LABORATORY MANUAL
ECE 132
BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

LOVELY PROFESSIONAL UNIVERSITY

Transforming Education Transforming India

NAME OF STUDENT:-……………………………………………

REGISTERATION NO:-……………………….........................

ROLL NO:-………………………………………………………….

SECTION:-………………………………………………………….

GROUP:-………………………………………………………….

GENERAL GUIDELINES

The following general rules and precautions are to be observed at all times in the laboratory.

1. Shoes must be worn at all times.
2. Remove all loose conductive jewellery and trinkets, including rings, which may come in contact with exposed circuits. (Do not wear long loose ties, scarves, or other loose clothing around machines.
3. Don’t switch ON the power supply without confirming the connections from the lab instructor.
4. When making measurements, form the habit of using only one hand at a time. No part of a live circuit should be touched by the bare hand.
5. Keep the body, or any part of it, out of the circuit. Where interconnecting wires and cables are involved, they should be arranged so people will not trip over them.
6. Be as neat as possible. Keep the work area and workbench clear of items not used in the experiment.
7. Always check to see that the power switch is OFF before plugging into the outlet. Also, turn instrument or equipment OFF before unplugging from the outlet.
8. When unplugging a power cord, pull on the plug, not on the cable.
9. When disassembling a circuit, first remove the source of power.
10. "Cheater" cords and 3-to-2 prong adapters are prohibited unless an adequate separate ground lead is provided, the equipment or device is double insulated, or the laboratory ground return is known to be floating.
11. No ungrounded electrical or electronic apparatus is to be used in the laboratory unless it is double insulated or battery operated.
12. Keep fluids, chemicals, and beat away from instruments and circuits.
13. Report any damages to equipment, hazards, and potential hazards to the laboratory instructor.
14. Regarding specific equipment, consult the instruction manual provided by the manufacturer of the equipment. Information regarding safe use and possible- hazards should be studied carefully.
15. Do not install standard electrical equipment in locations where flammable gases, vapours, dusts, or other easily ignitable materials are present. If electrical equipment is used in a chemical fume hood, elevate it to allow efficient air flow.
16. Use tools designed for electrical work that has a non-conductive cover. Electrically insulated gloves are also available.
17. Use appropriate rating of the electrical meters required for experiment.

Table of Content

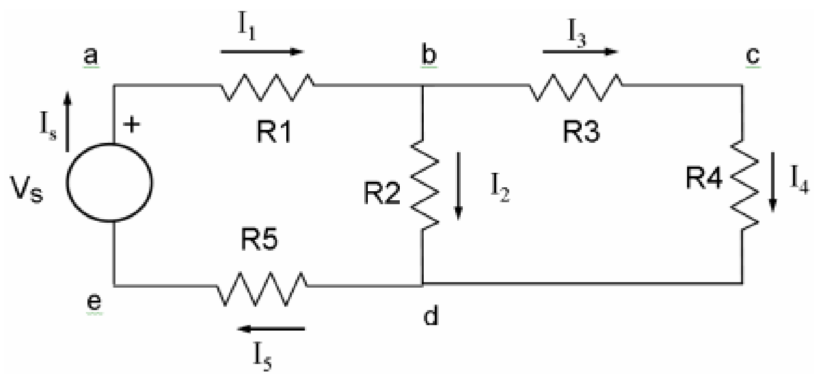
EXPERIMENT No.1

Aim: To verify Kirchhoff Voltage Law and Kirchhoff Current Law.

Apparatus required:

S. No.	Items	Specifications	Quantity
1	DC Voltage source	0-20V	01
2	Resistors	1-2 ohms	05
3	Ammeter	Digital type	01
4	Voltmeter	Digital type	01
5	Connecting wires	As per requirements	

1. Kirchhoff's Voltage Law states that the algebraic sum of all the voltages around any closed path (loop or mesh) is zero.



Applying Kirchhoff's voltage law to the first and the second loops in the circuit shown in Figure yields:

Loop 1: $-Vs + V1 + V2 + V5 = 0$ (1a)

Loop 2: $-V2 + V3 + V4 = 0$ (1b)

2. Kirchhoff's Current Law states that the algebraic sum of all the currents at any node is zero.

Applying Kirchhoff's current law to the first four nodes in the circuit shown in Figure yields the following equations;

Node a: $-Is + I1 = 0$ (2a)

Node b: $-I1 + I2 + I3 = 0$ (2b)

Node c: $-I3 + I4 = 0$ (2c)

Node d: $-I2 - I4 + I5 = 0$ (2d)

Procedure:

1. Construct the circuit shown in Figure using the values below:
   R1 = 1 KΩ R2 = 2.4 KΩ R3 = 1.2 KΩ R4 = 1 KΩ R5 = 1.2 KΩ
2. Set the Variable Power Supply (Vs) to 5 Volts.
3. Accurately measure all voltages and currents in the circuit using the Digital Multi-Meter (DMM).
4. Record the measurements in a tabular form containing the measured voltage and current values.
5. Verify KVL for the loops in the circuit using equations 1a and 1b.
6. Verify KCL for the nodes in the circuit using equations 2a, 2b, 2c and 2d.

Precautions:

1. All the connections should be perfectly tight.
2. Always connect ammeter in series and voltmeter in parallel
3. Use safety guards while working on live parts
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor
6. Use proper wire for connections

Worksheet of the students

Observation and Calculations:

Branch current/voltage	V [volts]	I [mA]	R [KΩ]
V1, I1			
V2, I2			
V3, I3			
V4, I4			
V5, I5			
Vs, Is			

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.2

Aim: To understand the principle of turn ratio of a transformer.

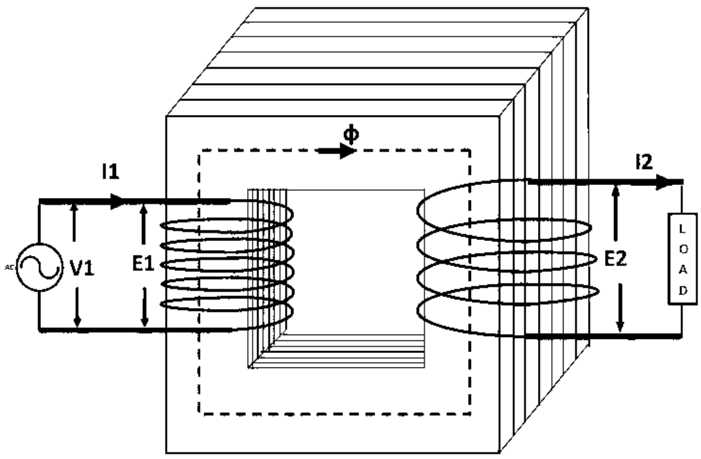
Apparatus Required:-

S. No.	Apparatus Required	Specification	Qty.
1	Transformer	1 Φ,2KVA, 220/220 V	1
2	Auto Transformer	1 Φ,0-270V	1
3	Voltmeter	Digital	1

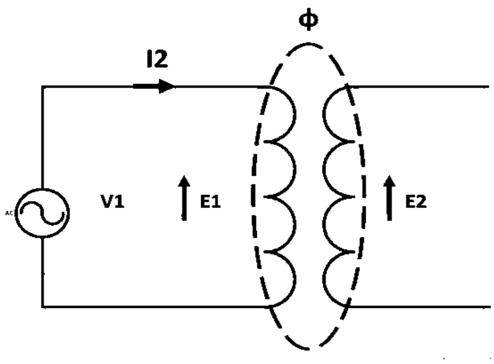
Theory:

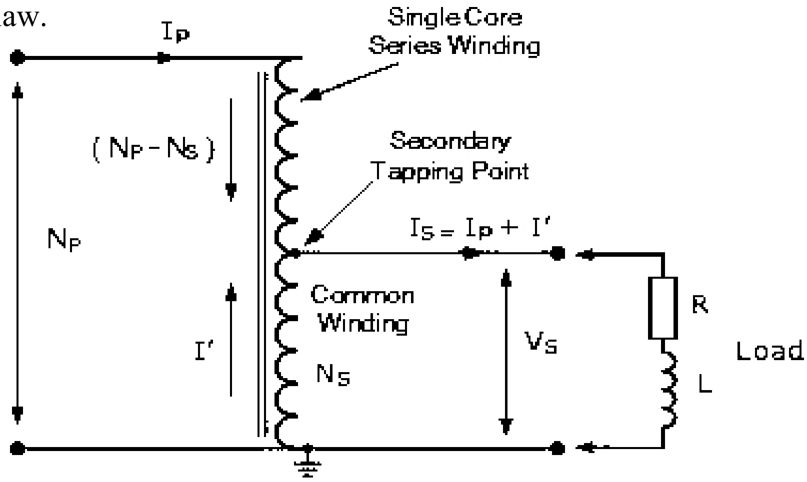
A transformer is a static device which transfers electrical energy from one circuit to another with no direct electrical connection between the two but they are magnetically coupled. It transforms power from one circuit to another without changing its frequency and KVA. A transformer can increase or 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.

Working Principle: The basic principle on which the transformer works is **Faraday's Law of Electromagnetic Induction** or **mutual induction** between the two coils. The working of the transformer is explained below.



It consists of two separate windings placed over laminated silicon steel core. The winding to which AC supply is connected is called primary winding and to which load is connected is called secondary winding. It works on the alternating current only because an alternating flux is required for mutual induction between the two windings. When the AC supply is given to the primary winding with a voltage of V_1, an alternating flux ϕ sets up in the core of the transformer, which links with the secondary winding and as a result of it, an emf is induced in it called Mutually Induced emf. The direction of this induced emf is opposite to the applied voltage V_1, this is because of the Lenz's law.





The induced emf in the primary and secondary windings depends upon the rate of change of flux linkage that is ($N\ d\phi/dt$) where, $d\phi/dt$ is the change of flux and is same for both the primary and secondary windings. The induced emf $E_1 \propto N_1$. Similarly $E_2 \propto N_2$.

Turns Ratio:

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

Turns Ratio = N_1 / N_2

If $N_2 > N_1$ the transformer is called Step up transformer
If $N_2 < N_1$ the transformer is called Step down transformer
If $N_2 = N_1$ the transformer is called Isolation transformer

Transformation Ratio

The transformation ratio is defined as the ratio of the secondary voltage to the primary voltage. It is denoted by K.

$$\textbf{Turns Ratio} = \frac{N_1}{N_2}$$

Procedure

1) Connect the primary side of the transformer with the auto transformer.
2) Turn on the supply
3) Measure the voltage on the secondary side using multimeter.

(NOTE: For step up transformer the percentage take tapping on the primary side should be less than the secondary side while for step down transformer it should be more than that of secondary.)

4) Calculate the value of turns ratio.

Precautions:

1. All the connections should be perfectly tight.
2. Always connect ammeter in series and voltmeter in parallel
3. Use safety guards while working on live parts
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor
6. Use proper wire for connections.

Worksheet of the students

Observation and Calculations:

S.No.	V1	V2	N1	N2	Turns ratio

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No. 3

Aim: To verify Thevenin's and Norton's theorems in DC circuits along with simulation on P-spice.

Experiment No. 3.1: Verification of Thevenin's theorem.

Apparatus required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1Kohm, 330ohm	3,1
4	Bread Board	--	Required
5	DRB	--	1

Statement:

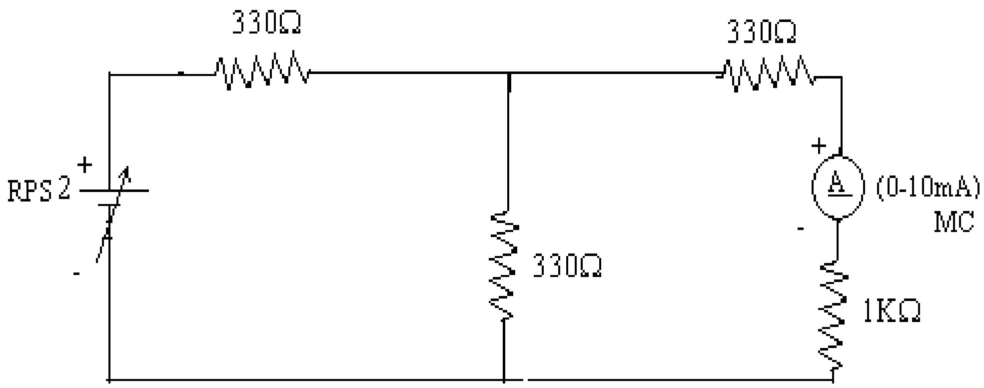
Any linear bilateral, active two terminal network can be replaced by a equivalent voltage source (V_{TH}). Thevenin's voltage or V_{OC} in series with looking back resistance R_{TH}.

Procedure:

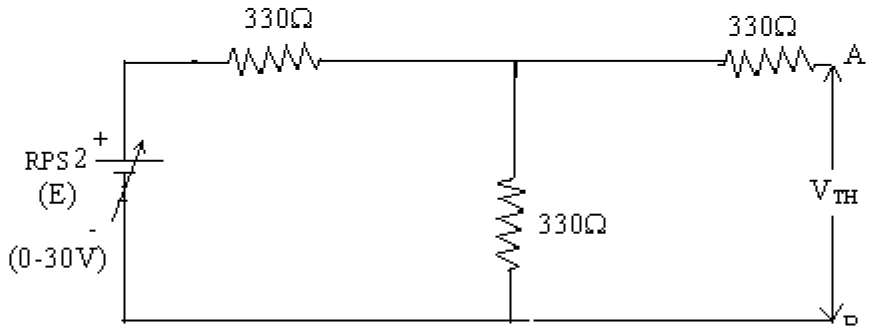
1. Connections are given as per the circuit diagram.
2. Set a particular value of voltage using RPS and note down the corresponding ammeter readings.
3. To find V_{TH} : Remove the load resistance and measure the open circuit voltage using multimeter (V_{TH}).
4. To find R_{TH} : Remove the RPS and short circuit it and find the R_{TH} using multimeter.
5. Give the connections for equivalent circuit and set V_{TH} and R_{TH} and note the corresponding ammeter reading.
6. Verify Thevenins theorem.

Circuit Diagrams:

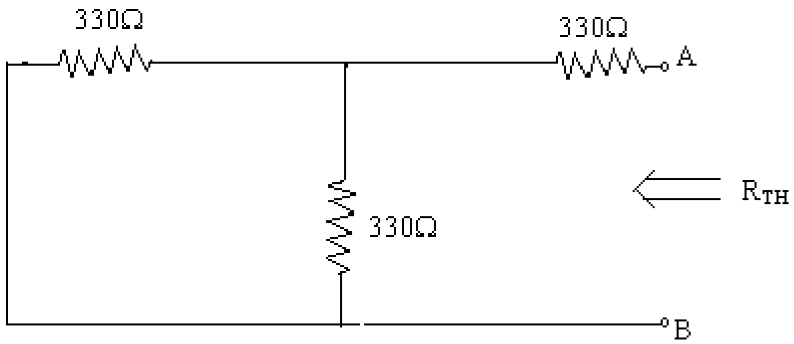
Circuit - 1 : To find load current



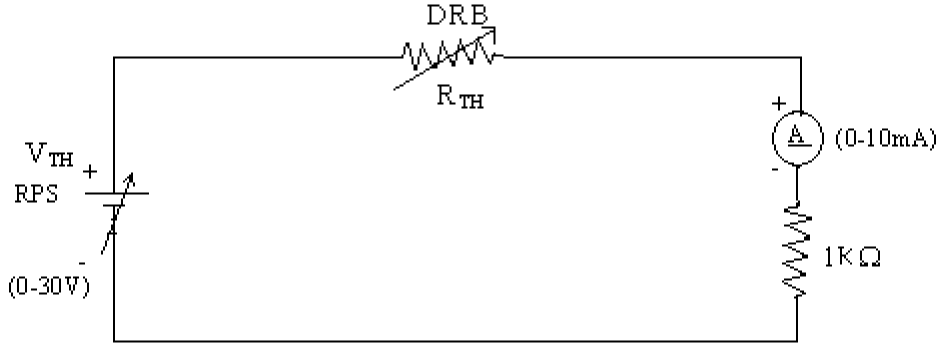
Circuit 2: To find V_{TH}



Circuit 3 : To find R_{TH}



Thevenin's Equivalent Circuit:



Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position

Worksheet of the student

Date of Performance: Registration Number:

Observation Table:

Load current from Circuit 1	V_{TH} from Circuit 2	R_{TH} from Circuit 3	V_{TH} / R_{TH}

Calculations:

Results and Discussion:

Learning Outcomes (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, Discipline and Cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

Experiment No. 3.2: Verification of Norton's theorem.

Apparatus required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1Kohm, 330ohm	3,1
4	Bread Board	--	Required
5	DRB	--	1

Statement:

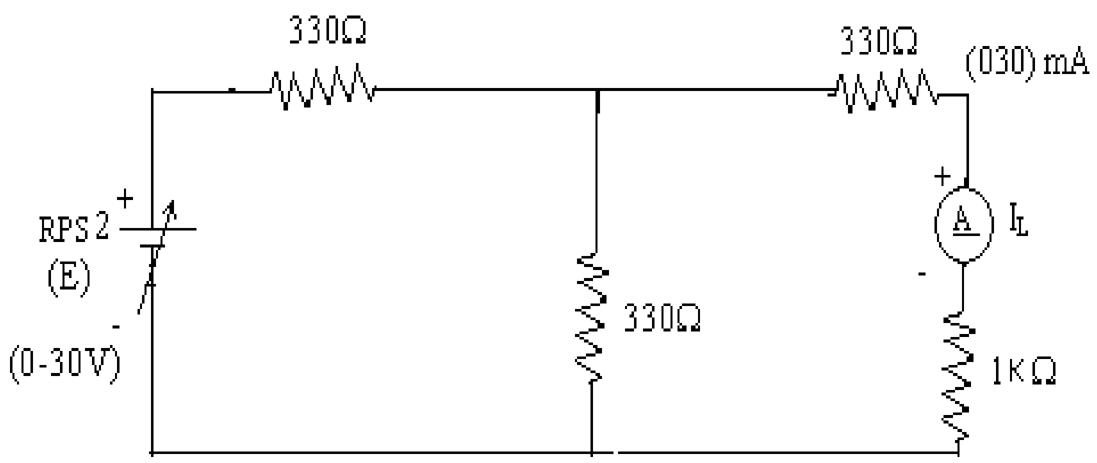
Any linear, bilateral, active two terminal network can be replaced by an equivalent current source (I_N) in parallel with Norton's resistance (R_N)

Procedure:

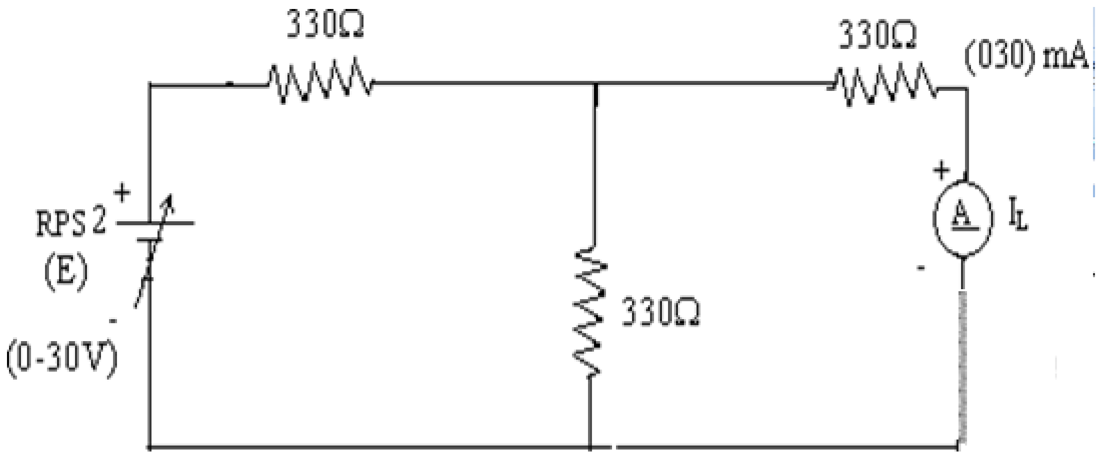
1. Connections are given as per circuit diagram.
2. Set a particular value in RPS and note down the ammeter readings in the original circuit.
3. To Find I_N: Remove the load resistance and short circuit the terminals.
4. For the same RPS voltage note down the ammeter readings.
5. To Find R_N: Remove RPS and short circuit the terminal and remove the load and note down the resistance across the two terminals.
6. Equivalent Circuit: Set I_N and R_N and note down the ammeter readings.
7. Verify Norton's theorem.

Circuit Diagrams:

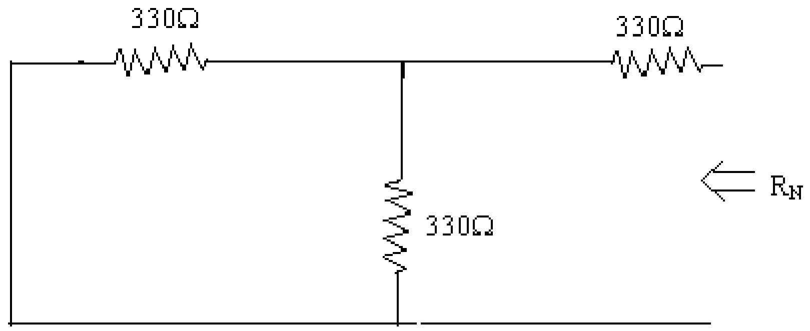
Circuit 1: To find load current



Circuit 2: To find I_N



Circuit 3: To find R_N



Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position.

Worksheet of the student

Date of Performance: Registration Number:

Observation Table:

Load current from Circuit 1	I_N from Circuit 2	R_N from Circuit 3	

Calculations:

Results and Discussion:

Learning Outcomes (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, Discipline and Cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT 4

Aim :-To compare incandescent lamp, fluorescent lamp, CFL and LED based light source for its efficiency, Switching control of single lamp by using four 2 way switches.

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Apparatus Required:-

. No.	Apparatus Required	Specification	Qty.
1	Incandescent Lamp(Bulb)	230V,40W	1
2	Fluorescent Lamp	230V,40W	1
3	CFL	230V,40W	1
4	LED	230V,40W	1
5	Luxmeter	Digital	1
6	SPDT Switch	230V,10A	2
7	Bulb	230V,60W	1
8	Wires	As per requirement	

Theory: There are various light sources used at home such as Incandescent lamp,fluorescent lamp, CFL and LED . Out of all these LED is the greenest option available in all forms of lighting. And that is because:

- It does not contain any mercury, which is harmful for environment unlike the fluorescent bulbs and lights.
- It lasts much longer (about 10-20 years) and thus their disposal is less of a concern.

Fluorescent lights and CFLs on the other hand contain mercury that is harmful for environment and their disposal is a concern.
Most fluorescent bulbs/tubes may not last more than 3-4 years (10000-15000 hrs of usage). But LEDs last much longer (upto 25000-50000 hrs of usage).

Lumens or brightness of the light:LEDs are always marketed as lighting options that givemore brightness per watt of electricity. The claim is true if LEDs are used for spotlighting. LEDs are unidirectional source of light and thus they are excellent for spot lighting. LED luminaires that are available for general-purpose lighting have inbuilt reflectors that spread the light in all directions. And the use of reflectors causes decrease in brightness per watt. This results in their efficiency come down to as low as that of fluorescent lights.

Costs: It’s commonly known that LED luminaires are expensive. They cost at least 3-4 times more than T5 fluorescent lights. However their life is also much longer as compared to fluorescent lights.

	Incandescent Bulbs	CFLs	LED Bulbs
Life (4 hours daily usage)	4 months (observed)	2.5 years (observed)	10 years (advertised)
Wattage of Bulb Required	40	8	5
Savings (compared to Incandescent Bulbs)	0%	45.74%	73.98%
Lumen / Watt	16	50 - 70	90 - 100
Total Cost of Ownership per year (C = A + B)	Rs. 545.24	Rs. 295.82	Rs. 141.82
Cost of Bulb / Year (B)	Rs. 75.00	Rs. 74.00	Rs. 46.90
Cost of Bulb	Rs. 25.00	Rs. 185.00	Rs. 469.00
Electricity Cost per Year (Rs. 6.75/KWH) (A)	Rs. 470.24	Rs. 221.82	Rs. 94.92

Wiring Standards: Wires **and** cables **are** rated by the circuit voltage, temperature and environmental conditions in which they can be used, and their maximum current. Wiring safety codes vary by country, and the International Electro-technical Commission (IEC) is attempting to standardize wiring amongst member countries. Colour codes are used to distinguish line, neutral and earth (ground) wires.

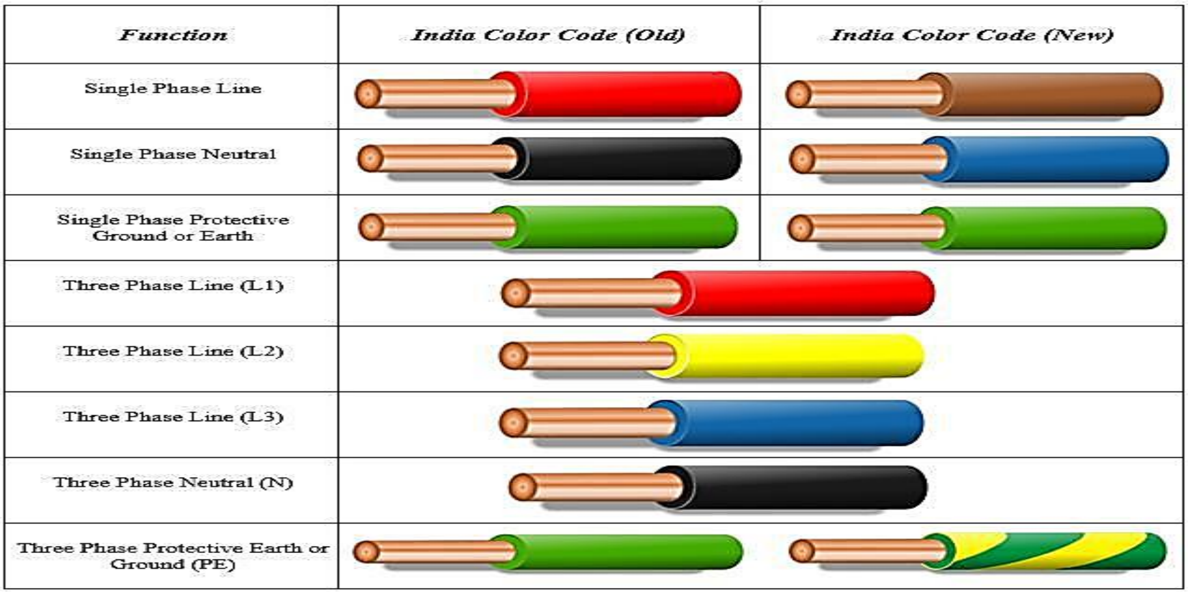
Wire Rating: The conductor material, insulation, size and the number of cores, specifies the electrical wires. These are important parameters as they determine the current and voltage handling capability of the wires. The wires may be of single strand or multi strand. The conductors are specified as 1/20,3/22,7/20etc.The numerator indicates the number of strands while the denominator corresponds to the diameter of the wire in SWG (Standard Wire Gauge).As the SWG number increases the thickness of the wire decreases. The selection of the wire is made depending on the requirement considering factors like current and voltage ratings, cost and application

Colour coding: Electrical wires follow standard colour coding that helps classify each wirefunction in the circuit. **In India wires are RGB mode i.e. Red- Green- Black**. Each of these RGB wire have different functions.

Red –Red wire signifies the phase in electric circuit. It is he live wire which cannot beconnected to another red wire or black wire. When the switch is turned on, the wire becomes hot that’s why it’s known as hot wire.

Black –Black wires signifies neutral wire in electric circuit. Black wire can be connected to black wire only and no other colour wire. Black wire being neural, it does carry charge/current. It mainly carries the unbalanced load i.e. the return current that we call.

Green –Green wire stands for grounding/ earthing in electric circuit. A green wire can be connected to green wire only (no other wire). Grounding wires are usually not meant for lights and fan purposes. Green wires are chiefly used for socket purpose. Socket could be for AC, geyser, TV, microwave, etc. Normally, switches have only 2 wires i.e. neutral and phase.

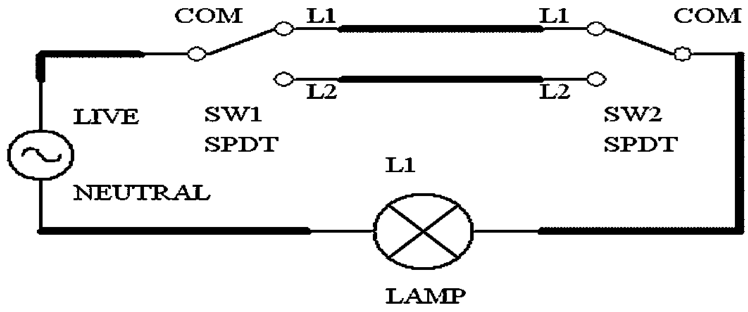


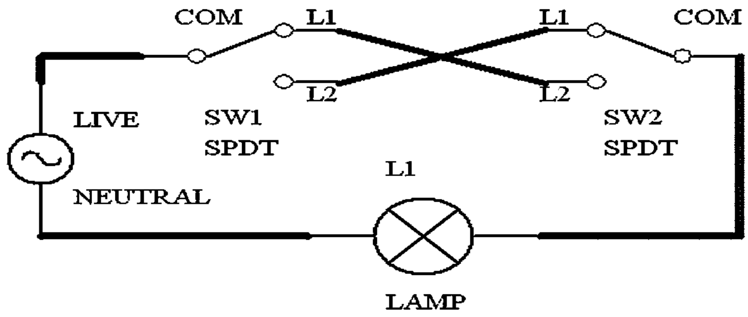
Two Way Switch: 2 way switching means having two or more switches in different locationsto control one lamp. They are wired so that operation of either switch will control the light. This arrangement is often found in stairways or in long hallways with a switch at either end. The switches can be connected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

SWG TO mm CONVERSION TABLE

SWG	Dia(mm)	SWG	Dia(mm)	SWG	Dia(mm)	SWG	Dia(mm)
1	7.62	14	2.032	27	0.4166	40	0.1219
2	7.0104	15	1.8288	28	0.3759	41	0.1118
3	6.4008	16	1.6256	29	0.3454	42	0.1016
4	5.8928	17	1.4224	30	0.315	43	0.0914
5	5.3848	18	1.2192	31	0.2946	44	0.0813
6	4.8768	19	1.016	32	0.2743	45	0.0711
7	4.4704	20	0.9144	33	0.254	46	0.061
8	4.064	21	0.8128	34	0.2337	47	0.058
9	3.6576	22	0.7112	35	0.2134	48	0.0406
10	3.2512	23	0.6096	36	0.193	49	0.0305
11	2.9464	24	0.5588	37	0.1727	50	0.0254
12	2.6416	25	0.508	38	0.1524		
13	2.2368	26	0.4572	39	0.1321		

Circuit Diagram:-





Procedure:

1) Connect the Incandescent bulb in series to the power supply.
2) Connect voltmeter in parallel and ammeter in series to the incandescent bulb
3) Place the lux meter at some specific distance from incandescent bulb. If required, take help of scale for this purpose.
4) Note down the lumens and fix this lumens as reference for rest of the bulbs.
5) Note down the reading of voltmeter and ammeter.
6) Repeat steps 1 to 5 for the fluorescent lamp, CFL and LED bulbs.

Precautions:

1. All the connections should be perfectly tight.
2. Use safety guards while working on live parts.
3. Don’t touch the bare conductor when supply is ON.
4. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor.

Worksheet of the students

Observation and Calculations:

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

Truth table for Switching control:

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		20
2	Observations and analysis including learning outcome		20
3	Completion of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.5

Aim: To learn the use of electrical fuse, MCB, energy meter, house wiring and connection of switches.

Apparatus required:

S. No.	Items	Specifications	Quantity
1	Kit Kat Fuse	0-10A	02
2	MCB	0-10A	01
3	ELCB	0-230V	01
4	Switch	0-10A	01
5	Ammeter	Digital type	01
6	Voltmeter	Digital type	01
7	Variac	1-phase, 230V	01
8	Resistive load	200-2000W	01 Set
9	Connecting wires	As per requirements	

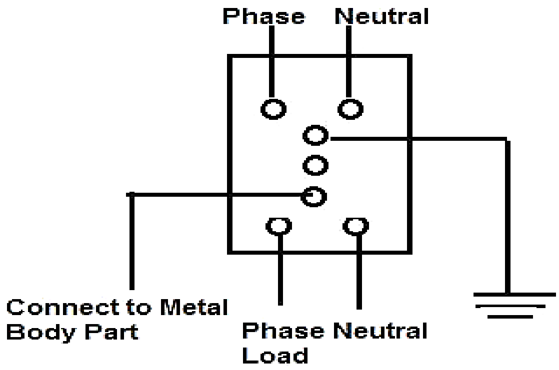
Theory: Over current protection devices are essential in electrical systems to limit threats tohuman life and property damage. Short circuits, overloading, mismatched loads, or device failure are the prime reasons for excessive current. So we need devices to prevent safety hazards to the end user. The various protecting devices used for domestic purposes are,

a. Kit Kat Fuse
b. Miniature Circuit breaker (MCB)
c. Earth Leakage Circuit breaker (ELCB)

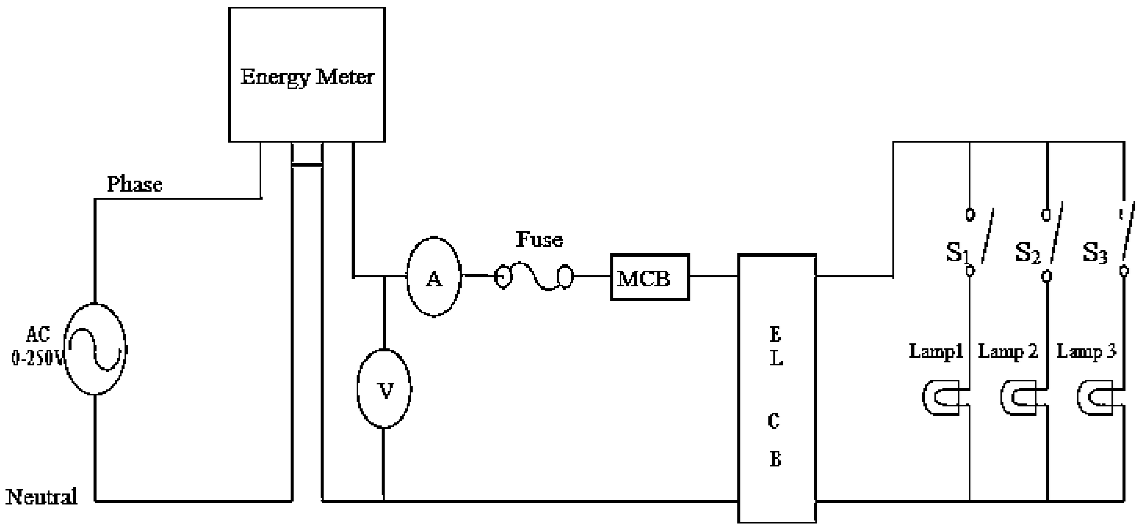
Fuse: It interrupts excessive current so that further damage by overheating or fire isprevented. It is a short length of wire, having low resistance designed to melt and separate in the event of excessive current and provide protection of either the load or source circuit.

MCB: It is abbreviated for miniature circuit breaker (MCB). It also interrupts the excessivecurrent in the circuit due to over loading, short circuiting and when live conductor comes in contact with earth surface.

Earth leakage circuit breaker (**ELCB**): It is a safety device used in electrical installationswith high earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected.
The ELCB detects fault currents from live to the earth (ground) wire within the installation it protects. If sufficient voltage appears across the ELCB's sense coil, it will switch off the power, and remain off until manually reset. A voltage-sensing ELCB does not sense fault currents from live to any other earthed body.



Circuit Diagram:



Procedure:

1. Connect the energy meter just after the supply terminals of variac.
2. Connect MCB/FUSE/ELCB in the circuit as shown in diagram.
3. Connect the load across the supply after protecting devices as per diagram.
4. Now gradually vary the supply in the circuit, so that current flowing through the circuit increases.
5. With different size of fuse wire, connect the full load across the system and note down the value of current/voltage at which Fuse burns/MCB trips/ELCB operates independently.
6. Connect the ammeter and voltmeter as shown in circuit diagram.
7. Connect the variable resistive load and vary the load as per requirement.

Precautions:

1. All the connections should be perfectly tight.
2. Always connect ammeter in series and voltmeter in parallel
3. Use safety guards while working on live parts
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor
6. Use proper wire for connections.

Worksheet of the students

Observation and Calculations:

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.6

Aim: To understand the use of diode for half wave and full wave rectifiers.

Apparatus Required:-

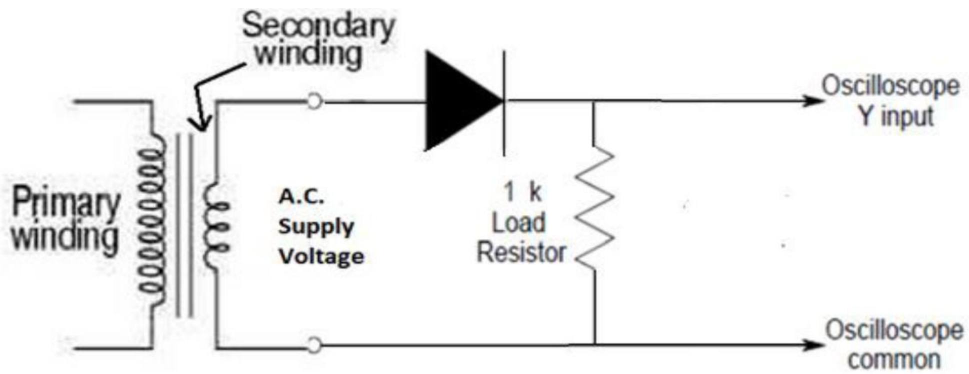
S. No.	Apparatus Required	Specification	Qty.
1	Diode	1N4007	2
2	Power supply	DC	1
3	Resistor	1kΩ	1
4	CRO	Dual trace,Digital	1

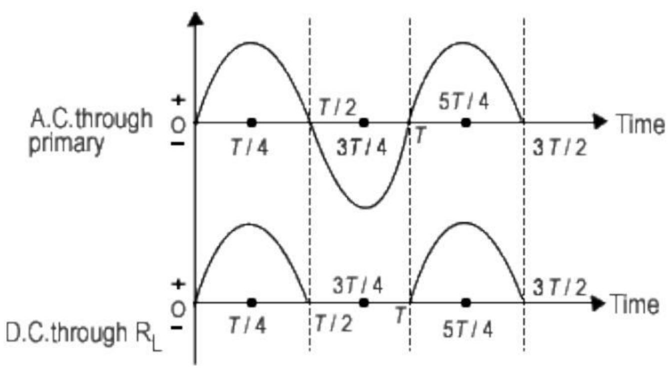
Theory:

A rectifier is a device that converts AC to DC. It can be of two types:

1) Half Wave Rectifier
2) Full wave reactifier

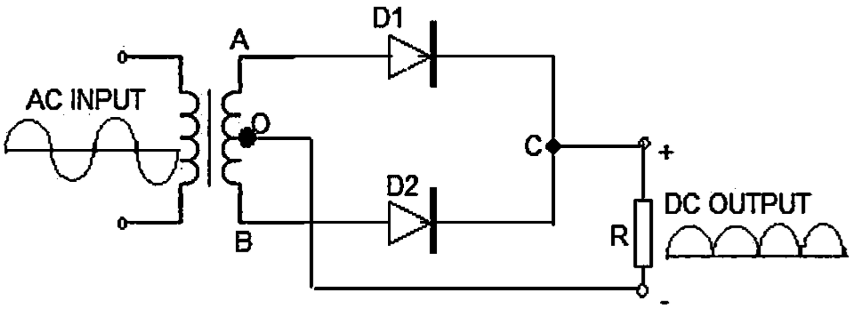
Half Wave Rectifier: In half-wave rectification of a single-phase supply, either the positiveor negative half of the AC wave is passed, while the other half is blocked. Because only one half of the input waveform reaches the output, mean voltage is lower. The peak value of the output is same as that of input voltage.



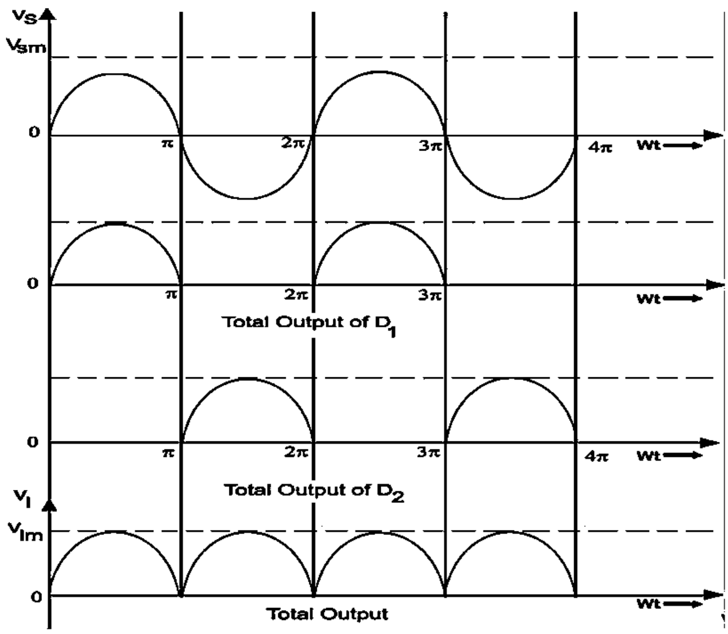


Full Wave Rectifier:

A full-wave rectifier converts the whole of the input waveform to one of constant polarity (positive or negative) at its output. Full-wave rectification converts both polarities of the input waveform to pulsating DC (direct current), and yields a higher average output voltage. In this case the peak value of the output voltage will be half of the total input voltage on the secondary side.



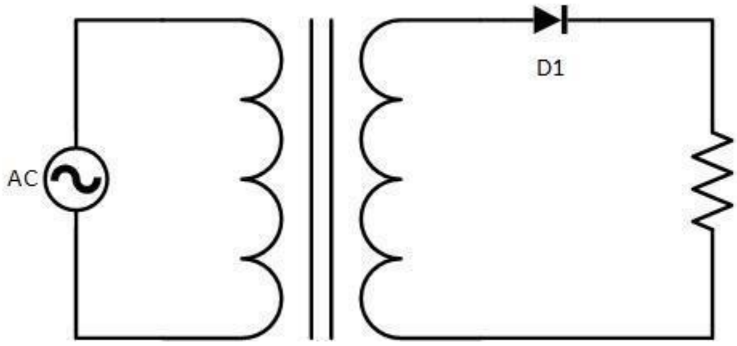
Full Wave rectifier (Centre tap)



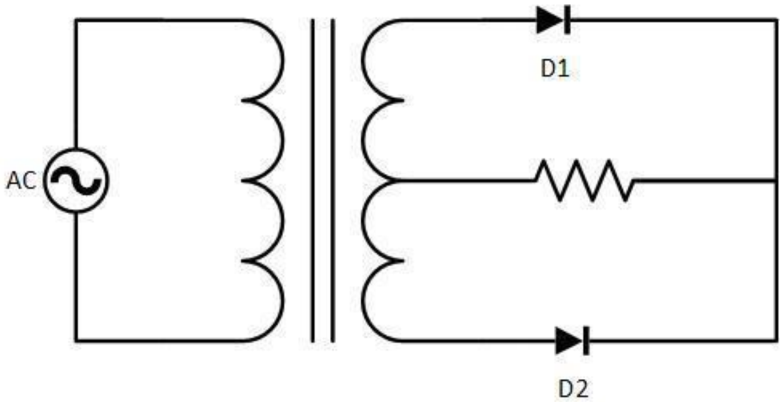
Procedure:

1) Connect the circuit as per the circuit diagram.
2) Switch on the oscilloscope in dual race mode and sinusidal supply.
3) Adjust the time base of the oscilloscope and and the Y axis for both the channels in order to obtain the desired graph on the screen.
4) Measure and record time T and peak voltage V_P.
5) Trace the waveform.
6) Confirm that V_P should be same as the peak value of the alternating supply in case of half wave while in case of Full wave it will be halved.

Circuit Diagram:



Half Wave Rectifier



Full Wave Rectifier

Worksheet of the students

Observation and Calculations:

Rectifier type	Input V_{peak}	Output V_{peak}	Output V_{rms}	Ripple frequency
Half wave				
Full wave				

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.7

Aim: To understand principle of speed control of a DC motor using hardware and Proteus software.

Apparatus Required:-

S. No.	Apparatus Required	Specification	Qty.
1	DC motor	Permanent magnet motor	1
2	Ammeter	0-5A DC	1
3	Tachometer	Digital	1

Theory: 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 carryingconductor is placed in a magnetic field, it experiences a mechanical force"*. The direction ofthis 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.

A motor has basically two main parts:

a) Stator, which contains the field windings

b) Rotor, which carries the armature conductor.

Back Emf: When the armature of the motor is rotating, the conductors are also cutting themagnetic 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 (I_a) .

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’**.

$$E_a = V_T - I_a \cdot R_{acir}$$

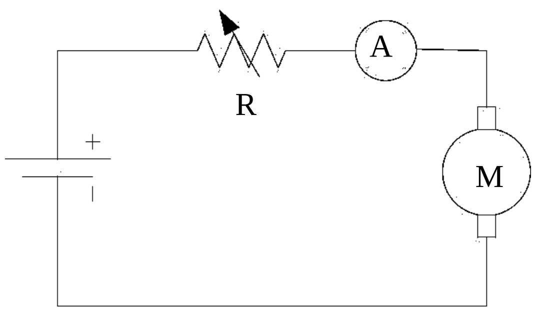
$$n = \frac{E_a}{\Phi_p \cdot K_G}$$

$$n = \frac{V_T - I_a \cdot R_{acir}}{\Phi_p \cdot K_G}$$

Procedure:

1) Connections are made as per the circuit diagram.
2) Now armature voltage is fixed t various values and for each fixed value, by adjusting the field rheostat, speed is noted using tachometer for various field currents
3) .Convert the RPM to angular speed(in rad/sec)

Circuit diagram:



Worksheet of the students

Observation and Calculations:

S.No.	V (i Volts)	I (in Amp)	N (RPM)	ω (Rad/sec)

Calculations:

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		20
2	Observations and analysis including learning outcome		20
3	Completion of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.8

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

Apparatus Required:-

Sr. No.	Component	Specification	Quantity
1	Oscilloscope	-	1
2	Function generator	-	1
3	Circuit breadboard	-	1
4	Resistor	10 kΩ	1
5	Capacitor	0.01 μF	1

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.

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

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

According to the operating frequency range, the filters may be classified as audio frequency (AF) or radio frequency (RF) filters.

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, fc 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, fc point and higher to infinity to pass through while blocking those any lower.
3. **Band Pass Filter:** The band pass filter allows signals falling within a certain frequency band set up between two points to pass through while blocking both the lower and higher frequencies either side of this frequency band.
4. **Band Stop Filter:** The band stop filter blocks signals falling within a certain frequency band set up between two points while allowing both the lower and higher frequencies either side of this frequency band.

Procedure:

Low-pass Filter

1. Set up the circuit in figure 1.Channel 1 is observing the incoming signal and channel 2 is looking at the out coming signal. Make sure you use the same ground point in your circuit for both channels.
2. Set the V_{in} to 3.5 volts peak to peak (3.5 V_{pp}) at 500 Hz.
3. Use the measurement tools on the scope to measure the amplitude and frequency of the incoming signal and outgoing signal.
4. Record the data for 10 points from 500 Hz to 10,000 Hz
5. Graph the results of Vout vs. frequency
6. Use the graph to find the cutoff frequency.
7. Calculate the cutoff frequency and compare

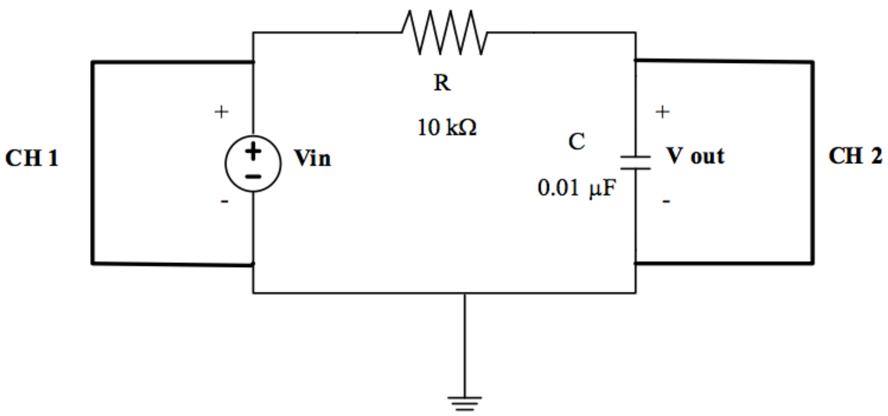


Figure 1

High Pass Filter:

1. Build the circuit in figure 2.
2. Repeat the above procedure for the high pass filter and find its cut-off frequency from m graph and calculation.

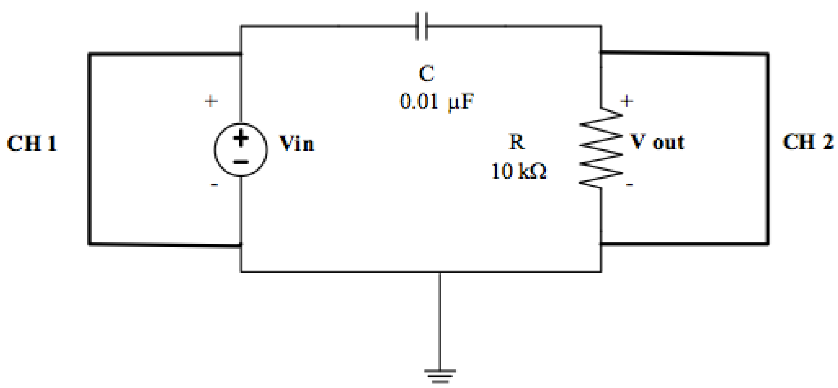


Figure 2

Worksheet of the students

Observations:

Observation table for low pass filter:

S.No.	Frequency	V_{out}

Observation table for high pass filter:

S.No.	Frequency	V_{out}

Calculations:

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		20
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3	Completion of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT NO.9

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

Apparatus Required:

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
7	IC Trainer Kit	--
8	Single stranded Wire	--

Theory:

AND gate: The AND gate is an electronic circuit that gives a **high** output (1) only if **all** itsinputs are high. A dot (.) is used to show the AND operation i.e. A.B. Bear in mind that this dot is sometimes omitted i.e. AB

OR gate: The OR gate is an electronic circuit that gives a high output (1) if **one or more** ofits inputs are high. A plus (+) is used to show the OR operation.

NOT gate: The NOT gate is an electronic circuit that produces an inverted version of theinput at its output. It is also known as an *inverter*. If the input variable is A, the inverted output is known as NOT A. This is also shown as A', or A with a bar over the top, as shown at the outputs.

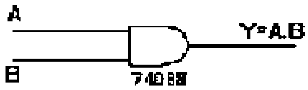
NAND gate: This is a NOT-AND gate which is equal to an AND gate followed by a NOTgate. The outputs of all NAND gates are high if **any** of the inputs are low. The symbol is an AND gate with a small circle on the output. The small circle represents inversion.

NOR gate: his is a NOT-OR gate which is equal to an OR gate followed by a NOT gate.The outputs of all NOR gates are low if **any** of the inputs are high.The symbol is an OR gate with a small circle on the output. The small circle represents inversion.

EXOR gate: The '**Exclusive-OR**' gate is a circuit which will give a high output if **either, but not both**, of its two inputs are high. An encircled plus sign ($\oplus$) is used to show the EOR operation.

AND GATE

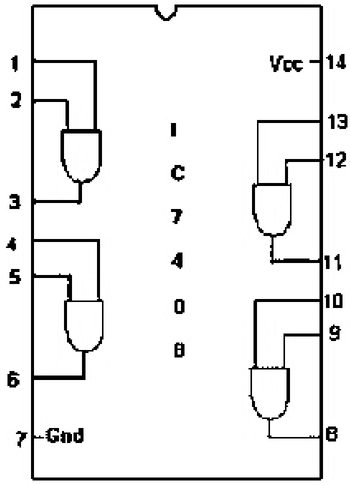
SYMBOL:



TRUTH TABLE

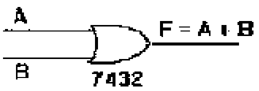
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

PIN DIAGRAM:



OR GATE

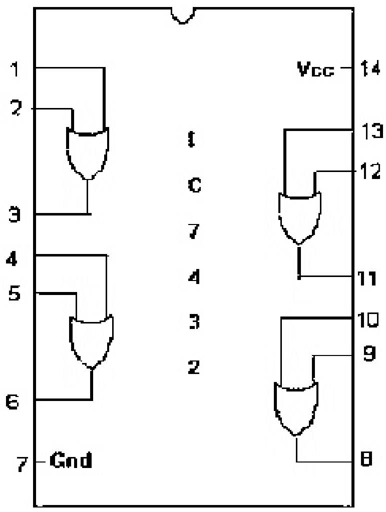
SYMBOL :



TRUTH TABLE

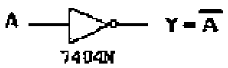
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

PIN DIAGRAM :

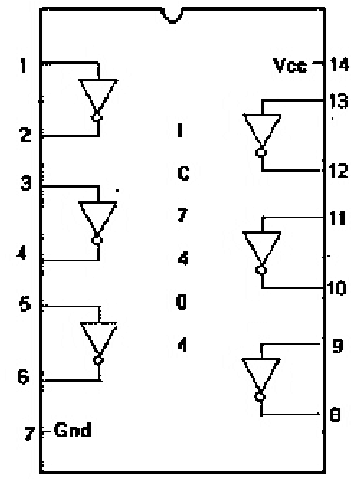


NOT GATE

SYMBOL:



PIN DIAGRAM:



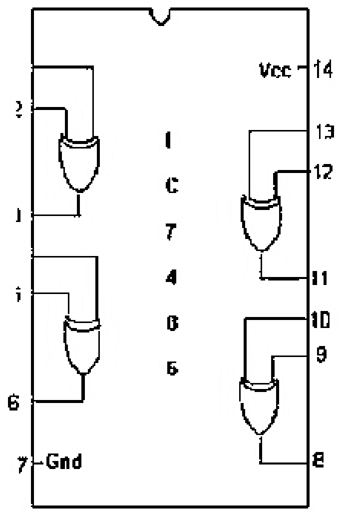
TRUTH TABLE :

A	$\overline{A}$
0	1
1	0

XOR GATE

SYMBOL :

PIN DIAGRAM :

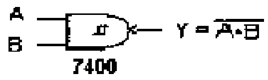


Truth table for XOR Gate

INPUTS		OUTPUTS
A	B	$Y = A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

NAND GATE

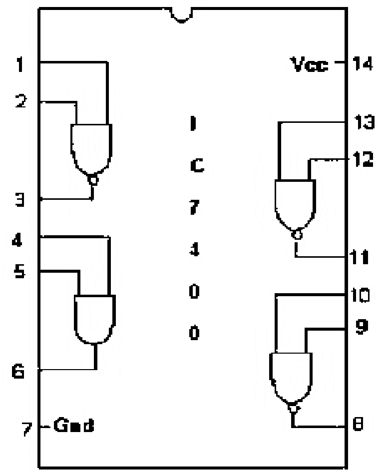
SYMBOL:



TRUTH TABLE

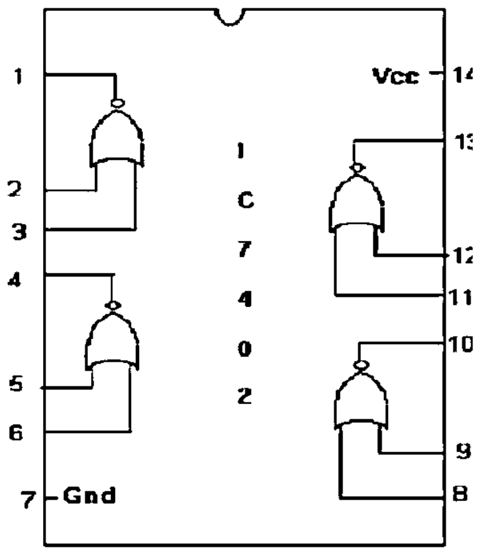
A	B	$\overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

PIN DIAGRAM:

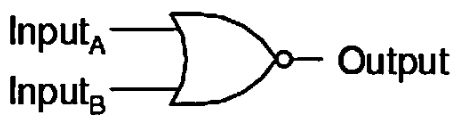


NOR GATE

PIN DIAGRAM :



NOR gate



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

Worksheet of the students

Date of Performance: **Registration No.:**

Truth Table:

Results and Discussion:

Learning Outcome(what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT NO. 10

Aim: To study VI characteristics of a zener diode and its application as a voltage regulator.

Apparatus Required:

S. No.	Apparatus Required	Specification	Qty.
1	Zener Diode	1N4728A	1
2	Power supply	DC	1
3	Resistor	1kΩ	1
4	Ammeter	0-5mA	1
5	Voltmeter	0-15V, 0-5V	1 each
5	CRO	Dual trace,Digital	1

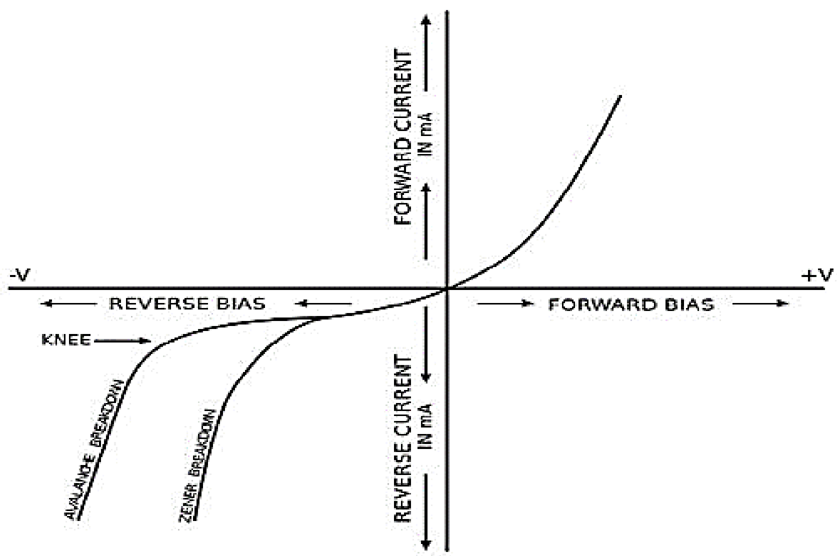
Theory:

A **Zener diode** acts as normal diode in forward dirction, but conducts in the reverse direction also when its "Zener voltage" is reached. Zener diodes have a highly doped p-n junction. Normal diodes will also break down with a reverse voltage but the voltage and sharpness of the knee are not as well defined as for a Zener diode. Also normal diodes are not designed to operate in the breakdown region, but Zener diodes can reliably operate in this region.

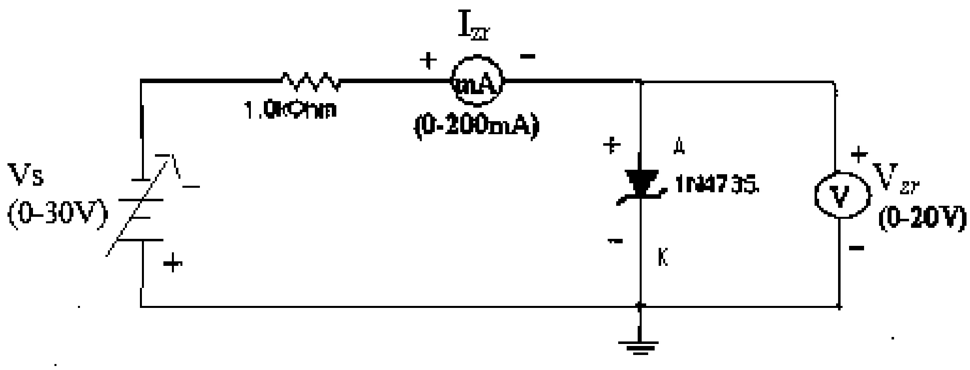
Zener Breakdown: Since they are heavily doped so they have narrow depletion region which is seen to increase with an increase in the voltage applied across its terminals, which increases the electric field developed across the p-n junction. Due to this intensified electric field, a few of the covalent bonds in the p-n junction break-off releasing their valence electrons. Such free electrons will get excited and move into the conduction band leading to an abrupt increase in the current flow through the device. This phenomenon is referred to as Zener Breakdown and the corresponding voltage is called **Zener Breakdown** Voltage.

Zener Diode As A Voltage Regulator:

A zener diode can be used to stabilize or regulate voltage. he zener diode is connected in series with resistor RS.The resistor allows enough current to flow for the zener diode to operate in the zener breakdown region. The DC input voltage must be higher than the zener diode breakdown voltage. The voltage drop across the zener diode is equal to the zener diode’s voltage rating. Zener diodes are manufactured to have a specific breakdown voltage rating that is often referred to as the diode’s *zener voltage rating* (EZ). The voltage drop across the resistor is equal to the difference between the zener (breakdown) voltage and the input voltage. The input voltage may increase or decrease. This causes the current through the zener diode to increase or decrease accordingly. When the zener diode is operating in the zener voltage, or breakdown region, a large current will flow through the zener with an increase in input voltage. However, the zener voltage remains the same. The zener diode opposes an increase in input voltage, because when the current increases the resistance drops. This allows the zener diode’s output voltage to remain constant as the input voltage changes. The change in the input voltage appears across the series resistor. The resistor is in series with the zener diode, and the sum of the voltage drop must equal the input voltage.



Circuit Diagram:



Procedure:

1) Connect the circuit diagram as per the circuit diagram.
2) Turn on the supply first in reverse biased mode.
3) Slowly and gradually vary the input voltage and note down the readings of the ammeter and voltmeter.
4) Plot a graph to obtain the breakdown point.
5) For forward characteristic: Reverse the Zener diode and now again vary the input voltage from zero to higher values and note down the reading of Ammeter and voltmeter
   Note: In case of forward characteristic, lower range voltmeter has to be used.

Worksheet of the students

Observation and Calculations:

Reverse characteristic:

S.No.	Vinput	Voutput	I

Forward characteristic:

S.No.	Voutput	I

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Faculty Signature	**Total**	