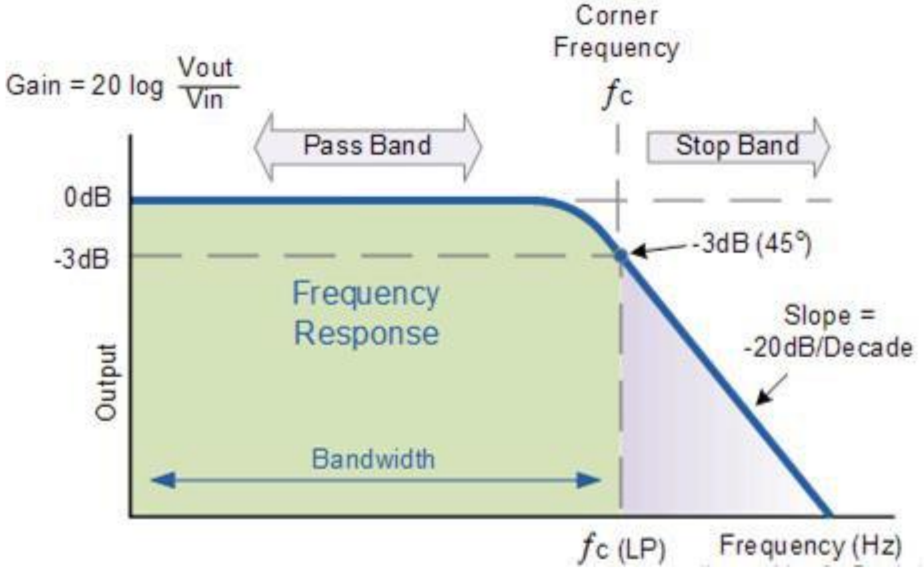


Low Pass filter

A Low Pass Filter circuit consisting of a resistor of 4.7kΩ in series with a capacitor of 47nF is connected across a 10v sinusoidal supply. Calculate the output voltage (VOUT) at a frequency of 100Hz and again at frequency of 10,000Hz or 10kHz.

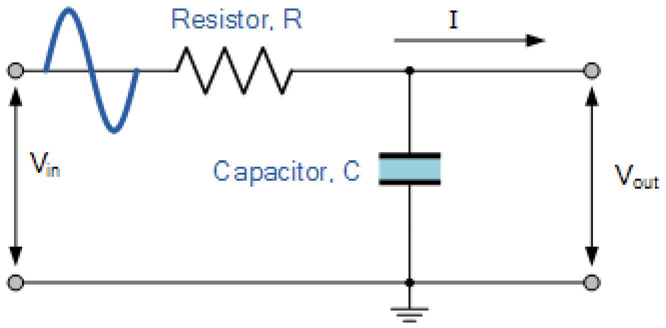


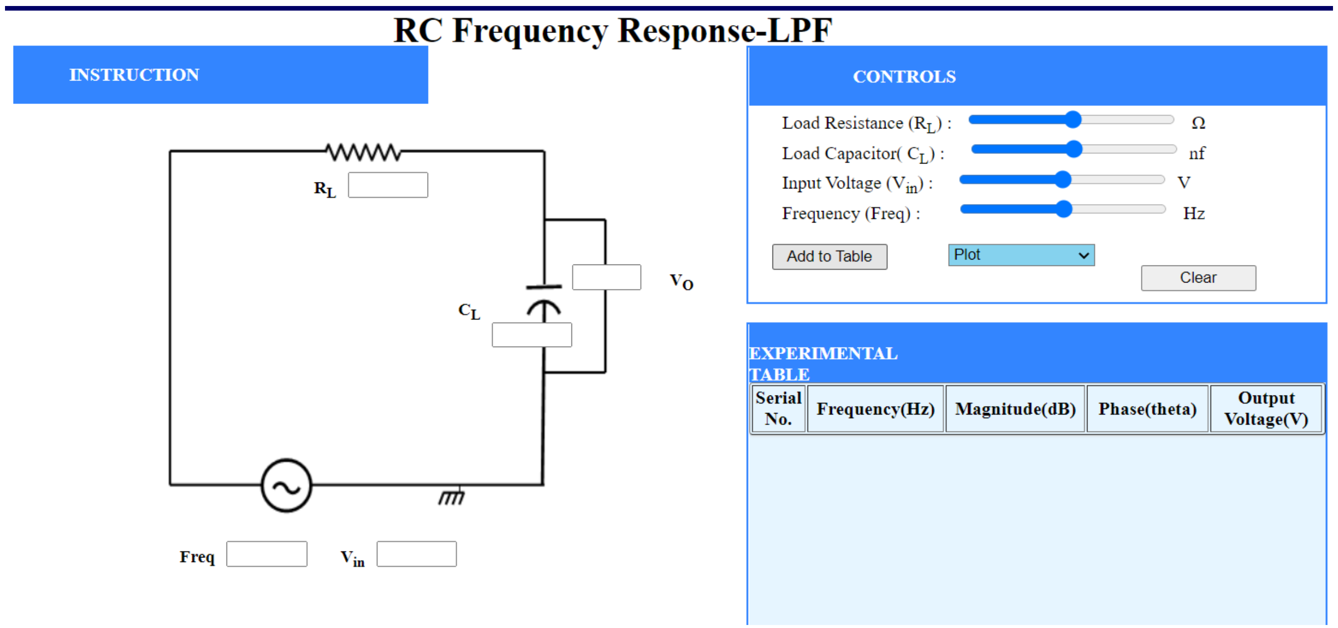
$$fc = \frac{1}{2\pi RC} = \frac{1}{2\pi \times 4700 \times 47 \times 10^{-9}} = 720\text{Hz}$$



Low Pass filter

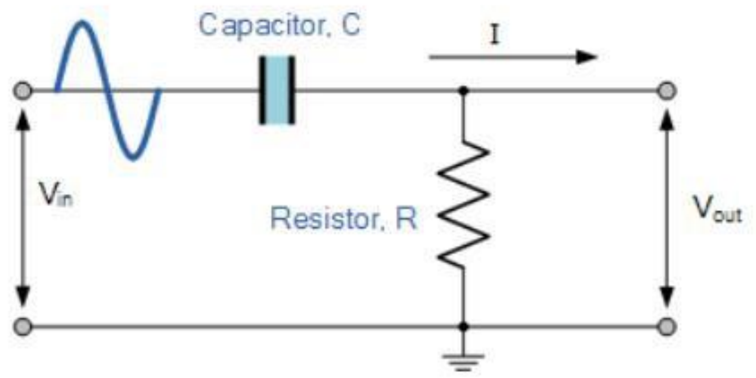
A Low Pass Filter circuit consisting of a resistor of 4.7kΩ in series with a capacitor of 40nF is connected across a 10v sinusoidal supply. Calculate the output voltage (VOUT) at a frequency of 100Hz and again at frequency of 100Hz or 10kHz.

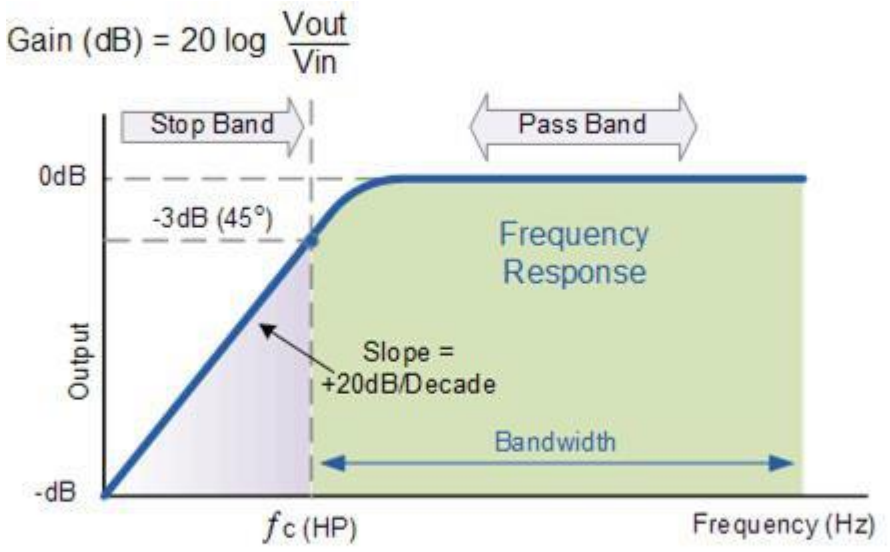




High Pass filter

In this circuit arrangement, the reactance of the capacitor is very high at low frequencies so the capacitor acts like an open circuit and blocks any input signals at VIN until the cut-off frequency point is reached.

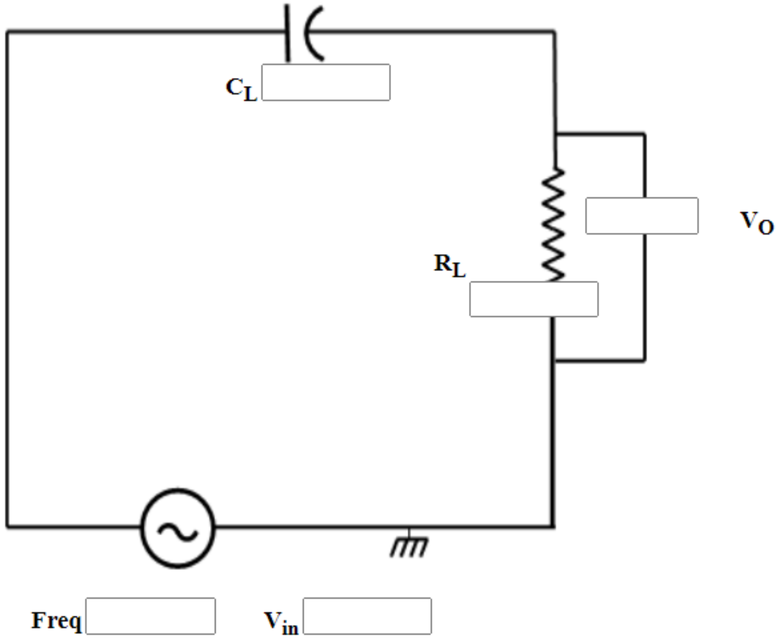




High Pass filter

RC Frequency Response-HPF

INSTRUCTION



CONTROLS

Load Resistance (R_L) : Ω

Load Capacitor(C_L) : nf

Input Voltage (V_{in}) : V

Frequency (Freq) : Hz

Add to Table

Plot

Clear

EXPERIMENTAL TABLE

Serial No.	Frequency(Hz)	Magnitude(dB)	Phase(theta)	Output Voltage(V)

THANKS TO ALL

ECE132: Basic Electrical and Electronics Engineering Lab

Experiment 9:

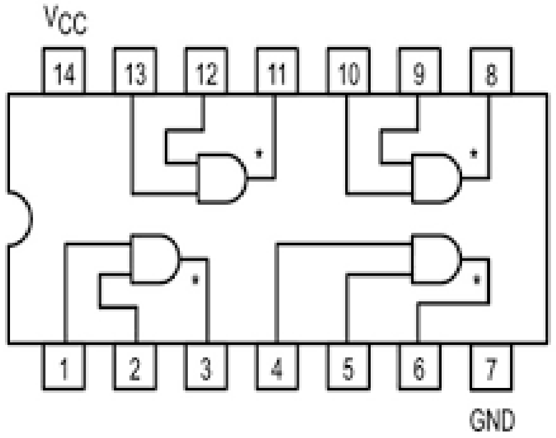
To understand Truth table of Logic gates and verifying the Boolean equations.

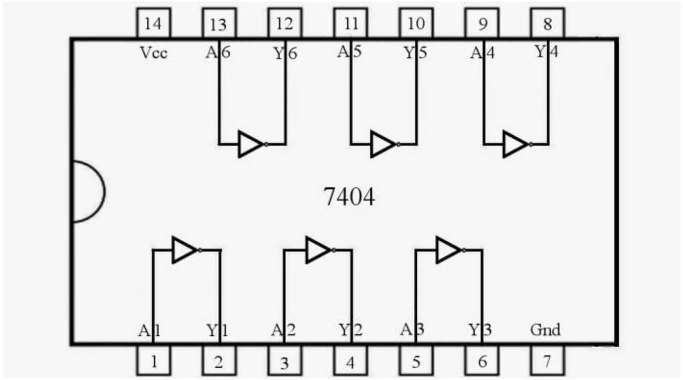
Introduction to Logic Gates

- Logic gates are the basic building blocks of any digital system. It is an electronic circuit having one or more than one input and only one output. The relationship between the input and the output is based on a certain logic. Based on this, logic gates are named as AND gate, OR gate, NOT gate etc.

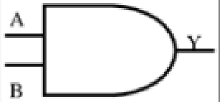
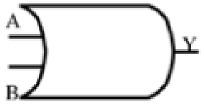
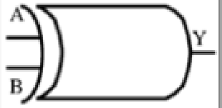
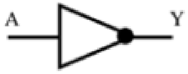
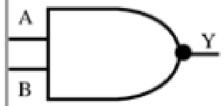
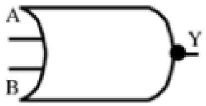
Introduction to Logic Gates

Sr. No.	Component	Specification
1	AND Gate	IC7408
2	OR Gate	IC 7432
3	NOT Gate	IC7404
4	NAND Gate	IC7400
5	NOR Gate	IC7402
6	XOR Gate	IC7486

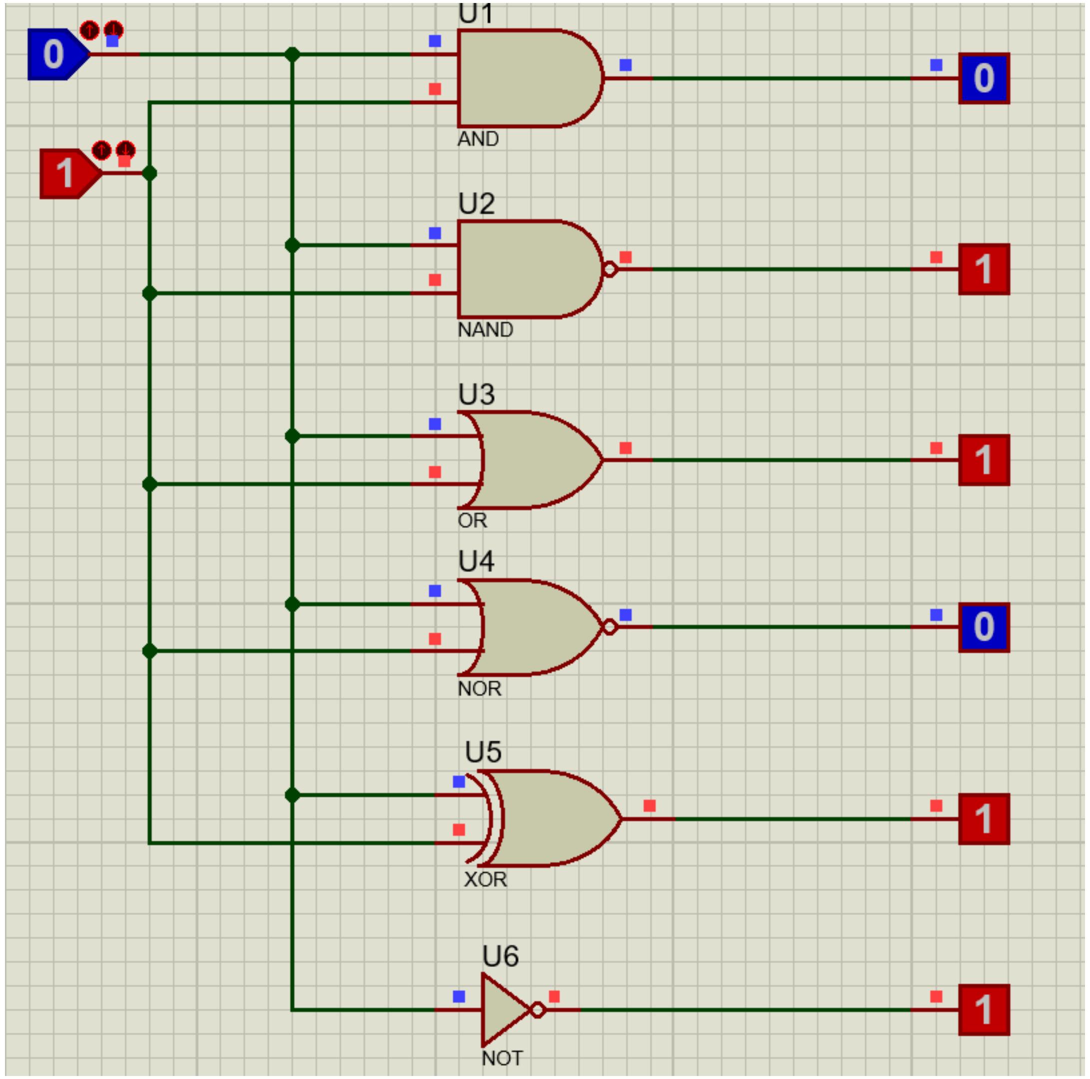




Introduction to Logic Gates

Logic	Schematic	Boolean Expression	Truth Table	English Expression
AND		$A \bullet B = Y$	A B Y 0 0 0 1 1 0 1 1	The only time the output is positive is when all the inputs are positive.
OR		$A + B = Y$	A B Y 0 0 0 1 1 0 1 1	The output will be positive when any one or all inputs are positive.
XOR		$A \oplus B = Y$	A B Y 0 0 0 1 1 0 1 1	The only time the output is positive is when the inputs are not the same.
NOT		$\bar{A} = Y$	A Y 0 1	The output is the opposite of the input.
NAND		$\overline{A \bullet B} = Y$	A B Y 0 0 0 1 1 0 1 1	The output is positive provided all the inputs are not positive.
NOR		$\overline{A + B} = Y$	A B Y 0 0 0 1 1 0 1 1	The only time the output is positive is when all the inputs are negative.

Simulation



Observation and Calculation

Truth Table

Input A	Input B	Output
0	0	0
1	0	1
0	1	1
1	1	1

THANKS TO ALL

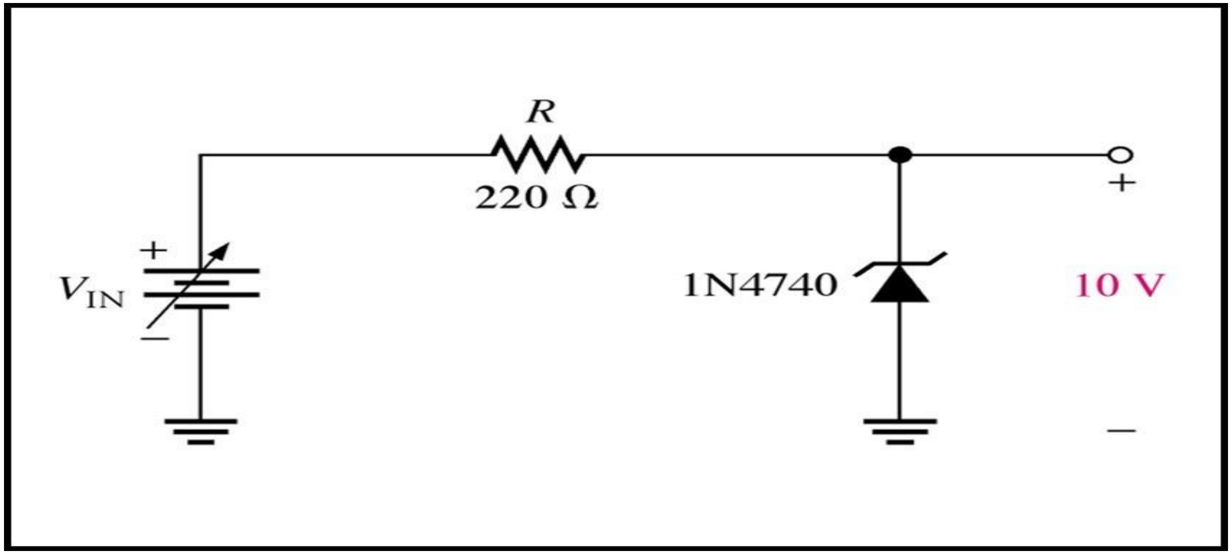
ECE132: Basic Electrical and Electronics Engineering Lab

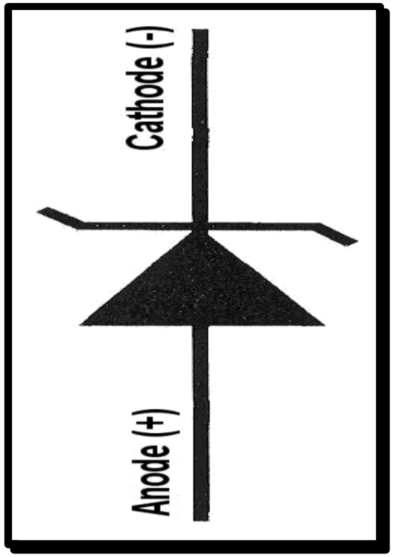
Experiment 10:

To study VI char of a Zener diode and its application as a voltage regulator.

Introduction

The **zener diode** is a silicon pn junction devices that differs from rectifier diodes because *it is designed for operation in the reverse-breakdown region*. The breakdown voltage of a zener diode is set by carefully controlling the level during manufacture. The basic function of **zener diode** is to maintain a specific voltage across it's terminals within given limits of line or load change. Typically it is used for providing a stable reference voltage for use in power supplies and other equipment.





This particular zener circuit will work to maintain 10 V across the load.

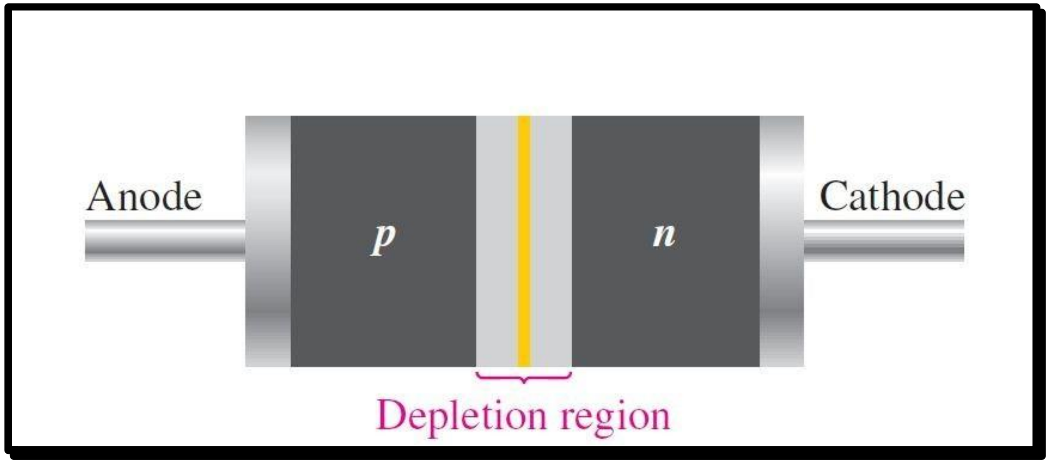
Construction of Zener

Zener diodes are designed to operate in reverse breakdown. Two types of reverse breakdown in a zener diode are *avalanche* and *zener*. The avalanche break down occurs in both rectifier and zener diodes at a sufficiently high reverse voltage. **Zener breakdown** occurs in a zener diode at low reverse voltages.

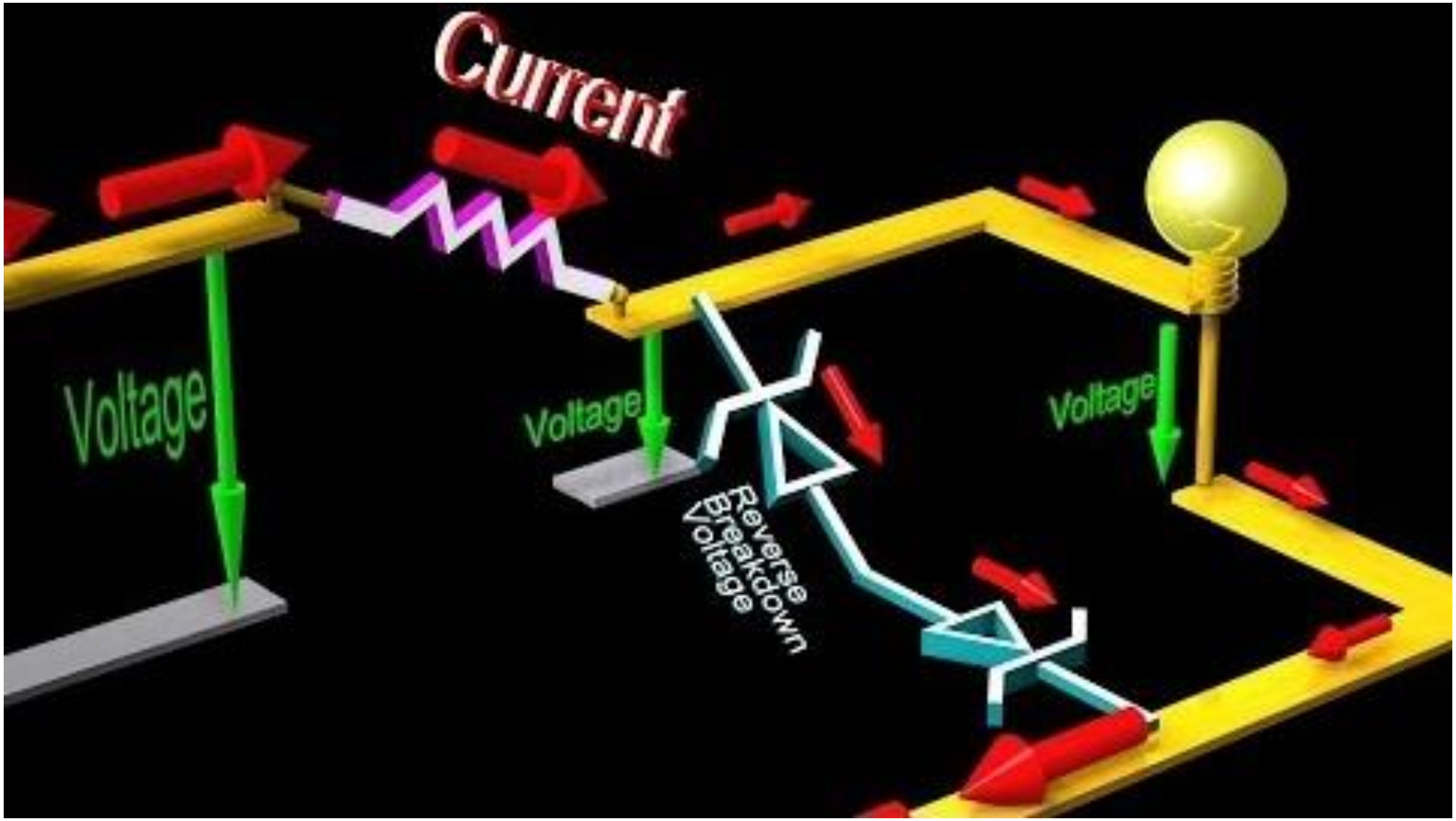
A zener diode is heavily doped to reduced the breakdown voltage. This causes a very thin depletion region.

The zener diodes breakdown characteristics are determined by the doping process

Zeners are commercially available with voltage breakdowns of **1.8 V to 200 V**.

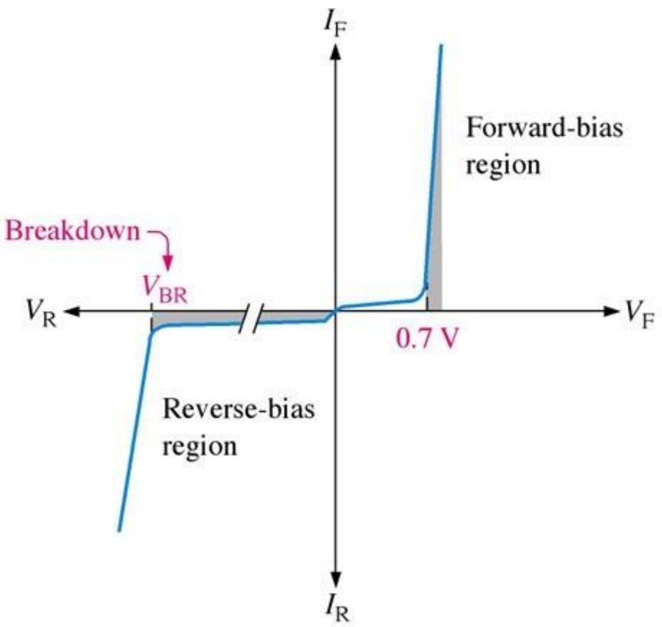


Working Principle

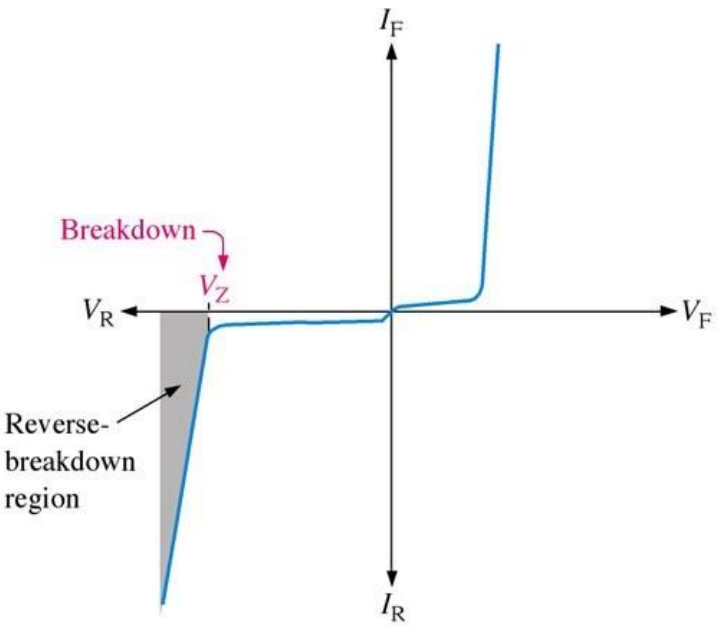


Characteristics of Zener

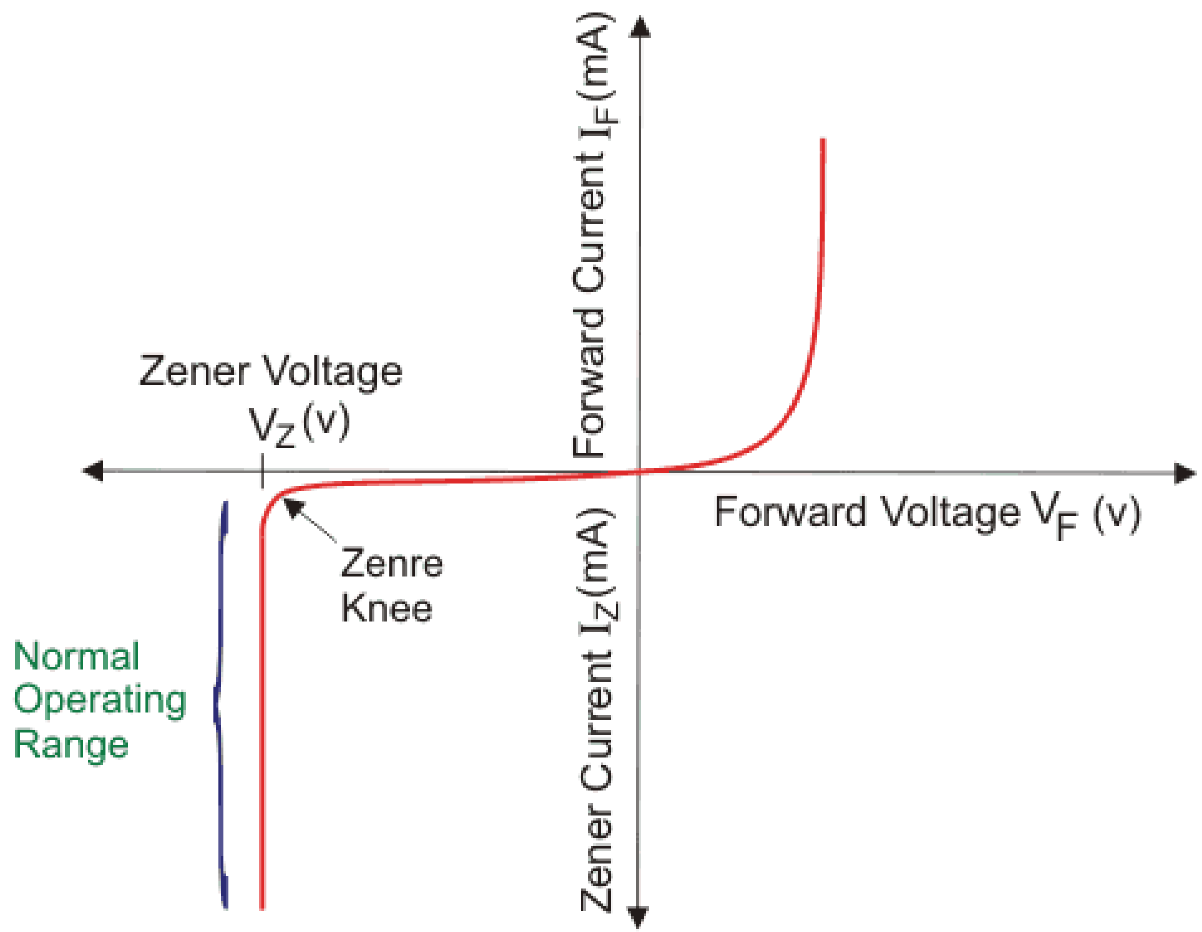
A **zener diode** is much like a normal diode. The exception being is that it is placed in the circuit in reverse bias and operates in reverse breakdown. This typical characteristic curve illustrates the operating range for a zener. Note that it's forward characteristics are just like a normal diode.



(a) The normal operating regions for a rectifier diode are shown as shaded areas.



(b) The normal operating region for a zener diode is shaded.


Forward Current I_F(mA)
Zener Voltage
V_Z(v)
Forward Voltage V_F (v)
Zenre
Knee
Normal
Operating
Range
Zener Current I_Z(mA)

Simulation

Zener Diode - LINE Regulator

INSTRUCTION

CONTROLS

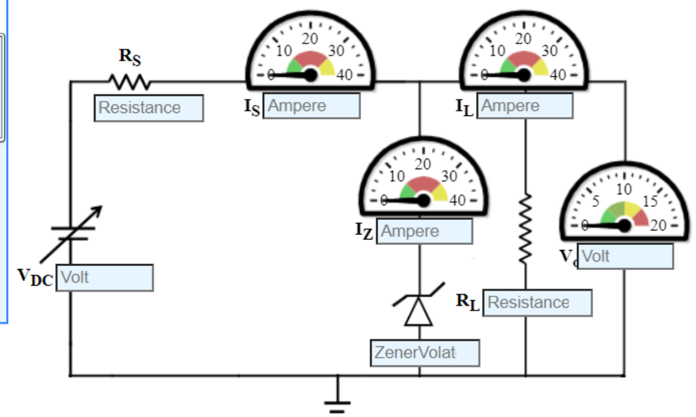
DC volt : Volt
Zener Diode(V_Z) : Volt
Resistance(R_S) : Ohms
Resistance(R_L) : Ohms

Add to Table | Plot | Clear

EXPERIMENTAL TABLE

Zener Voltage(V_Z): V
Series Resistance(R_S): KΩ
Load Resistance (R_L): KΩ

Serial No.	Unregulated supply voltage(V_S) V	Load Current(I_L) mAmp	Zener Current(I_Z) mAmp	Regulated Output Voltage(V_O) V	% Voltage Regulation



THANKS TO ALL