MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Recognized under 2(f) and 12 (B) of UGC ACT 1956

(Affiliated to JNTUH, Hyderabad, Approved by AICTE-Accredited by NBA & NACC-'A' Grade – ISO 9001:2015 Certified)

Maisammaguda, Dhulapally (Post Via. Hakimpet), Secunderabad -500100, Telangana State, India

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BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
LABORATORY MANUAL

Student Name:…………………………………………………

RollNo:…………………………………………………………

Branch:…………………………….Section……………………

Year ………………………Semester………………………..

FACULTY INCHARGE

PREFACE

Engineering institutions have been continually modernizing and updating their curricula to keep pace with the technological advancements and meet the demands of the industry. In recent past, numerous universities brought a significant change in the graduate programs of engineering at first year level .To meet the needs of the light–current engineering industries (electronics, communication, instrumentation, controls, computers, etc.) and to enhance the employability of their graduates, several universities replaced their traditional 'Basic Electrical Engineering' (common to all disciplines) with 'Basic Electrical and Electronics Engineering'. The present course has been designed and developed to ensure that the fundamentals of this course are well understood by students of Mechanical and Aeronautical engineering. Simultaneously, fundamentals of important topics, in major subject areas, have been discussed to provide a foundation for the study of advanced topics, by students of various current engineering disciplines in their subsequent programmes of study. This course ideally meets the requirement of the first level course in 'Basic Electrical and Electronics Engineering Laboratory'.

It is firmly believed that this course will help students to overcome their initial apprehensions and initiate a life-long affair with electrical and electronics engineering. It also presents a clear and concise exposition of the principles and applications of electrical and electronics engineering.

Faculty of BEEE

MRCET

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi disciplinary environments.
12. **Life- long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

I Year B.Tech - ME/ANE-I SEM L T P C
0 0 3 1.5

(R18A0281) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

OBJECTIVES:

1. To Design Electrical Systems.
2. To Analyze A Given Network By Applying Various Network Theorems.
3. To Expose The Students To The Operation Of DC Generator
4. To Expose The Students To The Operation Of DC Motor and Transformer.

List of Experiments

1. Verification of KVL and KCL.
2. Verification of Thevenin's theorem.
3. Verification of Norton's theorem.
4. Verification of Superposition theorem.
5. Swinburne's test on DC shunt machine.
6. OC & SC tests on single phase transformer.
7. PN Junction diode characteristics.
8. Zener diode characteristics.
9. Half wave rectifier with and without filter.
10. Full wave rectifier with and without filter.
11. Transistor CB Characteristics (Input And Output)
12. Transistor CE Characteristics (Input And Output)

NOTE: Any 10 of Above Experiments Are To Be Conducted

OUTCOMES:

After successfully studying this course, students will:

1. Explain the concept of circuit laws and network theorems and apply them to laboratory measurements.
2. Be able to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and DC Machines
3. Acknowledge the principles of operation and the main features of electric machines and their applications.
4. Acquire skills in using electrical measuring devices.

INSTRUCTIONS TO STUDENTS

- Before entering the lab the student should carry the following things.
    - Identity card issued by the college.
    - Class notes
    - Lab observation book
    - Lab Manual
    - Lab Record
- Student must sign in and sign out in the register provided when attending the lab session without fail.
- Come to the laboratory in time. Students, who are late more than 15 min., will not be allowed to attend the lab.
- Students need to maintain 100% attendance in lab if not a strict action will be taken.
- All students must follow a Dress Code while in the laboratory
- Foods, drinks are NOT allowed.
- All bags must be left at the indicated place.
- The objective of the laboratory is learning. The experiments are designed to illustrate phenomena in different areas of Physics and to expose you to measuring instruments, conduct the experiments with interest and an attitude of learning
- You need to come well prepared for the experiment.
- Work quietly and carefully
- Be honest in recording and representing your data.
- If a particular reading appears wrong repeat the measurement carefully, to get a better fit for a graph
- All presentations of data, tables and graphs calculations should be neatly and carefully done
- Graphs should be neatly drawn with pencil. Always label graphs and the axes and display units.
- If you finish early, spend the remaining time to complete the calculations and drawing graphs. Come equipped with calculator, scales, pencils etc.
- Do not fiddle with apparatus. Handle instruments with care. Report any breakage to the Instructor. Return all the equipment you have signed out for the purpose of your experiment.

SPECIFIC SAFETY RULES FOR BEEE LABORATORY

- You must not damage or tamper with the equipment or leads.
- You should inspect laboratory equipment for visible damage before using it. If there is a problem with a piece of equipment, report it to the technician or lecturer. DONOT return equipment to a storage area
- You should not work on circuits where the supply voltage exceeds 40 volts without very specific approval from your lab supervisor. If you need to work on such circuits, you should contact your supervisor for approval and instruction on how to do this safely before commencing the work.
- Always use an appropriate stand for holding your soldering iron.
- Turn off your soldering iron if it is unlikely to be used for more than 10 minutes.
- Never leave a hot soldering iron unattended.
- Never touch a soldering iron element or bit unless the iron has been disconnected from the mains and has had adequate time to cool down.
- Never strip insulation from a wire with your teeth or a knife, always use an appropriate wire stripping tool.
- Shield wire with your hands when cutting it with a pliers to prevent bits of wire flying about the bench.

CONTENTS

CYCLE – 1

1. VERIFICATION OF KIRCHOFF'S LAWS

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

APPARATUS REQUIRED:

S.No	Name of the equipment	Range	Type	Quantity
1	RPS	0-30V	-	1N0
2	Voltmeter	0-20 V	Digital	4 NO
3	Ammeter	0-20mA	Digital	4 NO
4	Bread board	-	-	1 NO
5	Connecting wires	-	-	Required number.
6	Resistors	470 Ω		2 NO
		1kΩ		1 NO
		680Ω		1 NO

CIRCUIT DIAGRAMS:

GIVEN CIRCUIT:

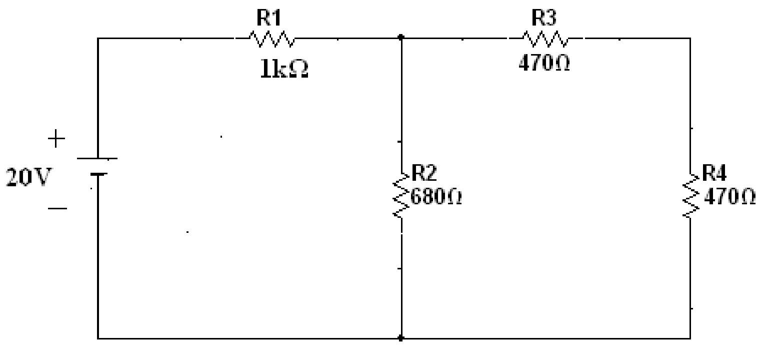


Fig (1)

1. KVL:

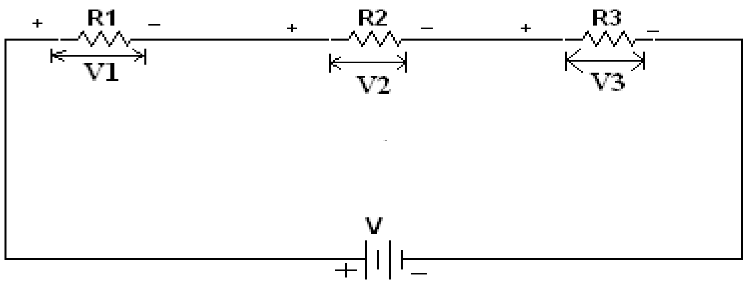
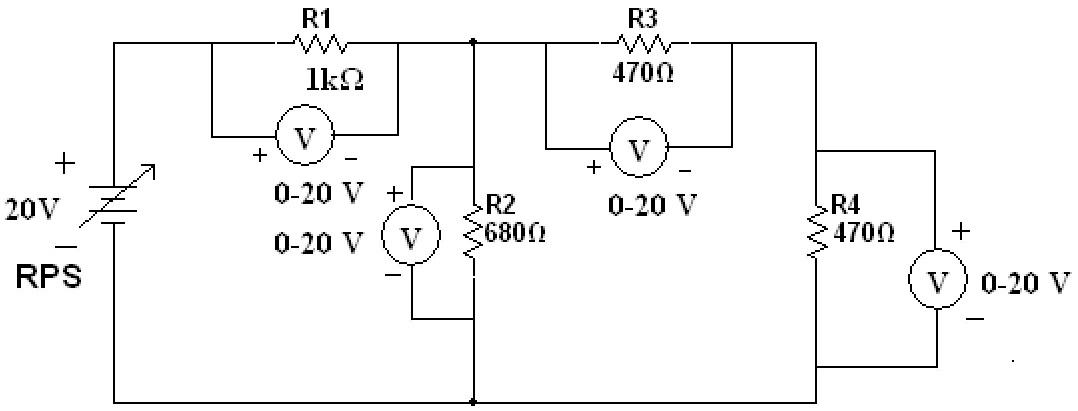


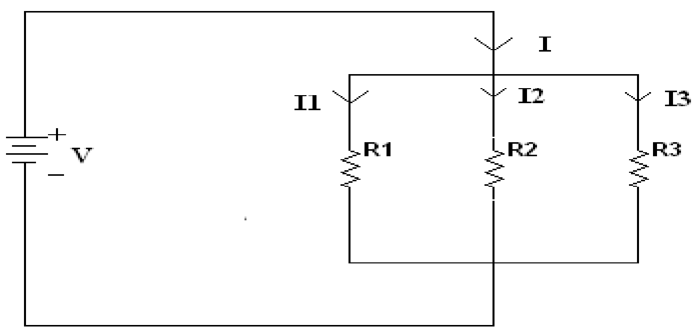
Fig (1a)

PRACTICAL CIRCUIT:



Fig(2a)

2. KCL:



Fig(1b)

PRACTICAL CIRCUIT:

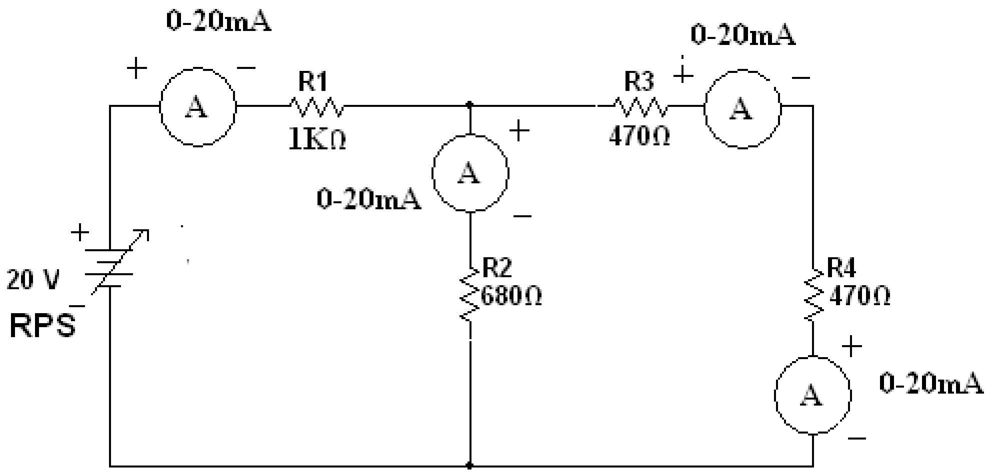


Fig (2b)

THEORY:

a) Kirchhoff's Voltage law states that the algebraic sum of the voltage around any closed path in a given circuit is always zero. In any circuit, voltage drops across the resistors always have polarities opposite to the source polarity. When the current passes through the resistor, there is a loss in energy and therefore a voltage drop. In any element, the current flows from a higher potential to lower potential. Consider the fig (1a) shown above in which there are 3 resistors are in series. According to kickoff's voltage law….

$$V = V_1 + V_2 + V_3$$

b) Kirchhoff's current law states that the sum of the currents entering a node equal to the sum of the currents leaving the same node. Consider the fig (1b) shown above in which there are 3 parallel paths. According to Kirchhoff's current law...

$$I = I_1 + I_2 + I_3$$

PROCEDURE:

1. Kirchhoff's Voltage law:
    1. Connect the circuit as shown in fig (2a).
    2. Measure the voltages across the resistors.
    3. Observe that the algebraic sum of voltages in a closed loop is zero.
2. Kirchhoff's current law:
    1. Connect the circuit as shown in fig (2b).
    2. Measure the currents through the resistors.
    3. Observe that the algebraic sum of the currents at a node is zero.

OBSERVATION TABLE:

KVL:

S.NO	Voltage Across Resistor	Theoretical	Practical

KCL:

S.NO	Current Through Resistor	Theoretical	Practical

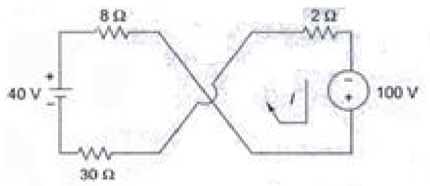
PRECAUTIONS:

1. Avoid loose connections.
2. Keep all the knobs in minimum position while switch on and off of the supply.

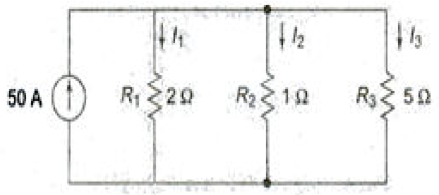
RESULT:

EXERCISE QUESTIONS:

1. In The Circuit Given In Fig Find A)The Current I B)The Voltage Across 30 Ω resistance



2. Determine The Current In All Resistors In The Circuit Shown In Fig.



VIVA QUESTIONS:

1. What is another name for KCL & KVL?
2. Define network and circuit?
3. What is the property of inductor and capacitor?

2. VERIFICATION OF THEVENIN'S THEOREM

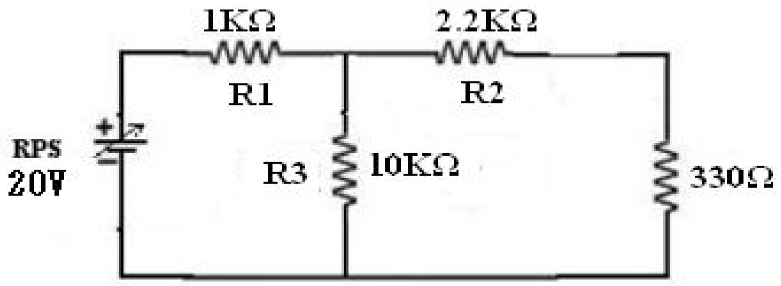
AIM: To verify Theremin's theorem for the given circuit.

APPARATUS REQUIRED:

S.No	Name Of The Equipment	Range	Type	Quantity
1	Voltmeter	(0-20)V	Digital	1 NO
2	Ammeter	(0-20)mA	Digital	1 NO
3	RPS	0-30V	Digital	1 NO
4	Resistors	10K Ω,1K Ω		1 NO
		2.2Ω		1 NO
		330 Ω		1 NO
5	Breadboard	-	-	1 NO
6	DMM	-	Digital	1 NO
7	Connecting wires			Required number

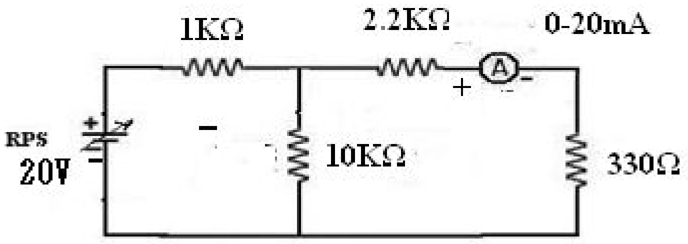
CIRCUIT DIAGRAM:

GIVEN CIRCUIT:



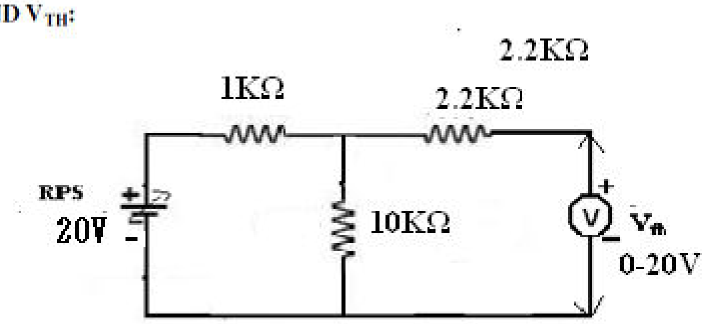
PRACTICAL CIRCUIT DIAGRAMS:

TO FIND I_L:



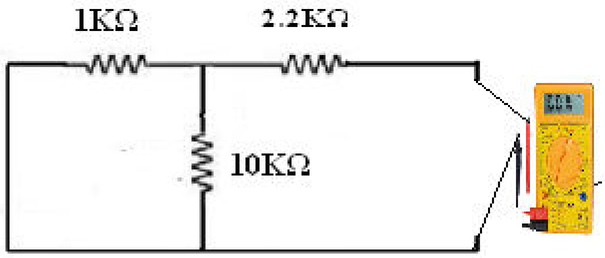
FIG(1)

TO FIND V_{TH}:



FIG(2)

TO FIND R_{th}:



fig(3)

THEORY:

THEVENIN'S THEOREM:

It states that in any lumped, linear network having more number of sources and elements the equivalent circuit across any branch can be replaced by an equivalent circuit consisting of Theremin's equivalent voltage source Vth in series with Theremin's equivalent resistance Rth. Where Vth is the open circuit voltage across (branch) the two terminals and Rth is the resistance seen from the same two terminals by replacing all other sources with internal resistances.

Thevenin's theorem:

The values of VTh and RTh are determined as mentioned in thevenin's theorem. Once the thevenin equivalent circuit is obtained, then current through any load resistance RL connected across AB is given by, $I = \frac{V_{TH}}{R_{TH}+R_L}$

Thevenin's theorem is applied to d.c. circuits as stated below.

Any network having terminals A and B can be replaced by a single source of e.m.f. V_{Th} in series with a source resistance R_{Th}

(i) The e.m.f the voltage obtained across the terminals A and B with load, if any removed i.e., it is open circuited voltage between terminals A and B.

(ii) The resistance R_{Th} is the resistance of the network measured between the terminals A and B with load removed and sources of e.m.f replaced by their internal resistances. Ideal voltage sources are replaced with short circuits and ideal current sources are replaced with open circuits.

To find V_{Th}, the load resistor 'RL' is disconnected, then $VTh = \frac{V}{R_1+R_2} X R3$

To find R_{Th},

$$R_{Th} = R2 + \frac{R_1 R_3}{R_1 + R_3}$$

Thevenin's theorem is also called as "Helmoltz theorem"

PROCEDURE:

1. Connect the circuit as per fig (1)
2. Adjust the output voltage of the regulated power supply to an appropriate value (Say 20V).
3. Note down the response (current, IL) through the branch of interest i.e. AB (ammeter reading).
4. Reduce the output voltage of the regulated power supply to 0V and switch-off the supply.
5. Disconnect the circuit and connect as per the fig (2).
6. Adjust the output voltage of the regulated power supply to 20V.
7. Note down the voltage across the load terminals AB (Voltmeter reading) that gives Vth.
8. Reduce the output voltage of the regulated power supply to 0V and switch-off the supply.
9. Disconnect the circuit and connect as per the fig (3).
10. Connect the digital multimeter(DMM) across AB terminals and it should be kept in resistance mode to measure Thevenin's resistance(R_{Th}).

THEORITICAL VALUES:

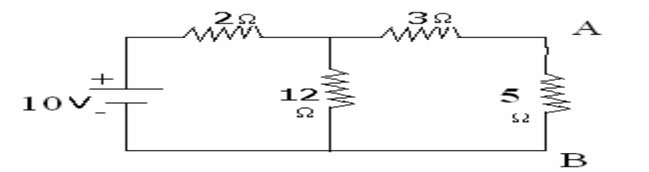
Tabulation for Thevenin's Theorem:

THEORITICAL VALUES	PRACTICAL VALUES
V_{th}= R_{th}= I_L=	V_{th}= R_{th}= I_L=

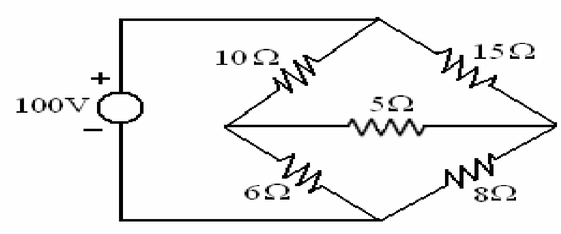
RESULT:

EXERCISE QUESTIONS:

1. Determine current through current 5 ohms resistor using Norton's theorem.



2. Determine the current flowing through the 5 ohm resistor using Thevenin's theorem



VIVA QUESTIONS:

1) The internal resistance of a source is 2 Ohms and is connected with an External Load Of 10 Ohms Resistance. What is Rth ?
2) In the above question if the voltage is 10 volts and the load is of 50 ohms What is the load current and Vth? Verify I_L?
3) If the internal resistance of a source is 5 ohms and is connected with an External Load Of 25 Ohms Resistance. What is Rth?
4) In the above question if the voltage is 20V and the load is of 50 Ohms, What is the load current and I_N ? Verify I_L ?

3. VERIFICATION OF NORTON'S THEOREM

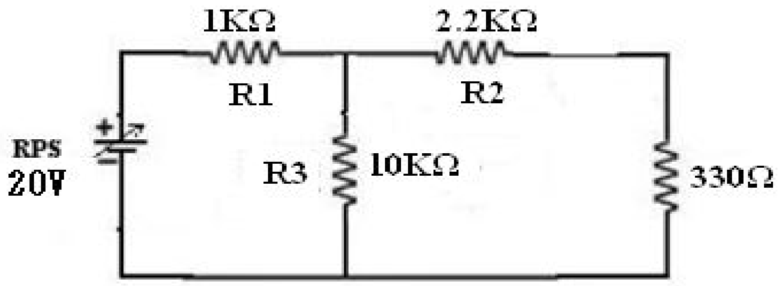
AIM: To verify Norton's theorem for the given circuit.

APPARATUS REQUIRED:

S.No	Name Of The Equipment	Range	Type	Quantity
1	Voltmeter	(0-20)V	Digital	1 NO
2	Ammeter	(0-20)mA	Digital	1 NO
3	RPS	0-30V	Digital	1 NO
4	Resistors	10K Ω,1K Ω		1 NO
		2.2Ω		1 NO
		330 Ω		1 NO
5	Breadboard	-	-	1 NO
6	DMM	-	Digital	1 NO
7	Connecting wires			Required number

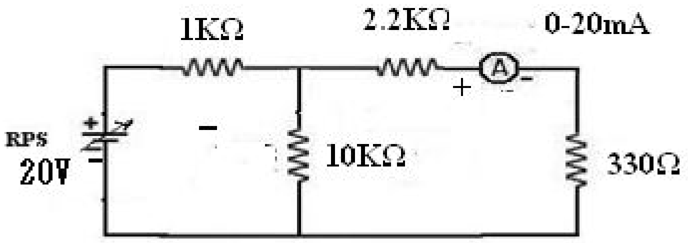
CIRCUIT DIAGRAM:

GIVEN CIRCUIT:



PRACTICAL CIRCUIT DIAGRAMS:

TO FIND I_L:



FIG(1)

TO FIND I_N:

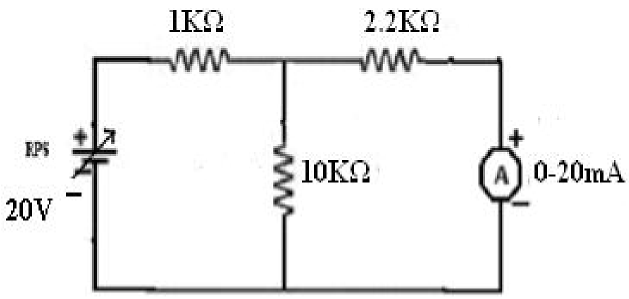
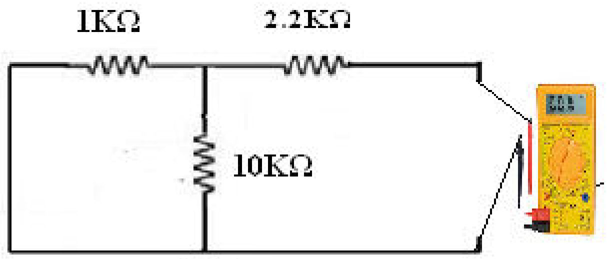


fig (2)

TO FIND R_N:



fig(3)

THEORY:

NORTON'S THEOREM:

Norton's theorem states that in a lumped, linear network the equivalent circuit across any branch is replaced with a current source in parallel a resistance. Where the current is the Norton's current which is the short circuit current though that branch and the resistance is the Norton's resistance which is the equivalent resistance across that branch by replacing all the sources sources with their internal resistances

for source current,

$$I = \frac{V}{R^{I}} = \frac{V(R_2 + R_3)}{R_1R_2 + R_1R_3 + R_2R_3}$$

FOR NORTON's CURRENT

$$I_N = I \times \frac{R_3}{R_3 + R_2} = \frac{VR_3}{R_1R_2 + R_1R_3 + R_2R_3}$$

Load Current through Load Resistor

$I_L = I_N \times [R_N / (R_N + R_L)]$

PROCEDURE:

1. Connect the circuit as per fig (1)
2. Adjust the output voltage of the regulated power supply to an appropriate value (Say 20V).
3. Note down the response (current, IL) through the branch of interest i.e. AB (ammeter reading).
4. Reduce the output voltage of the regulated power supply to 0V and switch-off the supply.
5. Disconnect the circuit and connect as per the fig (2).
6. Adjust the output voltage of the regulated power supply to 20V.
7. Note down the response (current, I_N) through the branch AB (ammeter reading).
8. Reduce the output voltage of the regulated power supply to 0V and switch-off the supply.
9. Disconnect the circuit and connect as per the fig (3).
10. Connect the digital multimeter(DMM) across AB terminals and it should be kept in resistance mode to measure Norton's resistance(R_N).

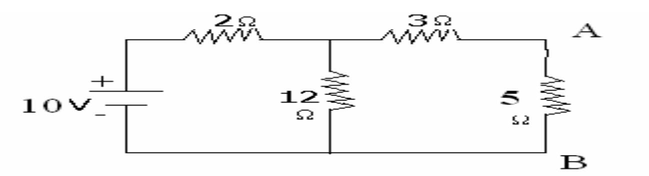
TABULATION FOR NORTON'S THEOREM:

THEORITICAL VALUES	PRACTICAL VALUES
I_N= R_N= I_L=	I_N= R_N= I_L=

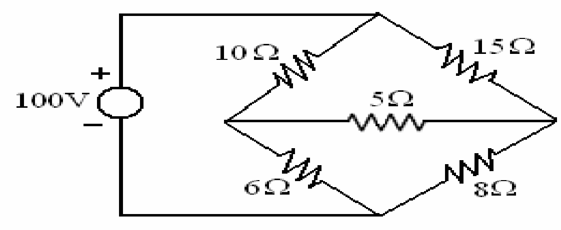
RESULT:

EXERCISE QUESTIONS:

1. Determine current through current 5 ohms resistor using Norton's theorem.



2. Determine the current flowing through the 5 ohm resistor using Thevenin's theorem



VIVA QUESTIONS:

1) The internal resistance of a source is 2 Ohms and is connected with an External Load Of 10 Ohms Resistance. What is Rth ?
2) In the above question if the voltage is 10 volts and the load is of 50 ohms. What is the load current and Vth? Verify I_L?
3) If the internal resistance of a source is 5 ohms and is connected with an External Load Of 25 Ohms Resistance. What is Rth?
4) In the above question if the voltage is 20V and the load is of 50 Ohms. What is the load current and I_N ? Verify I_L ?

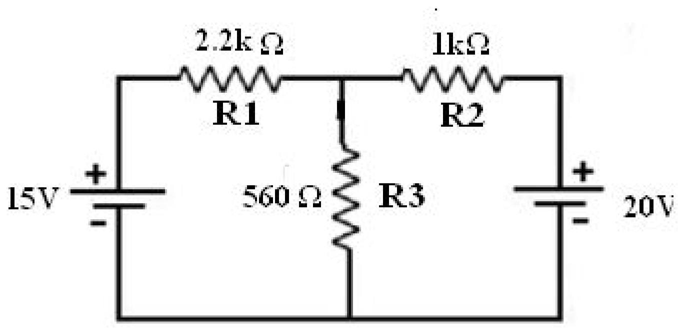
4. VERIFICATION OF SUPERPOSITION THEOREM

AIM: To verify the superposition theorem for the given circuit.

APPARATUS REQUIRED:

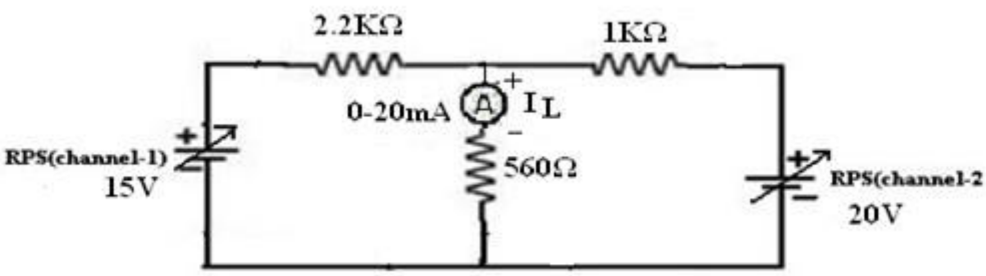
S.No	Name Of The Equipment	Range	Type	Quantity
1	Bread board	-	-	1 NO
2	Ammeter	(0-20)mA	Digital	1 NO
3	RPS	0-30V	Digital	1 NO
4	Resistors	2.2k Ω		1 NO
		1k Ω		1 NO
		560 Ω		1 NO
5	Connecting Wires	-	-	As required

CIRCUIT DIAGRAM:



PRACTICAL CIRCUITS:

When V_1&V_2 source acting(To find I_L):-



Fig(1)

When V_1 Source Acting (To Find I_L^I)

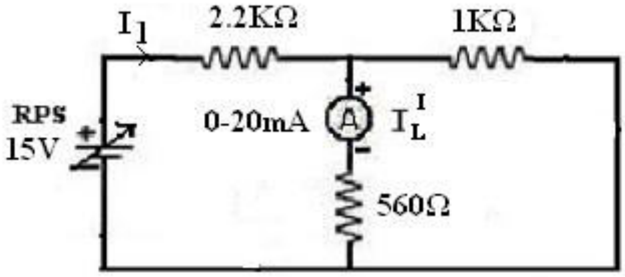


Fig (2)

WhenV_2 source acting (To find I_L^{II}):

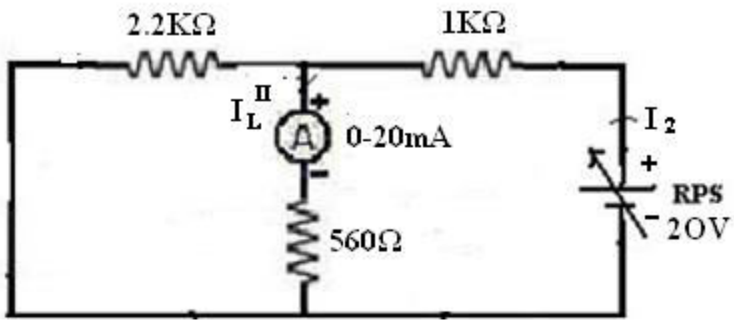


Fig (3)

THEORY:

SUPERPOSITION THEOREM:

Superposition theorem states that in a lumped ,linear, bilateral network consisting more number of sources each branch current(voltage) is the algebraic sum all currents (branch voltages), each of which is determined by considering one source at a time and removing all other sources. In removing the sources, voltage and current sources are replaced by internal resistances.

PROCEDURE:

1. Connect the circuit as per the fig (1).
2. Adjust the output voltage of sources X and Y to appropriate values (Say 15V and20V respectively).
3. Note down the current (I_L) through the 560 0hm resistor by using the ammeter.
4. Connect the circuit as per fig (2) and set the source Y (20V) to 0V.
5. Note down the current ($I_L^{I)}$ through 560ohm resistor by using ammeter.
6. Connect the circuit as per fig(3) and set the source X (15V) to 0V and source Y to 20V.
7. Note down the current (I_L^{II}) through the 560 ohm resistor branch by using ammeter.
8. Reduce the output voltage of the sources X and Y to 0V and switch off the supply.
9. Disconnect the circuit.

THEORITICAL CALCULATIONS

From Fig(2)

$$I_1 = V_1/(R_1+(R_2//R_3))$$

$$I_L^{1} = I_1 * R_2/(R_2+R_3)$$

From Fig(3)

$$I_2 = V_2/(R_2+(R_1//R_3))$$

$$I_L^{11} = I_2 * R_1/(R_1+R_3)$$

$$I_L = I_L^{1} + I_L^{11}$$

TABULAR COLUMNS:

From Fig(1)

S. No	Applied voltage (V_1) Volt	Applied voltage (V_2) Volt	Current I_L (mA)

From Fig(2)

S. No	Applied voltage (V_1) Volt	Current I_L^{I} (mA)

From Fig(3)

S. No	Applied voltage (V_2) Volt	Current I_L^{II} (mA)

S.No	Load current	Theoretical Values	Practical Values
1	When Both sources are acting, I_L		
2	When only source X is acting, I_L^{I}		
3	When only source Y is acting, I_L^{II}		

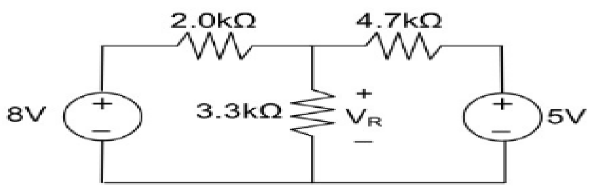
PRECAUTIONS:

1. Initially keep the RPS output voltage knob in zero volt position.
2. Set the ammeter pointer at zero position.
3. Take the readings without parallax error.
4. Avoid loose connections.
5. Avoid short circuit of RPS output terminals.

RESULT:

EXERCISE QUESTIONS:

1. Using the superposition theorem, determine the voltage drop and current across the resistor 3.3K as shown in figure below.



VIVA QUESTIONS:

1) What do you man by Unilateral and Bilateral network? Give the limitations of Superposition Theorem?
2) What are the equivalent internal impedances for an ideal voltage source and for a Current source?
3) Transform a physical voltage source into its equivalent current source.
4) If all the 3 star connected impedance are identical and equal to ZA, then what is the Delta connected resistors

5. SWINBURNE'S TEST ON D.C SHUNT MACHINE

AIM: To perform Swinburne's test on the given D.C machine and predetermine the efficiency at any desired load both as motor and as generator.

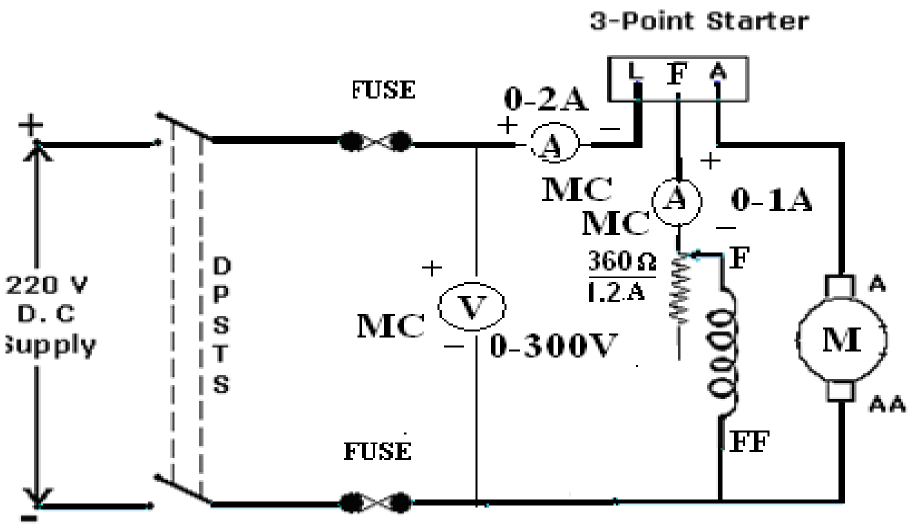
NAME PLATE DETAILS:

S.NO	Characteristic	D.C Motor
1	Voltage	220V
2	Current	20A
3	Speed	1500rpm
4	Power	5HP

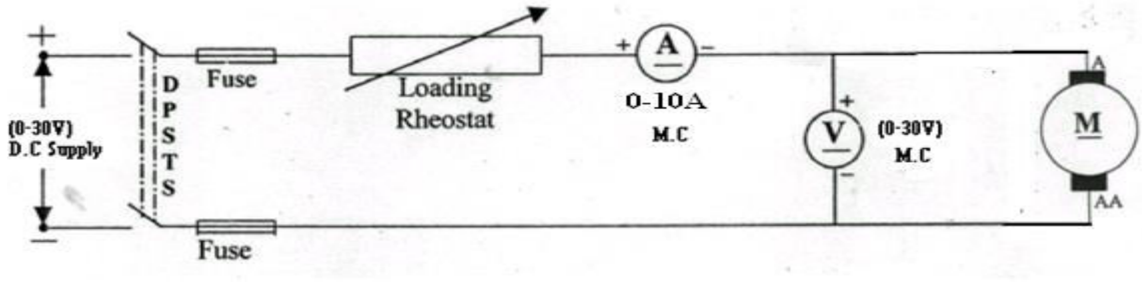
APPARATUS REQUIRED:

S.NO	Name Of The Equipment	Type	Range	Quantity
1	Ammeter	MC	0-2A,0-1A,0-10A	3NO
2	Voltmeter	MC	0-30V,0-300V	2NO
3	Rheostat	WW	370 Ω /2A	1NO
4	Tachometer	Digital	1000rpm	1NO

CIRCUIT DIAGRAM:



CIRCUIT DIAGRAM TO FIND ARMATURE RESISTANCE:



THEORY:

This test is to find out the efficiency of the machine .It is a simple indirect method in which losses are determined separately and from their knowledge, efficiency at any desired load can be predetermined. The only test needed is no-load test. This test cannot be performed on DC series motor. The machine is run as a no load shunt motor at rated speed and with a rated terminal voltage .However, this test is applicable to those machines in which flux is practically constant.

The constant losses in a dc shunt machine= Wc = stray losses (magnetic & mechanical losses) +shunt field copper losses.

Wc = No load input – No load armature copper losses

$= VI_{L0} - I^2_{ao}Ra$, where Ra is the armature resistance

$I_{ao}=I_L-I_{sh}$

PROCEDURE

1) Make all the connections are as per the circuit diagram.
2) Keep the field rheostat in **minimum** resistance position.
3) Excite the motor with **220V, DC** supply by closing the **DPST** switch and start the Motor by moving the handle of 3-point starter from **OFF** to **ON** position.
4) By adjusting the rheostat in motor field bring the speed of the motor to its rated value. Note down the readings of Ammeter and Voltmeter at no load condition.
5) The necessary calculations to find efficiency of machine as motor & generator at any given value of armature current is done.

TO FIND ARMATURE RESISTANCE (Ra):

1) Connect the circuit per the circuit diagram
2) Keep the rheostat in maximum position.
3) Now excite the motor terminals by 30V supply by closing DPST switch.
4) Note down the readings of Ammeter and voltmeter.

MODEL CALCULATIONS:-

For motor:

$I_L= I_a+I_f$

No load losses = $W_o = VI_o - I^2_{ao}Ra$

Input = VI

Cu losses = $I_a^2R_a$

Total losses =No load losses + cu losses

Output = Input-Total losses
%Efficiency (η) = (Output / Input)*100

For generator:
$I_a = I_L + I_f$
No load losses = $W_o = V I_o - I^2_{ao}Ra$
Output = VI
Cu losses = Ia^2 Ra
Total losses =No load losses + cu losses
Input =Output+ Total losses
%Efficiency (η) = (Output / Input)*100

TABULAR COLOUMN:

S.NO	Voltmeter reading V in Volts	Ammeter Reading I in Amps	Ammeter reading I_{sh} in Amps	Speed in RPM

ARMATURE RESISTANCE (Ra):

S.No	Voltage	Current

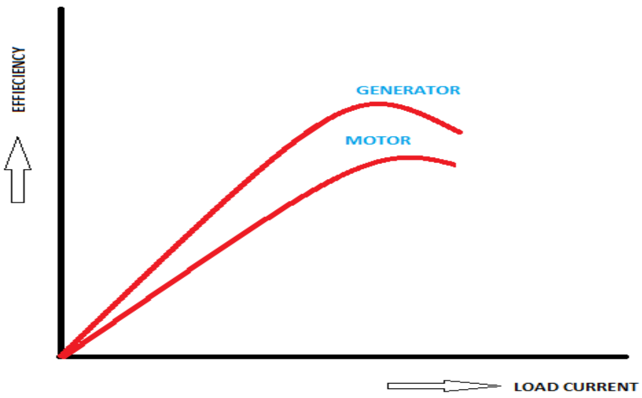
CALCULATION TABLE:
As a Motor:

S.NO	I_L (A)	$I_a=(I_L-I_{sh})$ in A	$W=I_a^2R_a$ in watts	Total losses	%Efficiency

As a Generator:

S.NO	I_L (A)	$I_a=(I_L+I_{sh})$ in A	$W=I_a^2R_a$ in watts	Total losses	%Efficiency

MODEL GRAPH:



PRECAUTIONS:

1. We should start the motor under no load
2. Take the reading without parallax error.
3. The connections must be tight.

RESULT:

EXERCISE QUESTIONS:

1. A 220v dc shunt motor at no load takes a current of 2.5A. The resistances of armature and shunt field are 0.8 Ω and 200Ω respectively. Estimate the efficiency of the motor when the input current is 20A. State precisely assumptions made

VIVA QUESTIONS:

1. Why the magnetic losses calculated by this method are less than the actual value?
2. Is it applied to D.C series machines?
3. Comment on the efficiency determined by this method.

6. OC & SC TESTS ON SINGLE PHASE TRANSFORMER

AIM:

To conduct Open circuit and Short circuit tests on single phase transformer to pre-determine the efficiency of single phase transformer.

NAME PLATE DETAILS:

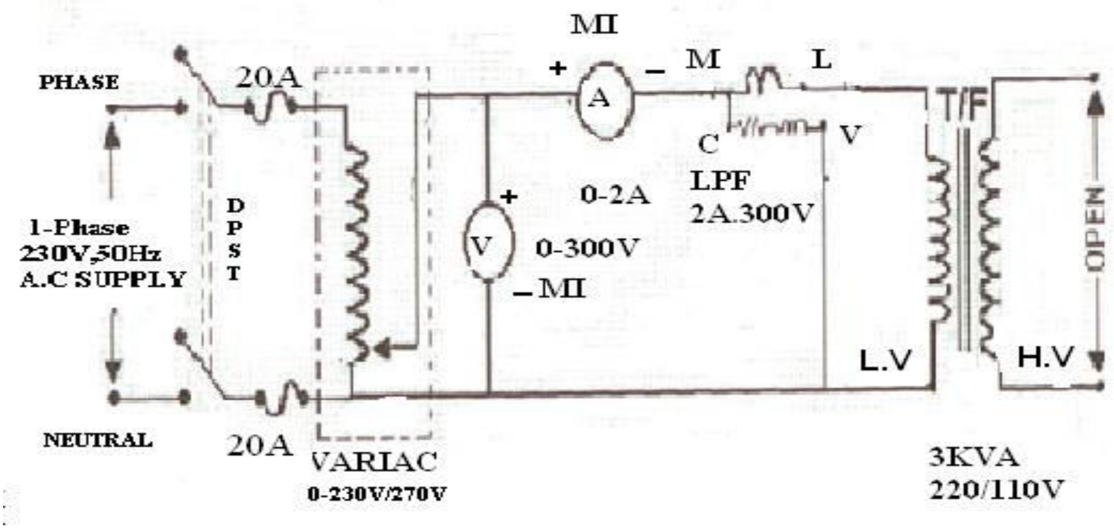
Voltage Ratio	220/110V
Full load Current	13.6A
KVA RATING	3KVA

APPARATUS:

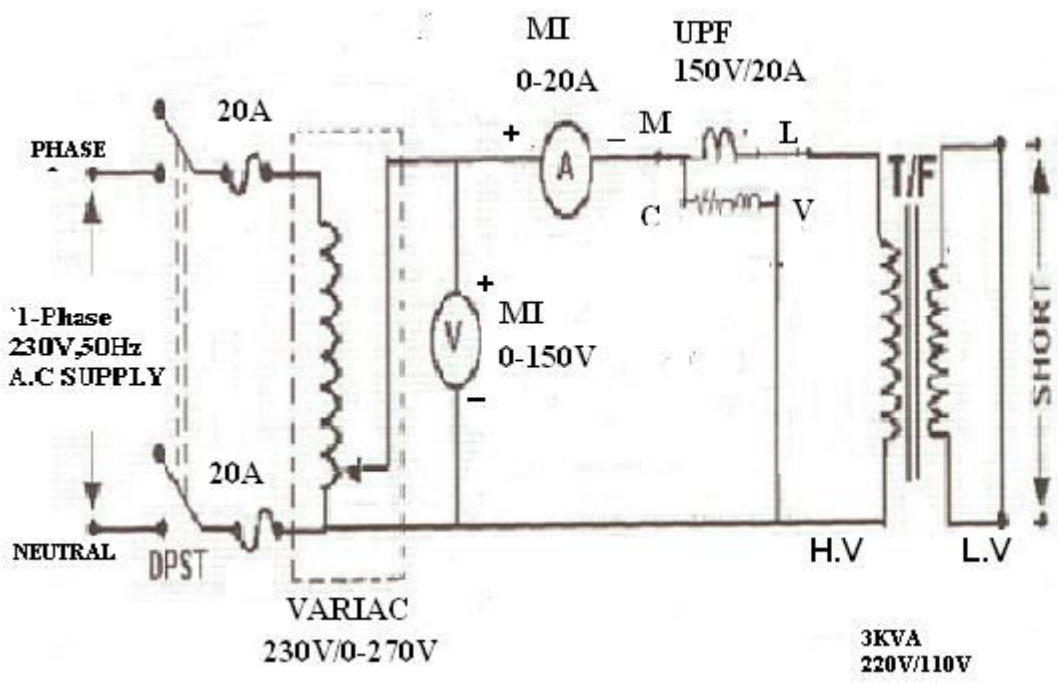
S.NO	Description	Type	Range	Quantity
1	Ammeter	MI	0-20A 0-5A	2NO
2	Voltmeter	MI	0-150V 0-300V	2NO
3	Wattmeter	LPF UPF	2A,!50V 20A,300V	2NO
4	Auto transformer	-	230/0-270V	1NO
5	Transformer	-	220V/110V	1NO

CIRCUIT DIAGRAM:

OPEN CIRCUIT TEST:



SHORT CIRCUIT TEST:



THEORY:

Transformer is a device which transforms the energy from one circuit to other circuit without change of frequency.

The performance of any transformer calculated by conducting tests .OC and SC tests are conducted on transformer to find the efficiency and regulation of the transformer at any desired power factor.

OC TEST:

The objectives of OC test are

1. To find out the constant losses or iron losses of the transformer.
2. To find out the no load equivalent parameters.

SC TEST:

The objectives of OC test are

1. To find out the variable losses or copper losses of the transformer.
2. To find out the short circuit equivalent parameters.

By calculating the losses and equivalent parameters from the above tests the efficiency and regulation can be calculated at any desired power factor.

PROCEDURE (OC TEST):

1. Connections are made as per the circuit diagram
2. Initially variac should be kept in its minimum position
3. Close the DPST switch.
4. By varying Auto transformer bring the voltage to rated voltage
5. When the voltage in the voltmeter is equal to the rated voltage of HV winding note down all the readings of the meters.
6. After taking all the readings bring the variac to its minimum position
7. Now switch off the supply by opening the DPST switch.

PROCEDURE (SC TEST):

1. Connections are made as per the circuit diagram.
2. Short the LV side and connect the meters on HV side.
3. Before taking the single phase, 230 V, 50 Hz supply the variac should be in minimum position.
4. Now close the DPST switch so that the supply is given to the transformer.
5. By varying the variac when the ammeter shows the rated current
(i.e. 13.6A) then note down all the readings.
6. Bring the variac to minimum position after taking the readings and switch off the supply.

O.C TEST OBSERVATIONS:

S.NO	V_0(VOLTS)	I_0(AMPS)	Constant Losses(W_0) watts

S.C TEST OBSERVATIONS:

S.NO	V_{SC}(VOLTS)	I_{SC}(AMPS)	Full Load Copper Losses(W_{SC})watts

CALCULATIONS:

(a) Calculation to find Efficiency

$$\eta = \frac{n \times KVA \times \cos\phi}{n \times KVA \times \cos\phi + n^2\ Cu.\ Loss + constant\ loss}$$

Where 'n' represents % of full load.

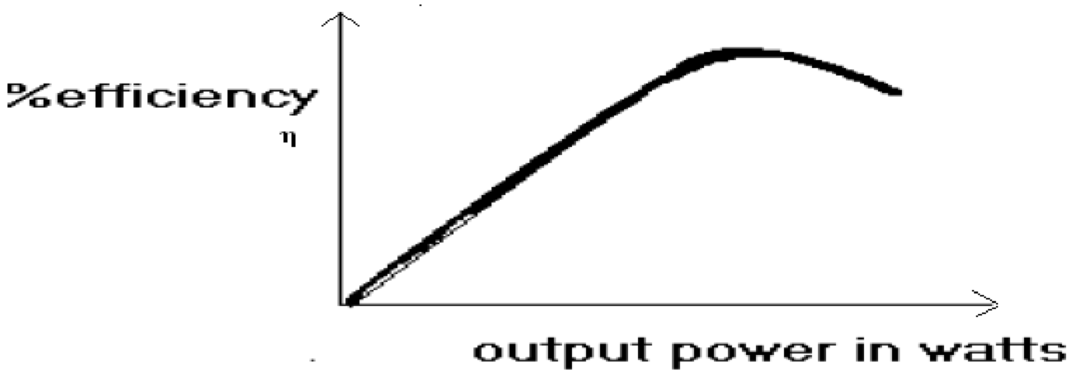
TABULAR COLUMN:

POWER FACTOR =

S.NO	% OF LOAD	EFFICIENCY
1	12.5	
2	25	
3	50	
4	75	
5	100	

MODEL GRAPHS:

EFFICIENCY VS OUTPUT



RESULT:

EXERCISE QUESTIONS:

1. The readings obtained from tests on 10 KVA, 450/120V, 50Hz transformer are
O.C. Test (LV Side): 120V, 4.2A, 80W
S.C. Test (HV Side): 9.65V, 22.2A, 120W
Determine the equivalent circuit constants.

VIVA QUESTIONS:

1) What is a transformer?
2) Draw the equivalent circuit of transformer?
3) What is the efficiency and regulation of transformer?

CYCLE – 2

1. P-N JUNCTION DIODE CHARACTERISTICS

AIM: 1. To observe and draw the Forward and Reverse bias V-I Characteristics of a P-N Junction diode.
2. To calculate static and dynamic resistance in both forward and Reverse Bias Conditions.

APPARATUS:

1. P-N Diode IN4007 - 1No.
2. Regulated Power supply (0-30V) - 1No.
3. Resistor 1KΩ - 1No.
4. Ammeter (0-20 mA) - 1No
5. Ammeter (0-200µA) - 1No.
6. Voltmeter (0-20V) - 2No.
7. Bread board - 1No.
8. Connecting wires

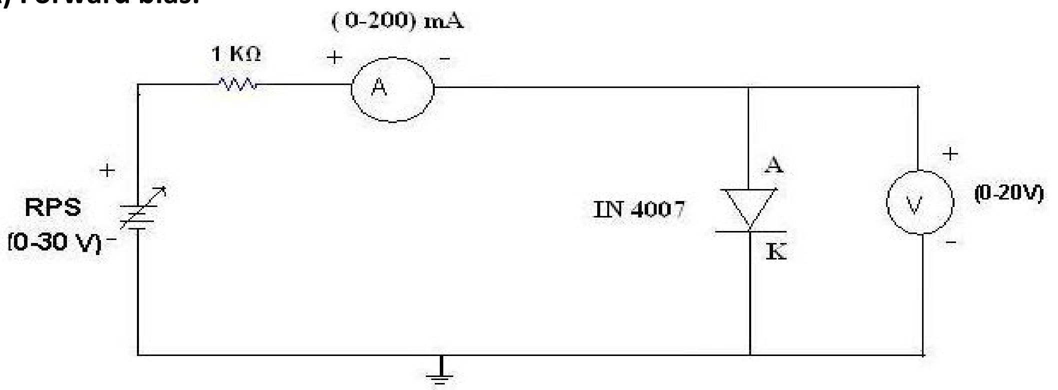
THEORY:

A P-N junction diode conducts only in one direction. The V-I characteristics of the diode are curve between voltage across the diode and current flowing through the diode. When external voltage is zero, circuit is open and the potential barrier does not allow the current to flow. Therefore, the circuit current is zero. When P-type (Anode) is connected to +ve terminal and n- type (cathode) is connected to –ve terminal of the supply voltage is known as forward bias. The potential barrier is reduced when diode is in the forward biased condition. At some forward voltage, the potential barrier altogether eliminated and current starts flowing through the diode and also in the circuit. Then diode is said to be in ON state. The current increases with increasing forward voltage.

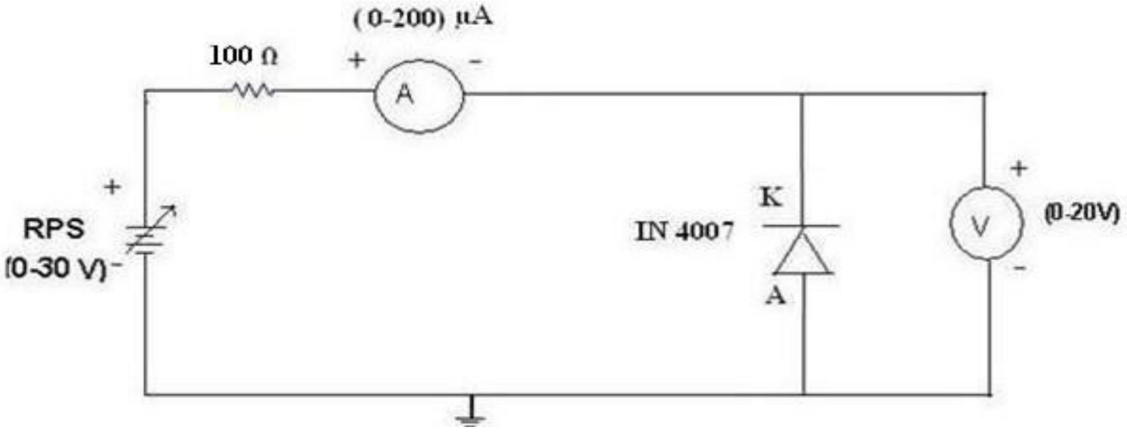
When N-type (cathode) is connected to +ve terminal and P-type (Anode) is connected –ve terminal of the supply voltage is known as reverse bias and the potential barrier across the junction increases. Therefore, the junction resistance becomes very high and a very small current (reverse saturation current) flows in the circuit. Then diode is said to be in OFF state. The reverse bias current is due to minority charge carriers.

CIRCUIT DIAGRAM:

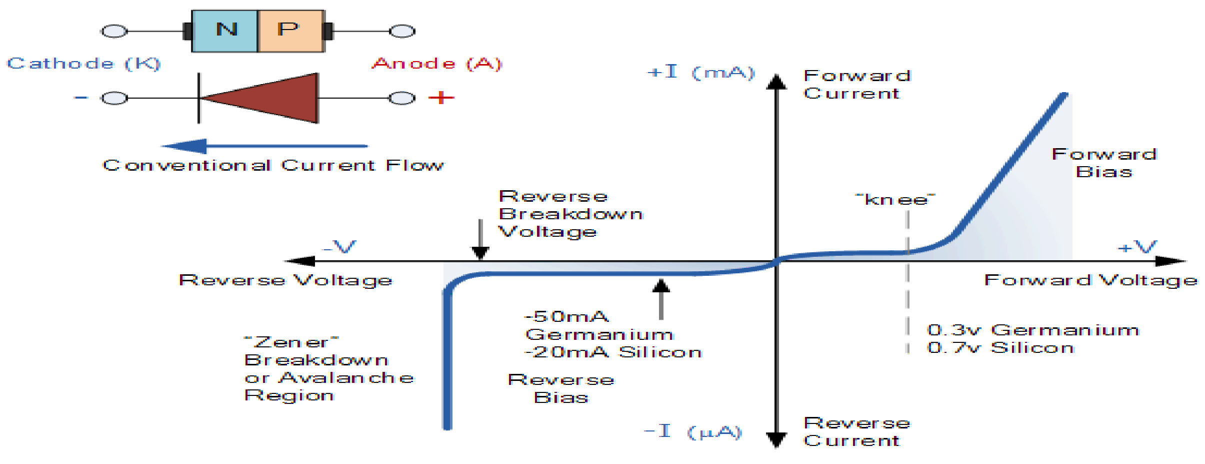
A) Forward bias:



B) Reverse Bias:



MODEL GRAPH:



OBSERVATIONS:

A) FORWARD BIAS:

S.NO	Applied Voltage(V)	Forward Voltage(V_f)	Forward Current(I_f(mA))

B) REVERSE BIAS:

S.NO	Applied Voltage(V)	Reverse Voltage(V_R)	Reverse Current(I_R(μA))

Calculations:

Calculation of Static and Dynamic Resistance for a given diode.

In forward bias condition:

Static Resistance , $R_s = Vf/I_f =$

Dynamic Resistance, $R_D = \Delta V_f / \Delta I_f =$

In Reverse bias condition:

Static Resistance , $R_s = V_R/I_R =$

Dynamic Resistance, $RD = \Delta V_R / \Delta I_R =$

PROCEDURE:

A) FORWARD BIAS:

1. Connections are made as per the circuit diagram.
2. For forward bias, the RPS +ve is connected to the anode of the diode and RPS –ve is connected to the cathode of the diode
3. Switch on the power supply and increases the input voltage (supply voltage) in Steps of 0.1V
4. Note down the corresponding current flowing through the diode and voltage across the diode for each and every step of the input voltage.
5. The reading of voltage and current are tabulated.
6. Graph is plotted between voltage (V_f) on X-axis and current (I_f) on Y-axis.

B) REVERSE BIAS:

1. Connections are made as per the circuit diagram
2. for reverse bias, the RPS +ve is connected to the cathode of the diode and RPS –ve is connected to the anode of the diode.
3. Switch on the power supply and increase the input voltage (supply voltage) in Steps of 1V.
4. Note down the corresponding current flowing through the diode voltage across the diode for each and every step of the input voltage.
5. The readings of voltage and current are tabulated
6. Graph is plotted between voltage (V_R) on X-axis and current (I_R) on Y-axis.

PRECAUTIONS:

1. All the connections should be correct.
2. Parallax error should be avoided while taking the readings from the Analog meters.

RESULT:

EXERCISE QUESTIONS:

1. The reverse saturation current of a silicon p – n function diode at an operating temperature of 270C is 50 nA. Compute the dynamic forward and reverse resistances of the diode for applied voltages of 0.8 V and -0.4 V respectively
2. Find the value of D.C. resistance and A.C resistance of a Germanium junction diode at 250 C with reverse saturation current, Io = 25µA and at an applied voltage of 0.2V across the diode

VIVA QUESTIONS:

1. Define depletion region of a diode?
2. What is meant by transition & space charge capacitance of a diode?
3. Is the V-I relationship of a diode Linear or Exponential?
4. Define cut-in voltage of a diode and specify the values for Si and Ge diodes?
5. What are the applications of a p-n diode?
6. Draw the ideal characteristics of P-N junction diode?
7. What is the diode equation?
8. What is PIV?
9. What is the break down voltage?
10. What is the effect of temperature on PN junction diodes?

8. ZENER DIODE CHARACTERISTICS

AIM:

a) To observe and draw the static characteristics of a zener diode

b) To find the voltage regulation of a given zener diode

APPARATUS:

1. Zener diode - 1No.
2. Regulated Power Supply (0-30v) - 1No.
3. Voltmeter (0-20v) - 1No.
4. Ammeter (0-20mA) - 1No.
5. Resistor (1K ohm) - 1No.
6. Bread Board - 1No.
7. Connecting wires

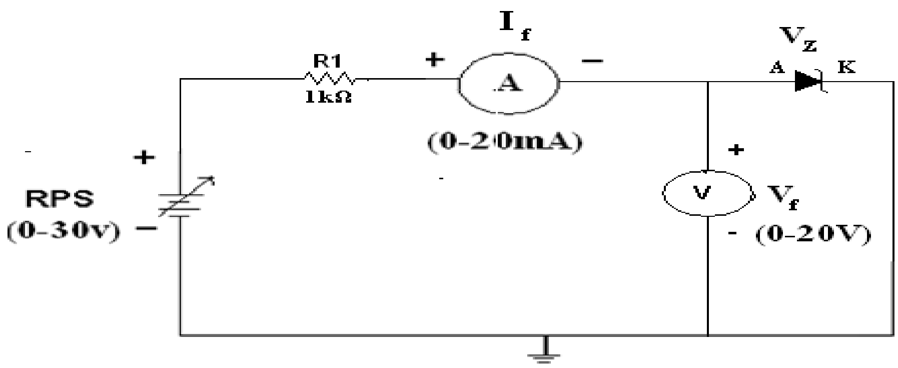
THEORY:

A zener diode is heavily doped p-n junction diode, specially made to operate in the break down region. A p-n junction diode normally does not conduct when reverse biased. But if the reverse bias is increased, at a particular voltage it starts conducting heavily. This voltage is called Break down Voltage. High current through the diode can permanently damage the device

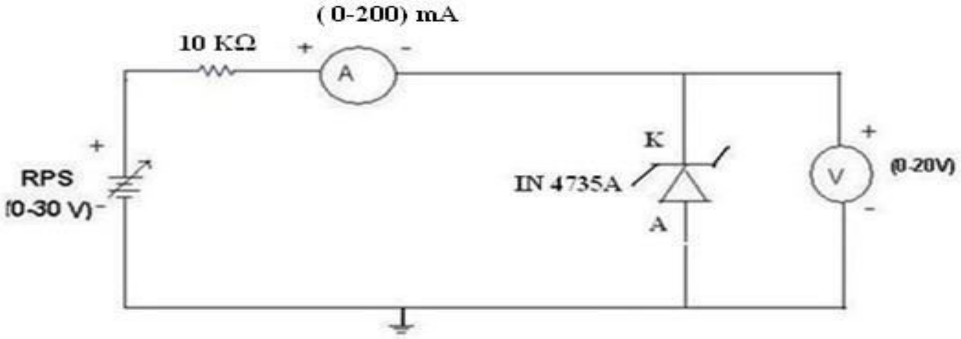
To avoid high current, we connect a resistor in series with zener diode. Once the diode starts conducting it maintains almost constant voltage across the terminals whatever may be the current through it, i.e., it has very low dynamic resistance. It is used in voltage regulators.

CIRCUIT DIAGRAM

A) STATIC CHARACTERISTICS :

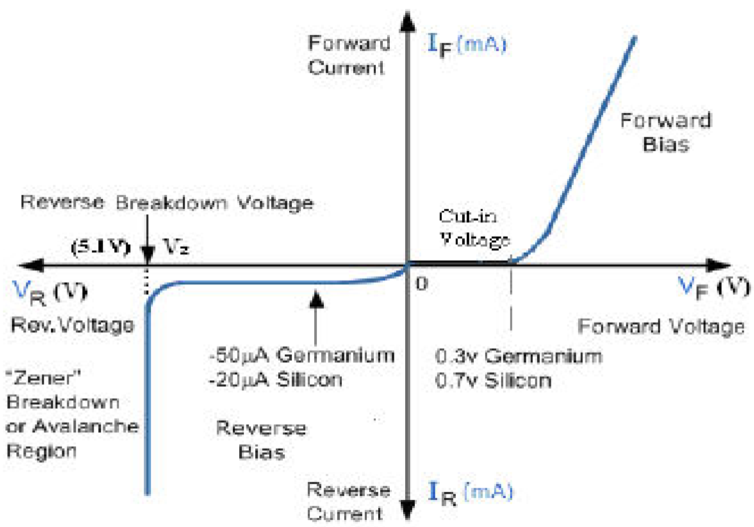


b) REVERSE BIAS CHARACTERISTICS:



MODEL GRAPHS:

ZENER DIODE CHARACTERISTICS:



V-I Characteristics of Zener Diode

OBSERVATIONS:

A) FORWARD BIAS characteristics:

S.NO	Applied Voltage(V)	Forward Voltage(V_f)	Forward Current(I_f(mA))

B) REVERSE BIAS Characteristics:

S.NO	Applied Voltage(V)	Reverse Voltage(V_R)	Reverse Current(I_R(mA))

PROCEDURE:

A) Static characteristics:

1. Connections are made as per the circuit diagram.
2. The Regulated power supply voltage is increased in steps.
3. The Forward current (I_f), and the forward voltage (V_f.) are observed and then noted in the tabular form.
4. A graph is plotted between Forward current (I_f) on X-axis and the forward voltage (V_f) on Y-axis.

PRECAUTIONS:

1. The terminals of the zener diode should be properly identified
2. While determined the load regulation, load should not be immediately shorted.
3. Should be ensured that the applied voltages & currents do not exceed the ratings of the diode.

RESULT:

EXERCISE QUESTIONS:

1. A Zener voltage regulator circuit is to maintain constant voltage at 60 V, over a current range from 5 to 50 mA. The input supply voltage is 200 V. Determine the value of resistance R to be connected in the circuit, for voltage regulation from load current I_L = 0 mA to I_L max, the maximum possible value of I_L. What is the value I_L max?

VIVAQUESTIONS:

1. What type of temp coefficient does the zener diode have?
2. If the impurity concentration is increased, how the depletion width effected?
3. Does the dynamic impendence of a zener diode vary?
4. Explain briefly about avalanche and zener breakdowns?
5. Draw the zener equivalent circuit?
6. Differentiate between line regulation & load regulation?
7. In which region zener diode can be used as a regulator?
8. How the breakdown voltage of a particular diode can be controlled?
9. What type of temperature coefficient does the Avalanche breakdown has?
10. By what type of charge carriers the current flows in zener and avalanche breakdown diodes?

9. HALF -WAVE RECTIFIER WITH AND WITHOUT FILTER

AIM:

To examine the input and output waveforms of half wave Rectifier and also calculate its load regulation and ripple factor.

1. with Filter
2. without Filter

APPARATUS:

Digital Multimeter	- 1No.
Transformer (6V-0-6V)	- 1No.
Diode, 1N4007	- 1No.
Capacitor 100µf/470 µf	- 1No.
Decade Resistance Box	- 1No.
Breadboard	- 1No.
CRO and CRO probes	
Connecting wires	

THEORY:

In Half Wave Rectification, When AC supply is applied at the input, only Positive Half Cycle appears across the load whereas, the negative Half Cycle is suppressed. How this can be explained as follows:

During positive half-cycle of the input voltage, the diode D1 is in forward bias and conducts through the load resistor R_L. Hence the current produces an output voltage across the load resistor R_L, which has the same shape as the +ve half cycle of the input voltage.

During the negative half-cycle of the input voltage, the diode is reverse biased and there is no current through the circuit. i.e., the voltage across R_L is zero. The net result is that only the +ve half cycle of the input voltage appears across the load. The average value of the half wave rectified o/p voltage is the value measured on dc voltmeter.

For practical circuits, transformer coupling is usually provided for two reasons.

1. The voltage can be stepped-up or stepped-down, as needed.
2. The ac source is electrically isolated from the rectifier. Thus preventing shock hazards in the secondary circuit.

The efficiency of the Half Wave Rectifier is 40.6%

Theoretical calculations for Ripple factor:

Without Filter:

$V_{rms}=V_m/2$

$V_m=2V_{rms}$

$V_{dc}=V_m/\Pi$

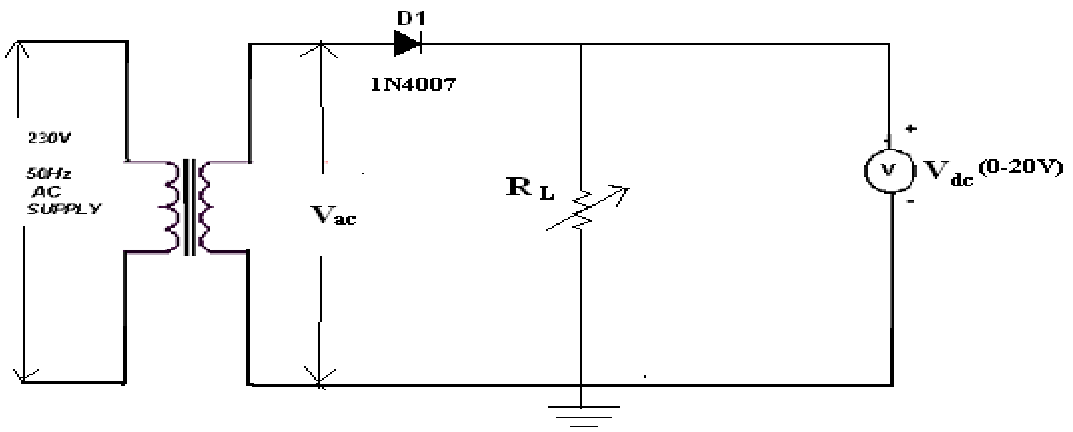
Ripple factor $r=\sqrt{(V_{rms}/V_{dc})^2-1}=1.21$

With Filter:

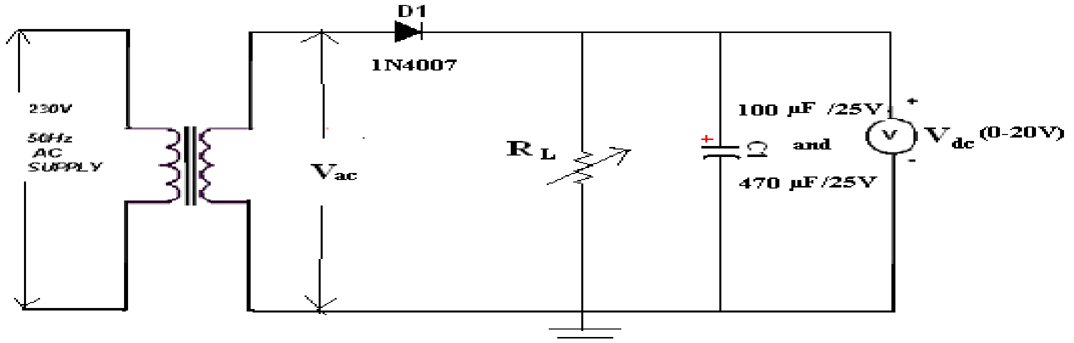
Ripple factor, $r=1/(2\sqrt{3}\,f\,C\,R)$

CIRCUIT DIAGRAM:

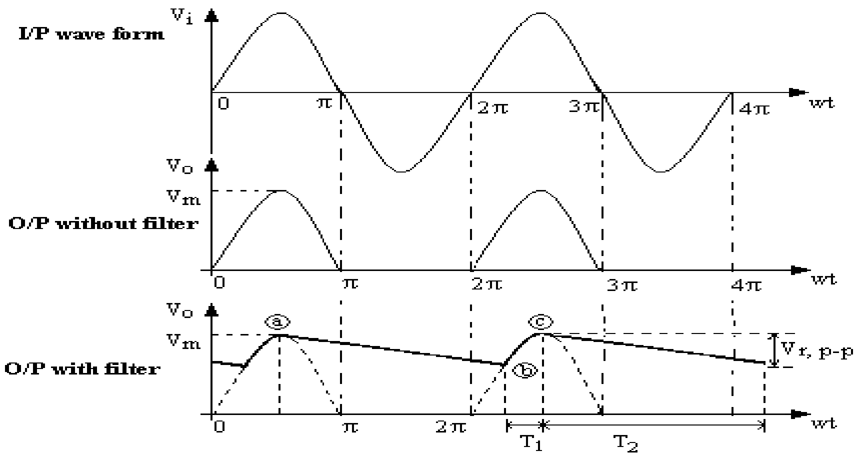
A) Half wave Rectifier without filter:



B) Half wave Rectifier with filter



MODEL WAVEFORMS:



Half-wave Rectifier with capacitor filter wave form

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Connect the primary side of the transformer to ac mains and the secondary side to the rectifier input.
3. By the multimeter, measure the ac input voltage of the rectifier and, ac and dc voltage at the output of the rectifier.
4. Find the theoretical of dc voltage by using the formula,

   Vdc=Vm/Π

   Where, Vm=2Vrms, (Vrms=output ac voltage.)
5. The Ripple factor is calculated by using the formula

   r = ac output voltage/dc output voltage.

WITHOUT FILTER:

V no load Voltage (Vdc) = V

S.No	Load Resistance R_L (kilo-ohm)	O/P Voltage (Vo) V_{ac} (V)	O/P Voltage (Vo) V_{dc} (V)	Ripple factor $\left(\gamma = \frac{V_{ac}}{V_{dc}}\right)$	% of Regulation $\left(\frac{V_{NL} - V_{FL}}{V_{NL}} * 100\%\right)$
1	1				
2	2				
3	3				
4	4				
5	5				
6	6				
7	7				
8	8				
	.				

WITH CAPACITOR FILTER:

V no load Voltage (Vdc) = V

S.No	Load Resistance R_L (kilo-ohm)	O/P Voltage (Vo) V_{ac} (V)	O/P Voltage (Vo) V_{dc} (V)	Ripple factor $\left(\gamma = \frac{V_{ac}}{V_{dc}}\right)$	% of Regulation $\left(\frac{V_{NL} - V_{FL}}{V_{NL}} * 100\%\right)$
1	1				
2	2				
3	3				
4	4				
5	5				
6	6				
7	7				
8	8				
	.				

REGULATION CHARACTERSTICS:

1. Connections are made as per the circuit diagram.
2. By increasing the value of the rheostat, the voltage across the load and current flowing through the load are measured.
3. The reading is tabulated.
4. From the value of no-load voltages, the %regulation is calculated using the formula,

%Regulation = $[(V_{NL}-V_{FL})/V_{FL}]*100$

PRECAUTIONS:

1. The primary and secondary side of the transformer should be carefully identified
2. The polarities of all the diodes should be carefully identified.
3. While determining the % regulation, first Full load should be applied and then it should be decremented in steps.

RESULT:

EXERCISE QUESTIONS:

1. A half wave rectifier having a resistor load of 1000 ohms rectifier an alternating of 325V peak value and the diode has a forward resistance of 100 ohms calculate a) peak ,average and RMS value of current) dc power output c) A.C input power and d) efficiency of the rectifier

VIVA QUESTIONS:

1. What is the PIV of Half wave rectifier?
2. What is the efficiency of half wave rectifier?
3. What is the rectifier?
4. What is the difference between the half wave rectifier and full wave Rectifier?
5. What is the o/p frequency of Bridge Rectifier?
6. What are the ripples?
7. What is the function of the filters?
8. What is TUF?
9. What is the average value of o/p voltage for HWR?
10. What is the peak factor?

10. FULL-WAVE RECTIFIER WITH AND WITHOUT FILTER

AIM: To Examine the input and output waveforms of Full Wave Rectifier and also calculate its load regulation and ripple factor.

1. with Filter
2. without Filter

APPARATUS:

Digital multimetersMultimeter	- 1No.
Transformer (6V-0-6V)	- 1No.
Diode, 1N4007	- 2No.
Capacitor 100µf/470 µf	- 1No.
Decade Resistance Box	- 1No.
Breadboard	- 1No.
CRO and CRO probes	
Connecting wires	

THEORY:

The circuit of a center-tapped full wave rectifier uses two diodes D1&D2. During positive half cycle of secondary voltage (input voltage), the diode D1 is forward biased and D2is reverse biased. So the diode D1 conducts and current flows through load resistor R_L.

During negative half cycle, diode D2 becomes forward biased and D1 reverse biased. Now, D2 conducts and current flows through the load resistor R_L in the same direction. There is a continuous current flow through the load resistor R_L, during both the half cycles and will get unidirectional current as show in the model graph. The difference between full wave and half wave rectification is that a full wave rectifier allows unidirectional (one way) current to the load during the entire 360 degrees of the input signal and half-wave rectifier allows this only during one half cycle (180 degree).

THEORITICAL CALCULATIONS:

$$V_{rms} = V_m/\sqrt{2}$$
$$V_m = V_{rms}\sqrt{2}$$
$$V_{dc} = 2V_m/\Pi$$

(i)Without filter:

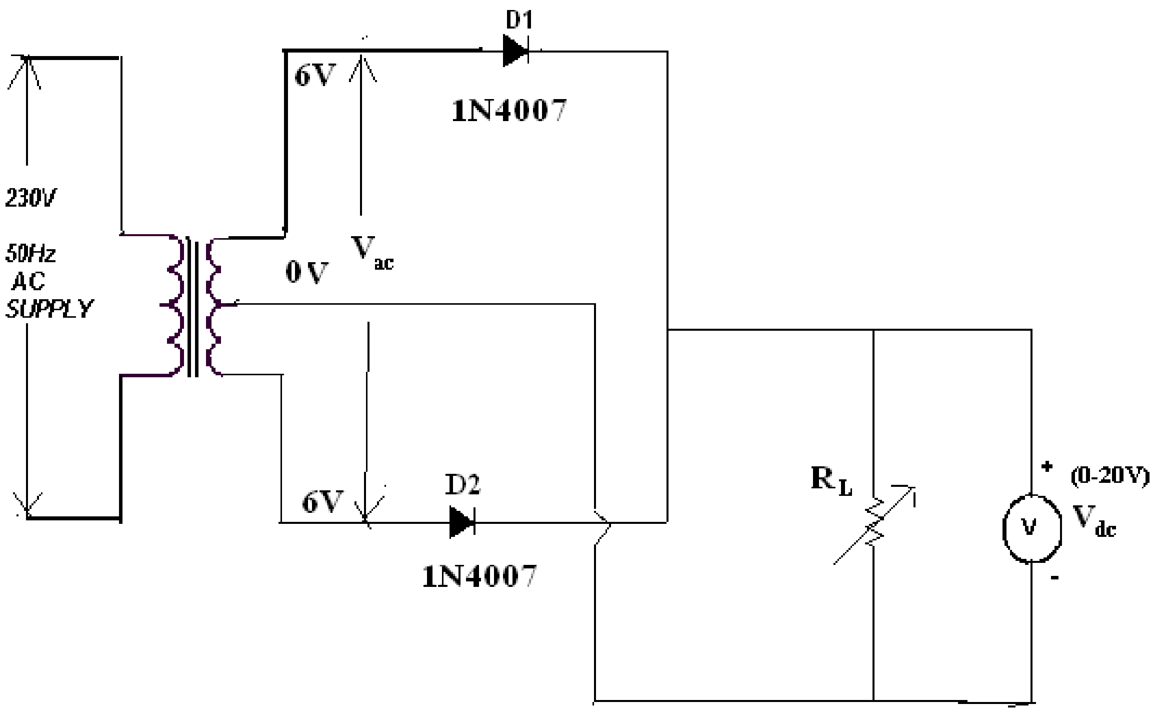
Ripple factor, $r = \sqrt{(V_{rms}/V_{dc})^2 - 1} = 0.812$

(ii)With filter:

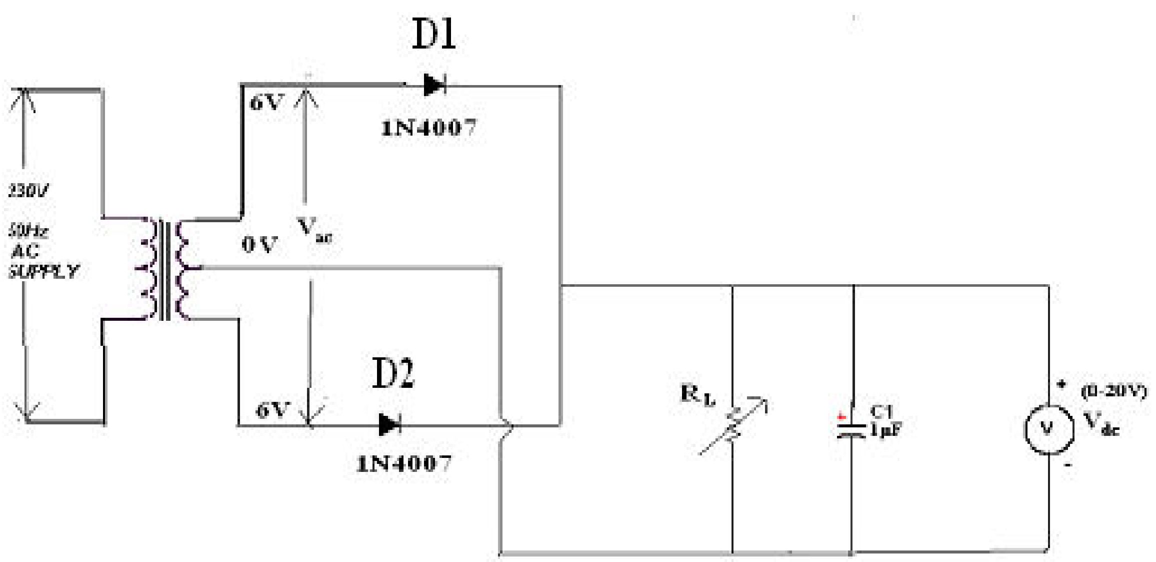
Ripple factor, $r = 1/(4\sqrt{3}\, f\, C\, R_L)$

CIRCUIT DIAGRAM:

A) FULL WAVE RECTIFIER WITHOUT FILTER:

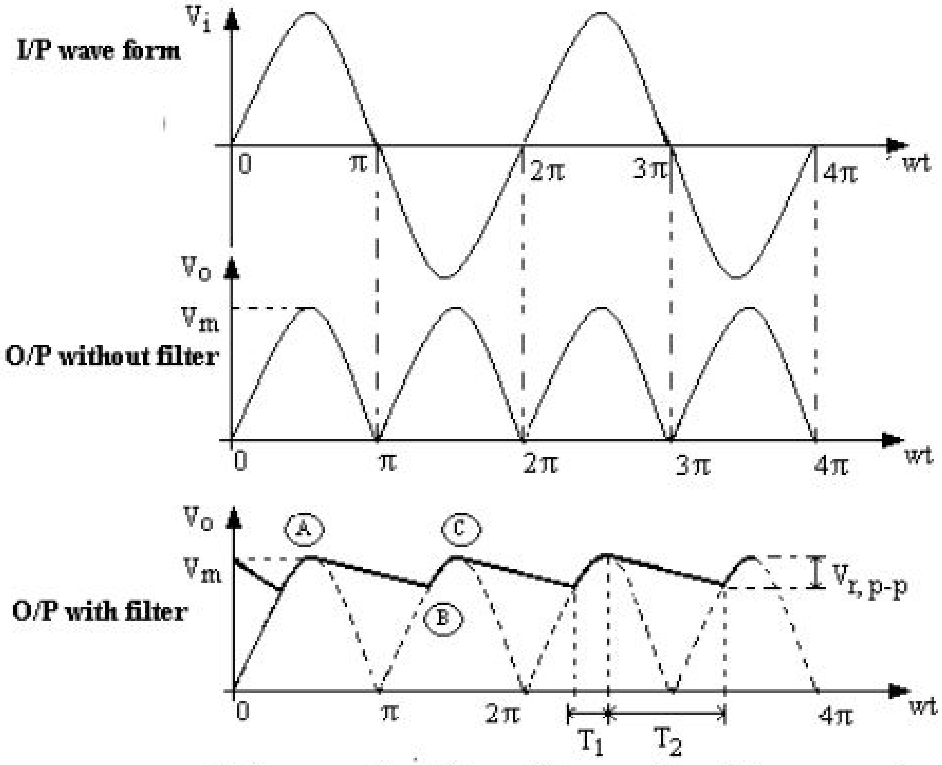


B) FULL WAVE RECTIFIER WITH FILTER:



MODEL WAVEFORMS:

A) WAVEFORMS:



Full-wave Rectifier with capacitor filter wave form

WITHOUT FILTER:

V no load Voltage (Vdc) = V

S.No	Load Resistance R_L (kilo-ohm)	O/P Voltage (Vo) V_{ac} (V)	V_{dc} (V)	Ripple factor $\left(\gamma = \frac{V_{ac}}{V_{dc}}\right)$	% of Regulation $\left(\frac{V_{NL}-V_{FL}}{V_{NL}} * 100\%\right)$
1	1				
2	2				
3	3				
4	4				
5	5				
6	6				
7	7				
8	8				

WITH CAPACITOR FILTER:

V no load Voltage (Vdc) = V

S.No	Load Resistance R_L (kilo-ohm)	O/P Voltage (Vo) V_{ac} (V)	O/P Voltage (Vo) V_{dc} (V)	Ripple factor $\left(\gamma = \frac{V_{ac}}{V_{dc}}\right)$	% of Regulation $\left(\frac{V_{NL}-V_{FL}}{V_{NL}} * 100\%\right)$
1	1				
2	2				
3	3				
4	4				
5	5				
6	6				
7	7				
8	8				

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Connect the ac mains to the primary side of the transformer and the secondary side to the rectifier.
3. Measure the ac voltage at the input side of the rectifier.
4. Measure both ac and dc voltages at the output side the rectifier.
5. Find the theoretical value of the dc voltage by using the formula Vdc=2Vm/Π
6. Connect the filter capacitor across the load resistor and measure the values of Vac and Vdc at the output.
7. The theoretical values of Ripple factors with and without capacitor are calculated.
8. From the values of Vac and Vdc practical values of Ripple factors are calculated. The practical values are compared with theoretical values.

PRECAUTIONS:

1. The primary and secondary side of the transformer should be carefully identified.
2. The polarities of all the diodes should be carefully identified.

RESULT:

EXERCISE QUESTIONS:

1. A Full wave single phase rectifier makes use of 2 diodes, the internal forward resistance of each is considered to be constant and equal to 30Ω. The load resistance is 1KΩ. The transformer secondary voltage is 200-0-200V (rms).Calculate V_{DC}, I_{DC}, and Ripple factor efficiency**.**

VIVA QUESTIONS:

1. Define regulation of the full wave rectifier?
2. Define peak inverse voltage (PIV)? And write its value for Full-wave rectifier?
3. If one of the diode is changed in its polarities what wave form would you get?
4. Does the process of rectification alter the frequency of the waveform?
5. What is ripple factor of the Full-wave rectifier?
6. What is the necessity of the transformer in the rectifier circuit?
7. What are the applications of a rectifier?
8. What is meant by ripple and define Ripple factor?
9. Explain how capacitor helps to improve the ripple factor?
10. Can a rectifier made in INDIA (V=230v, f=50Hz) be used in USA (V=110v, f=60Hz)?

11. INPUT AND OUTPUT CHARACTERISTICS OF TRANSISTOR CB CONFIGURATION

AIM: 1.To observe and draw the input and output characteristics of a transistor connected in common base configuration.
2. To find α of the given transistor and also its input and output Resistances.

APPARATUS:

Transistor, BC107	-1No.
Regulated power supply (0-30V)	-1No.
Voltmeter (0-20V)	- 2No.
Ammeters (0-10mA)	-2No.
Resistor, 1KΩ	-2No
Bread board	-1No.
Connecting wires	

THEORY:

A transistor is a three terminal active device. The terminals are emitter, base, collector. In CB configuration, the base is common to both input (emitter) and output (collector). For normal operation, the E-B junction is forward biased and C-B junction is reverse biased. In CB configuration, I_E is +ve, I_C is –ve and I_B is –ve. So,

$$V_{EB} = F1\ (V_{CB}, I_E) \text{ and}$$

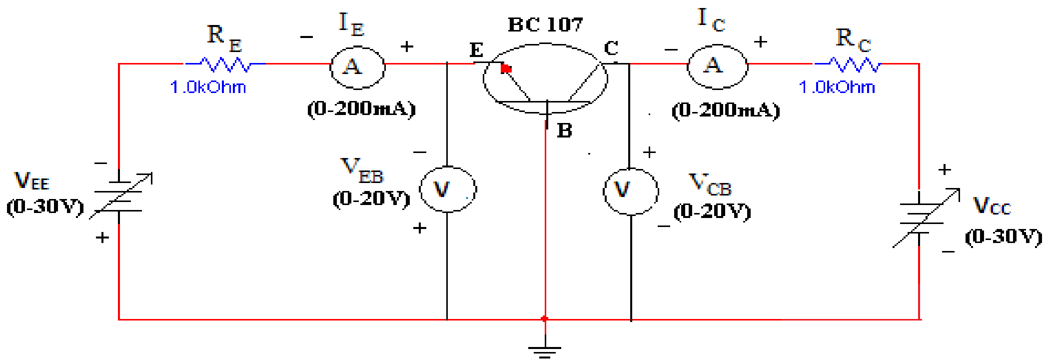
$$I_C = F_2\ (V_{EB}, I_B)$$

With an increasing the reverse collector voltage, the space-charge width at the output junction increases and the effective base width 'W' decreases. This phenomenon is known as "Early effect". Then, there will be less chance for recombination within the base region. With increase of charge gradient with in the base region, the current of minority carriers injected across the emitter junction increases.
The current amplification factor of CB configuration is given by,

$$\alpha = \Delta I_C / \Delta I_E$$

Input Resistance, r_i = $\Delta V_{BE} / \Delta I_E$ at Constant V_{CB}

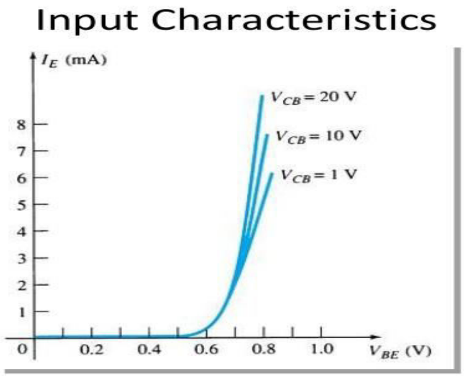
Output Résistance, r_o = $\Delta V_{CB} / \Delta I_C$ at Constant I_E



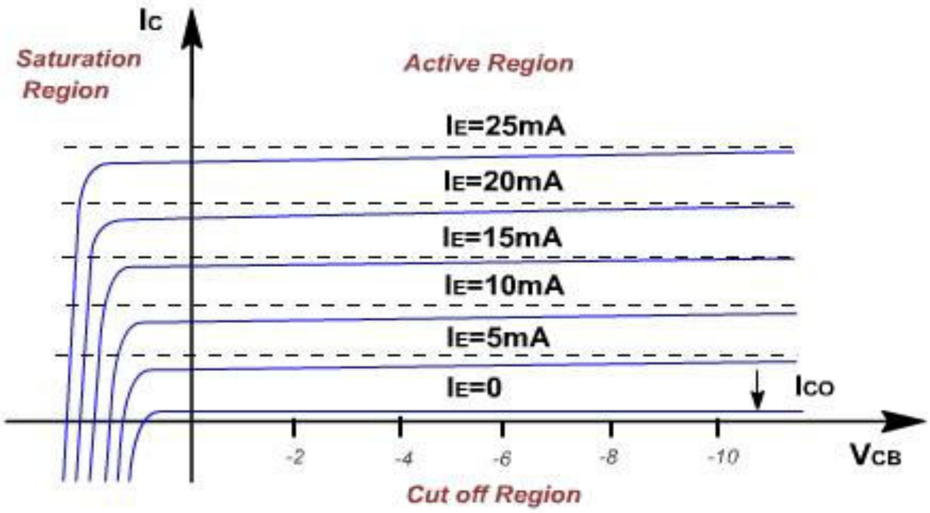
CIRCUIT:

MODEL GRAPHS:

A) INPUT CHARACTERISTICS



B) OUTPUTCHARACTERISTICS



OBSERVATIONS:

A) INPUT CHARACTERISTICS:

V_{EE}(V)	$V_{CB=}$1V		$V_{CB=}$ = 2V		$V_{CB=}$ 4V	
	V_{EB}(V)	I_E(mA)	V_{EB}(V)	$I_{E(}$mA)	V_{EB}(V)	$I_{E(}$mA)

B) OUTPUT CHARACTERISTICS:

V_{cc}(V)	$I_{E=}$10mA		$I_{E=}$20mA		I_E=30mA	
	V_{CB}(V)	$I_{C(}$mA)	V_{CB}(V)	$I_{C(}$mA)	V_{CB}(V)	$I_{C(}$mA)

PROCEDURE:

A) INPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the input characteristics, the output voltage V_{CE} is kept constant at 0V and for different values of V_{EE} ,note down the values of I_E and V_{BE}
3. Repeat the above step keeping V_{CB} at 2V, 4V, and 6V and all the readings are tabulated.
4. A graph is drawn between V_{EB} and I_E for constant $V_{CB.}$

B) OUTPUT CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. For plotting the output characteristics, the input I_E is kept constant at 0.5mA and for different values of V_{CC}, note down the values of I_C and V_{CB}.

3. Repeat the above step for the values of I_E at 1mA, 5mA and all the readings are tabulated.
4. A graph is drawn between V_{CB} and Ic for constant I_E

PRECAUTIONS:

1. The supply voltages should not exceed the rating of the transistor.
2. Meters should be connected properly according to their polarities.

RESULT:

EXERCISE QUESTIONS:

1. Calculate the collector current and emitter current for a transistor with $\alpha_{D.C.} = 0.99$ and $I_{CBO} = 20\ \mu A$ when the base current is 50µ A.

VIVA QUESTIONS:

1. What is the range of α for the transistor?
2. Draw the input and output characteristics of the transistor in CB configuration?
3. Identify various regions in output characteristics?
4. What is the relation between α and β?
5. What are the applications of CB configuration?
6. What are the input and output impedances of CB configuration?
7. Define α (alpha)?
8. What is early effect?
9. Draw Circuit diagram of CB configuration for PNP transistor?
10. What is the power gain of CB configuration?

12. INPUT AND OUTPUT CHARACTERISTICS OF TRASISTOR CE CONFIGURATION

AIM:

1. To draw the input and output characteristics of transistor connected in CE configuration
2. To find β of the given transistor and also its input and output Resistances

APPARATUS:

Transistor, BC107	-1No.
Regulated power supply (0-30V)	-1No.
Voltmeter (0-20V)	-2No.
Ammeters (0-20mA)	-1No.
Ammeters (0-200μA)	-1No.
Resistor, 100Ω	-1No
Resistor, 1KΩ	-1No.
Bread board	-1No.
Connecting wires	

THEORY:

In common emitter configuration, input voltage is applied between base and emitter terminals and out put is taken across the collector and emitter terminals. Therefore the emitter terminal is common to both input and output.

The input characteristics resemble that of a forward biased diode curve. This is expected since the Base-Emitter junction of the transistor is forward biased. As compared to CB arrangement I_B increases less rapidly with $V_{BE.}$ Therefore input resistance of CE circuit is higher than that of CB circuit.

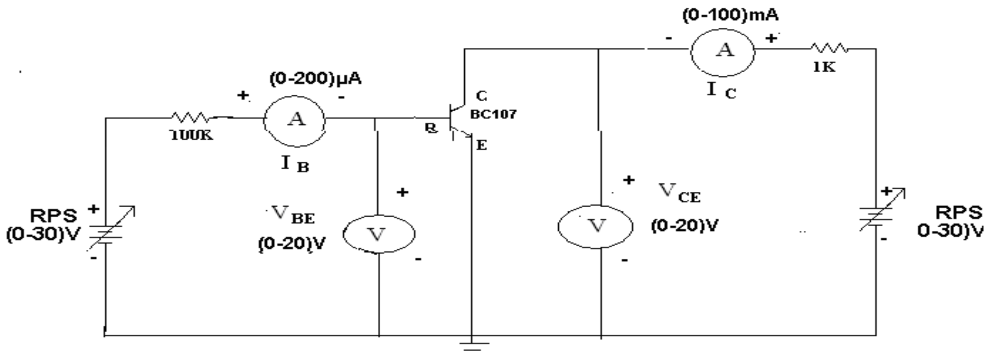
The output characteristics are drawn between I_c and V_{CE} at constant $I_{B.}$ the collector current varies with V_{CE} upto few volts only. After this the collector current becomes almost constant, and independent of $V_{CE.}$ The value of V_{CE} up to which the collector current changes with V_{CE} is known as Knee voltage. The transistor always operated in the region above Knee voltage, I_C is always constant and is approximately equal to $I_{B.}$The current amplification factor of CE configuration is given by

$$\beta = \Delta I_C/\Delta I_B$$

Input Resistance, r_i = $\mathbf{\Delta V_{BE} / \Delta I_B}$ (μA) at Constant V_{CE}

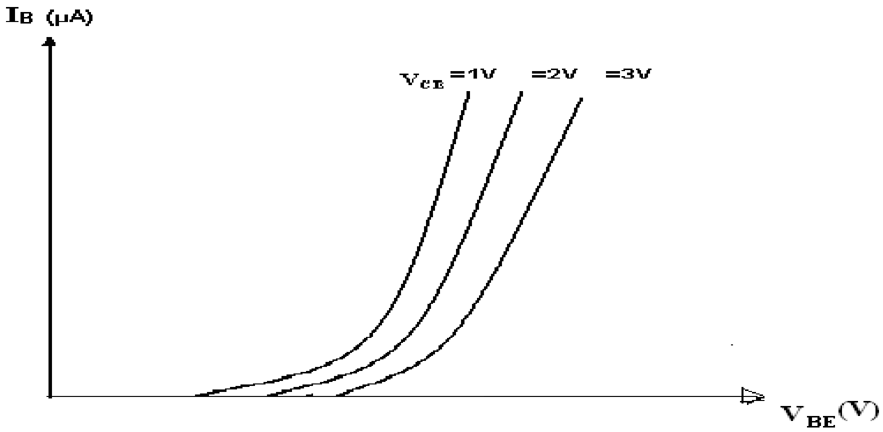
Output Résistance, r_o = $\mathbf{\Delta V_{CE} / \Delta I_C}$ at Constant I_B (μA)

CIRCUIT DIAGRAM:

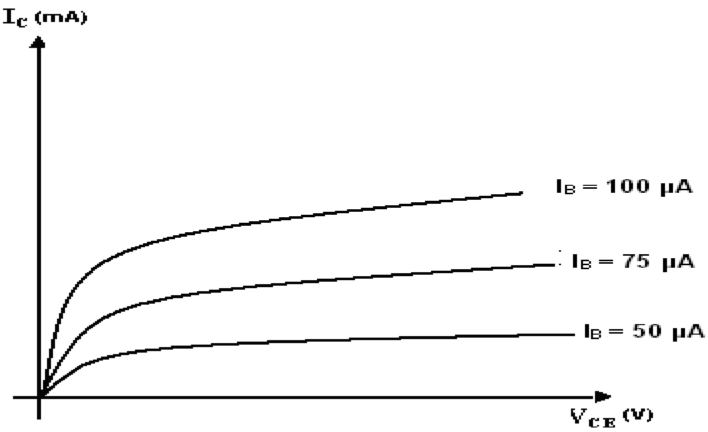


MODEL GRAPHS:

A) INPUT CHARACTERISTICS:



B) OUTPUT CHARACTERSITICS:



OBSERVATIONS:

A) INPUT CHARACTERISTICS:

V_{BB}	V_{CE} = 1V		V_{CE} = 2V		V_{CE} = 4V	
	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)

B) OUTPUT CHAREACTARISTICS:

S.NO	I_B = 50 μA		I_B = 75 μA		I_B = 100 μA	
	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)

PROCEDURE:

INPUT CHARECTERSTICS:

1. Connect the circuit as per the circuit diagram.
2. For plotting the input characteristics the output voltage V_{CE} is kept constant at 1V and for different values of V_{BB} , note down the values of I_B and V_{BE}
3. Repeat the above step by keeping V_{CE} at 2V and 4V and tabulate all the readings.
4. plot the graph between V_{BE} and I_B for constant V_{CE}

OUTPUT CHARACTERSTICS:

1. Connect the circuit as per the circuit diagram

2. For plotting the output characteristics the input current I_B is kept constant at 50μA and for different values of V_{CC} note down the values of I_C and V_{CE}
3. Repeat the above step by keeping I_B at 75 μA and 100 μA and tabulate the all the readings
4. Plot the graph between V_{CE} and I_C for constant I_B

PRECAUTIONS:

1. The supply voltage should not exceed the rating of the transistor
2. Meters should be connected properly according to their polarities

RESULT:

EXERCISE QUESTIONS:

1. For an NPN transistor with α_N= 0.98, I_{CO}= 2μA and I_{EO}= 1.6μA connected in Common Emitter Configuration, calculate the minimum base current for which the transistor enters into saturation region. V_{CC} and load resistance are given as 12 V and 4.0 KΩ respectively.

2. Calculate the values of I_E, α_{dc} and β_{dc} for a transistor with I_B=13μA, I_C=200mA, I_{CBO}=6μA. Also determine the new level of I_C which will result from reducing I_B to 100 mA.

VIVA QUESTIONS:

1. What is the range of β for the transistor?
2. What are the input and output impedances of CE configuration?
3. Identify various regions in the output characteristics?
4. What is the relation between α and β?
5. Define current gain in CE configuration?
6. Why CE configuration is preferred for amplification?
7. What is the phase relation between input and output?
8. Draw diagram of CE configuration for PNP transistor?
9. What is the power gain of CE configuration?
10. What are the applications of CE configuration?