18EES101J-BASIC ELECTRICAL AND ELECTRONICS ENGINEERING (LAB)

RECORD

SEMESTER I

ACADEMIC YEAR: 2018-19

NAME :

REG. NO.:

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

FACULTY OF ENGINEERING & TECHNOLOGY

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Formerly SRM University, Under section 3 of UGC Act, 1956)

S.R.M. NAGAR, KATTANKULATHUR – 603 203

KANCHEEPURAM DISTRICT

SRM Institute of Science and Technology

(Deemed to be University)

S.R.M. NAGAR, KATTANKULATHUR -603 203

KANCHEEPURAM DISTRICT

BONAFIDE CERTIFICATE

Register No______________________________

Certified to be the bonafide record of work done by _________________________ of _________________________ department, B.Tech degree course in the Practical of 18EES101J Basic Electrical and Electronics Engineering in **SRM IST, Kattankulathur** during the academic year 2018-2019.

Lab in-charge

Date: **Year Co-ordinator**

Submitted for end semester examination held in_______________________ Lab, SRM IST, Kattankulathur.

Date: **Examiner-1** **Examiner-2**

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's laws
2. Verification of All Theorems (Thevenin's theorem, Norton's theorem, Maximum power transfer theorem)
3. Transient analysis of RL an RC series circuits
4. Load test on single phase transformer
5. Demo of DC/AC machines & Parts
6. Types of wiring (fluorescent lamp wiring, staircase wiring)
7. Characteristics of semiconductor devices (PN junction, Zener diode, BJT)
8. Wave shaping circuits (Half and full wave rectifier, clipper)
9. Displacement measurement using LVDT and pressure measurement using Strain gauge
10. Verification and interpretation of Logic Gates.
11. Reduction of Boolean expression using K-map
12. Study of modulation and demodulation techniques.

INDEX

Sl. No.	Name of the Experiment	Marks (50)	Signature of the Staff
1	Verification of Kirchhoff's laws		
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General information

The Breadboard

The breadboard consists of two terminal strips and two bus strips (often broken in the centre). Each bus strip has two rows of contacts. Each of the two rows of contacts are a node. That is, each contact along a row on a bus strip is connected together (inside the breadboard). Bus strips are used primarily for power supply connections, but are also used for any node requiring a large number of connections. Each terminal strip has 60 rows and 5 columns of contacts on each side of the centre gap. Each row of 5 contacts is a node.

You will build your circuits on the terminal strips by inserting the leads of circuit components into the contact receptacles and making connections with 22-26 gauge wire. There are wire cutter/strippers and a spool of wire in the lab. It is a good practice to wire +5V and 0V power supply connections to separate bus strips.

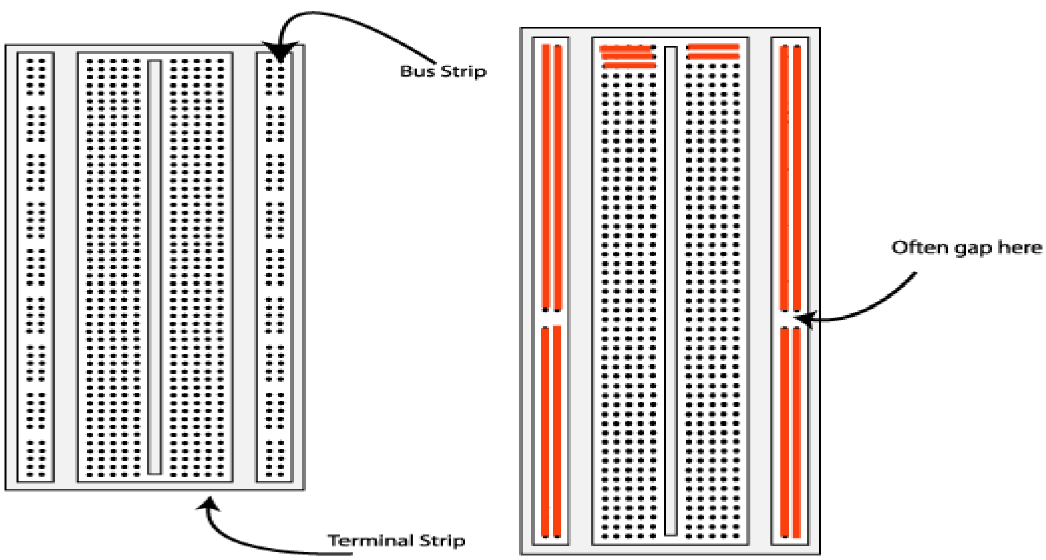

Fig 1. The breadboard. The lines indicate connected holes.

The 5V supply **MUST NOT BE EXCEEDED** since this will damage the ICs (Integrated circuits) used during the experiments. Incorrect connection of power to the ICs could result in them exploding or becoming very hot - with the **possible serious injury occurring to the people working on the experiment! Ensure that the power supply polarity and all components and connections are correct <u>before</u> switching on power .**

Building the Circuit

Throughout these experiments we will use TTL chips to build circuits. The steps for wiring a circuit should be completed in the order described below:

1. Turn the power (Trainer Kit) off before you build anything!
2. Make sure the power is off before you build anything!
3. Connect the +5V and ground (GND) leads of the power supply to the power and ground bus strips on your breadboard.
4. Plug the chips you will be using into the breadboard. Point all the chips in the same direction with pin 1 at the upper-left corner. (Pin 1 is often identified by a dot or a notch next to it on the chip package)
5. Connect +5V and GND pins of each chip to the power and ground bus strips on the breadboard.
6. Select a connection on your schematic and place a piece of hook-up wire between corresponding pins of the chips on your breadboard. It is better to make the short connections before the longer ones. Mark each connection on your schematic as you go, so as not to try to make the same connection again at a later stage.
7. Get one of your group members to check the connections, **before you turn the power on**.
8. If an error is made and is not spotted before you turn the power on. Turn the power off immediately before you begin to rewire the circuit.
9. At the end of the laboratory session, collect you hook-up wires, chips and all equipment and return them to the lab technician/ assisting staff.
10. Tidy the area that you were working in and leave it in the same condition as it was before you started.

Common Causes of Problems

1. Not connecting the ground and/or power pins for all chips.
2. Not turning on the power supply before checking the operation of the circuit.
3. Leaving out wires.
4. Plugging wires into the wrong holes.
5. Driving a single gate input with the outputs of two or more gates
6. Modifying the circuit with the power on.

In all experiments, you will be expected to obtain all instruments, leads, components at the start of the experiment and return them to their proper place after you have finished the experiment. Please inform the lab technician if you locate faulty equipment. If you damage a chip, inform a lab technician/ assisting staff, don't put it back in the box of chips for somebody else to use.

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Title of Experiment	: **1. Verification of Kirchhoff's Laws**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1. Define Ohm's law.

2. State KCL and KVL.

3. Define absolute potential and potential difference

4. What is the difference between mesh and loop?

5. What is super-node?

Experiment No. 1 Date :	VERIFICATION OF KIRCHOFF'S LAWS

Aim:

To verify Kirchhoff's current law and Kirchhoff's voltage law for the given circuit.

Apparatus Required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Resistance	330Ω, 220Ω 1kΩ	6
3	Ammeter	(0-30mA)MC	3
4	Voltmeter	(0-30V)MC	3
5	Bread Board & Wires	--	Required

Statement:

KCL: The algebraic sum of the currents meeting at a node/junction is equal to zero.

KVL: In any closed path / mesh, the algebraic sum of all the voltages is zero.

Precautions:

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

Procedure for KCL:

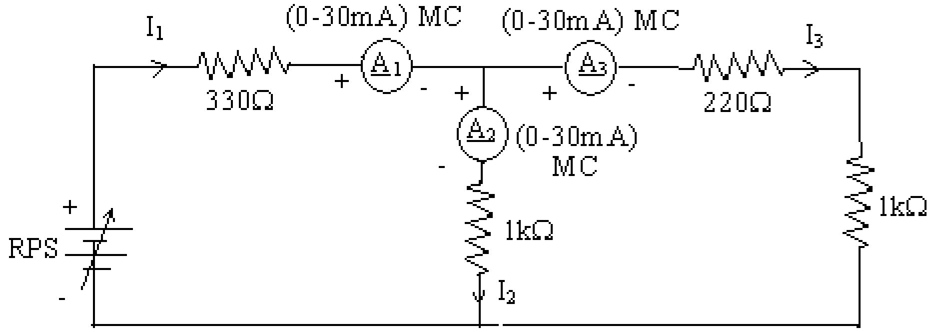
1. Give the connections as per the circuit diagram.
2. Set a particular value in RPS.
3. Note down the corresponding ammeter reading
4. Repeat the same for different voltages

Procedure for KVL:

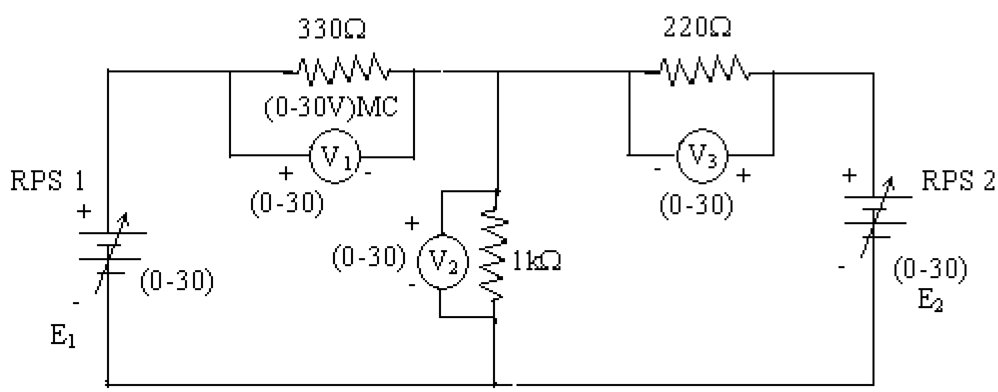
1. Give the connections as per the circuit diagram.
2. Set a particular value in RPS.
3. Note all the voltage reading
4. Repeat the same for different voltages

HARDWARE SETUP:

Circuit for KCL verification:



Circuit for KVL verification:



KCL - Theoretical Values:

Sl. No.	Voltage E	Current			$I_1 = I_2 + I_3$
		I_1	I_2	I_3	
	Volts	mA	mA	mA	mA
1					
2					
3					
4					
5					

KCL - Practical Values:

Sl. No.	Voltage E	Current			$I_1 = I_2 + I_3$
		I_1	I_2	I_3	
	Volts	mA	mA	mA	mA
1					
2					
3					

KVL – Theoretical Values

Sl.No.	RPS		Voltage			KVL
	E_1	E_2	V_1	V_2	V_3	$E_1 = V_1 + V_2$
	V	V	V	V	V	V
1						
2						
3						
4						
5						

KVL - Practical Values

Sl.No.	RPS		Voltage			KVL
	E_1	E_2	V_1	V_2	V_3	$E_1 = V_1 + V_2$
	V	V	V	V	V	V
1						
2						
3						

Model Calculations:

Result:

POST LAB QUESTIONS

1) **Illustrate KCL and KVL.**

2) **Express the limitations of Ohm's law?**

3) **What is the practical application of Kirchhoff's law?**

4) **Compare series and parallel circuits**

5) **What is the difference between series and parallel connection of batteries?**

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Title of Experiment	:	**2. VERIFICATION OF ALL THEOREMS- (THEVENIN, NORTON, MAXIMUM POWER TRANSFER)**
Name of the candidate	:	
Register Number	:	
Date of Experiment	:	

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1. Define Lumped and distributed elements.

2. State Thevenin's theorem?

3. State Norton's theorem?

4. List the applications of Thevenin's and Norton's theorems?

5. What are the different types of dependent or controlled sources?

Experiment No. 2 a) **Date :**	**THEVENIN'S THEOREM**

Aim:

To verify Thevenin's theorem and to find the full load current for the given circuit.

Apparatus Required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1KΩ, 330Ω	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 pack resistance R_{TH}.

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

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.

To find V_{TH}

3. Remove the load resistance and measure the open circuit voltage using multimeter (V_{TH}).

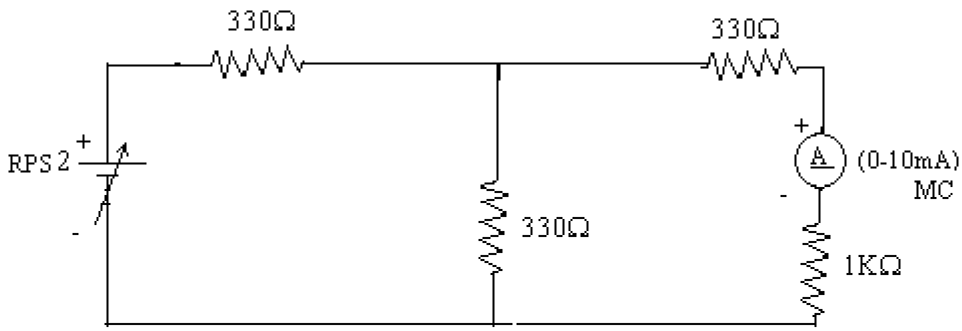
To find R_{TH}

4. To find the Thevenin's resistance, 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.

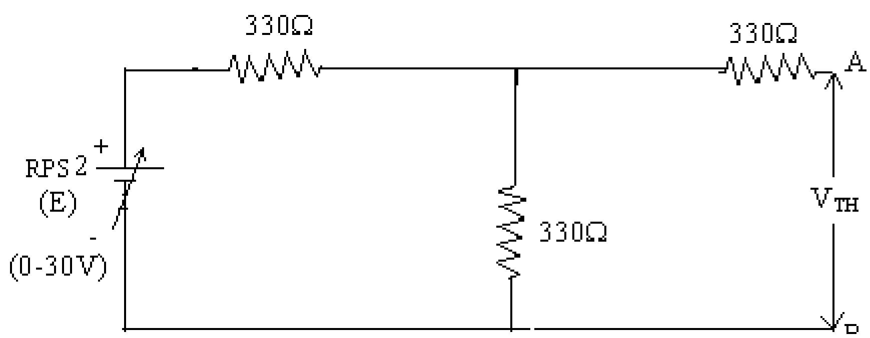
Theoretical and Practical Values

	E(V)	V_{TH}(V)	R_{TH}(Ω)	I_L (mA)	
				Circuit - I	Equivalent Circuit
Theoretical					
Practical					

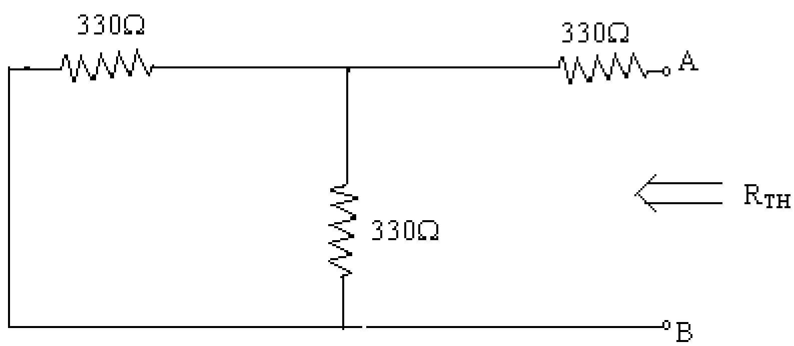
Circuit - 1 : To find load current



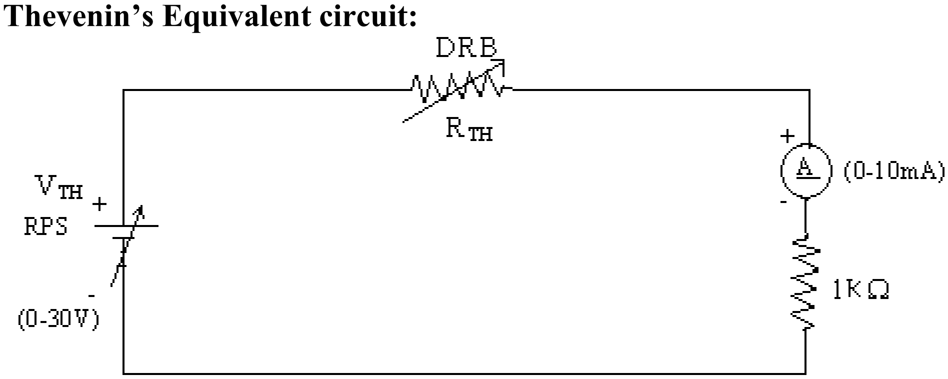
To find V_{TH}



To find R_{TH}



Thevenin's Equivalent circuit:



Model Calculations:

Result:

Experiment No. 2 b) **Date :**	**VERIFICATION OF NORTON'S THEOREM**

Aim:

To verify Norton's theorem for the given circuit.

Apparatus Required:

Sl.No.	Apparatus	Range	Quantity
1	Ammeter	(0-10mA) MC (0-30mA) MC	1 1
2	Resistors	330, 1KΩ	3,1
3	RPS	(0-30V)	2
4	Bread Board	--	1
5	Wires	--	Required

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)

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.

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.

To Find I_N:

3. Remove the load resistance and short circuit the terminals.
4. For the same RPS voltage note down the ammeter readings.

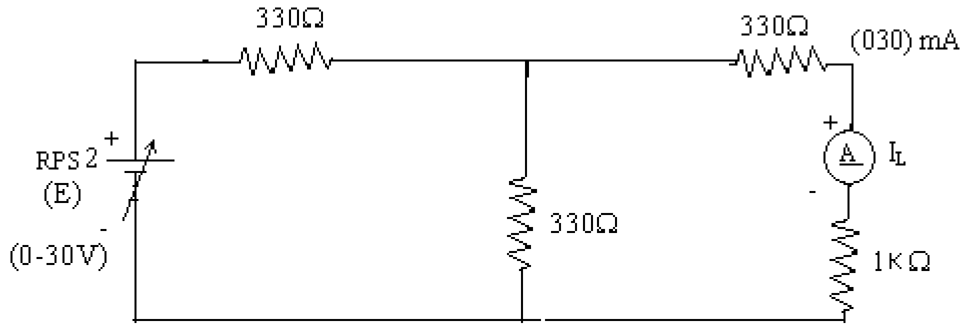
To Find R_N:

5. Remove RPS and short circuit the terminal and remove the load and note down the resistance across the two terminals.

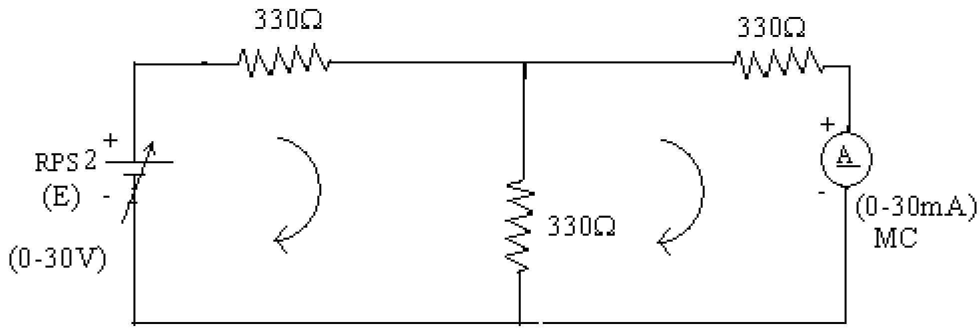
Equivalent Circuit:

6. Set I_N and R_N and note down the ammeter readings.
7. Verify Norton's theorem.

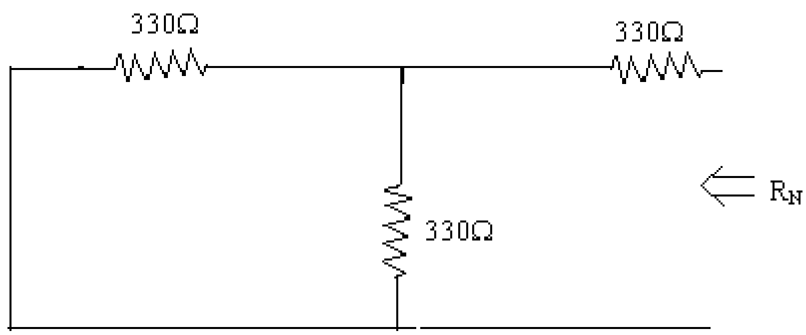
To find load current in circuit 1:



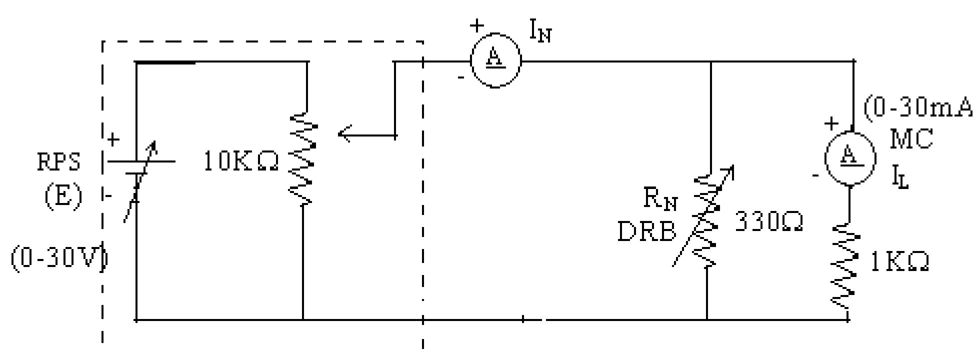
To find I_N



To find R_N



Norton's equivalent circuit



Constant current source

Theoretical and Practical Values

	E (volts)	I_N (mA)	R_N (Ω)	I_L (mA)	
				Circuit - I	Equivalent Circuit
Theoretical Values					
Practical Values					

Model Calculations:

Result:

Experiment No. 2 c) Date :	VERIFICATION OF MAXIMUM POWER TRANSFER THEOREM

Aim:

To verify maximum power transfer theorem for the given circuit

Apparatus Required:

Sl.No.	Apparatus	Range	Quantity
1	RPS	(0-30V)	1
2	Voltmeter	(0-10V) MC	1
3	Resistor	1KΩ, 1.3KΩ, 3Ω	3
4	DRB	--	1
5	Bread Board & wires	--	Required

Statement:

In a linear, bilateral circuit the maximum power will be transferred from source to the load when load resistance is equal to source resistance.

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.

Procedure:

Circuit – I

1. Connections are given as per the diagram and set a particular voltage in RPS.
2. Vary R_L and note down the corresponding ammeter and voltmeter reading.
3. Repeat the procedure for different values of R_L & Tabulate it.
4. Calculate the power for each value of R_L.

To find V_{TH}:

5. Remove the load, and determine the open circuit voltage using multimeter (V_{TH})

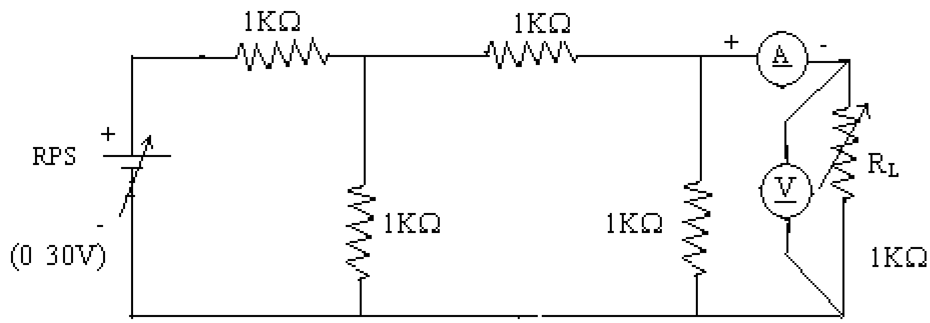
To find R_{TH}:

6. Remove the load and short circuit the voltage source (RPS).
7. Find the looking back resistance (R_{TH}) using multimeter.

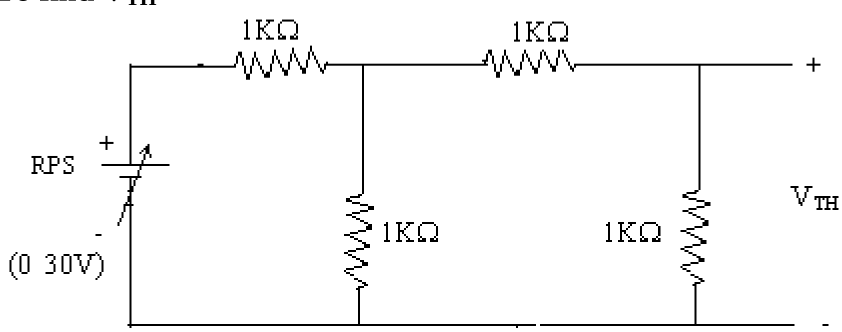
Equivalent Circuit:

8. Set V_{TH} using RPS and R_{TH} using DRB and note down the ammeter reading.
9. Calculate the power delivered to the load ($R_L = R_{TH}$)
10. Verify maximum transfer theorem.

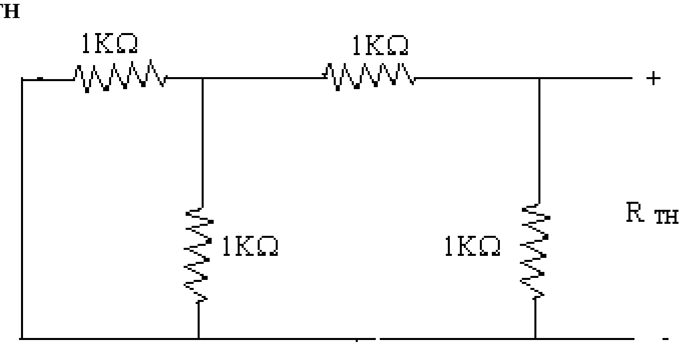
Circuit - 1



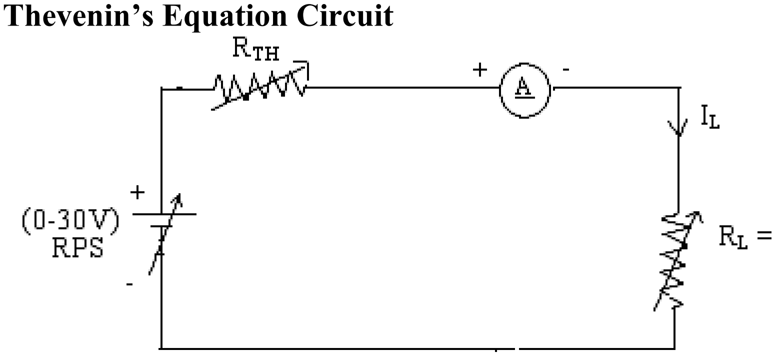
To find V_{TH}



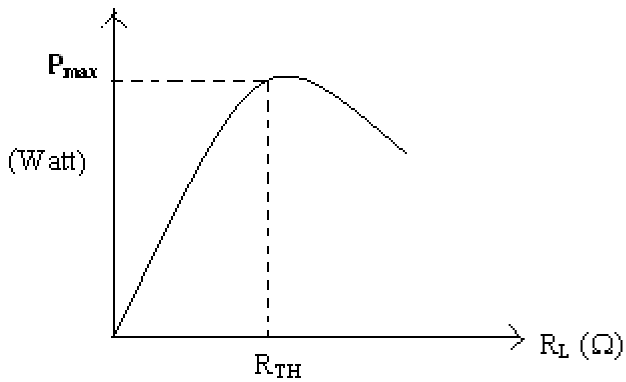
To find R_{TH}



Thevenin's Equation Circuit



Power V_S R_L



Circuit – I

Sl.No.	RL (Ω)	I (mA)	V(V)	P=VI (watts)

To find Thevenin's equivalent circuit

	V_{TH} (V)	R_{TH} (Ω)	I_L (mA)	P (milli watts)
Theoretical Value				
Practical Value				

Model Calculations:

GRAPH:

Result:

POST LAB QUESTIONS

1. **State Thevenin's Theorem.**

2. **Draw the Thevenin's equivalent circuit**

3. **State maximum power transfer theorem.**

4. **Write some applications of maximum transfer theorem.**

5. **Write the steps to find I_N**

6. **What are the steps to solve Maximum power transfer Theorem?**

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Title of Experiment	: **3.Transient analysis of Series RL, RC circuits**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1) Define Transient and classify

2) Deduce the time constant for simple RL series circuit.

3) Deduce the time constant for simple RC series circuit.

4) How will you design the values of L & C in a transient circuit?

Experiment No. 3 Date :	**Transient analysis of series RL, RC circuits**

Aim:

To obtain the transient response and measure the time constant of a series RL and RC circuit for a pulse waveform.

Apparatus Required:

Sl. No.	Apparatus	Range	Quantity
1	Function Generator	800 Hz	1
2	Inductor	1 mH	1
3	Resistor	4 KΩ	1
4	Capacitor	1 nF	1
5	Bread Board & Wires	--	Required
6	CRO		1
7	CRO Probes		2

Theory

In this experiment, we apply a pulse waveform to the RL or RC circuit to analyze the transient response of the circuit. The pulse-width relative to a circuit's time constant determines how it is affected by an RC or RL circuit.

Time Constant (τ): A measure of time required for certain changes in voltages and currents in RC and RL circuits. Generally, when the elapsed time exceeds five time constants (5τ) after switching has occurred, the currents and voltages have reached their final value, which is also called steady-state response.

The time constant of an RC circuit is the product of equivalent capacitance and the Thevenin's resistance as viewed from the terminals of the equivalent capacitor.

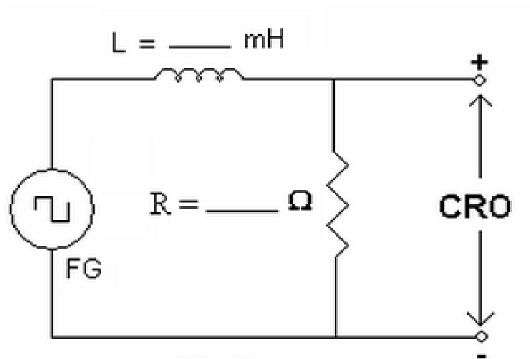
$$\tau = RC$$

A Pulse is a voltage or current that changes from one level to the other and back again. If a waveform's high time equals its low time, as in figure, it is called a square wave. The length of each cycle of a pulse train is termed its period (T). The pulse width (tp) of an ideal square wave is equal to half the time period.

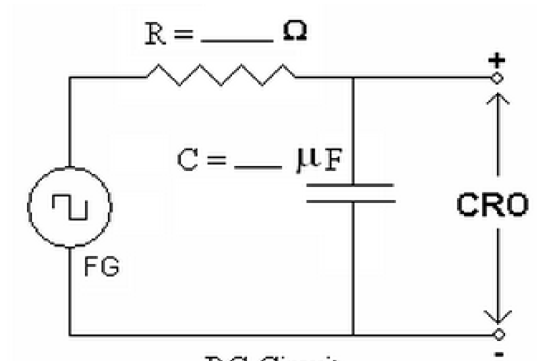
Procedure for RL:

1. Make the connections as per the circuit diagram.
2. Choose square wave mode in signal generator
3. Using CRO, adjust the amplitude to be 2 volts peak to peak.
4. Take care of the precaution and set the input frequency.
5. Observe and plot the output waveform.
6. Calculate the time required by the output to reach 0.632 times the final value (peak).
7. This value gives the practical time constant. Tabulate the theoretical and practical values.

Circuit Diagram:



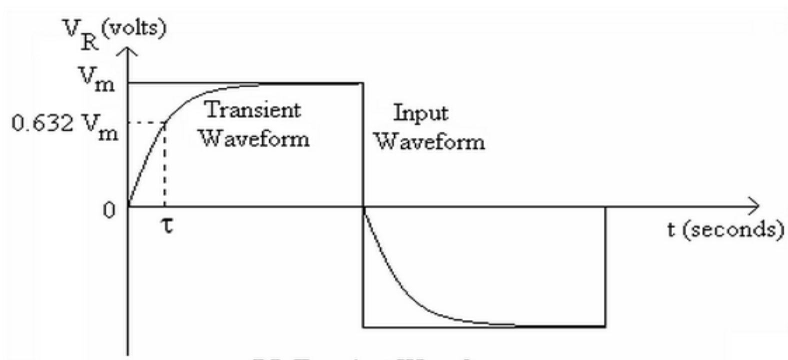
RL Circuit



RC Circuit

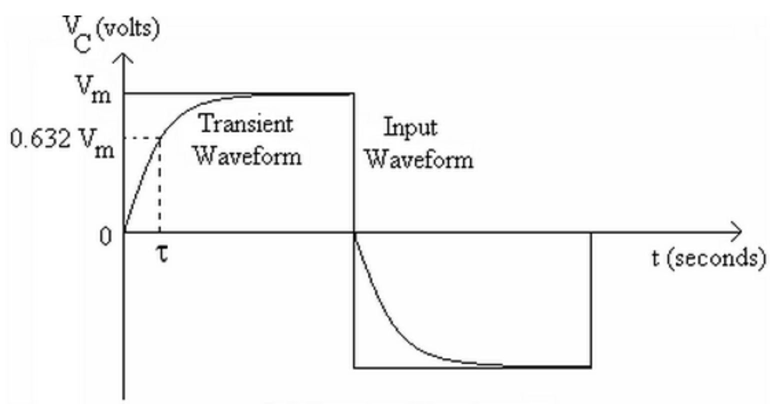
Model Graph:

a) RL Transient :Output voltage across Resistor:



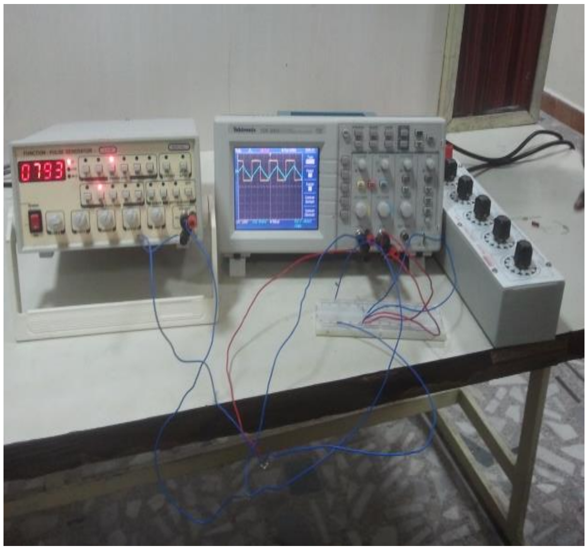
RL Transient Waveform

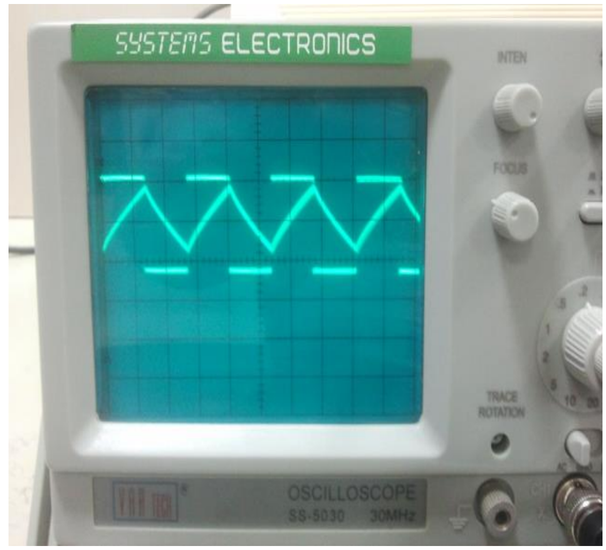
b) RC Transient :Output voltage across Capacitor:



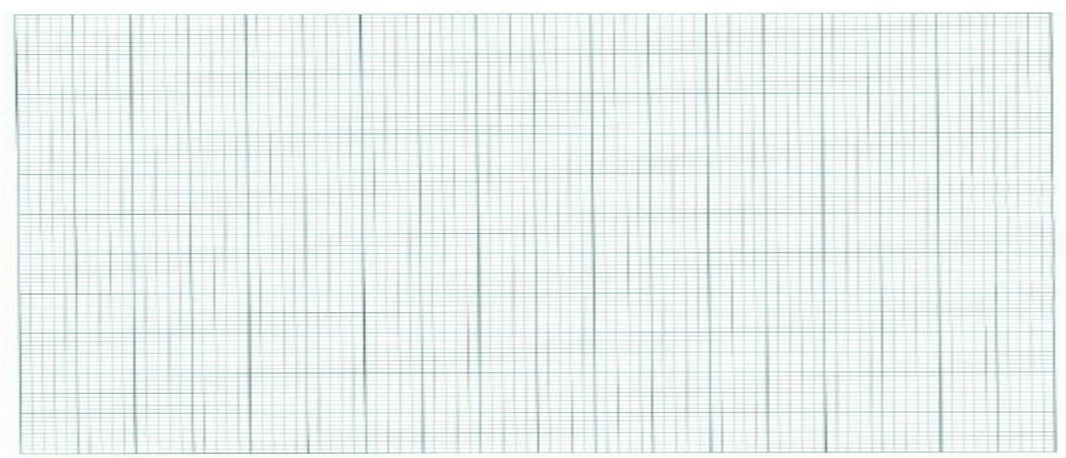
RC Transient Waveform

Hardware setup:

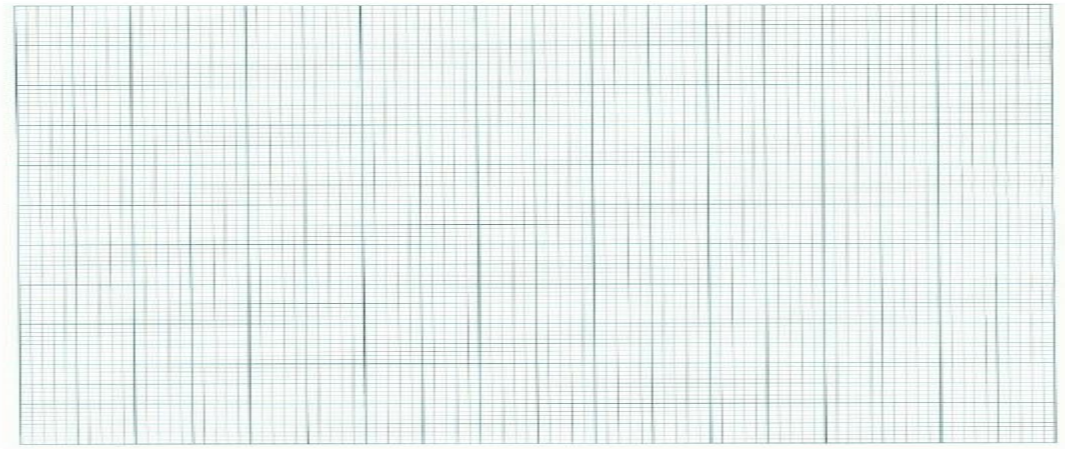




GRAPH:



GRAPH:



Result:

POST LAB QUESTIONS

1) Why it is necessary to discharge the capacitor every time you want to record another transient voltage across the capacitor?

2) If the capacitor remains charged, what would you expect to see across the capacitor when you re-close the switch to try to record another transient?

3) Give the expression for energy stored in the capacitor?

4) Draw the discharge of capacitor voltage with time in RC circuit?

5) What do you understand from the value of time constants (RL, RC)?

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Title of Experiment	: **4. LOAD TEST ON SINGLE PHASE TRANSFORMER**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

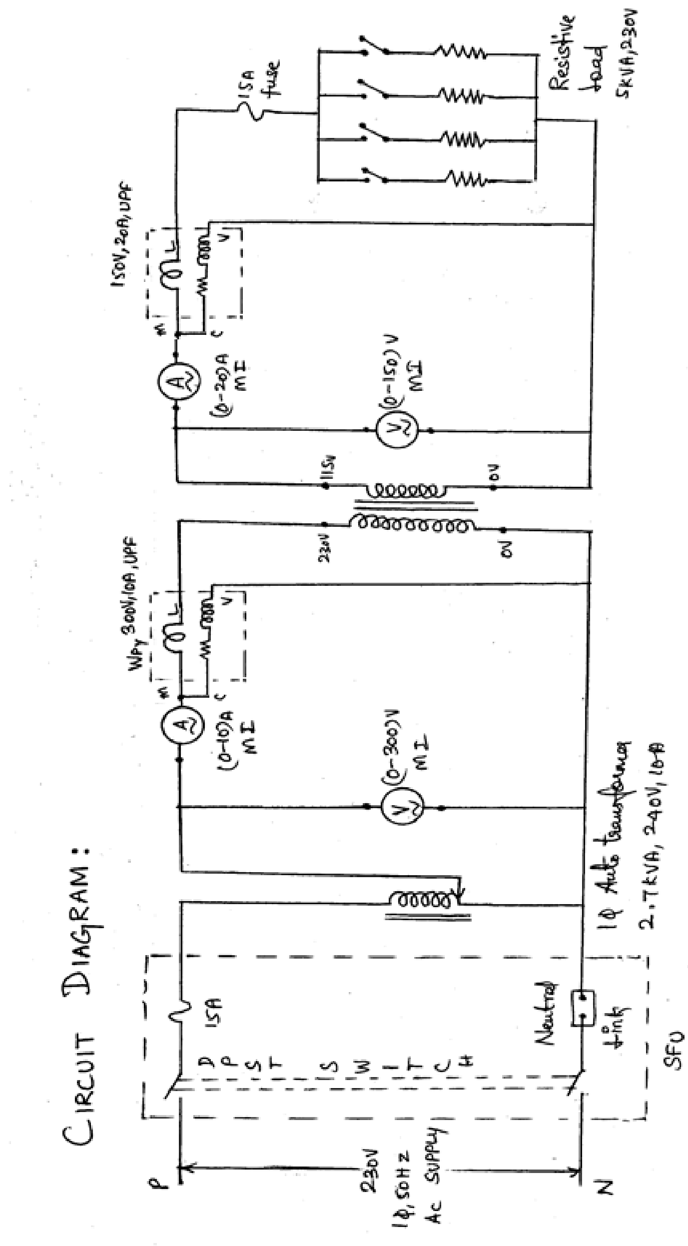
1. **Explain the working principle of transformer**

2. **What are the main parts of a transformer?**

3. **What are the types of transformers?**

4. **What is the meaning of KVA rating of transformer?**

5. **What is the necessity of the load test for a transformer?**


CIRCUIT DIAGRAM:
15A fuse
Resistive load 5KVA, 230V
150V, 20A, UPF
M L C V
(0-20)A MI
(0-150)V MI
115V
0V
230V
0V
WPy 300V,10A,UPF
M L C V
(0-10)A MI
(0-300)V MI
1φ Auto transformer 2.7KVA, 240V, 10A
15A
DPST SWITCH
Neutral link
SFU
P
N
230V 1φ, 50Hz AC SUPPLY

Experiment No. 4 Date :	**Load test on single phase transformer**

Aim:

To conduct the load test on the given a single phase transformer for finding the efficiency and its regulation.

Apparatus Required:

S.NO	APPARATUS	RANGE	TYPE	QUANTITY
1.	Voltmeter	(0-150)V (0-300) V	MI MI	1 1
2.	Ammeter	(0-10)A (0-20) A	MI MI	1 1
3.	Wattmeter	150V,20A 300V,10A	UPF UPF	1 1
4.	Auto transformer	240 V, 2.7 KVA,10A		1

Formula Used:

1.Percentage Regulation = $(V_{o2}-V_2) / V_{o2}*100$

Where V_{o2} = Secondary voltage on no load

V_o = Secondary voltage at a particular load

2. Power factor = $Pout/V_2*I_2$

Where Pout = Secondary wattmeter readings in Watts

V_2 = Secondary voltage in Volts

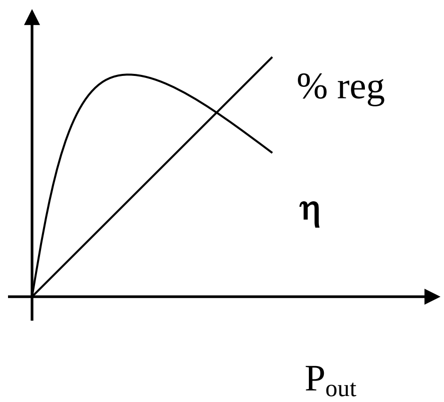
I_2 = Secondary current in Amps

3. Percentage efficiency = Pout/Pin*100

Where Pout = Secondary wattmeter readings in Watts

Pin = Primary wattmeter readings in Watts.

Model Graph:



Procedure

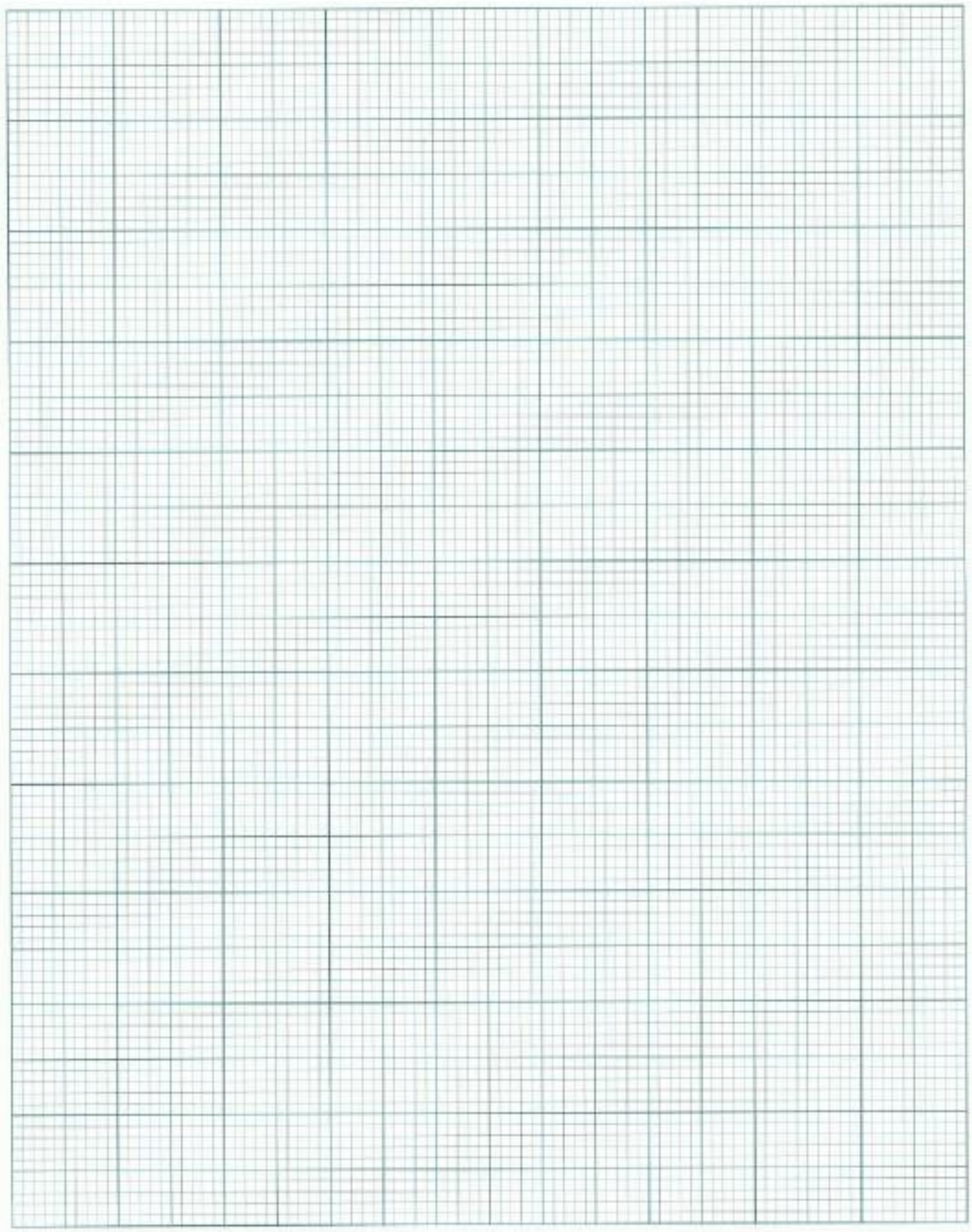
1. Connections are given as per the circuit diagram.
2. Verify whether the autotransformer is kept at zero voltage position.
3. By closing the DPST switch, 230V,1ϕ,50HZ AC supply is given to the transformer.
4. At no load, the readings from the meters are noted down.
5. The load is applied to the transformer in steps upto 125% of the rated value of the primary current by using rheostatic load.
6. The corresponding values from the meters are tabulated for different loads.
7. Then the load is removed gradually, auto transformer is brought to its minimum position and the supply is switched off.
8. From the recorded values, the regulation, power factor and efficiency are calculated.

TABULATION:

S. No	Primary Voltage V_1 (V)	Primary Current I_1 (A)	Primary Wattmeter W_1 (W)	Secondary Voltage V2 (V)	Secondary Current I_2 (A)	Secondary Wattmeter W_2 (W)	Power Factor Cosθ	% Regulation %	η %

Model Calculation:

GRAPH:



Result

POST LAB QUESTIONS

1. **What will happen if a DC voltage is given to the transformer primary?**

2. **What are the losses in a transformer?**

3. **How can we minimize the core losses in a transformer?**

4. **What is meant by eddy current losses?**

5. **How hysteresis loss can be reduced?**

DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603 203

Title of Experiment	: **5. Demo of DC/AC machine & Parts**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE-LAB QUESTIONS

1. What are the major parts of the DC generators?

2. Give the classification of AC machines.

3. What is the use of brushes in DC motor?

4. In a DC machine, rectification process is carried out in order to get unidirectional output (DC). This rectification process is carried out by ______________

5. Why the armature of DC motor is laminated?

Experiment No. 5 Date :	Demo of DC/AC machine & Parts

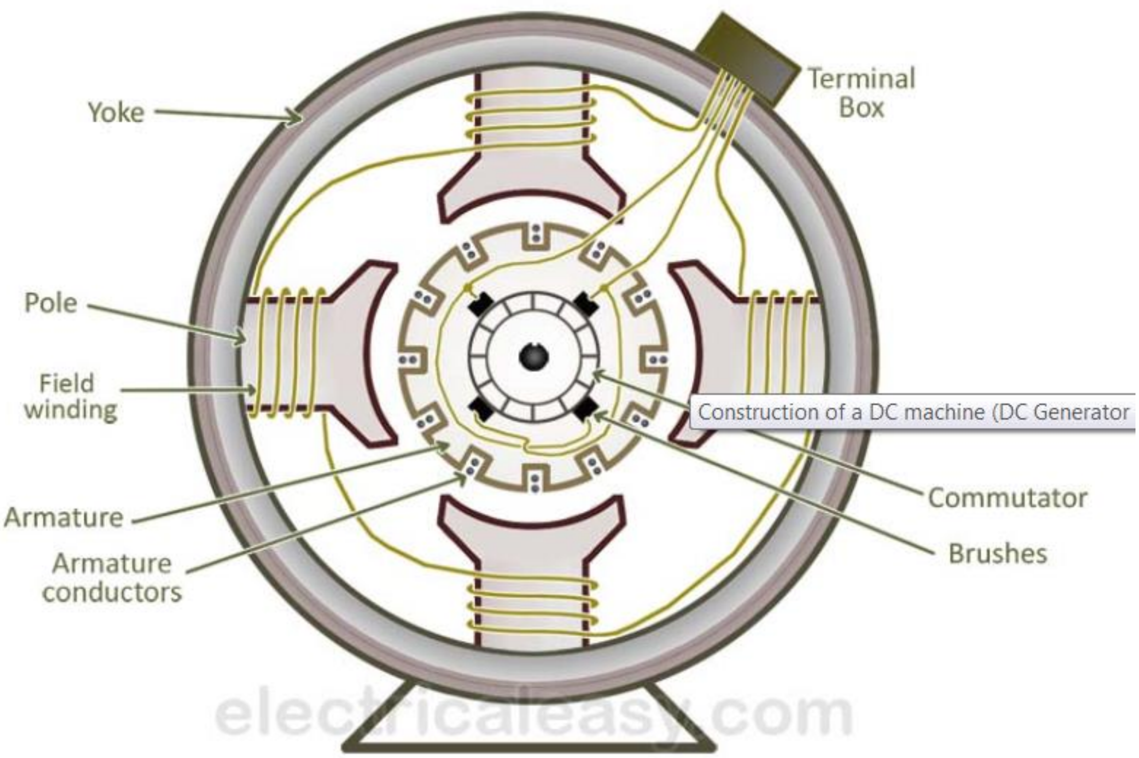
Aim : To know the construction of practical DC, AC machines and identify the parts

DC Generator.

A dc generator is an electrical machine which converts mechanical energy into direct current electricity. This energy conversion is based on the principle of production of dynamically induced emf. The following section outlines basic construction and working of a DC generator.

Construction of a DC Machine:

Note: A DC generator can be used as a DC motor without any constructional changes and vice versa is also possible. Thus, a DC generator or a DC motor can be broadly termed as a DC machine. These basic constructional details are also valid for the construction of a DC motor. Hence, let's call this point as construction of a DC machine instead of just 'construction of a dc generator'.



Armature core (rotor)

The above figure shows constructional details of a simple **4-pole DC machine**. A DC machine consists of two basic parts; stator and rotor. Basic constructional parts of a DC machine are described below.

1. **Yoke:** The outer frame of a dc machine is called as yoke. It is made up of cast iron or steel. It not only provides mechanical strength to the whole assembly but also carries the magnetic flux produced by the field winding.
2. **Poles and pole shoes:** Poles are joined to the yoke with the help of bolts or welding. They carry field winding and pole shoes are fastened to them. Pole shoes serve two purposes; (i) they support field coils and (ii) spread out the flux in air gap uniformly.
3. **Field winding:** They are usually made of copper. Field coils are former wound and placed on each pole and are connected in series. They are wound in such a way that, when energized, they form alternate North and South poles
4. **Armature core:** Armature core is the rotor of a dc machine. It is cylindrical in shape with slots to carry armature winding. The armature is built up of thin laminated circular steel disks for reducing eddy current losses. It may be provided with air ducts for the axial air flow for cooling purposes. Armature is keyed to the shaft.
5. **Armature winding:** It is usually a former wound copper coil which rests in armature slots. The armature conductors are insulated from each other and also from the armature core. Armature winding can be wound by one of the two methods; lap winding or wave winding. Double layer lap or wave windings are generally used. A double layer winding means that each armature slot will carry two different coils.
6. **Commutator and brushes:** Physical connection to the armature winding is made through a commutator-brush arrangement. The function of a commutator, in a dc generator, is to collect the current generated in armature conductors. Whereas, in case of a dc motor, commutator helps in providing current to the armature conductors. A commutator consists of a set of copper segments which are insulated from each other. The number of segments is equal to the number of armature coils. Each segment is connected to an armature coil and the commutator is keyed to the shaft. Brushes are usually made from carbon or graphite. They rest on commutator

segments and slide on the segments when the commutator rotates keeping the physical contact to collect or supply the current.

Commutator

CONSTRUCTION OF AC MACHINES (THREE PHASE INDUCTION MOTOR)

The three phase induction motor is the most widely used electrical motor. Almost 80% of the mechanical power used by industries is provided by three phase induction motors because of its simple and rugged construction, low cost, good operating characteristics, the absence of commutator and good speed regulation. In three phase induction motor, the power is transferred from stator to rotor winding through induction. The induction motor is also called a synchronous motor as it runs at a speed other than the synchronous speed.

Like any other electrical motor induction motor also have two main parts namely rotor and stator.

Stator: As its name indicates stator is a stationary part of induction motor. A stator winding is placed in the stator of induction motor and the three phase supply is given to it.

Rotor: The rotor is a rotating part of induction motor. The rotor is connected to the mechanical load through the shaft.

The rotor of the three phase induction motor are further classified as

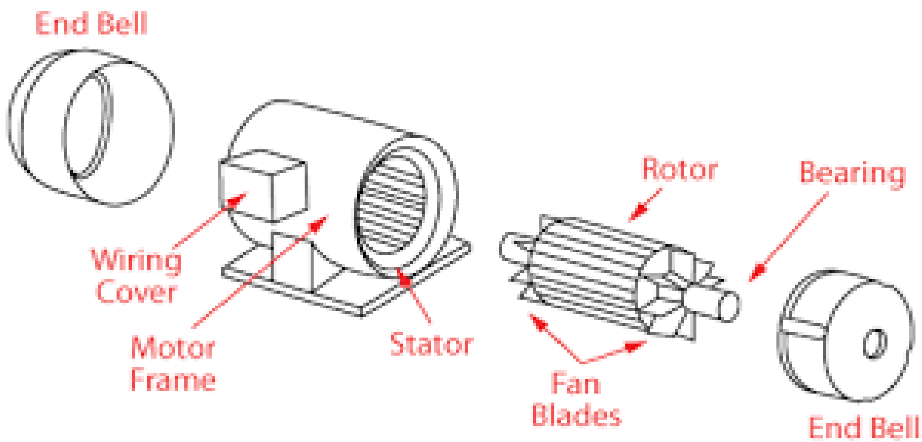
- Squirrel cage rotor,
- Slip ring rotor or wound rotor or phase wound rotor.

STATOR OF THREE PHASE INDUCTION MOTOR

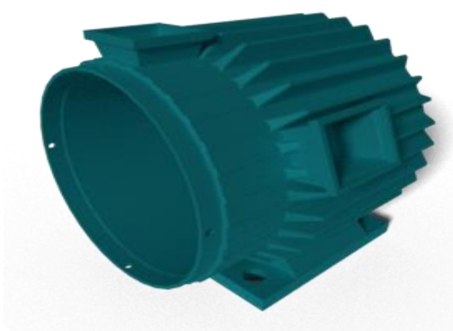
The stator of the three-phase induction motor consists of three main parts :

1. Stator frame,
2. Stator core,
3. Stator winding or field winding.

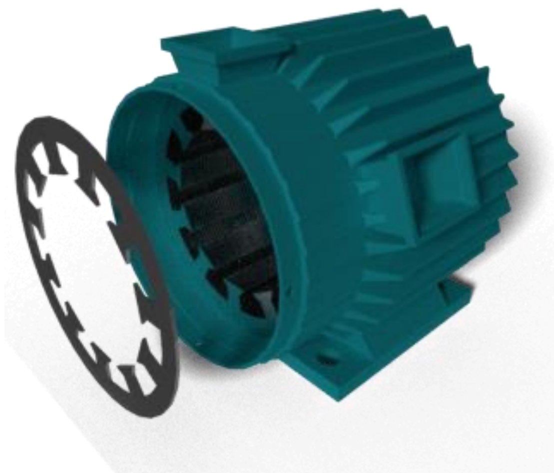
PARTS OF AC MOTOR (3-PHASE INDUCTION MOTOR)



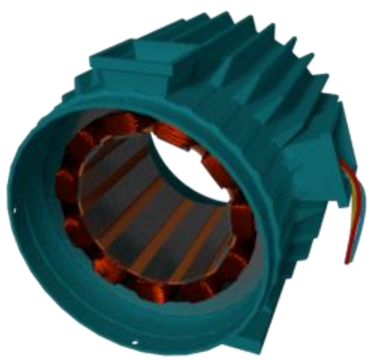
3-Phase Induction Motor



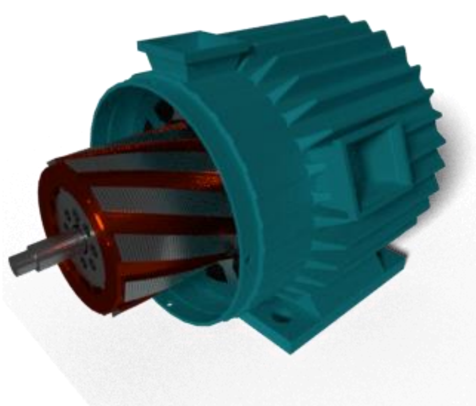
STATOR FRAME



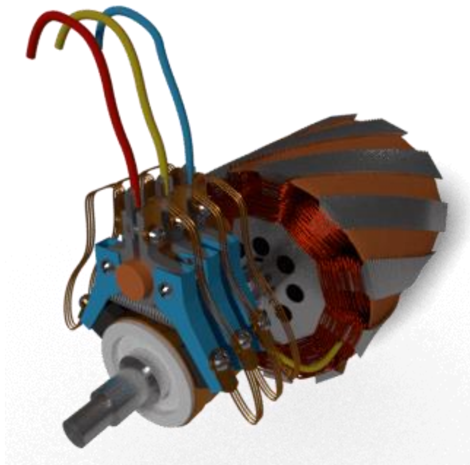
STATOR CORE



STATOR WINDING OR FIELD WINDING



SQUIRREL CAGE THREE PHASE INDUCTION MOTOR



SLIP RING OR WOUND ROTOR THREE PHASE INDUCTION MOTOR

POST-LAB QUESTIONS

1. Why we need starter for machines?

2. Name any four the domestic electrical machines with name plate details.

3. Difference between 3-phase squirrel cage and slip-ring induction motor?

4. What are the various types of rotors used in the alternators?

5. What are the applications of DC motors?

DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603 203

Title of Experiment	: **6. Types of wiring (a)Fluorescent Lamp wiring, (b) Stair case wiring**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS

1. **How does fluorescent lamp work?**

2. **What is the difference between fluorescent lamp and incandescent lamp?**

3. **What are the advantages of fluorescent light bulbs?**

4. **What is the voltage required to start a fluorescent lamp?**

5. **What is the function of starter in a fluorescent lamp?**

Experiment No. 6 a) Date :	FLUORESCENT LAMP WIRING

Aim:

To make connections of a fluorescent lamp wiring and to study the accessories of the same.

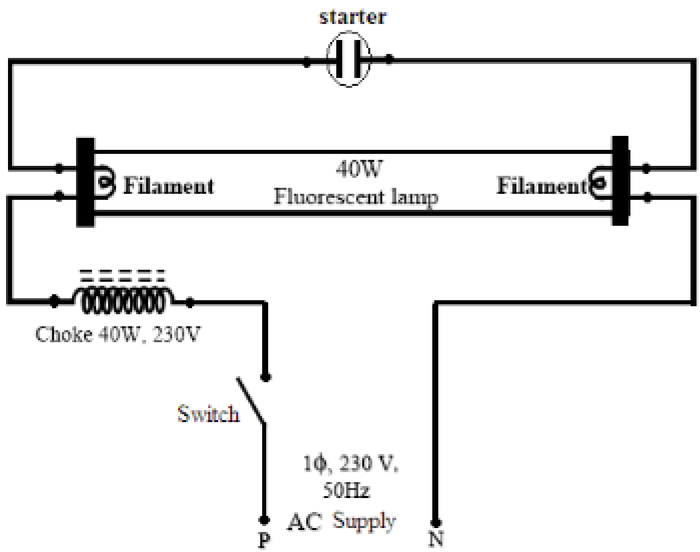
Apparatus Required:

S.No	Components	Range/Type	Quality
1.	Fluorescent Lamp fixture	4 ft	1
2.	Fluorescent lamp	40W	1
3.	Choke	40W, 230V	1
4.	Starter	-	1
5.	Connecting wires	-	As required

Tools Required:

Wire man's tool Kit - 1 No

Circuit diagram:



Theory:

1. The electrode of the starter which is enclosed in a gas bulb filled with argon gas, cause discharge in the argon gas with consequent heating.
2. Due to heating, the bimetallic strip bends and causes in the starter to close. After this, the choke, the filaments (tube ends) to tube and starter becomes connected in series.
3. When the current flows through the tube end filaments the heat is produced. During the process the discharge in the starter tube disappears and the contacts in the starter move apart.
4. When sudden break in the circuit occur due to moving apart of starter terminals, this causes a high value of e.m.f to be induced in the choke.
5. According to Lenz's law, the direction of induced e.m.f in the choke will try to oppose the fall of current in the circuit.
6. The voltage thus acting across the tube ends will be high enough to cause a discharge to occur in the gas inside the tube. Thus the tube starts giving light.
7. The fluorescent lamp is a low pressure mercury lamp and is a long evacuated tube. It contains a small amount of mercury and argon gas at 2.5 mm pressure. At the time of switching in the tube, mercury is in the form of small drops. Therefore, to start the tube, filling up of argon gas is necessary. So, in the beginning, argon gas starts burning at the ends of the tube; the mercury is heated and controls the current and the tube starts giving light. At each end of the tube, there is a tungsten electrode which is coated with fast electron emitting material. Inside of the tube is coated with phosphor according to the type of light.
8. A starter helps to start the start the tube and break the circuit.
9. The choke coil is also called blast. It has a laminated core over which enameled wire is wound. The function of the choke is to increase the voltage to almost 1000V at the time of switching on the tube and when the tube starts working, it reduces the voltage across the tube and keeps the current constant.

Procedure

1. Give the connections as per the circuit diagram.
2. Fix the tube holder and the choke in the tube.
3. The phase wire is connected to the choke and neutral directly to the tube
4. Connect the starter in series with the tube.
5. Switch on the supply and check the fluorescent lamp lighting.

Result

Experiment No. 6 b) Date :	6. b) STAIRCASE WIRING

Aim:

To control a single lamp from two different places.

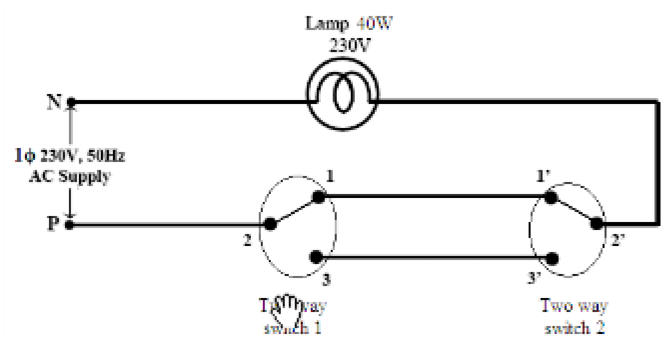
Apparatus Required:

S.No	Components	Quality/ Range
1	Incandescent Lamp	1(230V,40W)
2	Lamp holder	1
3	Two way switches	2 (230V, 5A)
4	Connecting Wires	As required

Tools Required:

Wire mans tool Kit - 1No.

Circuit Diagram:



Theory:

1. A two way switch is installed near the first step of the stairs. The other two way switch is installed at the upper part where the stair ends.
2. The light point is provided between first and last stair at an adequate location and height if the light is switched on by the lower switch. It can be switched off by the switch at the top or vice versa.
3. The circuit can be used at the places like bed room where the person may not have to travel for switching off the light to the place from where the light is switched on.
4. Two numbers of Two-way switches are used for the purpose. The supply is given to the switch at the short circuited terminals.
5. The connection to the light point is taken from the similar short circuited terminal of the second switch. Other two independent terminals of each circuit are connected through cables.

Procedure:

1. Give the connections as per the circuit diagram.
2. Verify the connections.
3. Switch on the supply.
4. Verify the conditions.

Tabulation:

Position of switches		Condition of lamp
S1	S2	

Result

POST LAB QUESTIONS

1. **What is the use of staircase wiring?**

2. **Why choke is used in fluorescent lamp?**

3. **What is the purpose of magnetic ballast in fluorescent lamp?**

4. **Compare electronic ballast and magnetic ballast?**

5. **List out the advantage of staircase wiring**

DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603203.

Title of Experiment	: 7. **Characteristics of semiconductor devices (a) PN junction diode, (b) Zener diode, (c)BJT**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
	Total	**50**	

Staff Signature

PRE LAB QUESTIONS

1. **What are intrinsic and extrinsic semiconductors?**

2. Give examples for Trivalent and Pentavalent impurity.

3. What is the need for Zener diode?

4. What is voltage regulation and mention its significance?

5. Give the different types of semiconductor devices with symbols

Experiment No. 7 a) Date :	CHARACTERISTICS OF PN JUNCTION DIODE

Aim

To study the characteristics of PN Junction diode under forward and reverse bias conditions.

Apparatus Required

S.No.	Name	Range	Qty
1	R.P.S	(0-30)V	1
2	Ammeter	(0–30)mA	1
		(0-500)µA	1
3	Voltmeter	(0–1)V	1
		(0-10)V	1

Components Required

S.No.	Name	Range	Qty
1	Diode	IN4001	1
2	Resistor	1kΩ	1
3	Bread Board	-	1
4	connecting Wires	-	Req

Theory

A PN junction diode is a two terminal semiconducting device. It conducts only in one direction (only on forward biasing).

Forward Bias

On forward biasing, initially no current flows due to barrier potential. As the applied potential exceeds the barrier potential the charge carriers gain sufficient energy to cross the potential barrier and hence enter the other region. The holes, which are majority carriers in the P-region, become minority carriers on entering the N-regions, and electrons which are the majority carriers in the N-region, become minority carriers on entering the P-region. This injection of minority carriers results in the current flow, opposite to the direction of electron movement.

Reverse Bias

On reverse biasing, the majority charge carriers are attracted towards the terminals due to the applied potential resulting in the widening of the depletion region. Since the charge carriers are pushed towards the terminals no current flows in the device due to majority charge carriers. There will be some current in the device due to the thermally generated minority carriers. The generation of such carriers is independent of the applied potential and hence the current is constant for all increasing reverse potential. This current is referred to as Reverse Saturation Current (I_O) and it increases with temperature. When the applied reverse voltage is increased beyond the certain limit, it results in breakdown. During breakdown, the diode current increases tremendously.

Procedure

Forward Bias

1. Connect the circuit as per the diagram.
2. Vary the applied voltage V in steps of 0.1V.
3. Note down the corresponding Ammeter readings I.
4. Plot a graph between V & I

Observations

1. Find the d.c (static) resistance = V/I.
2. Find the a.c (dynamic) resistance r = δV / δI (**r = ΔV/ΔI) =** $\frac{V_2 - V_1}{I_2 - I_1}$.
3. Find the forward voltage drop [Hint: it is equal to 0.7 for Si and 0.3 for Ge]

Reverse Bias

1. Connect the circuit as per the diagram.
2. Vary the applied voltage V in steps of 1.0V.
3. Note down the corresponding Ammeter readings I.
4. Plot a graph between V & I
5. Find the dynamic resistance **r = δV / δI.**

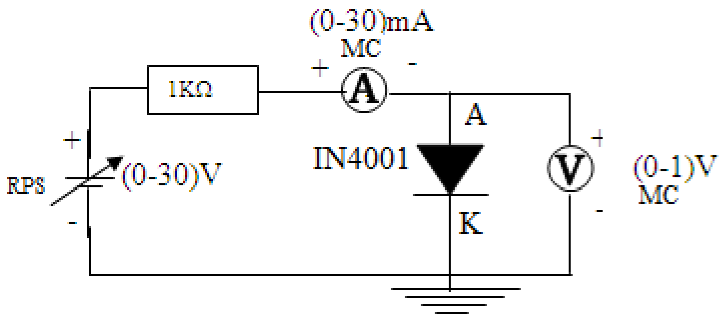
Formula for Reverse Saturation Current (I_O):

$$I = I_O(e^{V/\eta V_T} - 1)$$

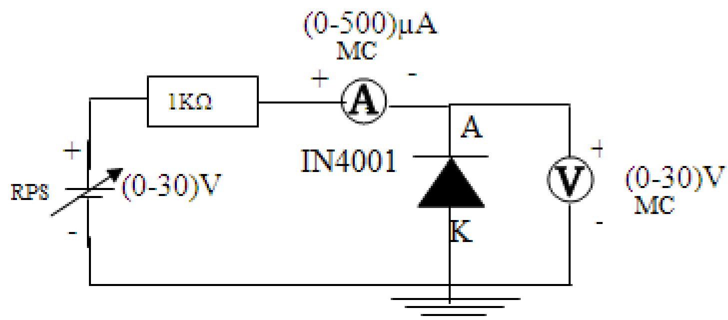
where I is forward (or reverse) diode current, I_0 is reverse saturation current, V is external voltage (+ve for forward bias & -ve for reverser bias), η is constant number (1 for Silicon and 2 for Germanium), V_T is the volt-equivalent of temperature (T/11600) and T is temperature in Kelvin.

Circuit Diagram

Forward Bias



Reverse Bias



Specification for 1N4001: Silicon Diode

Peak Inverse Voltage: 50V

I_{dc} = 1A.

Maximum forward voltage drop at 1 Amp is 1.1 volts

Maximum reverse current at 50 volts is 5μA

Tabular Column

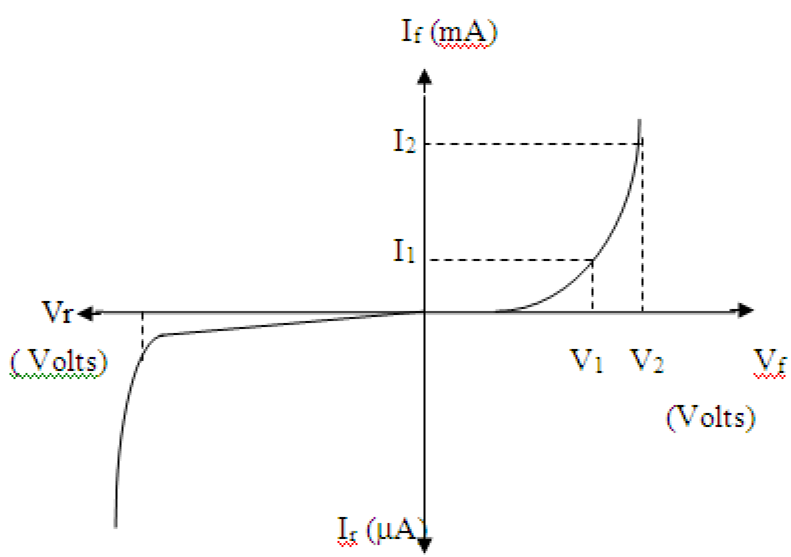
Forward Bias

S.No.	Voltage (In Volts)	Current (In mA)

Reverse Bias

S.No.	Voltage (In Volts)	Current (In µA)

Model Graph



GRAPH:

Result

Experiment No. 7 b) Date :	CHARACTERISTICS OF ZENER DIODE

Aim

To find the forward and reverse bias characteristics of a given Zener diode.

Apparatus Required

S.No.	Name	Range	Qty
1	R.P.S	(0-30)V	1s
2	Ammeter	(0–30)mA	2
3	Voltmeter	(0–10)V	1
		(0–1)V	1

Components Required

S.No.	Name	Range	Qty
1	Zener diode	FZ5.1	1
2	Resistor	1KΩ	1
3	Bread Board	-	1
4	Wires	-	Req

Theory

A properly doped crystal diode, which has a sharp breakdown voltage, is known as Zener diode.

Forward Bias

On forward biasing, initially no current flows due to barrier potential. As the applied potential increases, it exceeds the barrier potential at one value and the charge carriers gain sufficient energy to cross the potential barrier and enter the other region. The holes, which are majority carriers in p-region, become minority carriers on entering the N-regions and electrons, which are the majority carriers in the N-regions become minority carriers on entering the P-region. This injection of minority carriers results current, opposite to the direction of electron movement.

Reverse Bias

When the reverse bias is applied, due to majority carriers small amount of current (i.e.,) reverse saturation current flows across the junction. As the reverse bias is increased to breakdown voltage, sudden rise in current takes place due to Zener effect.

Zener Effect

Normally, PN junction of Zener Diode is heavily doped. Due to heavy doping the depletion layer will be narrow. When the reverse bias is increased the potential across the depletion layer is more. This exerts a force on the electrons in the outermost shell. Because of this force the electrons are pulled away from the parent nuclei and become free electrons. This ionization, which occurs due to electrostatic force of attraction, is known as **Zener effect**. It results in large number of free carriers, which in turn increases the reverse saturation current.

Procedure

Forward Bias

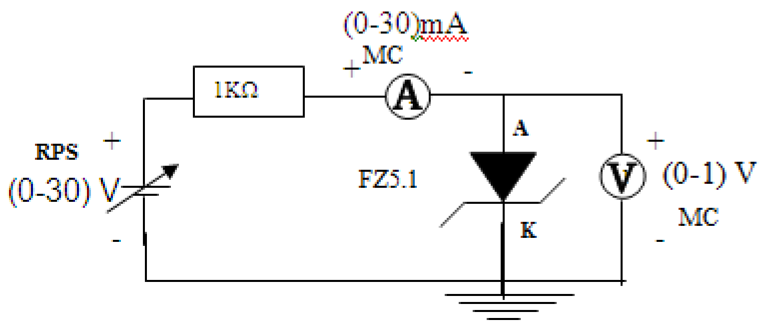
1. Connect the circuit as per the circuit diagram.
2. Vary the power supply in such a way that the readings are taken in steps of 0.1V in the voltmeter till the needle of power supply shows 30V.
3. Note down the corresponding ammeter readings.
4. Plot the graph between V & I.
5. Find the dynamic resistance **r = δV / δI.**

Reverse Bias

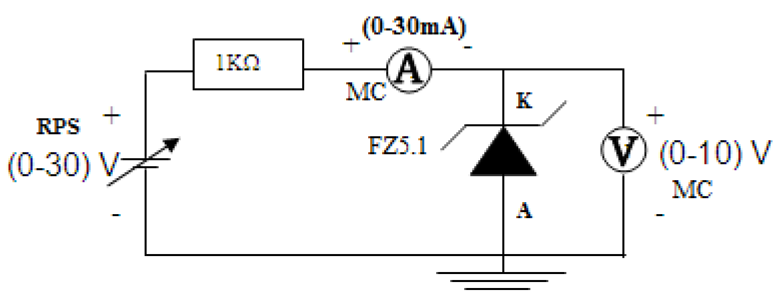
1. Connect the circuit as per the diagram.
2. Vary the power supply in such a way that the readings are taken in steps of 0.1V in the voltmeter till the needle of power supply shows 30V.
3. Note down the corresponding Ammeter readings I.
4. Plot a graph between V & I
5. Find the dynamic resistance **r = δV / δI.**
6. Find the reverse voltage Vr at I_z=20 mA.

Circuit Diagram

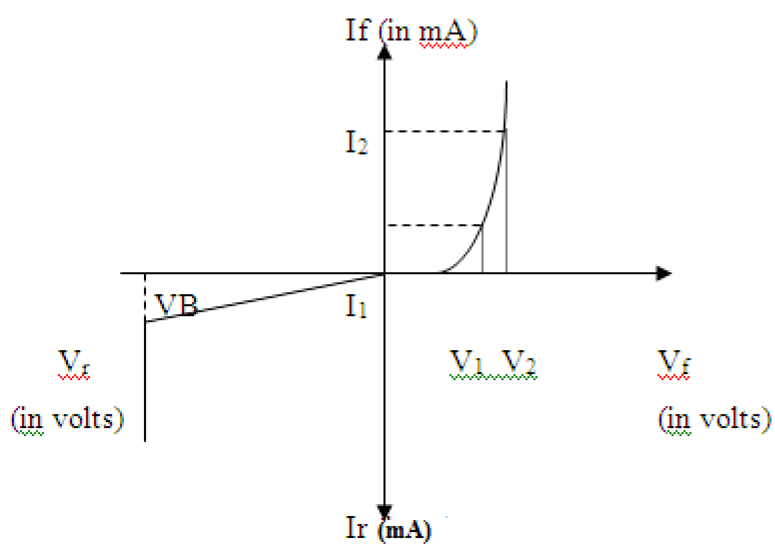
Forward Bias



Reverse Bias



Zener Diode



Tabular Column

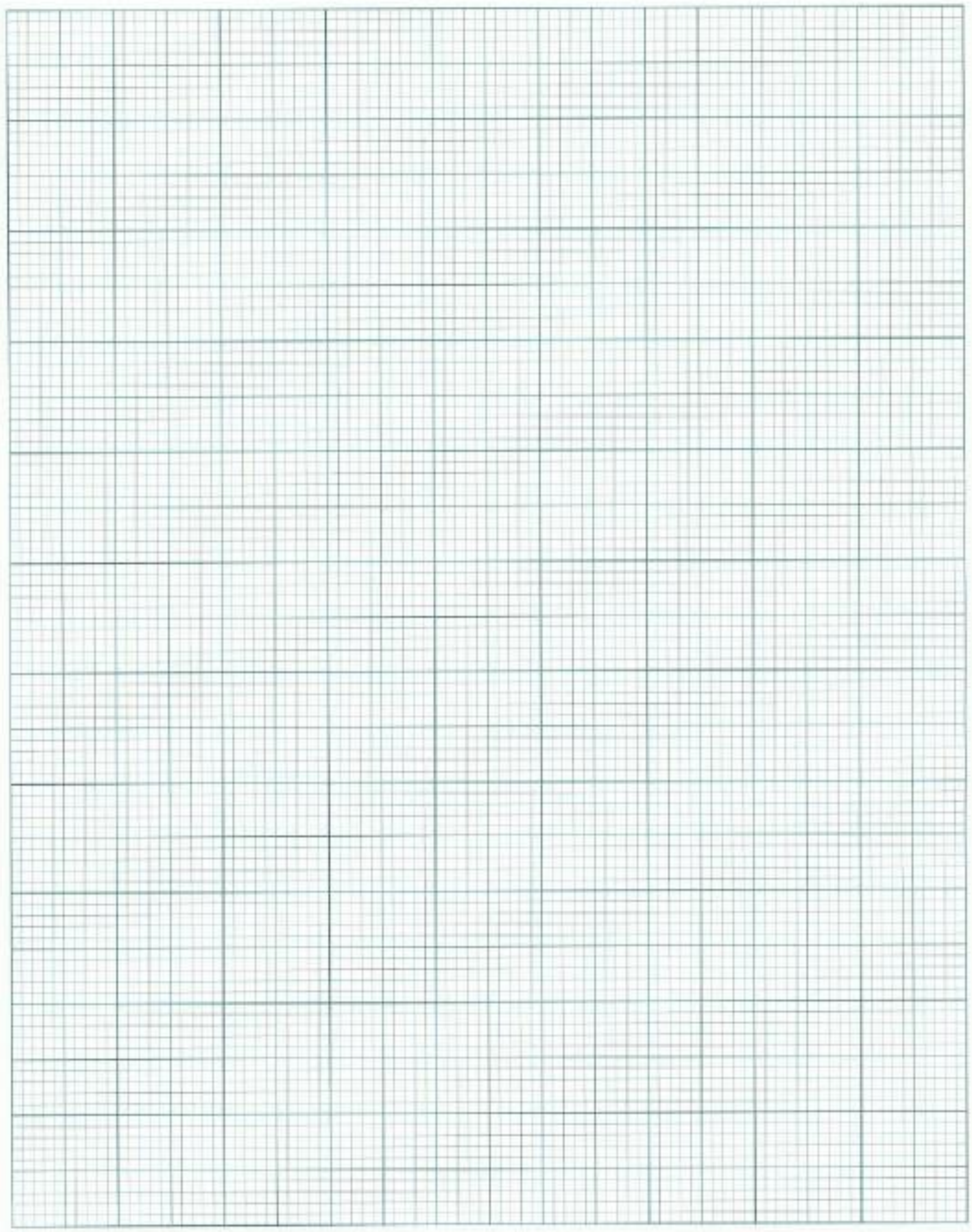
Forward Bias

S.No.	Voltage (In Volts)	Current (In mA)

Reverse Bias

S.No.	Voltage (In Volts)	Current (In mA)

GRAPH:



Result

Experiment No. 7 c) Date :	CHARACTERISTICS OF BJT (CE CONFIGURATION)

Aim

To plot the transistor (BJT) characteristics of CE configuration.

Apparatus Required

S.No.	Name	Range	Qty
1	R.P.S	(0-30)V	2
2	Ammeter	(0–30) mA MC	1
		(0–250) µA MC	1
3	Voltmeter	(0–30)V MC	1
		(0–1)V MC	1

Components Required

S.No.	Name	Range	Qty
1	Transistor	BC 107	1
2	Resistor	10 KΩ	1
	Resistor	1 KΩ	1
3	Bread Board		1
4	Wires		

Theory

A BJT is a three terminal two – junction semiconductor device in which the conduction is due to both the charge carrier. Hence it is a bipolar device. BJT is classified into two types – NPN & PNP. A NPN transistor consists of two N types in between which a layer of P is sandwiched. The transistor consists of three terminal emitter, collector and base. The emitter layer is the source of the charge carriers and it is heavily doped with a moderate cross sectional area. The collector collects the charge carries and hence moderate doping and large cross sectional area. The base region acts a path for the movement of the charge carriers. In order to reduce the recombination of holes and electrons the base region is lightly doped and is of hollow cross sectional area. Normally the transistor operates with the EB (emitter-base) junction forward biased.

Procedure

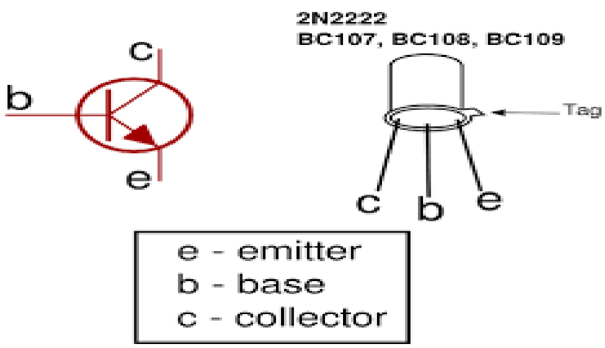
Input Characteristics

1. Connect the circuit as per the circuit diagram.
2. Set V_{CE}, vary V_{BE} in regular interval of steps and note down the corresponding I_B reading. Repeat the above procedure for different values of V_{CE}.
3. Plot the graph: V_{BE} Vs I_B for a constant V_{CE}.

Output Characteristics

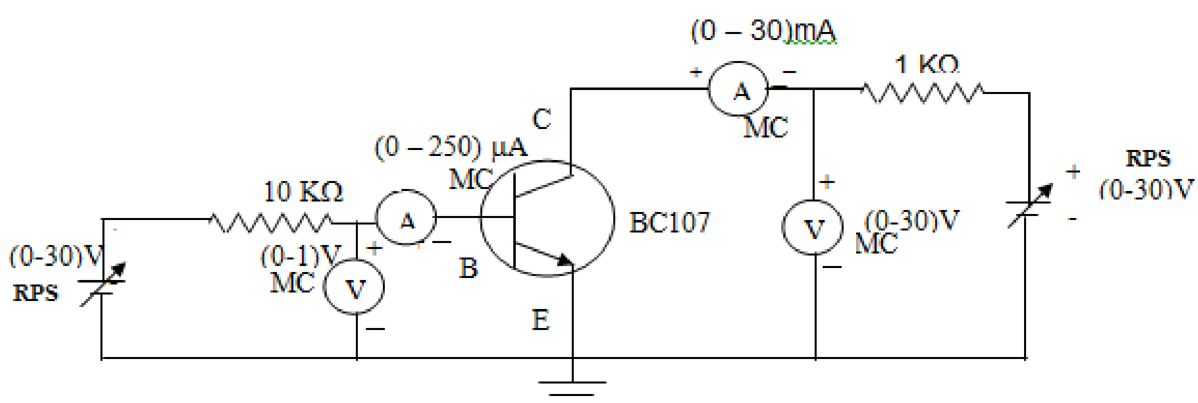
1. Connect the circuit as per the circuit diagram.
2. Set $I_{B,}$ Vary V_{CE} in regular interval of steps and note down the corresponding I_C reading. Repeat the above procedure for different values of I_B.
3. Plot the graph: V_{CE} Vs I_C for a constant I_B.

Pin Diagram



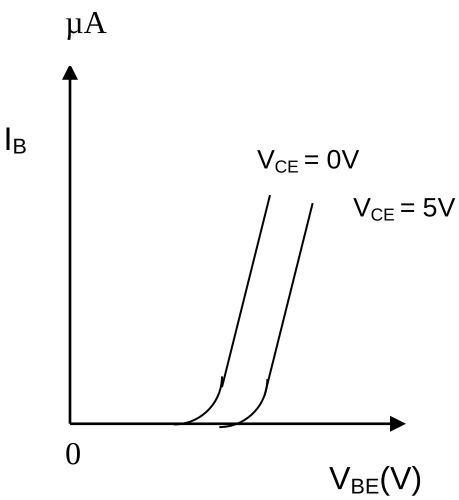
Specification: BC107/50V/0.1A,0.3W,300 MH

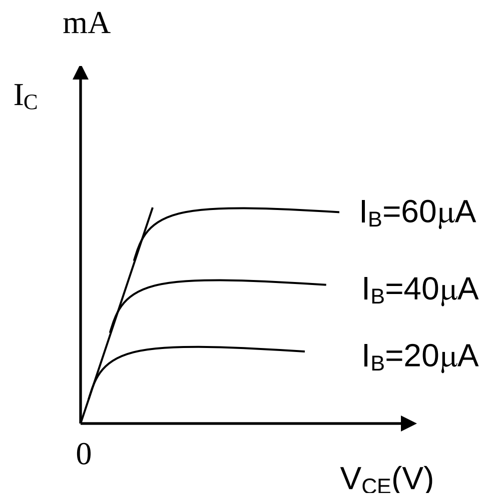
Circuit Diagram



Model Graph

Input Characteristics **Output Characteristics**





Tabular Column

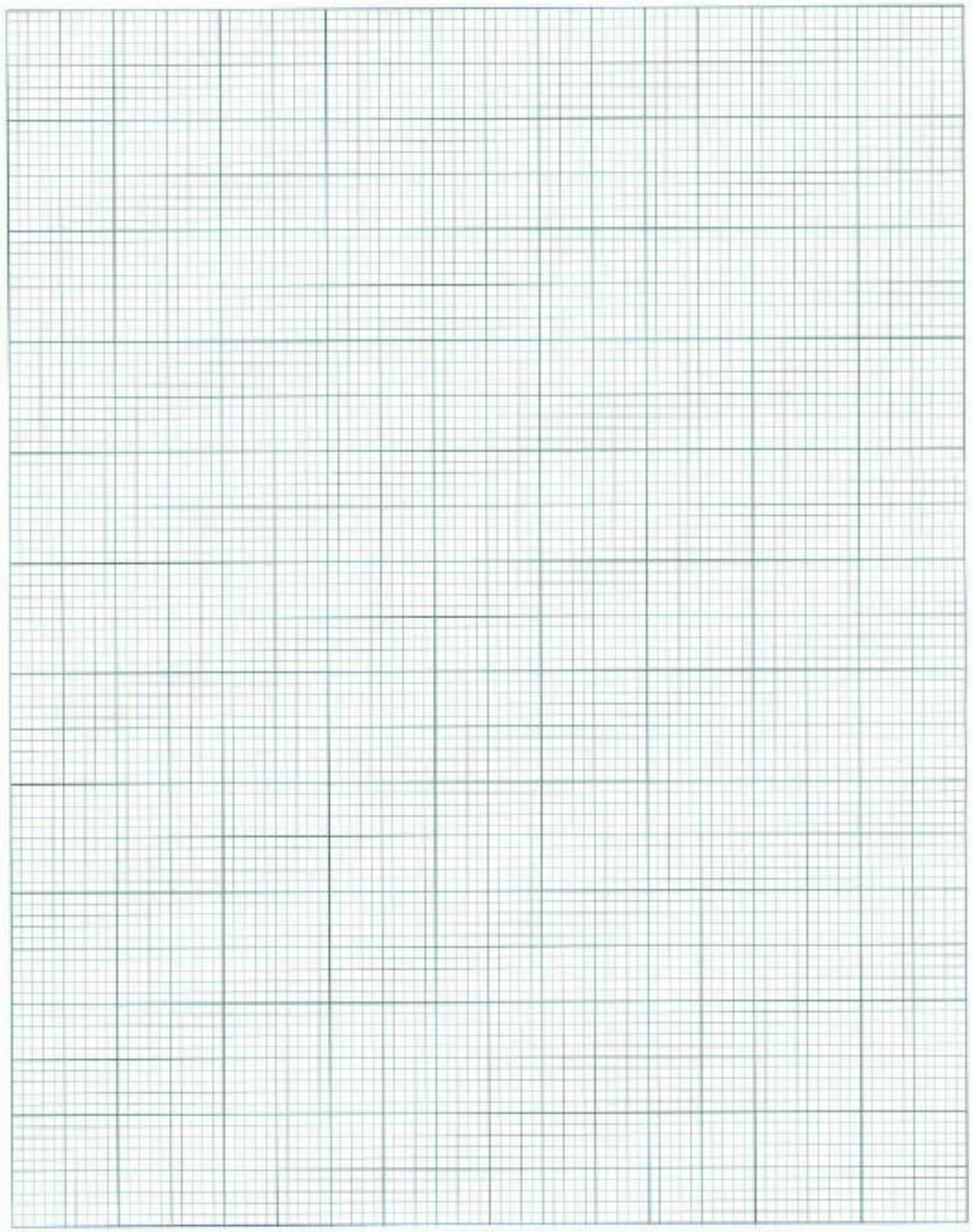
Input Characteristics

V_{CE} = 0 V		V_{CE} = 2V	
V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)

Output Characteristics

I_B=20μA		I_B=40μA	

GRAPH:



Result

POST LAB QUESTIONS

1 What is Punch through voltage?

2 What is early effect?

3 What are the differences between NPN and PNP transistors?

4. What is leakage current and mention its range?

5. What is base – width modulation?

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Title of Experiment	: **8. Wave shaping circuits (Half wave & Full Rectifiers, Clippers)**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS (Rectifiers)

1 What is the necessity of rectifier?

2 What is PIV of a diode in Full Wave Rectifier (FWR) and Half Wave Rectifier (HWR)?

3 What is ripple factor? Why it is required?

4 Why are filters connected at the output of rectifiers?

5 What are the types of filters used in rectifier? And which is better and why?
Types of filters

Experiment No. 8 a) Date :	SINGLE PHASE HALF WAVE RECTIFIER

Aim

To construct a half wave rectifier using diode and to draw its performance characteristics.

Apparatus Required

S. No.	Name	Range	Qty
1	Transformer	230/(6-0-6)V	1
2	R.P.S	(0-30)V	2

Components Required

S. No.	Name	Range	Qty
1	Diode	IN4007	1
2	Resistor	1K Ω	1
3	Bread Board	-	1
4	Capacitor	100µf	1
5	CRO	-	1

Formulae

Without Filter

(i) V_{rms} = $V_m / 2$

(ii) V_{dc} = V_m / π

(iii) Ripple Factor = $\sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$

(iv) Efficiency = $(V_{dc} / V_{rms})^2$ x 100

With Filter

(i) V_{rrms} = $\sqrt{V_{rms}{}^2 - V_{dc}{}^2}$

(ii) V_{rms} = $V_{rpp} / (\sqrt{3} \times 2)$, where V_{rpp} is peak to peak value of ripple voltage

(iii) V_{dc} = $V_m - 0.5 * V_{rpp}$

(iv) Ripple Factor = V_{rms} / V_{dc}

Procedure

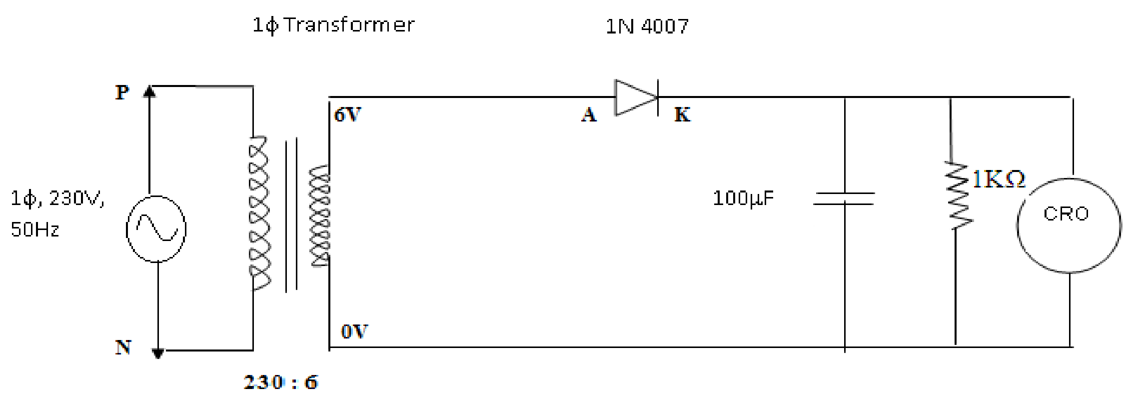
Without Filter

1. Give the connections as per the circuit diagram.
2. A 230 V, 50 Hz AC input given to primary side of the transformer where phase end of the secondary is connected to anode terminal of the diode.
3. Observe the output across the 1 K ohm load with use of CRO.
4. Plot its performance graph.

With Filter

1. Connections made as per the circuit diagram.
2. A 230 V, 50 Hz AC input given to primary side of the transformer where phase end of the secondary is connected to anode terminal of the diode.
3. Connect the Capacitor across the 1 K Ohm load
4. Observe the output across the 1 K Ohm load with use of CRO.
5. Plot its performance graph.

Circuit Diagram



Tabular Column

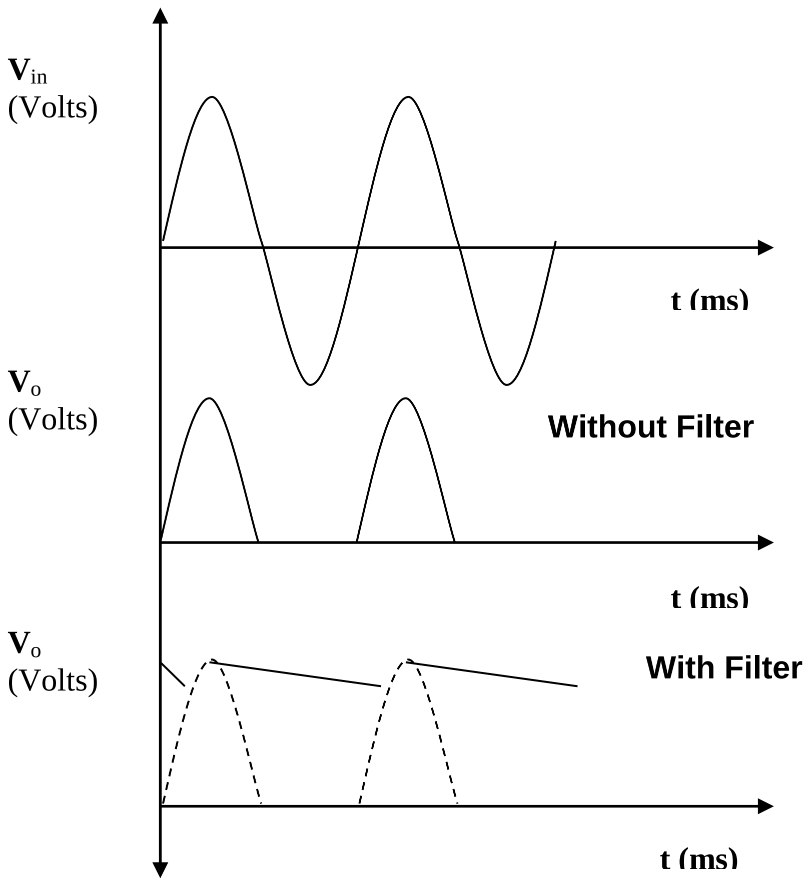
Without Filter

V_m (V)	V_{rms} (V)	V_{dc} (V)	Ripple factor	Efficiency

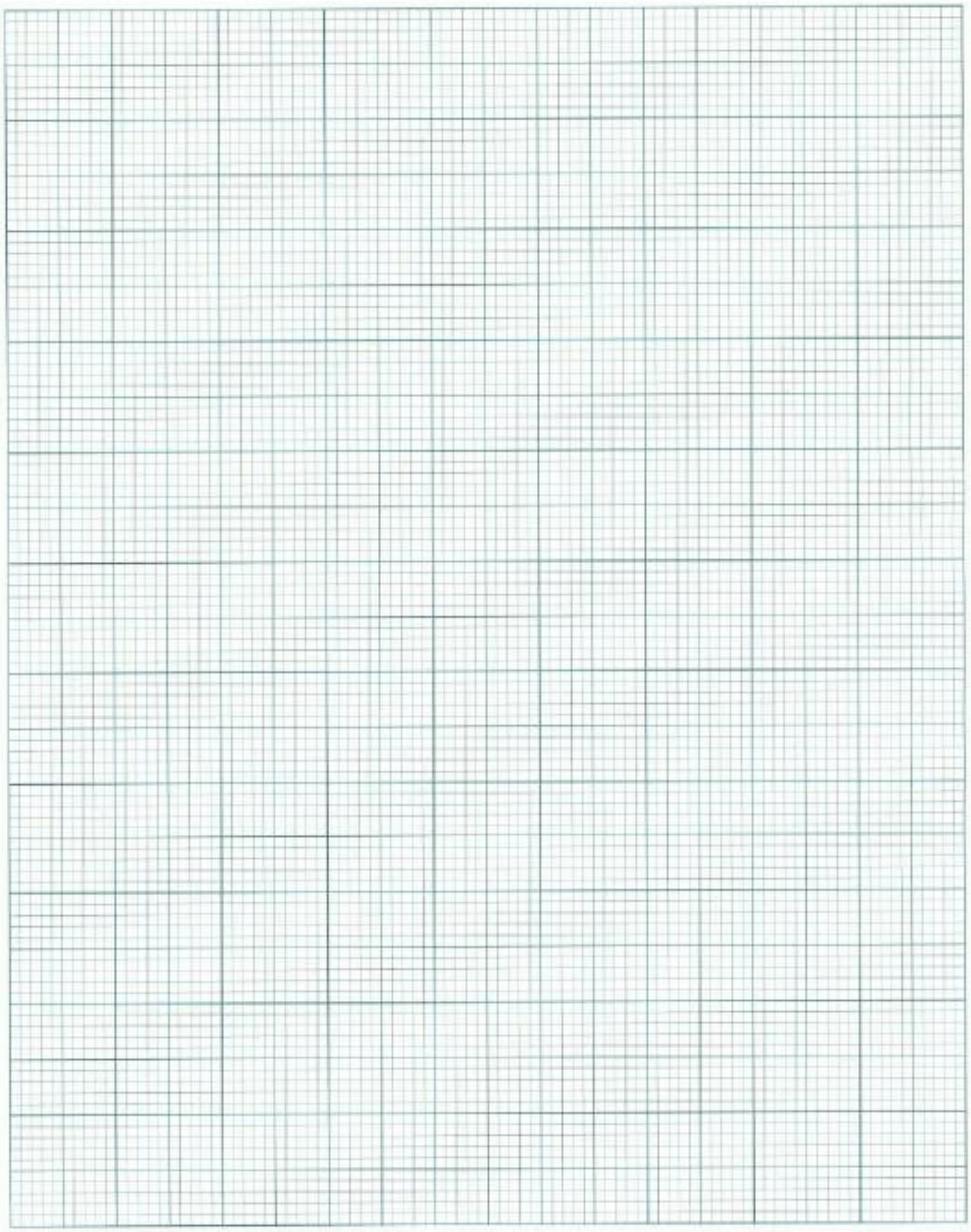
With Filter

V_{rpp} (V)	V_{rms} (V)	V_{dc} (V)	Ripple factor

Model Graph


Vin
(Volts)
t (ms)
Vo
(Volts)
Without Filter
t (ms)
Vo
(Volts)
With Filter
t (ms)

GRAPH:



Result

Experiment No. 8 b) Date :	SINGLE PHASE FULL WAVE RECTIFIER

Aim

To construct a single phase full-wave rectifier using diode and draw its performance characteristics.

Apparatus Required

S. No.	Name	Range	Qty
1	Transformer	230/(6-0-6)V	1
2	R.P.S	(0-30)V	2

Components Required

S. No.	Name	Range	Qty
1	Diode	IN4007	2
2	Resistor	1K Ω	1
3	Bread Board	-	1
4	Capacitor	100µf	1
5	CRO	1Hz-20MHz	1
6	Connecting wires	-	Req

Formulae

Without Filter

(i) $V_{rms} = V_m / \sqrt{2}$

(ii) $V_{dc} = 2V_m / \pi$

(iii) Ripple Factor $= \sqrt{\left(\frac{V_{rms}}{V_{dc}}\right)^2 - 1}$

(iv) Efficiency $= (V_{dc} / V_{rms})^2 \times 100$

With Filter

(i) $V_{rms} = V_{rpp} /(2*\sqrt{3})$

(ii) $V_{dc} = V_m - V_{rpp}$

(iv) Ripple Factor $= V_{rms'} / V_{dc}$

Procedure

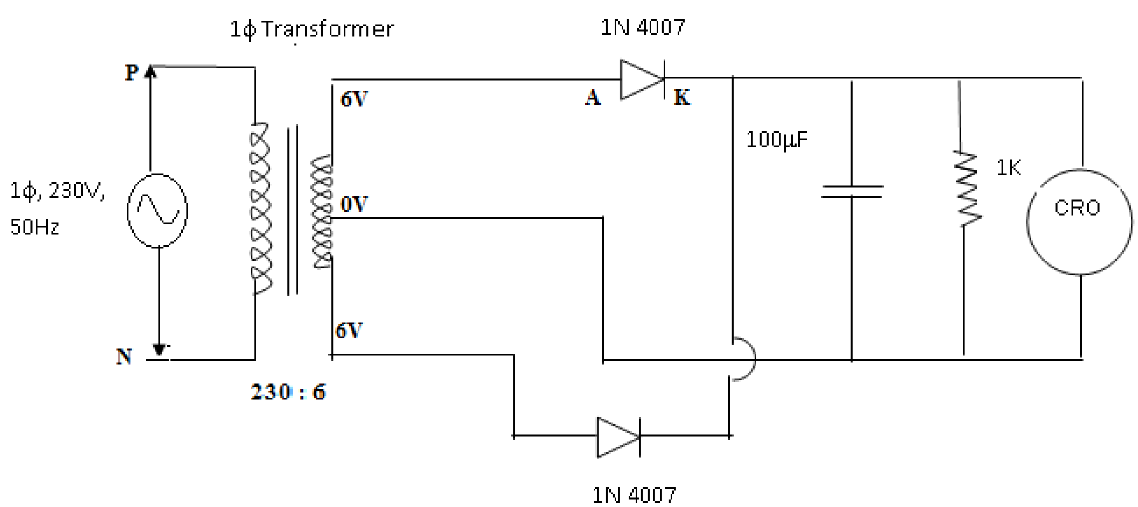
Without Filter

1. Give the connections as per the circuit diagram.
2. A 230 V, 50 Hz AC input given to primary side of the transformer where the phases end of the secondary is connected to anode terminal of the diode.
3. Observe the output across the 1 K ohm load with use of CRO.
4. Plot its performance graph.

With Filter

1. Give the connections as per the circuit diagram.
2. A 230 V, 50 Hz AC input given to primary side of the transformer where the phases end of the secondary is connected to anode terminal of the diode.
3. Connect the Capacitor across the load.
4. Observe the output across the 1 K ohm load with use of CRO.
5. Plot its performance graph.

Circuit Diagram



Tabular Column

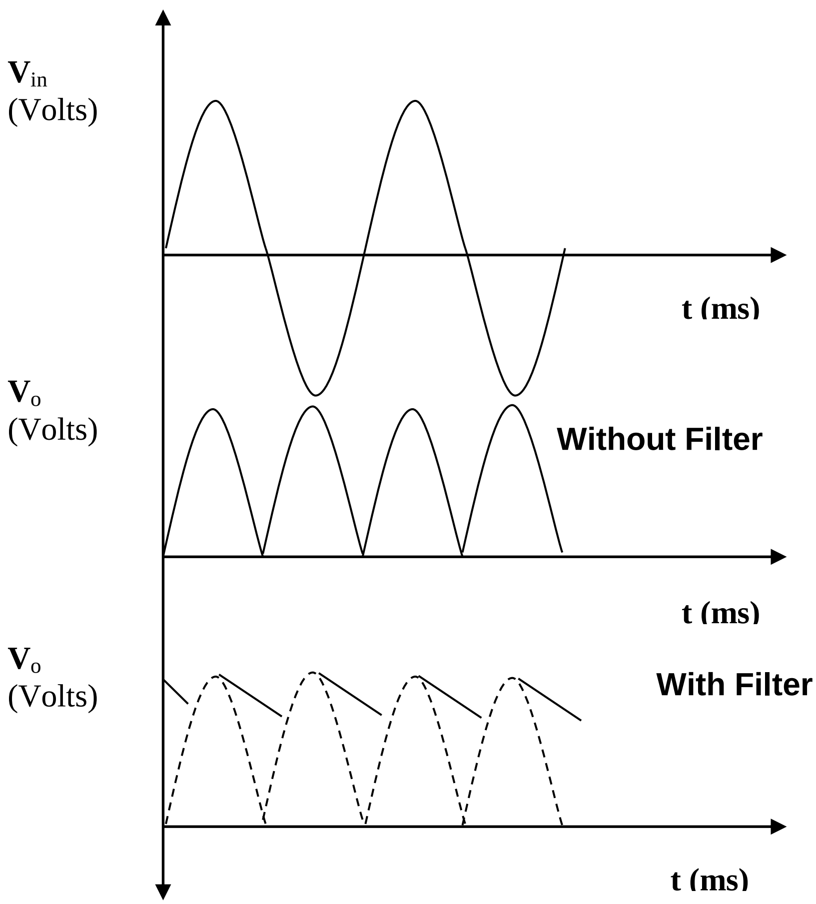
Without Filter

V_m	V_{rms}	V_{dc}	Ripple factor	Efficiency

With Filter

V_{rms}	V_{rpp}	V_{dc}	Ripple factor

Model Graph



GRAPH:

Result

POST LAB QUESTIONS

1. **What is Transformer Utilization Factor (TUF)?**

2. **Mention the value of ripple factor for HWR, FWR & rectifier with centre tapped transformer.**

3. **What is the difference between uncontrolled rectifier and controlled rectifier? Which is advantageous and why?**

4. **State the average and peak value of output voltage and current for full wave rectifier and half wave rectifier.**

5. **What is PIV of a diode in half wave and full wave rectifier?**

Clippers
PRE LAB QUESTIONS

1. **What are the differences between linear and nonlinear wave shaping circuit?**

2. **What are the applications of wave shaping circuit?**

3. **What is wave shaping?**

4. **What is the necessity of wave shaping?**

5. **Mention the application of clipper and clamper.**

Experiment No. 8c) Date :	CLIPPERS

Aim

To study the clipping circuits for different reference voltages and to verify the responses.

Apparatus Required

S.No.	Name	Range	Qty
1	CRO	1Hz-20MHz	1
2	RPS	(0–30) V	1
3	Bread Board	-	1
4	Connecting Wires	-	Req
5	Function Generator	1Hz-1MHz	1

Components Required

S.No.	Name	Range	Qty
1	Resistor	10KΩ	1
2	Diode	IN4007	1

Theory

The non-linear semiconductor diode in combination with resistor can function as clipper circuit. Energy storage circuit components are not required in the basic process of clipping. These circuits will select part of an arbitrary waveform which lies above or below some particular reference voltage level and that selected part of the waveform is used for transmission. So they are referred as voltage limiters, current limiters, amplitude selectors or slicers. There are three different types of clipping circuits.

1) Positive Clipping circuit.

2) Negative Clipping.

3) Positive and Negative Clipping (slicer).

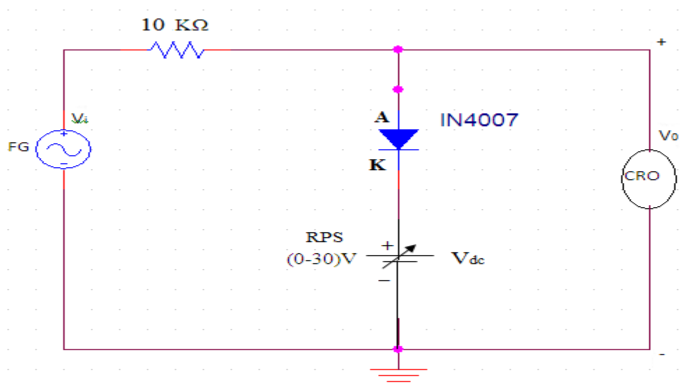
In positive clipping circuit positive cycle of Sinusoidal signal is clipped and negative portion of sinusoidal signal is obtained in the output of reference voltage is added, instead of complete positive cycle that portion of the positive cycle which is above the reference voltage value is clipped. In negative clipping circuit instead of positive portion of sinusoidal signal, negative portion is clipped. In slicer both positive and negative portions of the sinusoidal signal are clipped.

Procedure

1. Connect the circuit as shown in the circuit diagram.
2. Connect the function generator at the input terminals and CRO at the output terminals of the circuit.
3. Apply a sine wave signal of frequency 1 KHz, Amplitude greater than the reference voltage at the input and observe the output waveforms of the circuits.

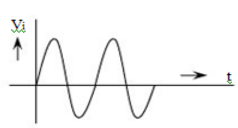
Circuit Diagram

<u>Positive Clipper</u>

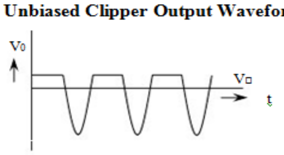


Model Graph:

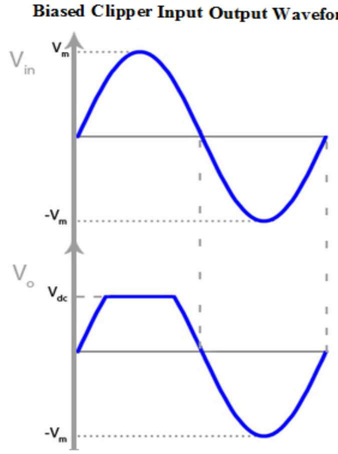
Input waveform



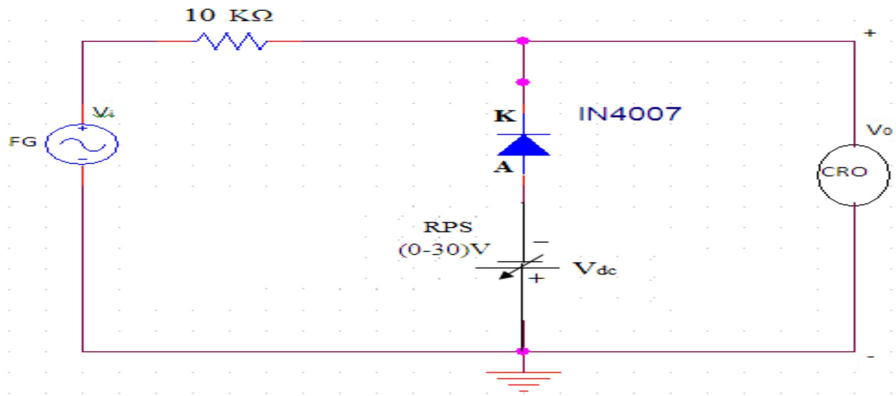
Unbiased Clipper Output Waveform

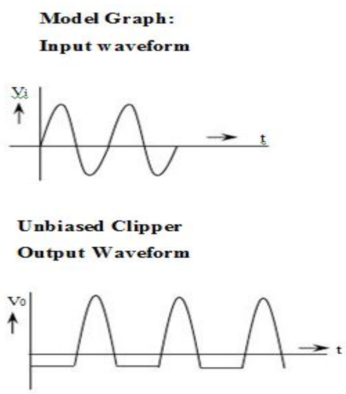


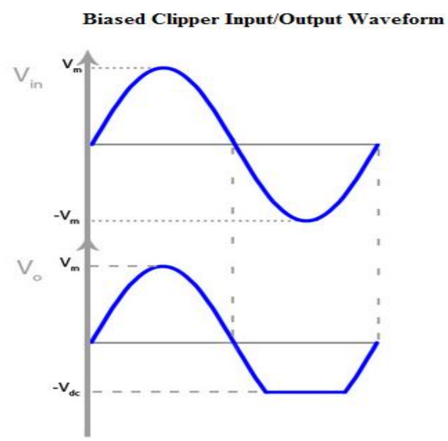
Biased Clipper Input Output Waveform



Negative Clipper







Tabulation:

Positive Clipper **Negative Clipper**

Unbiased Clipper			
V_{ref} = 0V		V_{ref} = 0V	
Output voltage (V)	Time Period (ms)	Output voltage (V)	Time Period (ms)
Biased Clipper			
V_{ref} = 2V		V_{ref} = 2 V	
Output voltage (V)	Time Period (ms)	Output voltage (V)	Time Period (ms)

GRAPH:

Result

POST LAB QUESTIONS

1. Differentiate +ve and -ve Clippers.

2. What is the function of Clampers?

3. Write the classifications of clippers and clampers.

4. Draw the output for the given input to the clamper circuit

5. What is the need of wave shaping circuit?

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Title of Experiment	: **9. Displacement measurement using LVDT and pressure measurement using Strain gauge**
Name of the candidate Register Number Date of Experiment	: : :

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

Experiment No. 9 a) Date :	**Displacement measurement using Linear Variable Differential Transformer**

Aim: To measure the displacement and to determine the characteristics of LVDT (Linear Variable Differential Transformer).

Apparatus required: LVDT, Digital displacement indicator, Calibration jig (with micrometre).

THEORY: LVDT (LINEAR VARIABLE DIFFERENTIAL TRANSFORMER)

The most widely used inductive transducer to translate the linear motion into electrical signals is the linear variable differential transformer (LVDT). The basic construction of LVDT is shown in Figure 1.

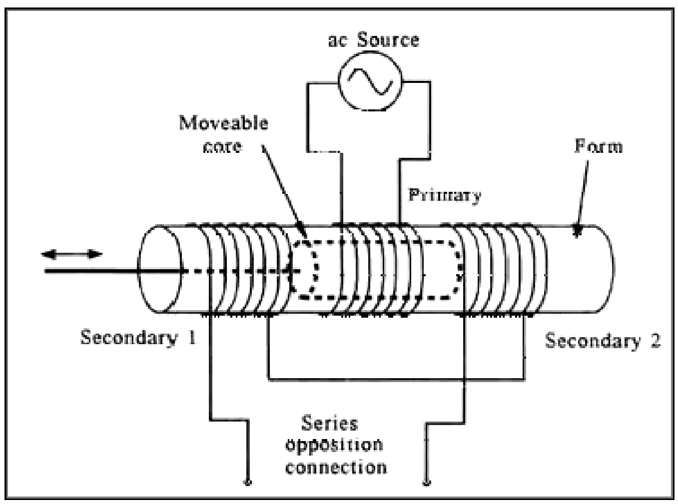


Figure 1. Linear Variable Differential Transformer

The transformer consists of a single primary P and two secondary windings S1 and S2 wound on a cylindrical former. The secondary windings have equal number of turns and are identically placed on either side. A moveable soft iron core is placed inside the transformer. The displacement to be measured is applied to the arm attached to the soft iron core. In practice the arm is made of highly permeability, nickel iron which is hydrogen annealed. This gives low harmonics low null voltage and high sensitivity. This is slotted longitudinally to reduce eddy current losses. The assembly is placed in stainless steel housing and the end leads provides electrostatic and electromagnetic shielding. The frequency of AC applied to primary windings may be between 50 Hz to 20 kHz. Since the primary winding is excited by an alternating source, it produces an alternating magnetic field which in turn induces alternating current voltage in the two secondary windings. Figure 2 depicts a cross-sectional view of an LVDT. The core causes the magnetic field generated by the primary winding to be coupled to the secondary. When the core is centred perfectly between both secondary and the primary as shown, the voltage induced in each secondary is equal in amplitude and 180 degree out of phase. Thus the LVDT output (for the series-opposed connection shown in this case) is zero because the voltage cancels each other. E0 = Es1 - Es2 = 0.

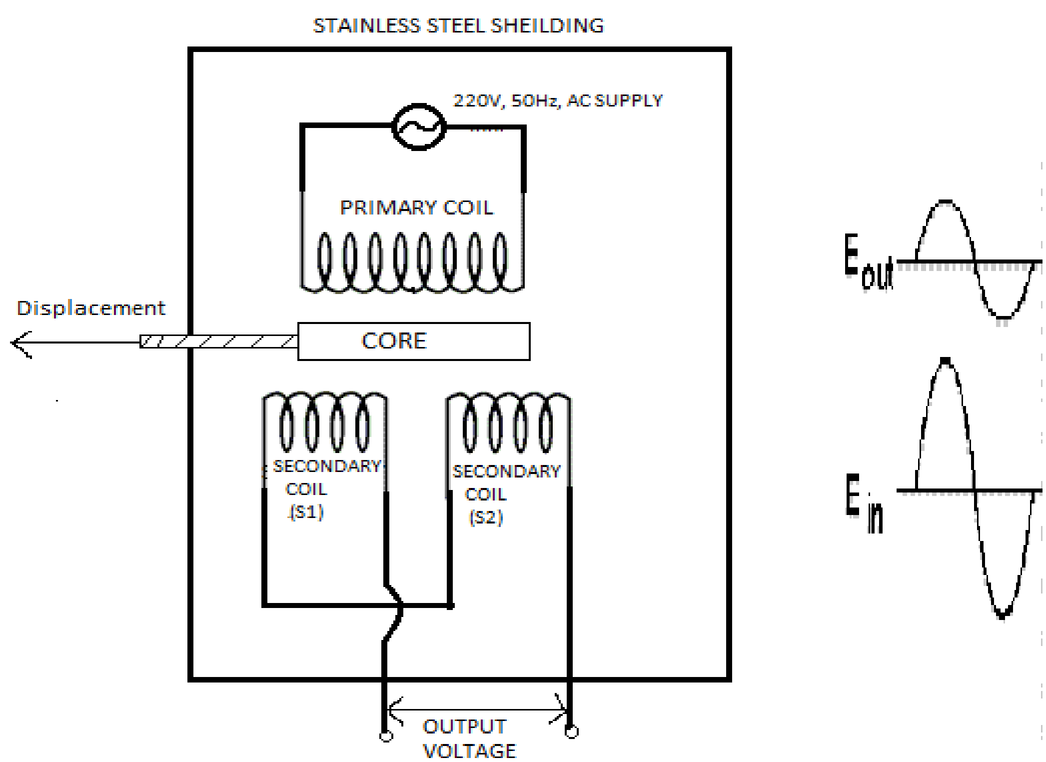


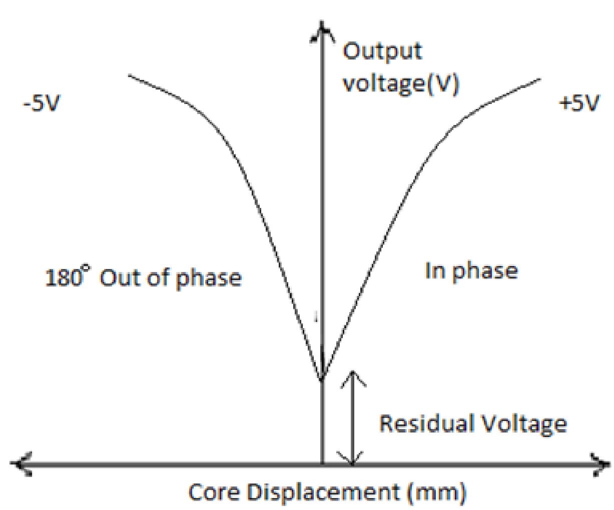
Figure 2. View of LVDT Core and Windings

Displacing the core to the left causes the first secondary to be more strongly coupled to the primary than the second secondary. The resulting higher voltage of the first secondary in relation to the second secondary causes an output voltage that is in phase with the primary voltage. Likewise, displacing the core to the right causes the second secondary to be more strongly coupled to the primary than the first secondary. The greater voltage of the second secondary causes an output voltage to be out of phase with the primary voltage.

Procedure:

1. Plug power chord to AC mains 230 V, 50 Hz and switch on the instrument.
2. Place the READ/CAL switch at READ position.
3. Balance the amplifier with the help of zero knob so that display should read zero without connecting the LVDT to instrument.
4. Replace the READ/CAL switch at CAL position.
5. Adjust the calibration point by rotating CAL knob so display should read 10.00 i.e., maximum calibration range.
6. Again keep the READ/CAL switch at READ position and connect the LVDT cable to instrument.
7. Make mechanical zero by rotating the micrometre. Display will read (00.00) this is null balancing.
8. Give displacement with micrometre and observe the digital readings.
9. Plot the graph of micrometre reading v/s digital reading.

Model Graph:



Tabulations:

MICROMETER DISPLACEMENT(mm)	CORE DISPLACEMENT (mm)	SECONDARY OUTPUT VOLTAGE(V)

GRAPH:

Result:

POST LAB QUESTIONS:

1. What are the three principles of Inductive transducers?

2. What are the limitations of LVDT?

3. Where LVDT is used?

4. What are the different types of transducers used for displacement measurement?

5. What is the difference between variable resistance & variable inductance displacement transducer?

PRE LAB QUESTIONS (Strain gauge):

1. How does a strain gauges work?

2. What is piezo-resistive effect?

3. What are the types of strain gauge?

4. Define gauge factor

5. Mention some practical applications of strain gauge

Experiment No. 9 b) Date :	**Strain measurement using Strain gauge**

Aim: To measure the strain using strain gauge.

Apparatus Required: Strain gauge, weight, LABVIEW software.

Theory: Strain is the amount of deformation of a body due to an applied force. More specifically, strain (e) is defined as the fractional change in length, Strain can be positive (tensile) or negative (compressive). Although dimensionless, strain is sometimes expressed in units such as in./in. or mm/mm. In practice, the magnitude of measured strain is very small. Therefore, strain is often expressed as microstrain (me), which is e x 10-6. When a bar is strained with a uniaxial force, as in Figure 1, a phenomenon known as Poisson Strain causes the girth of the bar, D, to contract in the transverse, or perpendicular, direction. The magnitude of this transverse contraction is a material property indicated by its Poisson's Ratio. The Poisson's Ratio n of a material is defined as the negative ratio of the strain in the transverse direction (perpendicular to the force) to the strain in the axial direction (parallel to the force), or n = eT/e. The most widely used gage is the bonded metallic strain gage. The metallic strain gauge consists of a very fine wire or, more commonly, metallic foil arranged in a grid pattern. The grid pattern maximizes the amount of metallic wire or foil subject to strain in the parallel direction (Figure 2). The cross-sectional area of the grid is minimized to reduce the effect of shear strain and Poisson Strain. The grid is bonded to a thin backing, called the carrier, which is attached directly to the test specimen.

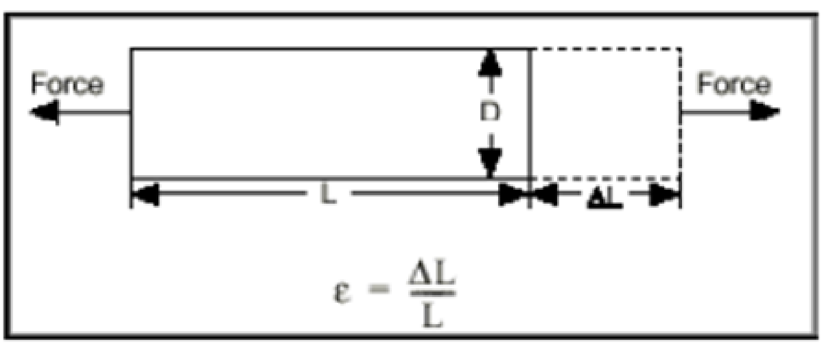


Figure 1. Strain measurement

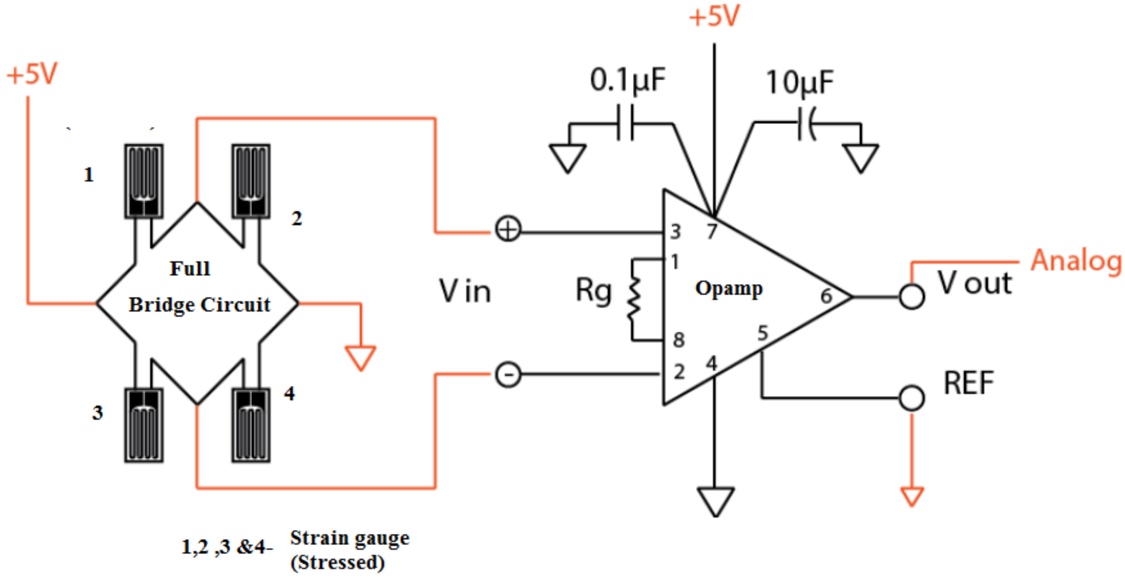


Figure 2. Full- Bridge Strain gauge circuit

Procedure:

1. Connect the cantilever strain measurement assembly to the main trainer and switch ON the trainer
2. Connect the multi meter at the Instrument output with multimeter in DC VOLTAGE mode and 20 V Range.
3. Connect this STRAIN output also to display section marked Vout.
4. Now without any strain or load in the cantilever beam. So adjust the OFFSET CONTROL to 0 volts at the output.
5. Now place 500 grams weights on the pan suspended n the beam and adjust the gain or call control to read 0.5 volt by multimeter at the strain output terminal.
6. Now remove the weight from the pan and the output must be 0 volt. IF not then readjust OFFSET Control
7. Table the readings for different weight or strain on the load cell as well as display readings.

Tabulation:

S.no	Weight in Pan (Grams)	Voltage measured	Display reading	Calculated value
1	100			
2	200			
3	300			
4	400			
5	500			
6	600			
7	700			
8	800			
9	900			
10	1000			

Result:

POST-LAB QUESTIONS:

1. How can you apply the principle of stain gauge?

2. What is meant by passive transducer?

3. What is sensitivity of strain gauge?

4. What is a microstrain?

5. What are the limitations of a strain gauge?

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Title of Experiment	: **10. Verification and interpretation of Logic Gates.**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE-LAB QUESTIONS

1. Name the different Logic Gates.

2. List out the IC names for the different logic Gates.

3. What is the Boolean expression for a NOR gate?

4. How does a NOR gate work?

5. Expression for Ex-OR and Ex-NOR?

Experiment No. 10 **Date :**	**Verification and interpretation of truth tables for AND, OR, NOT, NAND, NOR Exclusive OR (EX-OR), Exclusive NOR (EX-NOR) Gates.**

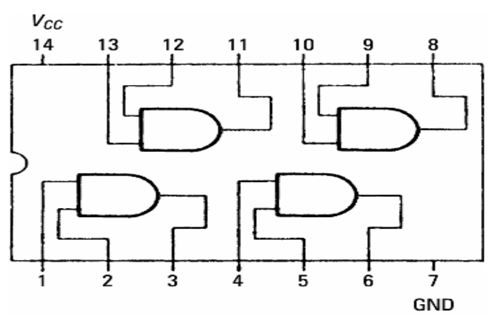
Aim: To verify the Boolean expression using logic gates.

Apparatus: Logic trainer kit, logic gates / ICs, wires.

Theory: Logic gates are electronic circuits which perform logical functions on one or more inputs to produce one output. There are seven logic gates. When all the input combinations of a logic gate are written in a series and their corresponding outputs written along them, then this input/ output combination is called **Truth Table**. The following logic gates and their working are explained.

i) AND Gate

AND gate produces an output as 1, when all its inputs are 1; otherwise the output is 0. This gate can have minimum 2 inputs but output is always one. Its output is 0 when any input is 0.



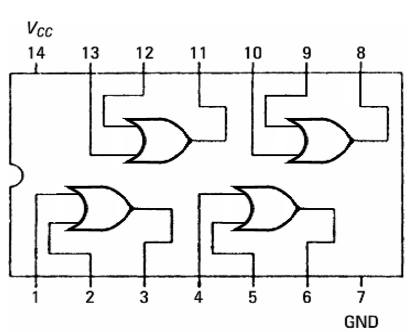
Y=A.B

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

IC 7408

ii) OR Gate

OR gate produces an output as 1, when any or all its inputs are 1; otherwise the output is 0. This gate can have minimum 2 inputs but output is always one. Its output is 0 when all input are 0.



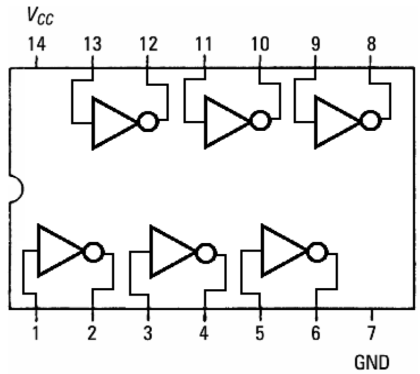
Y=A+B

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

IC 7432

iii) NOT Gate

NOT gate produces the complement of its input. This gate is also called an INVERTER. It always has one input and one output. Its output is 0 when input is 1 and output is 1 when input is 0.



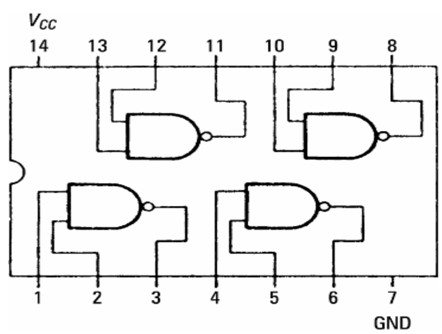
$Y=\overline{A}$

A	Y
0	1
1	0

IC 7404

iv) NAND Gate

NAND gate is actually a series of AND gate with NOT gate. If we connect the output of an AND gate to the input of a NOT gate, this combination will work as NOT-AND or NAND gate. Its output is 1 when any or all inputs are 0, otherwise output is 1.



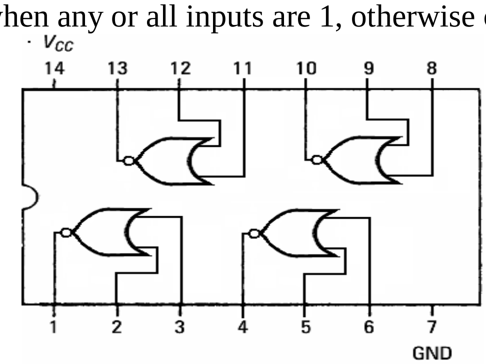
$Y=\overline{A.B}$

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

IC 7400

v) NOR Gate

NOR gate is actually a series of OR gate with NOT gate. If we connect the output of an OR gate to the input of a NOT gate, this combination will work as NOT-OR or NOR gate. Its output is 0 when any or all inputs are 1, otherwise output is 1.



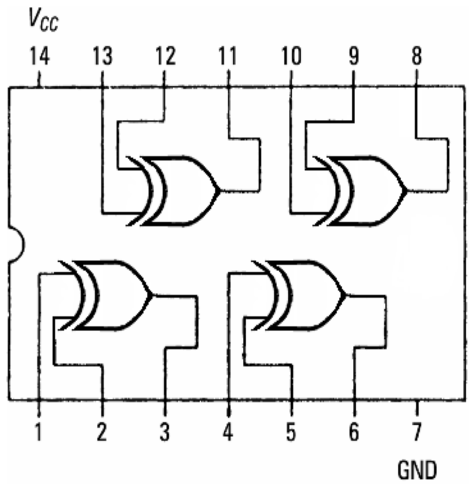
$Y=\overline{A+B}$

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

IC 7402

vi) Exclusive OR (X-OR) Gate

X-OR gate produces an output as 1, when number of 1's at its inputs is **odd**, otherwise output is 0. It has two inputs and one output.



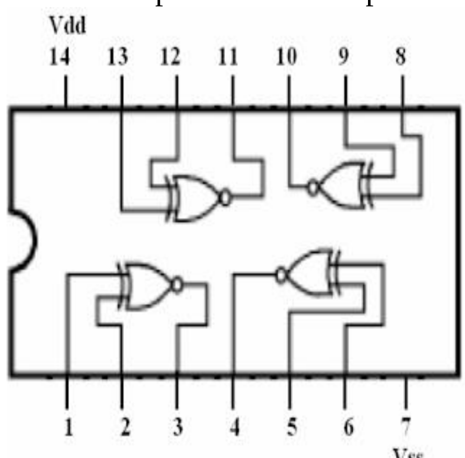
$Y = A \oplus B$

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

IC 7486

vii) Exclusive NOR (X-NOR) Gate

X-NOR gate produces an output as 1, when number of 1's at its inputs is **not odd**, otherwise output is 0. It has two inputs and one output.



$Y = A \oplus B$

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1

IC 74266

<u>Procedure:</u>

1. Connect the trainer kit to ac power supply.
2. Connect the inputs of any one logic gate to the logic sources and its output to the logic indicator.
3. Apply various input combinations and observe output for each one.
4. Verify the truth table for each input/ output combination.
5. Repeat the process for all other logic gates.
6. Switch off the ac power supply.

POST-LAB QUESTIONS

1. Name the universal Gates?

2. Deduce the logic of AND gate using NAND and NOR?

3. What is the symbol of NAND gate?

4. How many NAND gates are required to make an OR gate?

5. How many NOR gates are required to implement a NAND gate?

DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603203.

Title of Experiment	: **11. Reduction of Boolean expression using K-map**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE LAB QUESTIONS:

1. How many Cells are in 4 and 5 Variable K- Map.

2. What do you mean by don’t care condition in K-map or truth table?

3. Write the Distributive property of Boolean Algebra.

4. Write down the De Morgan law.

5. State the difference between SOP and POS.

Experiment No. 11 Date :	**Reduction of Logic Expression using Karnaugh map (K- Map)**

Aim: To simply and verify the Boolean expression using K-map.

Apparatus: Logic trainer kit, logic gates / ICs, wires.

Theory:

Karnaugh maps: Karnaugh maps or K-maps for short, provide another means of simplifying and optimizing logical expressions. This is a graphical technique that utilizes a sum of product (SOP) form. SOP forms combine terms that have been ANDed together that then get ORed together. This format lends itself to the use of De Morgan's law which allows the final result to be built with only NAND gates. The K-map is best used with logical functions with four or less input variables. One of the advantages of using K-maps for reduction is that it is easier to see when a circuit has been fully simplified. Another advantage is that using K-maps leads to a more structured process for minimization. In order to use a K-map, the truth table for a logical expression is transferred to a K-map grid. The grid for two, three, and four input expressions are provided in the tables below. Each cell corresponds to one row in a truth table or one given state in the logical expression. The order of the items in the grid is not random at all; they are set so that any adjacent cell differs in value by the change in only one variable. Because of this, items can be grouped together easily in rectangular blocks of two, four, and eight to find the minimal number of groupings that can cover the entire expression. Note that diagonal cells require that the value of more than two inputs change, and that they also do not form rectangles.

	A'B' 00	A'B 01	AB 11	AB' 10
C' 0				
C 1				

Figure 1. Three variables K Map

	A' 0	A 1
B' 0		
B 1		

Figure 2. Two variables K- Map

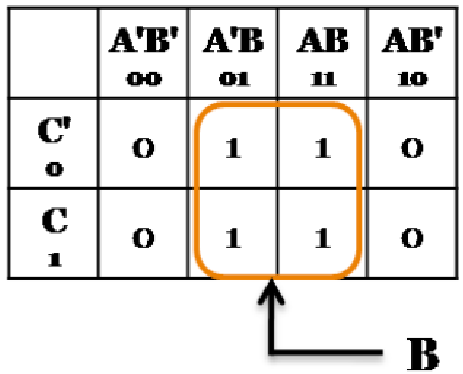
Given expression

F(C,A,B) = CAB + C'AB + CA'B + C'A'B

Simplification Using Boolean Properties

CAB + C'AB + CA'B + C'A'B	= AB(C + C') + A'B(C + C')	Distributive Property
	= AB + A'B	C + C' is always true
	= (A + A')B	Distributive Property
	= B	A + A' is always true

Simplification using K- Map



<u>Procedure:</u>

1. Connect the trainer kit to ac power supply.
2. Connect the circuit based on the given logic functions to be simplified.
3. Connect the inputs of first stage to logic sources and output of the last gate to logic indicator.
4. Apply various input combinations and observe output for each one.
5. Verify the output before and after reducing the expression.
6. Switch off the ac power supply.

Result:

Post-lab questions

1. Simply the expression F=AB+AB’

2. Name the different reduction techniques

3. Give the merits and demerits of K-map

4. What are differences between K-map and Quine McCluskey?

5. Give steps for reducing two variable expression using K-map?

DEPT. OF ELECTRICAL & ELECTRONICS ENGINEERING
SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, Kattankulathur – 603203.

Title of Experiment	: **12. Study of modulation and demodulation techniques.**
Name of the candidate	:
Register Number	:
Date of Experiment	:

Sl. No.	Marks Split up	Maximum marks (50)	Marks obtained
1	Pre Lab questions	5	
2	Preparation of observation	15	
3	Execution of experiment	15	
4	Calculation / Evaluation of Result	10	
5	Post Lab questions	5	
Total		**50**	

Staff Signature

PRE-LAB QUESTIONS

1. What is meant by modulation and demodulation in communication?

2. What is modulation and demodulation?

3. What is modulation and what is the purpose of it?

4. Compare AM and FM

5. What is the difference between a modem and router?

Experiment No. 12 Date :	**Study of modulation and demodulation techniques.**

Aim: To study the different modulation and demodulation techniques

Theory:

Modulation and demodulation

Communication is the basic attraction of mankind as it gives the knowledge of what is going on around us. In our daily life, we communicate with many people and use the entertainment media like television, radio, internet and newspaper to get ourselves involved. These entertainment media act as a source of communication**. Electronic communication** comprises TV, radio, internet, etc. When we want to transmit a signal from one location to another, we have to strengthen the signal. After undergoing strengthening process the signal travels to a long distance. This is called as modulation, and this article gives an overview of the modulation and types of modulation techniques.

Communication is nothing but, the process of exchanging (two way communications) or passing (one way communication) information from one person to another. The basic electronic communication system consists of these components: transmitter, receiver and communication channel.

Types of Modulation

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Communication is nothing but, the process of exchanging (two way communications) or passing (one way communication) information from one person to another. The basic electronic communication system consists of these components: transmitter, receiver and communication channel.

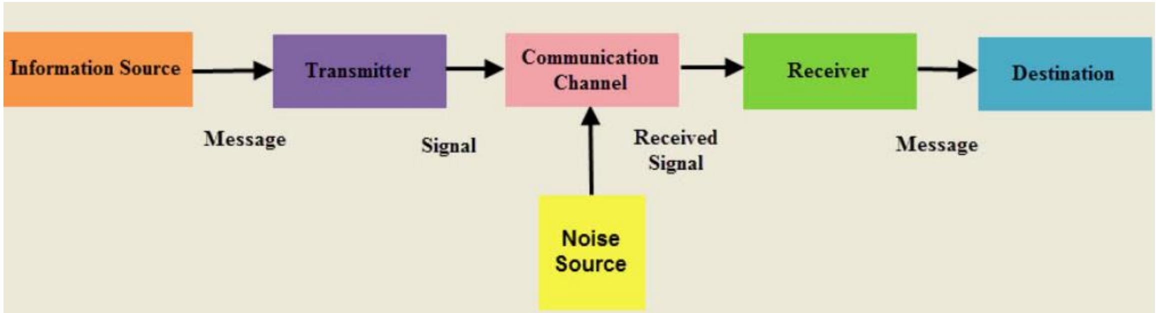


Figure 1. Communication System

A transmitter is a group of electronic circuits designed to convert the information into a signal for transmission over a given communication medium.

A receiver is a group of electronic circuits designed to convert the signal back to the original information.

The communication channel is the medium which is designed to transmit the electronic signal from one place to another.

Modulation is a way of sending signals of low frequency over long distances without a huge loss of energy by the use of another wave of very high frequency called a carrier wave.

Modulation is nothing but, a carrier signal that varies in accordance with the message signal. Modulation technique is used to change the signal characteristics. Basically, the modulation is of following two types:

- Analog Modulation
- Digital Modulation

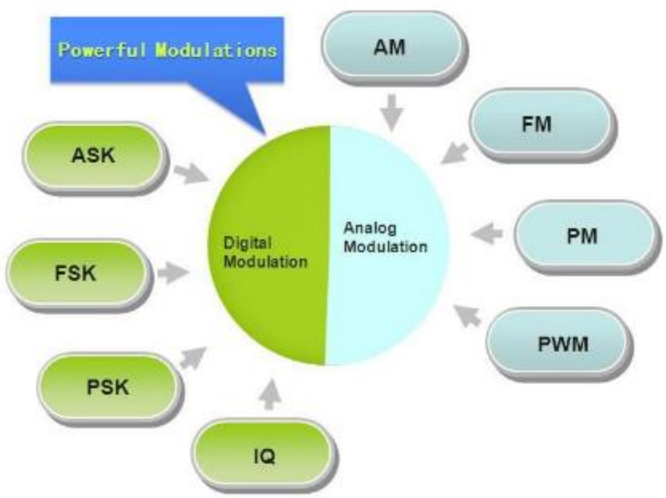


Figure 1. Types of Modulation

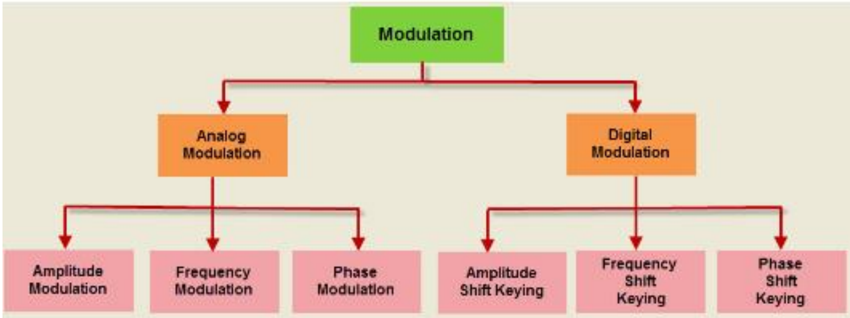


Figure 2. Modulation Techniques

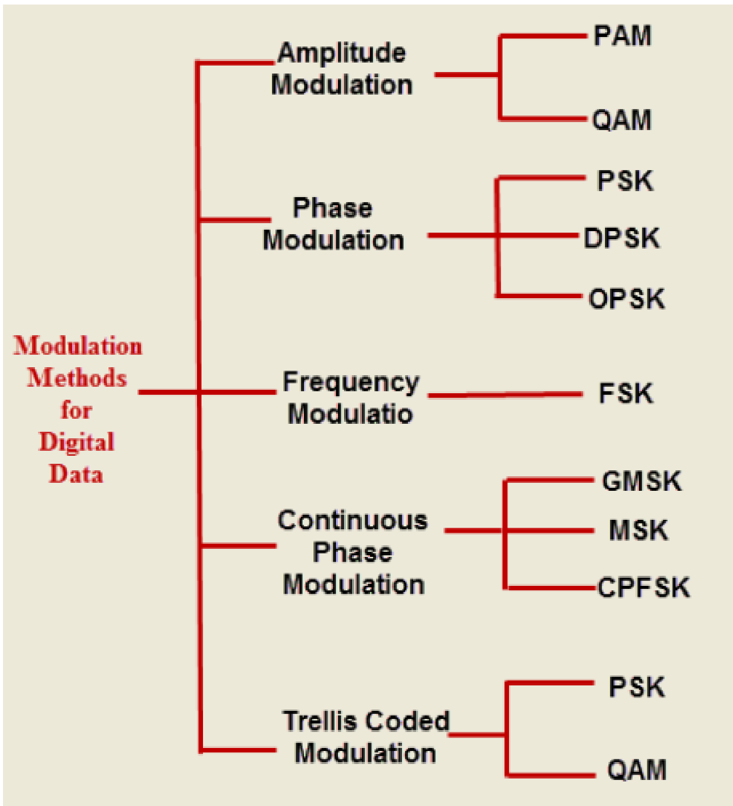


Figure 3. Types of Digital Modulation Techniques

High frequency signals are more directional and because high frequency waves have a small wavelength there is less diffraction. Also smaller aerials are needed because the size of the aerial has to be of the same sort of size as the wavelength of the signal to be transmitted.

Therefore a sound with a frequency of 256 Hz (middle C) received by a microphone, converted to an electrical signal and then transmitted would have a wavelength of 300000000/256 = 1 170 000 m, over 1000 km!

However a wave of frequency 100 MHz has a wavelength of only 3 m.

We can compare amplitude modulation with a long tube of soft clay on a conveyor belt. The clay moves between the hands of two people, one at each end of the belt.

Modulation – the person at one end moulds the clay by pressing on it as it moves between their hands. By squeezing and relaxing they make a tube of clay with a changing diameter.

At the other end of the belt there is a person with their eyes shut and their hands on either side of the clay at the other end. As the clay moves past their hands are forced in and out by the changing diameter of the clay cylinder. This is called detection

In reality we start with a carrier wave of very high frequency and add to it the audio signal (of relatively low frequency). This addition of the audio signal is called modulation. This can be done either by changing the amplitude of the carrier wave (amplitude modulation) or by changing its frequency (frequency modulation).

The audio signal is produced (Figure 1) and converted to an electrical signal by the

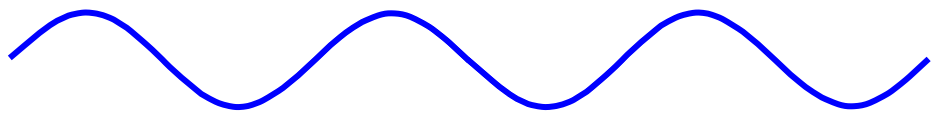


Figure 1

microphone.

The high frequency carrier wave (with a frequency of say 100 MHz) (Figure 2) is

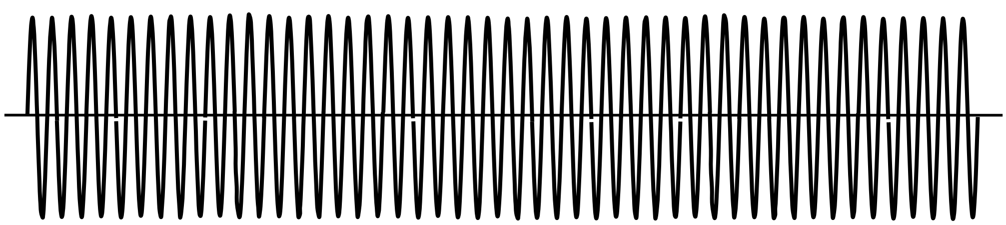


Figure 2

produced by the transmitter.

These two signals are added together (modulation) (Figure 3).

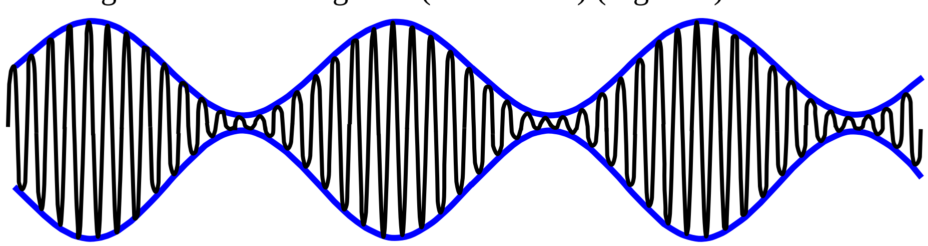


Figure 3

The modulated signal is transmitted (Figure 4).

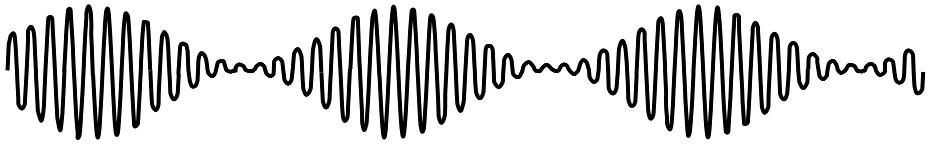


Figure 4

The modulated signal is received by the aerial.

A diode is used to separate the high frequency carrier wave from the low frequency audio signal (demodulation) by removing half the signal. This leaves the outline of the audio signal (Figure 5).

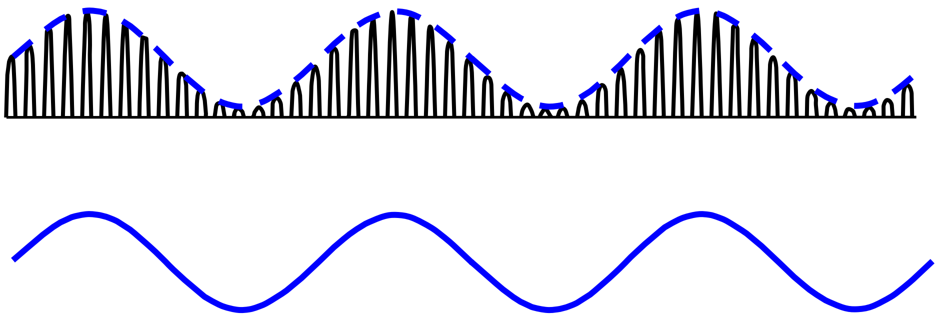
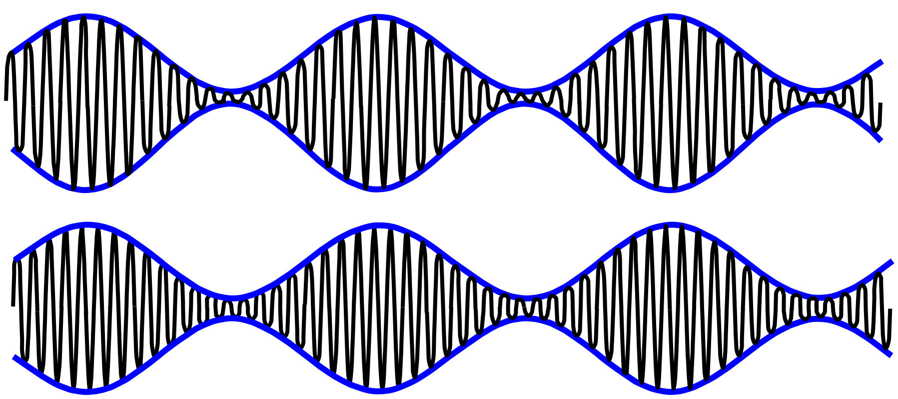


Figure 5

This signal is now amplified and fed to a loudspeaker.

The receiver is tuned to the carrier wave frequency. The following two diagrams (Figures 6 and 7) show two carrier waves of different frequency both modulated by the same frequency audio signal.



Figures 6 and 7

Result:

POST-LAB QUESTIONS

1. What are the different types of modulation?

2. Which type of modulation is used in television?

3. What is PPM modulation?

4. What is PWM modulation?

5. What are NTSC and PAL?