EINSTEIN

COLLEGE OF ENGINEERING

Sir.C.V.Raman Nagar, Tirunelveli-12

Department of Electrical and Electronic Engineering……………………….

Subject Code: EE37

Subject Name : **Electron Devices and Circuits lab**

Name : ……………………………………

Reg No : ……………………………………

Branch : ……………………………………

Year & Semester : ……………………………………

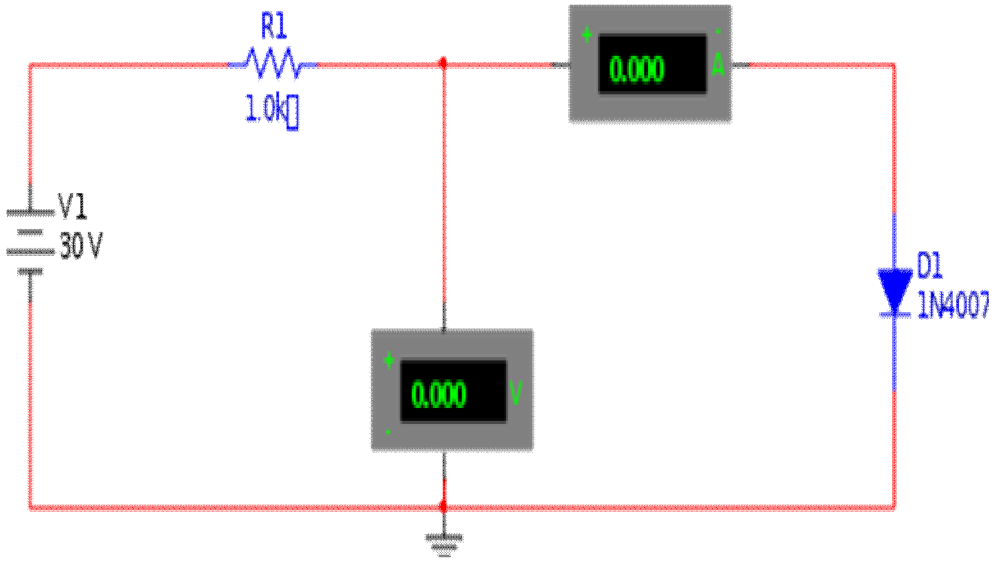
LIST OF EXPERIMENTS

INDEX

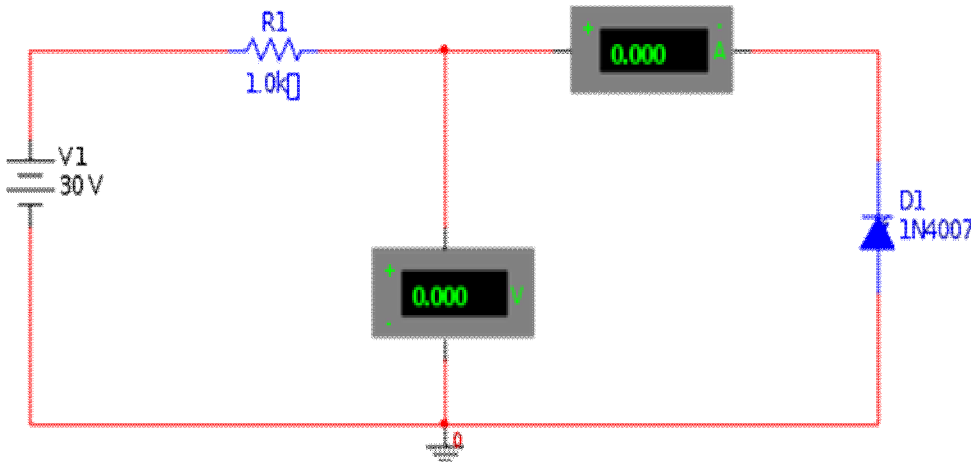
Expt. No.	Expt. Date	Name of the Experiment	Marks	Staff Signature

CIRCUIT DIAGRAM:

DIODE FORWARD BIASING



DIODE REVERSE BIASING



Ex. No: **CHARACTERISTICS OF PN JUNCTION DIODE**

Date:

AIM:

To draw the VI characteristics of PN Junction diode and find the parameters.

APPARATUS REQUIRED:

S.No.	Apparatus required	Range	Quantity
1.	RPS	(0-30)V	1
2.	Voltmeter	(0-2)V	1
		(0-30)V	1
3.	Ammeter	(0-100)mA.	1
		(0-500)μA	1
4.	Resistor	1KΩ	1
5.	Diode	IN 4007	1
6.	Bread Board		As required
7.	Connecting wires		As required

FORMULAE USED:

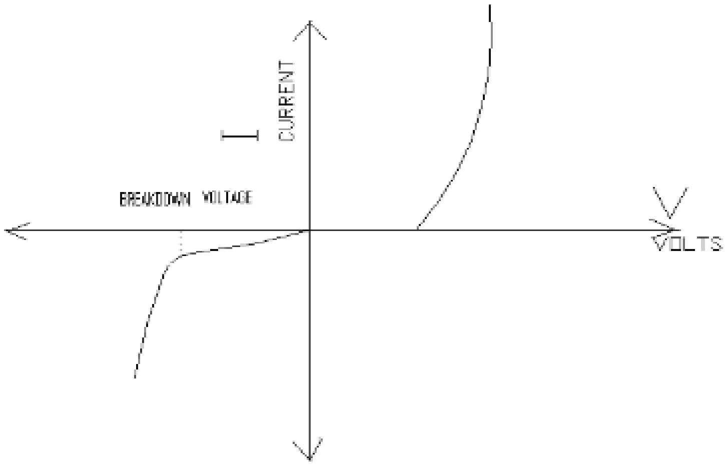
FOR DIODE:

(1) Diode forward resistance, $R_f = \Delta V_f / \Delta I_f$

(2) Reverse saturation current, $I_o = I / (\exp(V/ή V_T)-1)$

(3) Reverse resistance, $R_r = \Delta V_r / \Delta I_r$

V-I Characteristics of Diode



TABULATION:

FORWARD BIAS

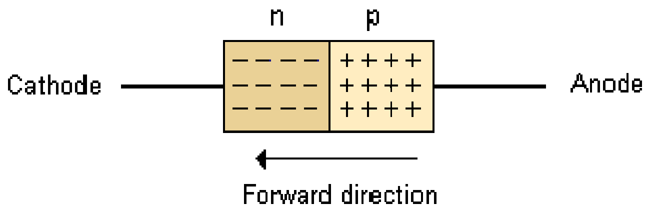
$V_{f\,(V)}$	I_f(mA)

REVERSE BIAS

V_r(v)	I_r(μA)

THEORY:

Diode is a simplest bipolar semiconductor component. It consists of two regions. One region is doped heavily with N type material. So it is called as N region. So it is denoted as cathode. Similarly, other region is doped heavily with P type material. It is called as P region. So it is denoted as anode. It is shown in fig:



PRINCIPLE OF OPERATION:

FORWARD BIAS:

The diode is said to be forward biased, when anode is connected to the positive terminal of DC source, the holes in the P region of the diode are repelled by the positive current. Hence these holes have sufficient energy to cross the potential barrier at the PN junction. Similarly as the cathode is connected to negative terminal of the DC source. So the electrons in the N region are repelled by the applied voltage. Hence they also get sufficient energy to cross the junction. So the potential barrier at the junction becomes zero. So the diode acts as ordinary resistor with a small resistance because of internal voltage drop in it..

REVERSE BIAS:

Similarly when the anode is connected to the negative terminal of the DC source, the diode is said to be reverse biased. In this case, the current from the source is in such a way that, it attracts the holes towards the negative terminal and electrons towards the positive terminal connected to cathode of the diode. So this causes the potential barrier at the junction to increase a lot. During reverse bias the diode acts almost as a open circuit.

MODEL CALCULATION:

During reverse bias small current flows through it. This current is called as reverse saturation current (I_o). When voltage is increased the electric field in the junction increases. This increases the reverse saturation current. At particular voltage, small increases in voltage, current increases large rate. This is called as **avalanche breakdown.**

CUT IN VOLTAGE:

Even though voltage is applied to the diode during forward bias, initially there is no current flowing through the diode till a particular forward voltage is applied. The forward voltage at which the diode current starts to increase is called as **cut-in voltage.** For silicon 0.7V, for germanium 0.3V.

PROCEDURE:

FORWARD CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. Keep the RPS in minimum value and switch ON the power supply.
3. Gradually increase the forward voltage in step by step of variation, Note down the forward voltage and current values and graph is plotted.

REVERSE CHARACTERISTICS:

1. Connections are made as per the circuit diagram.
2. Keep the RPS in minimum value and switch ON the power supply.
3. Gradually increase the reverse voltage in step by step of variation, Note down the reverse voltage and current values and graph is plotted.

The characteristics of diode are drawn between Voltage and Current with forward characteristics on **first quadrant** and reverse characteristics on **third quadrant.**

RESULT:

DISCUSSION QUESTIONS:

1. What is semiconductor material? How does it differ from a conductor?

A semiconductor is a material whose conductivity lies somewhere between that of a conductor and insulator. The typical value of conductivity is $100\Omega/cm^3$. Germanium and silicon are most commonly used as semiconductor materials.

2. Why do we prefer extrinsic semiconductor than intrinsic semiconductors?

Extrinsic semiconductor has high electrical conductivity which depends on the number of doping atoms and has high operating temperature. But in the intrinsic semiconductor the electrical conductivity is very small and is not a constant at different temperature.

3. Define the term drift current?

When an electrical field is applied across the semiconductor, the holes move towards the negative terminal of the battery and electrons more towards the positive terminal of the batter. This combine effect causes a current flow in the circuit. This current is called as drift current.

4. Define the term diffusion current?

Diffusion current is due to the movement of charge carriers by concentration gradients of charges by applied electrified d strength.

5. What is PN junction diode?

A PN junction diode is a two terminal device consisting of a PN junction formed either in germanium or silicon crystal. A PN junction is formed from a piece of semiconductor by diffusing P-type material to one half sides and N type material to other half side.

6. What is depletion region in a PN junction diode?

The region around the junction from which the charge carriers are depleted is called as depletion region.When a PN junction is forward biased, the depletion region width decreases

When a PN junction is reversed biased the depletion region width increase.

7. Define the term transition capacitance C_T of a diode?

When a PN junction is reverse biased the depletion layer acts like a dielectric material while P and N type region on either side have low resistance acts as the plates. In reverse biased PN junction may be regarded as parallel plate capacitor. This junction capacitance is called transition capacitance. It is denoted by C_T and is also called as space charge capacitance or depletion layer capacitance.

8. Explain the terms knee voltage and breakdown voltage w.r.t. diodes?

Knee voltage: the forward voltage at which the current through the PN junction starts increasing rapidly. It is also called as cut in voltage.

Breakdown voltage: the reverse voltage at which the PN junction breakdown occurs is called as breakdown voltage.

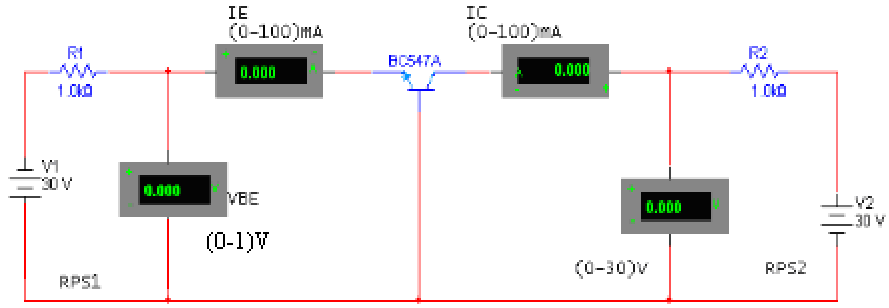
9. List the application of PN junction diode?

- Used as rectifier diodes in dc power supplies
- Used as signal diodes in communication circuits for modulation and demodulation
- Used in clipped and clamper circuits
- Used as a switch in logic circuits used in computers

10. What is avalanche breakdown in PN junction diode?

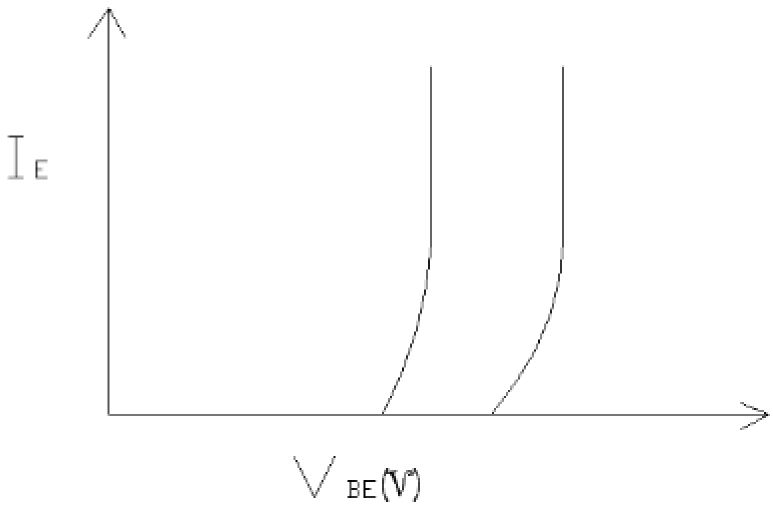
The avalanche breakdown takes place when both sides of the junction are lightly doped and consequently the depletion layer is large. When the reverse bias voltage is increased the accelerated free electrons collide with the semiconductor atoms in the depletion region. Due to the collision with valance electrons, covalent bonds are broken and electron hole pairs are generated. These new charges carriers so produced acquire energy from applied potential and in turn produced additional carriers. This forms cumulative process is called avalanche multiplication it causes the reverse current increase rapidly. This leads to avalanche breakdown. Once this breakdown occurs, the junction cannot regain its original position.

CIRCUIT DIAGRAM FOR COMMON BASE CONFIGURATION



CHARACTERISTICS OF CB CONFIGURATION:

INPUT CHARACTERISTICS



Ex.No: **CHARACTERISTICS OF COMMON BASE CONFIGURATION**

Date:

AIM:

To determine the characteristics of BJT under Common base configuration.

APPARATUS REQUIRED:

S.No.	Apparatus required	Range	Quantity
1.	RPS	(0-30)V	2
2.	Voltmeter	(0-1)V	1
		(0-10)V	1
3.	Ammeter	(0-500)µA	1
		(0-100)mA	1
4.	Resistance	1KΩ	2
5.	Transistor	BC 107	1
6.	Bread board		As required
7.	Connecting wires		As required

FORMULA USED:

(1) Input impedance $h_{ib} = \Delta V_{EB} / \Delta I_E$, with V_{CB} constant

(2) Output conductance $h_{ob} = \Delta I_c / \Delta V_{CB}$, with I_E constant

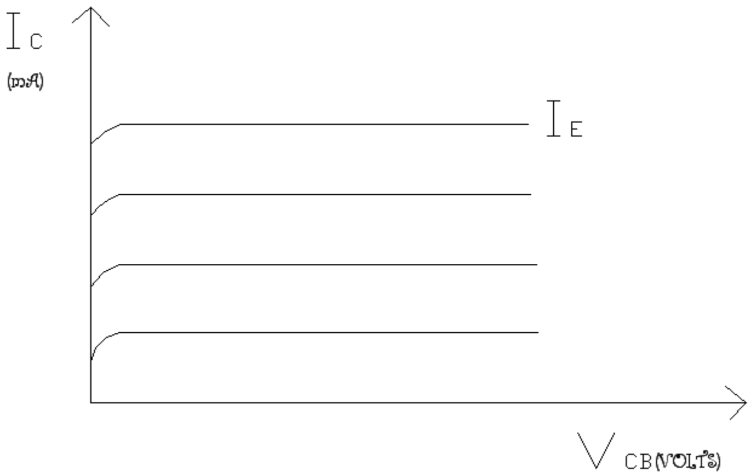
(3) Forward current gain $h_{fb} = \Delta I_c / \Delta I_E$, with V_{CB} constant

(4) Reverse Voltage gain $h_{rb} = \Delta V_{EB} / \Delta V_{CB}$, with I_E constant

THEORY:

A Bipolar Junction Transistor (BJT) is a three terminal device in which the operation depends on the interaction of both majority and minority carriers. The three terminals are Base, Emitter and collector. The arrow on the emitter specifies the direction of current flow when the EB junction is forward biased. Emitter is heavily doped; it can inject large number charge carriers into to the base. Base is lightly doped and very thin. It passes most of the injected charge carriers from the emitter into the collector. Collector is moderately doped.

OUTPUT CHARACTERISTICS



TABULATION FOR CB CONFIGURATION:

INPUT CHARACTERISTICS

$V_{CB} =$ V		$V_{CB} =$ V		$V_{CB} =$ V	
$V_{BE(V)}$	$I_{E(mA)}$	$V_{BE(V)}$	$I_{E(mA)}$	$V_{BE(V)}$	$I_{E(mA)}$

PRINCIPLE OF OPERATION:

This is also grounded Base Configuration. Emitter is the input terminal, Collector is the output terminal and Base is the common terminal.

INPUT CHARACTERISTICS: I_E Vs V_{EB} constant V_{CB}

The collector base voltage V_{CB} is kept constant at zero volt and emitter current I_E is increased from zero in suitable equal steps by increasing V_{EB}. This is repeated for higher fixed values of V_{CB}. When V_{CB} is equal to zero then the emitter-base junction is get forward biased and the junction behaves as a forward biased diode, so that the emitter current I_E increases rapidly with small increase in emitter base voltage V_{EB}. When V_{CB} is increased keeping V_{EB} constant, the width of the base region will decrease.

OUTPUT CHARACTERISTICS: I_C Vs V_{CB} constant I_E

The emitter current IE is kept constant at a suitable value by adjusting the emitter base voltage V_{EB}. Then V_{CB} increased in suitable equal steps and collector current I_C is noted for each value of I_E. This is repeated for different fixed values of $I_{E.}$

PROCEDURE:

Input characteristics:

1. Keeping the voltage across collector to emitter (V_{CE}) as constant, tabulate the values of base current for various values of base emitter voltage (V_{BE}.).
2. Repeat the same procedure for various values of $V_{CE.}$

Output characteristics:

1. Keeping the base current as constant, tabulate the values of collector current (I_C) for various values of collector emitter voltage (V_{CE}).
2. Repeat the same procedure for various constant values of base current (I_B).

OUTPUT CHARACTERISTICS

I_{E} = mA		I_{E} = mA		I_{E} = mA	
$V_{BC(V)}$	$I_{C(mA)}$	$V_{BC(V)}$	$I_{C(mA)}$	$V_{BC(V)}$	$I_{C(mA)}$

MODEL CALCULATION:

RESULT:

DISCUSSION QUESTIONS:

1. What is bipolar junction transistor?

A bipolar junction transistor (BJT) is a three terminal semiconductor device in which the operation depends on the interaction of both majority and minority carriers and hence the name bipolar.

2. What are the different configurations of BJT?

- Common emitter configuration
- Common collector configuration
- Common base configuration

3. What is thermal runaway?

The continuous increase in collector current due to poor biasing causes the temperature at collector terminal to increase. If no stabilization is done, the collector leakage current also increases. This further increases the temperature. This action becomes cumulative and ultimately the transistor burns out. The self destruction of an unstabilised transistor is known as thermal runaway.

4. Define the different operating region of transistor?

Active region: The collector junction is reverse biased and emitter junction is forward biased.

Cut off region: The collector and emitter junction are both reverse biased.

Saturation region: The collector and emitter junction are forward biased.

5. List the uses of emitter follower (common collector configuration) circuit?

- It is widely used in electronic instruments because of low output impedance and high input impedance.
- It is used of impedance matching.

6. Define alpha and beta of the transistor?

The ratio of change in collector current I_C to the change in emitter current I_E at constant collector base voltage V_{CB}

$$\alpha = I_C / I_E$$

Base current amplification factor (β)

The ratio of change in collector current I_C to the change in base current I_B

$$\beta = I_C / I_B$$

7. What is meant by early effect?

When the collector base voltage is made to increase, it increase the depletion region across the collector base junction, with the result that the effective width of base terminal decreases. This variation of effective base width by collector base voltage is known as base width modulation or early effect.

8. Explain the significance of early effect or base width modulation?

It reduces the charges recombination of electron with holes in ht base region, hence the current gain increase with increase in collector base voltage.

The charge gradient is increased within the base; hence the current due to minority carriers across emitter junction increases.

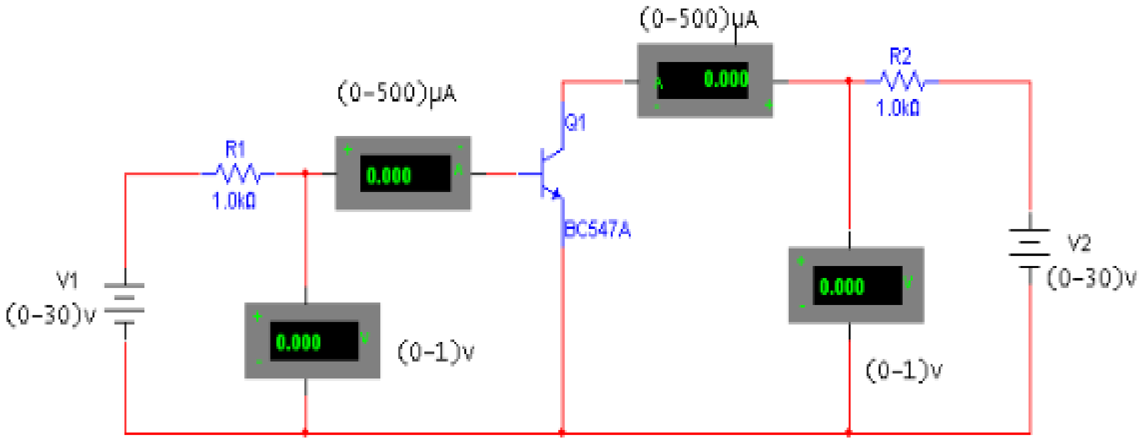
9. Which configuration provides better current gain?

CB configuration

10. What is the significance of V_{BE} and I_{CO}?

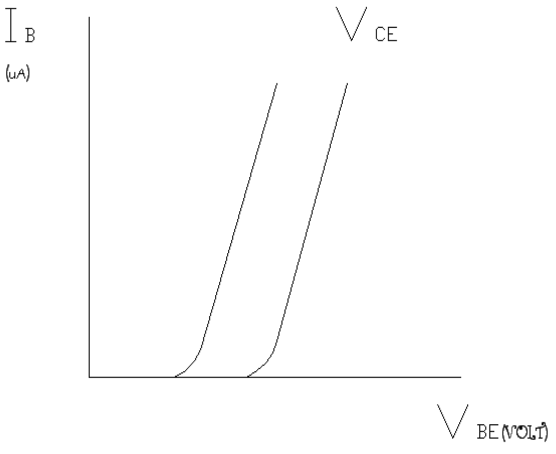
V_{BE} and I_{CO} are significant because any changes in V_{BE} and I_{CO} cause a drastic change in temperature and collector current I_C. It leads to thermal runaway problem.

CIRCUIT DIAGRAM FOR COMMON EMITTER CONFIGURATION:



MODEL GRAPH FOR CE CONFIGURATION:

INPUT CHARACTERISTICS



Ex.No: CHARACTERISTICS OF COMMON EMITTE CONFIGURATION

Date:

AIM:

To determine the characteristics of BJT under Common Emitter configuration.

APPARATUS REQUIRED:

S.No.	Apparatus required	Range	Quantity
1.	RPS	(0-30)V	2
2.	Voltmeter	(0-1)V	2
3.	Ammeter	(0-500)µA	2
4.	Resistance	1KΩ	1
5.	Transistor	BC 107	1
6.	Bread board		2
7.	Connecting wires		As required

FORMULA USED:

(1) Input impedance hie = $\Delta V_{BE} / \Delta I_B$, with V_{CE} as constant

(2) Output Admittance $h_{oe} = \Delta I_c / \Delta V_{CE}$, with I_B as constant

(3) Forward Current gain $h_{fe} = \Delta I_c / \Delta I_B$, with V_{CE} as constant

(4) Reverse voltage gain $h_{re} = \Delta V_{BE} / \Delta V_{CE}$, with I_B as constant

THEORY:

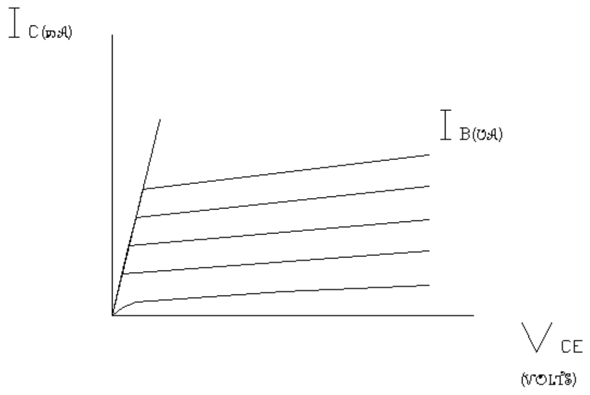
This is also called grounded emitter configuration. Base is the input terminal, collector is the out put terminal and emitter is the common terminal.

OPERATION:

Input characteristics:

The collector to emitter voltage is kept constant at zero volt and base current increased from zero in equal steps by increasing V_{BE}. This procedure is repeated for higher fixed values of V_{CE} and curves of I_B Vs V_{BE} are drawn. When V_{CE} = 0, the emitter base junction is forward biased and the junction behaves as a

OUTPUT CHARACTERISTICS



OUTPUT CHARACTERISTICS

I_B = µA		I_B = µA		I_B = µA	
V_{CE} (V)	I_C (mA)	V_{CE} (V)	I_C (mA)	V_{CE} (V)	I_C (mA)

forward biased diode. When V_{CE} increased, the width of the depletion region at the reverse biased collector base junction will increase. Hence the effective width of the base will decrease.

Output characteristics:

The base current I_B is kept constant at a suitable value by adjusting base emitter voltage V_{BE}. The magnitude of collector emitter voltage V_{CE} is increased in suitable equal steps from zero and the collector current I_C is noted for each setting V_{CE} . Now the curves of I_C versus V_{CE} are plotted for different constant values of I_B.

Saturation region:

Both junctions are forward biased and an increase in the base current does not cause a corresponding large change in I_C. The ratio of V_{CE} (sat) to I_C in this region is called saturation resistance.

Cut off region:

Both junctions are reverse biased. When the operating point for the transistor enters the cut off region, the transistor is OFF. The transistor is virtually an open circuit between collector and emitter.

Active region:

Emitter base junction is forward biased and the collector base junction is reverse biased. If the transistor is to be used as a linear amplifier, it should be operated in the active region.

PROCEDURE:

Input characteristics:

1. Keeping the voltage across collector to emitter (V_{CE}) as constant, tabulate the values of base current for various values of base emitter voltage (V_{BE}.).
2. Repeat the same procedure for various values of V_{CE}.

Output characteristics:

1. Keeping the base current as constant, tabulate the values of collector current (I_C) for various values of collector emitter voltage (V_{CE}).
2. Repeat the same procedure for various constant values of base current (I_B).

MODEL CALCULATION:

RESULT:

DISCUSSION QUESTIONS:

1. What are the types of breakdown occurs in transistors?

- Avalanche multiplication or avalanche breakdown
- Reach through of punch through

2. Why do we prefer silicon for transistor?

Silicon is an indirect band semiconductor the life time of charge carriers is more and hence amplification is more.

3. What is meant by stabilization?

The maintenance of the operating point is fixed stable.

4. What is the need for biasing?

- To maintain proper zero signal emitter base voltage.
- To maintain proper zero signal collector emitter voltage.
- To maintain proper zero signal collector current.

5. What is meant by operating point?

The zero signal values of I_C and V_{CC} are known as operating point. It is also called so because the variations of I_C and V_{CC} take place about this point when signal is applied. It is also called as Q point and it is the point was the transistor is silent.

6. What types of components are used for temperature stabilization?

Passive type of components are used

7. What are the types of biasing?

- Fixed bias
- Collector feedback bias
- Self bias or emitter bias

8. Define stability factor?

Stability factor S defined as the rate of change of collector current IC w.r.t reverse saturation current Iα keeping β and V_{BE} constant.

$$S= \Delta I_C / \Delta I\alpha$$

9. What is Q point?

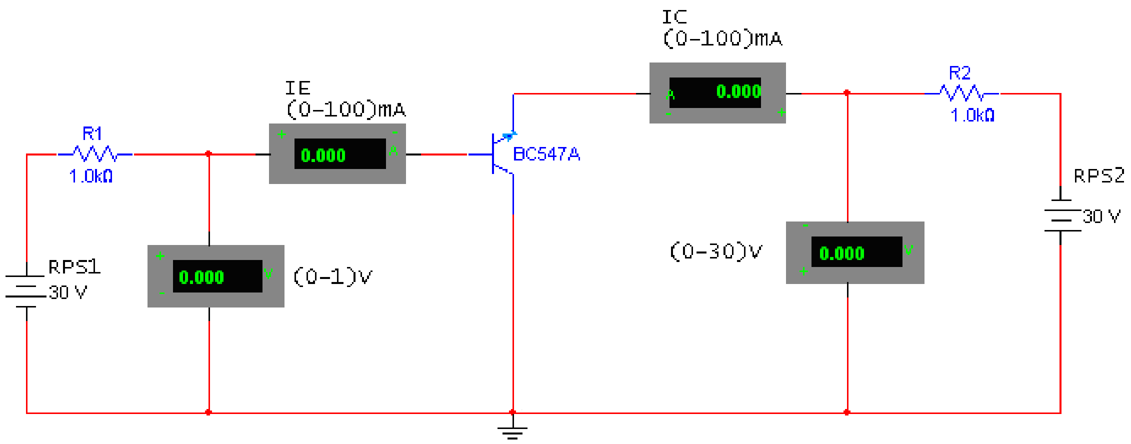
The quiescent operating point is given by the inter section of the bias curve and the dc load line.

10. What is bias? What is the need for biasing?

The proper flow of zero signal collector current and the maintenance of proper collector emitter voltage during the passage of signal is known as transistor biasing.

When a transistor is biased properly, it works efficiently and produces no distortion in the output signal and thus operating point can be maintained stable.

CIRCUIT DIAGRAM FOR COMMON COLLECTOR CONFIGURATION



Ex.N **CHARACTERISTICS OF COMMON COLLECTOR CONFIGURATION**

Date:

AIM:

To determine the characteristics of BJT under Common collector configuration.

APPARATUS REQUIRED:

S.No.	Apparatus required	Range	Quantity
1.	RPS	(0-30)V	2
2.	Voltmeter	(0-1)V	2
3.	Ammeter	(0-100)µA	2
4.	Resistance	10KΩ	1
5.	Transistor	BC 107	1
6.	Bread board		2
7.	Connecting wires		1
			As required
			As required

THEORY:

This is also called grounded collector configuration. Base is the input terminal, emitter is the out put terminal and collector is the common terminal.

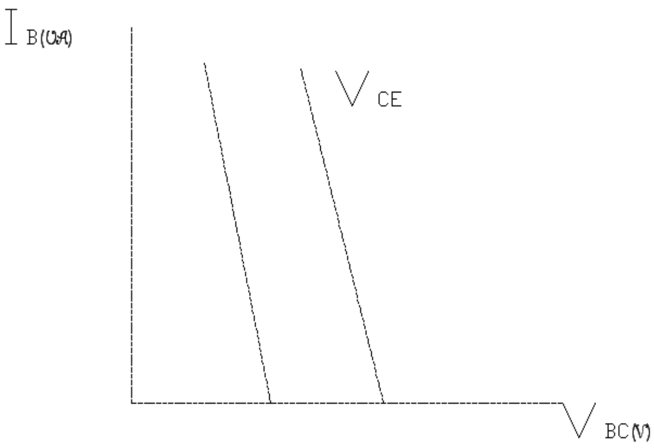
OPERATION:

Input characteristics:

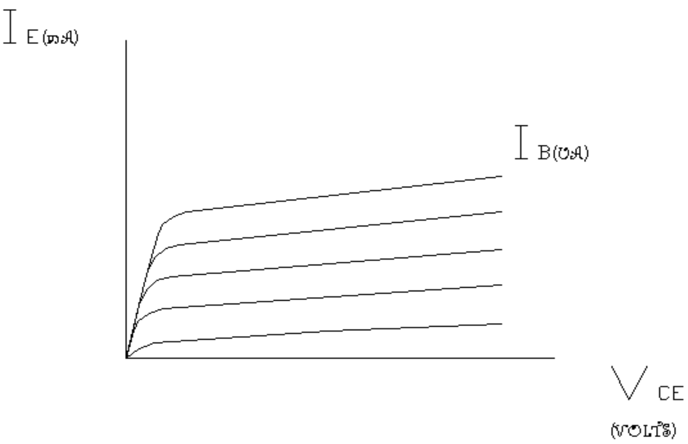
V_{CE} is kept at a suitable fixed value. The base collector voltage V_{BC} is increase in equal steps and the corresponding increase in I_B is noted. This is repeated for different fixed values of V_{CE}.

MODEL GRAPH FOR CC CONFIGURATION:

INPUT CHARACTERISTICS



OUTPUT CHARACTERISTICS



Output characteristics:

The base current I_B is kept constant at a suitable value by adjusting e emitter collector voltage V_{CE} . The magnitude of collector emitter voltage V_{CE} is increased in suitable equal steps from zero and the emitter current I_E is noted for each setting V_{CE} . Now the curves of I_E versus V_{CE} are plotted for different constant values of I_B.

PROCEDURE:

Input characteristics:

1. Keeping the voltage across collector to emitter (V_{CE}) as constant, tabulate the values of base current for various values of base collector voltage (V_{BC}).
2. Repeat the same procedure for various values of V_{CE}.

Output characteristics:

1. Keeping the base current as constant, tabulate the values of emitter current (I_E) for various values of collector emitter voltage (V_{CE}).
2. Repeat the same procedure for various constant values of base current (I_B).

TABULATION FOR CC CONFIGURATION:INPUT CHARACTERISTICS

$V_{CE(v)}$ = V		$V_{CE(V)}$ = V		$V_{CE(V)}$ = V	
$V_{BC(v)}$	$I_{B(\mu A)}$	$V_{BC(V)}$	$I_{B(\mu A)}$	$V_{BC(V)}$	$I_{B(\mu A)}$

OUTPUT CHARACTERISTICS

I_B = µA		I_B = µA		I_B = µA	
$V_{CE\ (V)}$	$I_{E\ (mA)}$	$V_{CE\ (V)}$	$I_{E\ (mA)}$	$V_{CE\ (V)}$	$I_{E\ (mA)}$

MODEL CALCULATION:

RESULT:

DISCUSSION QUESTIONS:

1. What do understand by dc and ac load line?

DC load line: the output characteristics of a transistor circuit which gives the values of I_C and V_{CE} corresponding to zero signal or dc conditions.

AC load line: output characteristics of a transistor circuit which gives the values of I_C and V_{CE} when signal is applied.

2. List the advantages and disadvantages of fixed bias method?

- Stability of operating point is improved.
- Less cost and simple circuit.

3. List the disadvantages of fixed bias method?

- Stability is poor
- When temperature changes, leads to thermal runaway problem.

4. What do you meant by Emitter Follower?

CC amplifier is called as output, and it exactly follows the input voltage variation.

5. What is the condition for avoiding thermal runaway problem?

The rate of release of heat at collector junction JC should be less than the rate of heat dissipation under $\partial P_m / \partial T_c < \partial P_d / \partial Tc$.

6. Comparison of transistor configuration?

Characteristics	**CB**	**CE**	**CC**
Input impedance	Low(about 100Ω)	Low(about 750KΩ)	High(about 750kΩ)
Output impedance	Very high(about 450kΩ)	High(about 45kΩ)	Low(about 50Ω)
Voltage gain	About 150	About 500	Less than 1
Application	High frequency	Audio frequency	Impedance matching

7. List the uses of emitter follower circuit?

- Used in electronic instruments because of low output impedance and high input impedance.

- Used for impedance matching.

8. List the advantage of CC configuration?

- High input impedance
- Low output impedance
- Voltage gain is nearly 1.

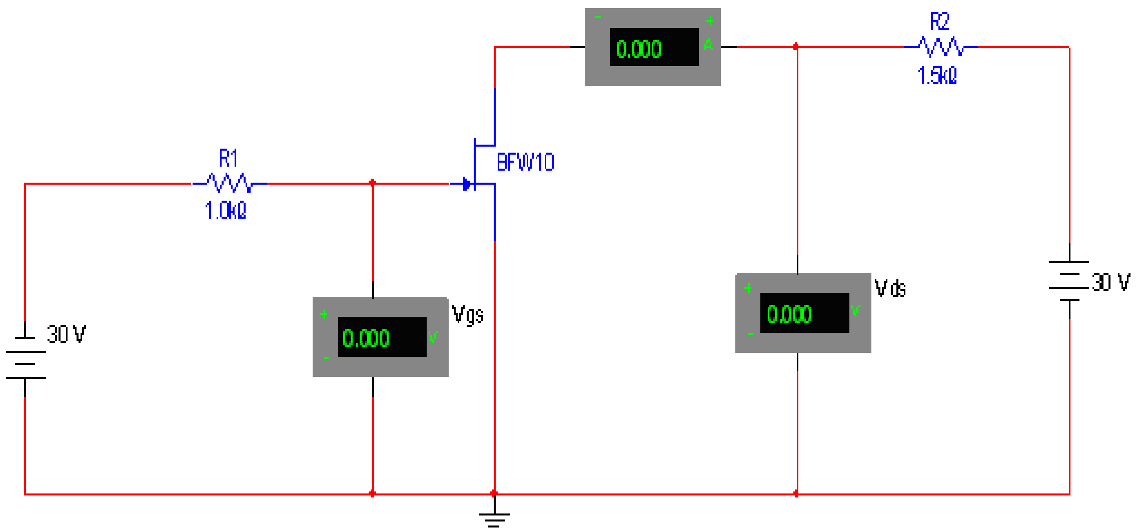
9. Define h parameters?

Hybrid parameter means mixed parameters. Actually these parameters have mixed dimensions and hence they are called as h parameters. The parameters (h_{fe} and h_{re}) are dimensionless.

10. What are the limitations of h parameters?

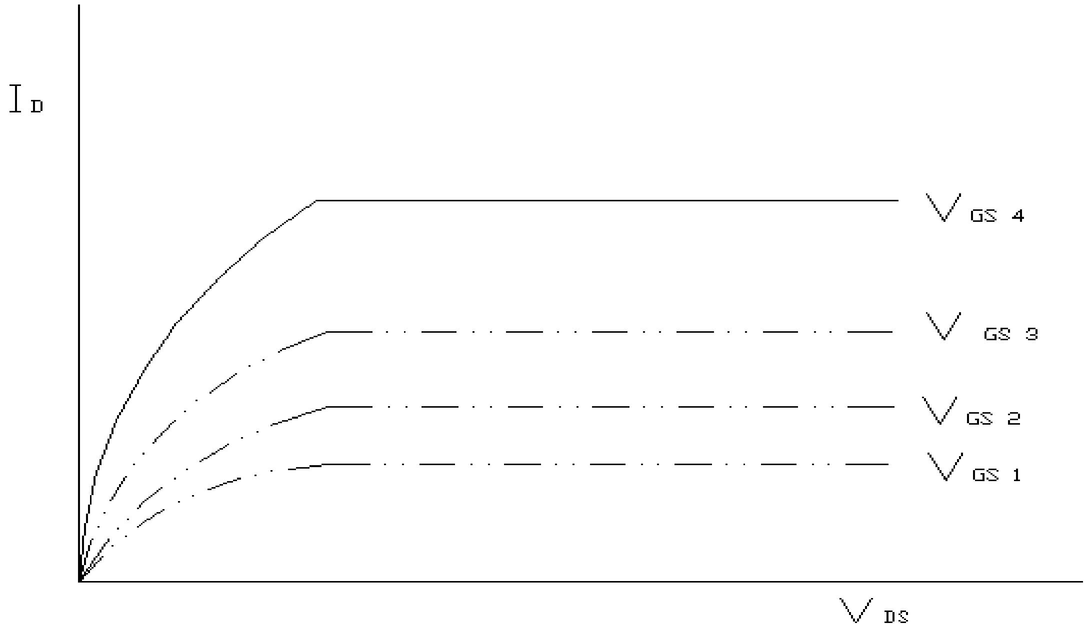
- h parameters an subjected to variation due to temperature Q point is varied as resulting this it in lightly difficult to compute accurately.
- Transistor behaves as a two point network for small signal only, hence h parameters can be used to analyze only the small signal amplifiers.

CIRCUIT DIAGRAM FOR JFET:



MODEL GRAPH FOR JFET:

DRAIN CHARACTERISTICS



Ex.No: **CHARACTERISTICS OF JFET**

Date:

AIM:

To draw the drain and transfer characteristics and determine the transconductance, drain resistance and amplification factor of the given JFET.

APPARATUS REQUIRED:

Sl.No.	Apparatus	Range	Quantity
1.	RPS	(0-30)V	2
2.	Resistor	1KΩ	1
		1.5 KΩ	1
3.	Voltmeter	(0-10)V	1
		(0-30)V	1
4.	JFET	BFW10	1
5.	Ammeter	(0-10)mA	1
6.	Bread board	-	As required
7.	Connecting wires		As required

FORMULA USED:

Drain Resistance $R_d = \Delta V_{DS} / \Delta I_D$, V_{GS} as constant

Amplification factor $\mu = g_m r_d$

Transconductance $g_m = \Delta I_D / \Delta V_{GS}$, V_{DS} as constant

THEORY:

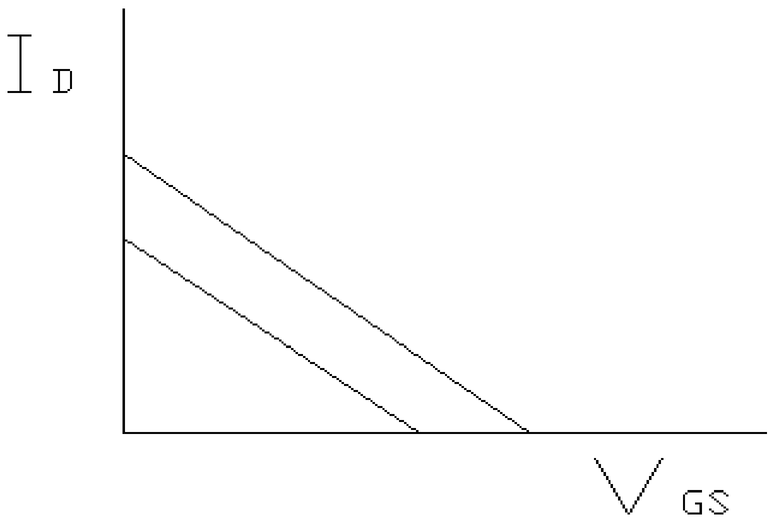
FET is a three terminal device which current is controlled an electrified. The operation of FET depends only on the majority carriers.

OPERATION:

When V_{GG} applied $V_{DD} = 0$

The P-type gate and N-type channel constitute PN junction is always reverse biased in JFET operation. The reverse bias is applied by a battery voltage, V_{GG} connected between the gate and the source terminal. When PN junction is reverse biased, the electrons and holes diffuse across the junction and leave behind the

TRANSFER CHARACTERISTICS



TABULATION FOR JFET:

DRAIN CHARACTERISTICS

V_{GS}= V		V_{GS} = V		V_{GS} = V	
V_{DS}(v)	I_D(mA)	V_{DS}(v)	I_D(mA)	V_{DS}(v)	I_D(mA)

positive ions on N side and negative ions on P side. The region containing immobile ions is known as **Depletion region.** Both regions are heavily doped, then the depletion region symmetrically on both sides.

When no V_{DD} is applied the depletion region is a symmetrical and the conductivity's zero, since there are no mobile carriers in the junction. As the reverse bias voltage across the junction is increased, thickness of the depletion region also increases.

When V_{DD} applied V_{GG} =0

When no voltage is applied to gate i.e V_{GG}=0 and V_{DD} is applied between source and drain. The electron will flow from source to drain through the channel.

When V_{DD} applied V_{GG} is applied

When voltage is applied between the drain and source with a battery V_{DD}, the electrons flow from source to drain through the narrow channel existing between the depletion regions.

TRANSFER CHARACTERISTICS:

The curves shows the relationship between drain current (I_D) and gate to source voltage (V_{GS}) for different values of drain source (V_{DS}) voltage. First adjust the drain to source voltage to some suitable value. Then increase the gate to source voltage in small suitable value at each step and record the corresponding values of drain current at each step. If V_{GS} continuously increasing, the channel width reduced when V_{GS} =V_P, the pinch off occurs thus I_D =0. **DRAIN CHARACTERISTICS:**

It shows the relation between the drain to source voltage (V_{DS}) and drain current ($_{ID}$).

Active Region:

In this region the for a small increase in drain to source voltage the drain current increases largely. Hence this is called active region.

Cut off region:

In this region the current never increases even if voltage increases. Hence it is called cutoff region.

Saturation region:

In this region after increasing from active region, the drain current remains constant over a range of drain to source voltage. After that current

TRANSFER CHARACTERISTICS

V_{DS} = V		V_{DS} = V		V_{DS} = V	
V_{GS}(V)	I_D(mA)	V_{GS}(V)	I_D(mA)	V_{GS}(V)	I_D(mA)

MODEL CALCULATION:

pinches off or shoots to a very high value. The drain to source voltage at which it occurs is called as pinch off Voltage.

PROCEDURE:

1. The connections are given as shown in circuit diagram.
2. By varying RPS1 V_{GS} is kept constant.
3. Now V_{DS} is varied and corresponding variation in drain current I_D is tabulated.
4. This process is repeated for another value of V_{GS}(V_{GS} is set at -1 V and -2Volts)
5. Plot these values on graph with V_{GS} on x axis and I_D on Y axis. This gives the drain characteristics.
6. By varying RPS2, it is kept at constant value. Say V_{DS} = 2V.
7. Now for various values of VGS, drain current is taken(I_D).This is repeated for another value of V_{DS}.
8. Plot these values on graph sheet with V_{GS} on X axis and I_D on Y axis. This gives us Transfer characteristics.
9. The various parameters are found as given in formula used.

RESULT:

DISCUSSION QUESTIONS:

1. What is a FET?

A field effect (FET) is a three terminal semiconductor device in which current conduction takes place by one type of carriers (either holes or electron) and is controlled by an electric field.

2. Why FET is called an unipolar device?

The operation of FET depends upon the flow of majority carriers only (either holes or electrons) the FET is said to be unipolar device.

3. Define pinch off voltage?

It is the voltage at which the channel is pinched off, i.e. all the free charge from the channel get removed.

4. Define drain resistance?

Drain resistance (r_d) is defined as the ratio of small change in drain to source voltage (ΔV_{ds}) to the corresponding change in drain current (ΔI_d) at constant gate to source voltage (V_{gs}). $r_d = \Delta V_{ds} / \Delta I_d$ at constant gate to source voltage (V_{gs})

5. Write down the relationship between various FET parameters?

Amplification factor = drain resistance * Transconductance

$$\mu = r_d * g_m$$

6. Mention the application of FET?

- Used as a low noise amplifier
- Used as a buffer amplifier
- Used as phase shift oscillator

7. Why the input impedance of FET is more than that of a BJT?

The input impedance of FET is more than that of a BJT because the input circuit of FET is reverse biased whereas the input circuit of BJT is forward biased.

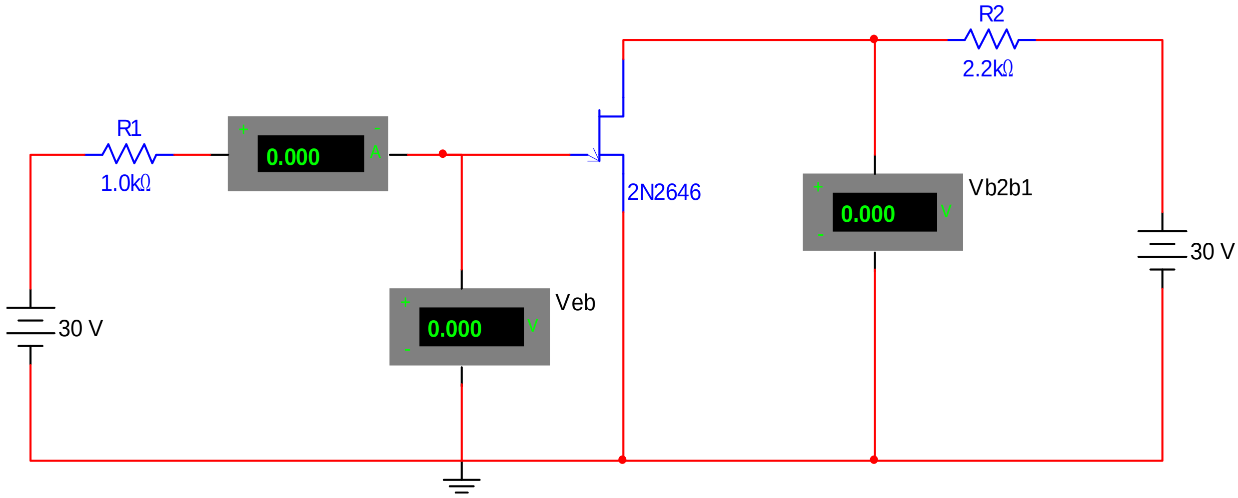
8. What is meant by gate source threshold voltage of a FET?

The voltage at which the channel is completely cur off and the drain current becomes zero is called as gate source threshold voltage.

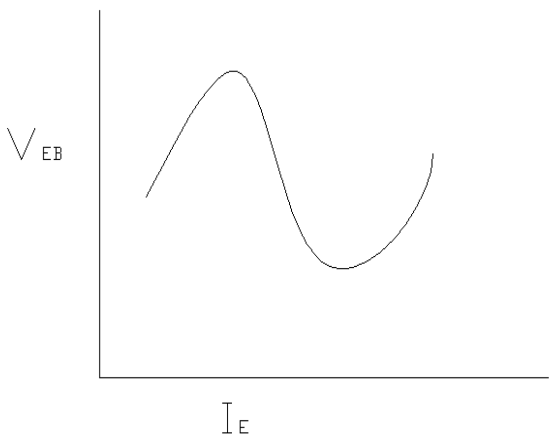
9. Why N channel FET's are preferred over P channel FET's?

In N channel FET the charge carriere are the electrons which have a mobility o9f about 1300 cm^2/ VS, whereas in P channel FET's the charge carriers are the holes which have a mobility of about 500 cm^2 /VS. the current in a semiconductor is directly proportional to mobility. Therefore the current in N channel FET is more than that of P channel FET.

CIRCUIT DIAGRAM FOR UJT:



UJT CHARACTERISTICS:



Ex.No: **CHARACTERISTICS OF UJT**

Date:

AIM:

To determine the static characteristics of UJT.

APPARATUS REQUIRED:

S.No.	Apparatus	Range	Quantity
1.	RPS	(0-30)V	2
2.	Voltmeter	(0-10)V	2
3.	Ammeter	(0-100)mA	1
4.	Resistance	1KΩ	1
		1.5KΩ	1
5.	UJT	2N2646	1
6.	Connecting wires		As required
7.	Read Board		As required

FORMULA USED:

1. Negative Resistance $= \Delta V_{BE} / \Delta I_E \quad / \quad V_{B1B2}$
2. Intrinsic Stand off ratio $= V_P - V_{BE} / V_{B1B2}$

THEORY:

The Uni Junction Transistor is a three terminal device. It has three terminals. Emitter, Base1 and base2. It consists of N type semiconductor bar into which P-Type semi conductor material is diffused. Contacts are then made into the device. The fig.1 shows the equivalent circuit of a n UJT.

TABULATION FOR UJT:

V_{B2B1} =		V_{B2B1} =	
$V_{EB(V)}$	$I_{E(\mu A)}$	$V_{EB(V)}$	$I_{E(\mu A)}$

MODEL CALCULATION:

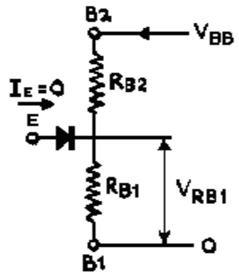


Fig.1.Equivalent circuit of UJT

OPERATION:

From the characteristics of UJT up to the peak point, the diode is reverse biased, and hence to the left of the peak point is known as cut off voltage. The voltage corresponding to this point is peak voltage. In the cut off region PN junction is reverse biased. The device does not conduct, only a small amount of current flows through the device. Once peak point is reached the device starts conducting. UJT has negative resistance characteristics. The device conducts up to one point which is called valley point. After the valley point the device passes to a saturation region. In this region the device voltage and current reach standard values.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. The voltage V_{B1B2} is kept as constant.
3. Varying the RPS1 the voltmeter readings of V_{EB1} and ammeter I_E readings are note down.
4. The above process is repeated for different values of V_{B1B2} readings.
5. At one point the needle deflects back and current starts increasing.
6. The current must not increase beyond 25mA.
7. The graph betweenV_{EB1} and I_E are plotted.

RESULT:

DISCUSSION QUESTIONS:

1. What does UJT stand for? Justify the name UJT.

UJT stands for uni junction transistor. The UJT is a three terminal semiconductor device having two doped regions. It has one emitter terminal and two base terminals. It has only one junction, moreover from the outlook; it resembles to a transistor hence the name uni junction transistor.

2. What is "interbase resistance" of UJT?

The resistance between the two bases of UJT is called interbase resistance. Its typical value ranges from 5kΩ to 10kΩ with emitter open.

Interbase resistance, $R_{bb} = R_{b1}+R_{b2}$

Where

R_{b1}= resistance of silicon bar between B_1 and emitter function

R_{b2} = resistance of silicon bar between B_2 and emitter function

3. What is meant by negative resistance region of UJT?

In a UJT the emitter voltage reaches the peak point voltage (Vp), emitter current starts flowing. After the peak point any effort to increase in emitter voltage (Ve) further leads to sudden increase in the emitter current with corresponding decrease in Ve, exhibition negative resistance. This takes place until the valley point is reached. The region between the peak point and valley point is called "negative resistance region".

4. How does UJT differ from a FET?

The gate junction of FET is reversed biased whereas in UJT the emitter junction is forward biased. BJT can amplify signals, whereas UJT has no ability to amplify signals.

5. What are the difference between UJT and BJT?

UJT	BJT
It has only one PN junction	It has two PN junction
Three terminals are labeled as emitter(E), base(B1)& base2(B2)	Three terminals are labeled as emitter(E),base(B)& collector(C)
It has no ability to amplify signals	It can amplify signals

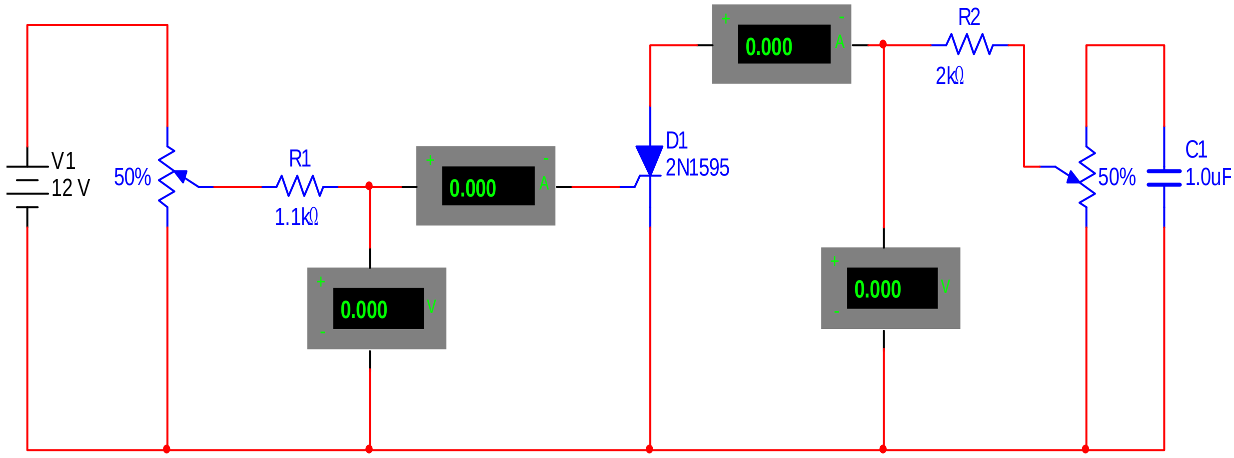
6. Mention the application of UJT?

- Used in timing circuits.
- Used in switching circuits.
- Used in phase control circuits
- Used in trigger device for SCR and TRIAC
- Used for pulse generation

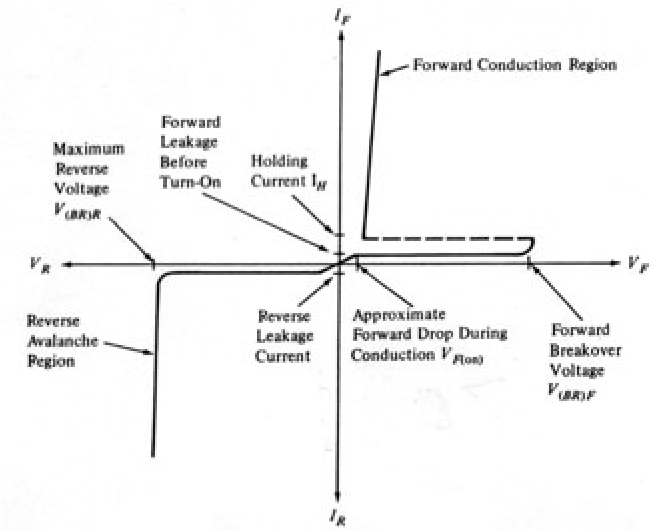
7. What sis source follower?

CD configuration of JFET is called as source follower because the output is taken from the source terminal of JFET. Since the output voltage closely follows the input voltage hence it is named as source follower.

CIRCUIT DIAGRAM FOR SCR:



MODEL GRAPH FOR SCR:



V–I characteristics of the SCR with gate open.

Ex.No: CHARACTERISTICS OF SCR

Date:

AIM:

To obtain the forward and reverse characteristics of SCR and measure the holding and latching current.

APPARATUS REQUIRED:

Apparatus	Range	Type	Quantity
SCR		TYN612	1
RPS	(0-30V)		2
Voltmeter	(0-30V)	MC	1
Ammeter	(0-500mA) (0-50mA)	MC MC	1 1
Resistor	1300Ω/1A 470Ω		1 1

THEORY:

An SCR is a three terminal device. The three terminals are anode, cathode, and gate. When the anode is more positive with respect to the cathode, junctions j1,j3 are forward biased and the junctions j2 is reverse biased. Only a small leakage current

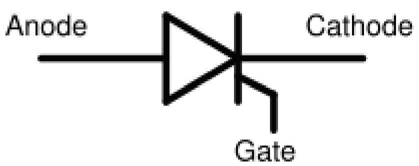


Fig.1. Schematic Symbol

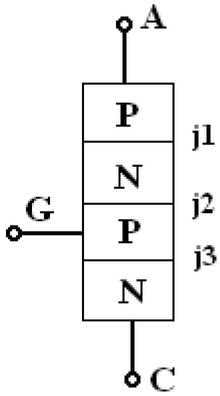


Fig.2. Block Construction

TABULATION FOR SCR:

$I_G =$ mA		$I_G =$ mA		$I_G =$ mA	
V_{AK}(V)	I_A(mA)	V_{AK}(V)	I_A(mA)	V_{AK}(V)	I_A(mA)

MODEL CALCULATION:

flows through the device. The device is said to be in the **forward blocking state or off state**. when the anode to cathode voltage is increased to break over value, the junction j2 breaks down and device starts conducting (ON state) the anode current must be more than the value known as latching current in order to maintain the device in the ON state. Once SCR starts conducting, it behaves like a conducting diode and gate has no control over the device. The device can be turned off only by bringing the device in below a value known as holding current. The forward voltage drop across the device in the ON state is around one volt. When the cathode voltage is made positive with respect to the anode voltage junction j2 is forward biased and the junction j1 and j3 are reversed biased. The device will be in the reverse blocking state and only small leakage current flows through the device. The device can be turned on at forward voltage less than break over voltage by applying suitable gate current.

PROCEDURE:

1. The connections are made as per the circuit diagram
2. RPS is adjusted to the required gate current flows through the device.
3. The V_{AK} is increased in steps by varying the RPS and each step, the corresponding anode current noted down.
4. Reading corresponding to Break over point, latching current, holding current and also noted down.
5. To determine latching current:
6. The forward voltage is increased to break over value, gradually. The device gets tureen ON. At this condition, the gate current is removed. If the anode current is less than the latching current, the SCR will go into OFF state immediately. The circuit resistance is repeated until the device remains in ON stat even after removing the gate current. This current is latching current.
7. To determine Holding current:
8. The gate current is removed after bringing the device into the ON state. The circuit resistance is increased in steps. The minimum value of anode current at which the SCR remains in the ON state is the holding current.

RESULT:

DISCUSSION QUESTIONS:

1. Define break over voltage of SCR?

Break over voltage is defined as the minimum forward voltage at which the SCR starts conducting heavily.

2. List the advantages of SCR?

- SCR can handle and control large currents.
- Switching speed is very high.
- It has no moving parts, therefore it gives noiseless operation.
- Operating efficiency is high.

3. List the applications of SCR?

- Used as speed controlled in DC and AC motors.
- Used as a inverter
- Used as an converter
- Used in battery chargers
- Used for phase control and heater control
- Used in light dimming control circuits

4. What is meant by latching?

The ability of SCR to remain conducting even when the gate signal is removed is called latching.

5. Define forward current rating of a SCR?

Forward current rating oaf a SCR is the maximum anode current that it can handle without destruction.

6. List the important ratings of SCR?

- Forward break over voltage
- Holding current
- Gate trigger current
- Average forward current
- Reverse breakdown voltage

7. Define latch current and holding current?

Latch current: the maximum anode current that an SCR is capable passing without destruction.

Holding current: the minimum value of anode current required to keep the SCR is a position.

8. Define reverse break down voltage (V_{BR})?

The reverse voltage (anode – negative and cathode- positive) above which the reverse breakdown occurs, breaking J_1 and J_3 junctions. When the SCR is reverse biased, the thickness of the J_2 depletion layer during the forward bias condition is greater than the total thickness of the two depletion layers at J_1 and J_3. Therefore the forward breakdown voltage V_{BO} is greater than the reverse break over voltage V_{BR}.

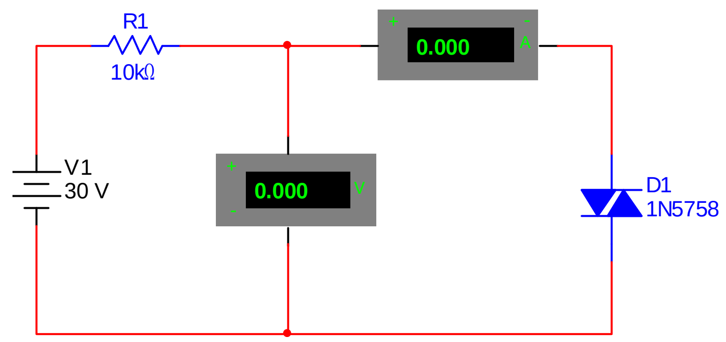
9. Define forward break over voltage?

Forward break over voltage is the voltage above which the SCR enters the conduction region (ON state). The forward breakdown voltage is dependent on the gate bias.

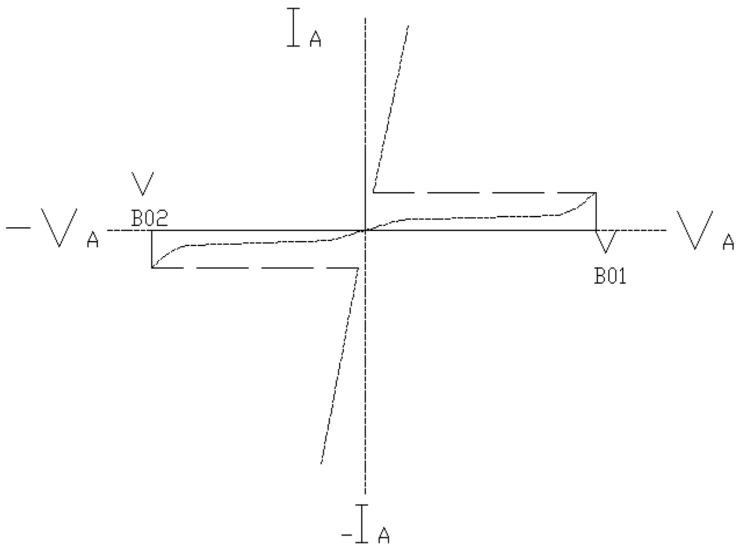
10. What are the losses o occurs in a thyristor during working conditions?

1. Forward conduction loss.
2. Loss due of leakage current during forward and reverse blocking
3. Switching losses at turn-on and turn-off
4. Gate triggering loss.

CIRCUIT DIAGRAM FOR DIAC:



CHARACTERISTICS OF DIAC:



Ex.No: **CHARATERISTICS OF DIAC**

Date:
AIM:

To obtain the forward and reverse characteristics of DIAC.

APPERATUS REQUIRED:

Apparatus	Range	Type	Quantity
DIAC			1
RPS	(0-30V)		2
Voltmeter	(0-30V)	MC	1
Ammeter	(0-100mA) (0-50mA)	MC MC	1 1
Resistor	1kΩ		2

THEORY:

Diac circuits use the fact that a diac only conducts current only after a certain breakdown voltage has been exceeded. The actual breakdown voltage will depend upon the specification for the particular component type.

When the diac breakdown voltage occurs, the resistance of the component decreases abruptly and this leads to a sharp decrease in the voltage drop across the diac, and a corresponding increase in current. The diac will remain in its conducing state until the current flow through it drops below a particular value known as the holding current. When the current falls below the holding current, the diac switches back to its high resistance, or non-conducting state. Diacs are widely used in AC applications and it is found that the device is "reset" to its non-conducting state, each time the voltage on the cycle falls so that the current falls below the holding current.

TABULATION FOR DIAC:

Voltage (V_A) V	**Current (I_A) mA**

MODEL CALCULATION:

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Keep in position minimum so Is and V_A across MT1 and MT2 are zero.
3. Switch on the supply.
4. Allow low voltage between MT1 and MT2 increase V_A so I_A increases. Repeat it till the device turn ON.
5. Slowly increases gate to MT1 voltage set particular Ig = 7 mA
6. Keep Ig constant and increases V_A in step by step when V_A increases. I_A increases slightly when break over is reached current increases sharply.

RESULT:

DISCUSSION QUESTIONS:

1. What is DIAC?

Diac is a two terminal, bidirectional semiconductor switching depending upon the polarity of the voltage applied across its main terminals. In operation diac is equivalent to two 4 layer diodes connected in antiparallel.

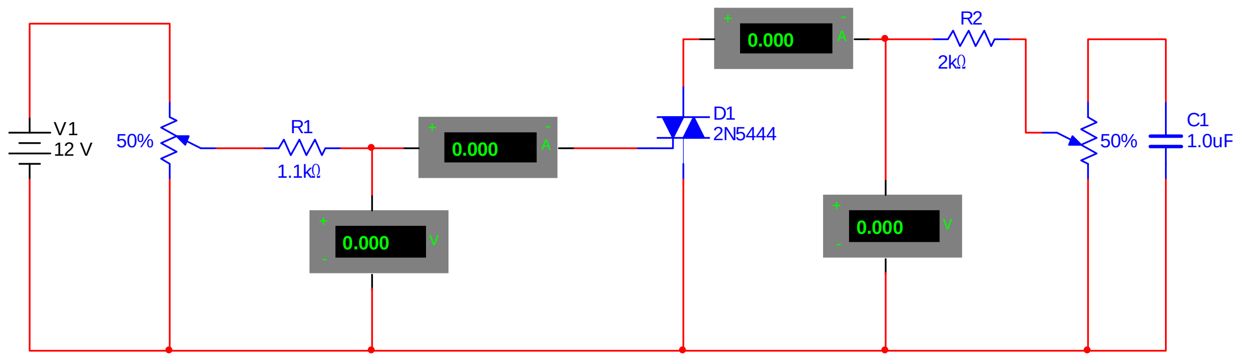
2. List the application of DIAC?

1. Used as a trigger device in TRIAC power control systems
2. Used in lamp dimmer circuits
3. Used in heater control circuits
4. Used for speed control of universal motor.

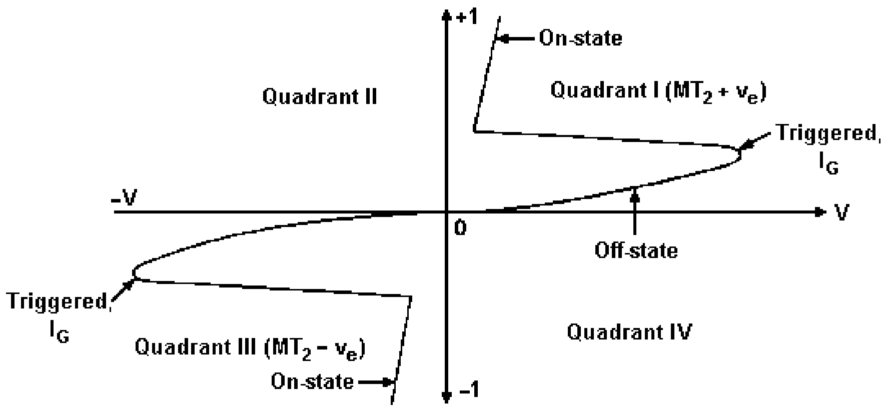
3. Define tunneling phenomenon?

The width of the depletion region of a reverse biased diode varies as the square root of impurity concentration. Hence with impurity concentration of 1 in 103, barrier width reduces to about 100A and there appears a non zero probability that an electron may puncture through the barrier. This is known as tunneling phenomenon.

CIRCUIT DIAGRAM FOR TRIAC:



MODEL GRAPH OF TRIAC:



(c) v-i characteristics

Ex.No: **CHARATERISTICS OF TRIAC**

Date:

AIM:

To obtain the forward and reverse characteristics of TRIAC.

APPERATUS REQUIRED:

Apparatus	Range	Type	Quantity
TRIAC			1
RPS	(0-30V)		2
Voltmeter	(0-30V)	MC	1
Ammeter	(0-100mA) (0-50mA)	MC MC	1 1
Resistor	1kΩ		2

THEORY:

A TRIAC is a bidirectional thyristor (it can conduct in both directions) with three terminals. It is used extensively for control of power in AC circuit. When in operation, a TRIAC is equivalent to two SCRs connected in anti-parallel. Its three terminals are usually designated as MT1, MT2 and gate. The V-I characteristics of a TRIAC is based on the terminal MT1 as the reference point. The first quadrant is the region wherein MT2 is positive w.r.t MT1 and vice-versa for the third quadrant. The peak voltage applied across the device in either direction must be less the break over voltage in order to retain control by the gate. A gate current of specified amplitude of either polarity will trigger the TRIAC into conduction in either quadrant, assuming that the device is in a blocking condition initially before the gate signal is applied.

TABULATION FOR TRIAC:

I_G = mA		I_G = mA		I_G = mA	
V_T(V)	I_A(mA)	V_T(V)	I_A(mA)	V_T(V)	I_A(mA)

MODEL CALCULTION:

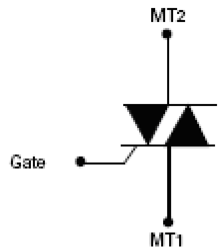


Fig.1. Schematic Symbol

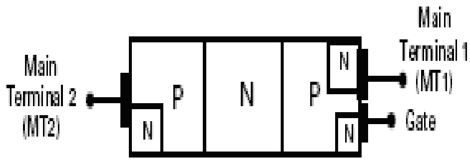


Fig.2. Block Construction

The characteristics of a TRIAC are similar to those of an SCR, both in blocking and conducting states, except for the fact that SCR conducts only in the forward direction, whereas the TRIAC conducts in both the directions

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. Keep in position minimum so Is and VA across MT1 and MT2 are zero.
3. Switch on the supply.
4. Allow low voltage between MT1 and MT2 increase VA so IA increases. Repeat it till the device turn ON.
5. Slowly increases gate to MT1 voltage set particular Ig = 7 mA
6. Keep Ig constant and increases VA in step by step when VA increases. IA increases slightly when break over is reached current increases sharply.

RESULT:

DISCUSSION QUESTIONS:

1. What are the applications of TRIAC?

- Phase control
- Heater control
- Motor speed control
- Light dimming control
- Static switch to turn ac power ON and OFF

2. What are the advantages of TRIAC?

- Triacs can be triggered with positive or negative polarity voltage
- Triac needs a single fuse for protection, which also simplifies the construction
- Triac needs a single heat sink of slightly larger size, where as antiparallel thyristor pair needs two heat sinks
- DC applications, SCR is required to be connected with a parallel diode to protect against reverse voltage, whereas a triac used work without diode, as safe breakdown in either direction is possible.

3. What is TRIAC?

TRIAC is a three terminal bidirectional semiconductor switching device. It can conduct in both the directions for any desired period. In operation it is equivalent to two SCR's connected in antiparallel . Next two SCR is widely used in power control.

4. Differences between SCR and TRIAC?

SCR	TRIAC
It is unidirectional	It is bidirectional
Triggered by narrow positive pulse applied at the gate terminal	Triggered by narrow pulse either positive or negative polarity applied at the gate terminal
SCR are available with a large current rating	Triacs are available for lower current rating as compared to that of SCRs

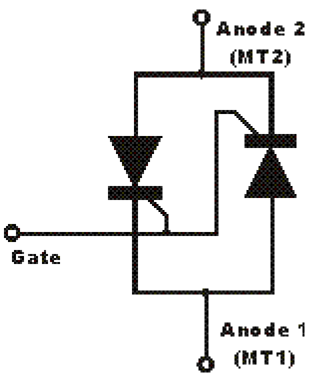
5. TRIAC is only used in AC circuits. Justify.

There are many applications, particularly in AC circuits, where bidirectional conduction is required. TRIAC is a bidirectional device; it can conduct in both directions. Hence TRIAC is used in AC circuits.

6. How does a TRIAC work?

When the voltage on the MT1 is positive with regard to MT2 and a positive gate voltage is applied, one of the thyristor conducts. When the voltage is reversed and a negative voltage is applied to the gate, the other thyristor conducts. This is provided that there is sufficient voltage across the device to enable a minimum holding current to flow.

7. Draw the equivalent circuit for TRIAC?



8. What are four modes of operation of TRIAC?

- MT2 is positive and Gate current is positive
- MT2 is positive and Gate current is negative
- MT2 is negative and Gate current is positive
- MT2 is negative and Gate current is negative

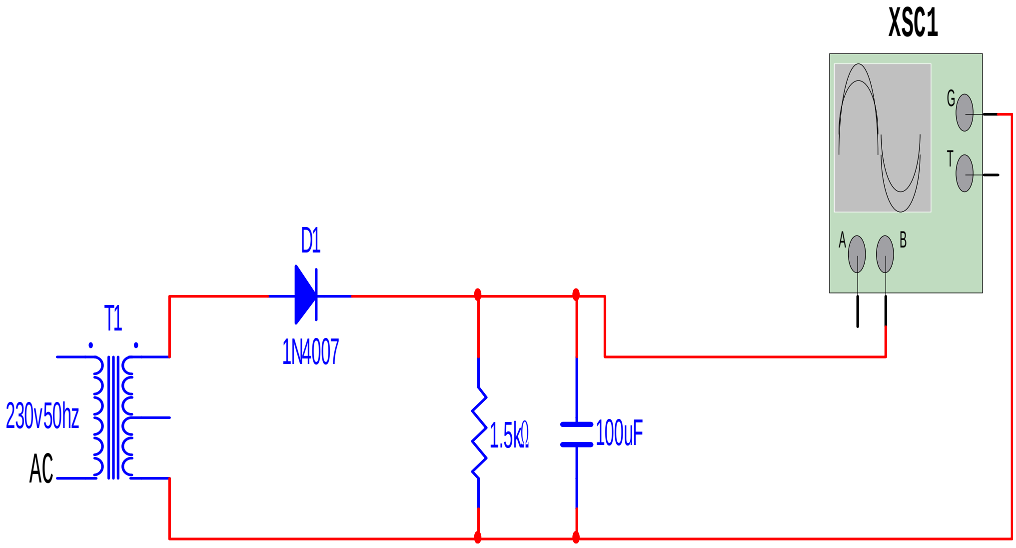
9. What is the method for overcoming the non symmetrical firing problem of TRIAC?

Due to their internal construction and slight differences between the two halves, TRIACs do not fire symmetrically. This results in harmonics being generated. In order to overcome the non-symmetrical firing problem, a DIAC (diode AC switch) is placed in series with the gate of the TRIAC.

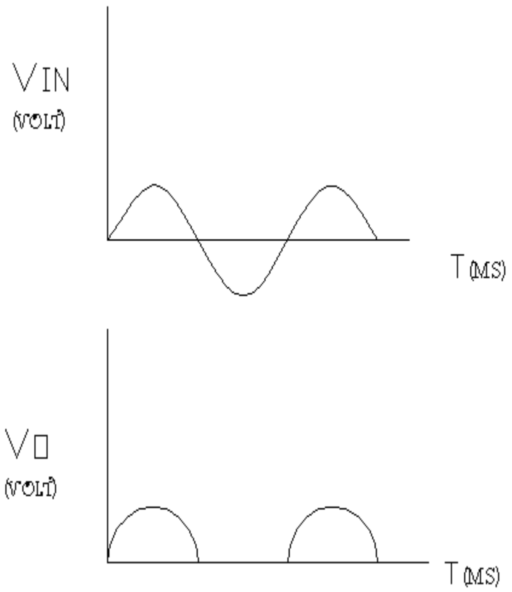
10. What are the disadvantages of TRIAC?

- TRIAC has low dv/dt rating compared to SCRs.
- SCRs are available in larger rating compared to TRIACs.
- Reliability of TRIACs is less than that of SCRs.

CIRCUIT DIAGRAM FOR HALF WAVE RECTIFIER:



MODEL GRAPH FOR INPUT & OUTPUT VOLTAGE:



Ex.No: **SINGLE PHASE HALF WAVE RECTIFIER**

Date:

AIM:

To construct half wave rectifier with and without filter and draw the waveforms.

APPARATUS REQUIRED:

Apparatus	Range	quantity
Step down transformer		1
Diode	IN 4007	1
Resistor	1.5kΩ	1
Capacitor	100μF	1
CRO		1
Bread board		1
Wires		few

FORMULA USED:

1. Ripple factor with filter $\gamma = 1/ 2\sqrt{3}\ FCR_L$
2. Ripple factor without filter $\gamma = \sqrt{V_{rms}^{2} - V_{ac}^{2}} / V_{dc}$

   $V_{rms} = V_m / 2$; $V_{dc} = V_m / \Pi$; $V_{ac} = 24V$

THEORY:

It converts an ac voltage into a pulsating dc voltage using one half of the applied ac voltage. The rectifying diode conducts during one half of the ac cycle only.

OPERATION:

During the positive half cycle of the input signal, the anode of the diode becomes positive with respect to cathode and hence diode D conducts. For an ideal diode, the forward voltage drop is zero. So the whole input voltage will appear across the load resistance R_L.

TABULATION FOR HALF WAVE RECTIFIER:

Type	Amplitude (v)	Time (t)
Input		
With filter		
Without filter		

MODEL CALCULATION:

During negative half cycle of the input signal, the anode of the diode becomes negative with respect to the cathode and hence, diode D does not conduct. For an ideal diode, the impedance offered by the diode is infinity.So the whole input voltage appears across the diode D. Hence, the voltage drop across R_L is zero.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. The transformer is tested for rated voltage at primary and secondary.
3. CRO connected across the load.
4. Note output waveforms with and without filters.
5. Calculate ripple factors compare with theoretical values.

RESULT:

DISCUSSION QUESTIONS:

1. What is rectifier?

A rectifier is a device which converts ac voltage to pulsating dc voltage using one or more PN junction diode.

2. Classification of rectifier?

- Half wave rectifier
- Full wave rectifier
- Bridge rectifier

3. Define half wave rectifier?

Half wave rectifier is a circuit that converts an AC input voltage into a unidirectional pulsating DC voltage. The diode conduct only during positive half cycle of AC supply. During negative half cycle of AC supply diode will not conduct.

4. What is meant by ripples?

The output of half wave rectifier is not pure DC but a pulsating DC. The output contains pulsating components called as ripples.

5. What do you mean by ripple factor?

Defined as the ratio of rms value of ripple voltage or current to the average value voltage or current.

γ = rms value of AC component / average value of DC component

6. Define rectification efficiency?

Defined as the ratio of the dc input power to the AC input power.

7. Define percentage regulation of a rectifier?

Defined as the variation of dc output power to the ac input power.

Percentage regulation = $V_{No\ load} - V_{load} / V_{load} * 100$

8. What is meant by transformer utilization factor?

Defined as the ratio of dc power delivered to the load (P_{dc}) to the ac rating of the transformer secondary P_{ac}

TUF = P_{dc} / P_{ac}

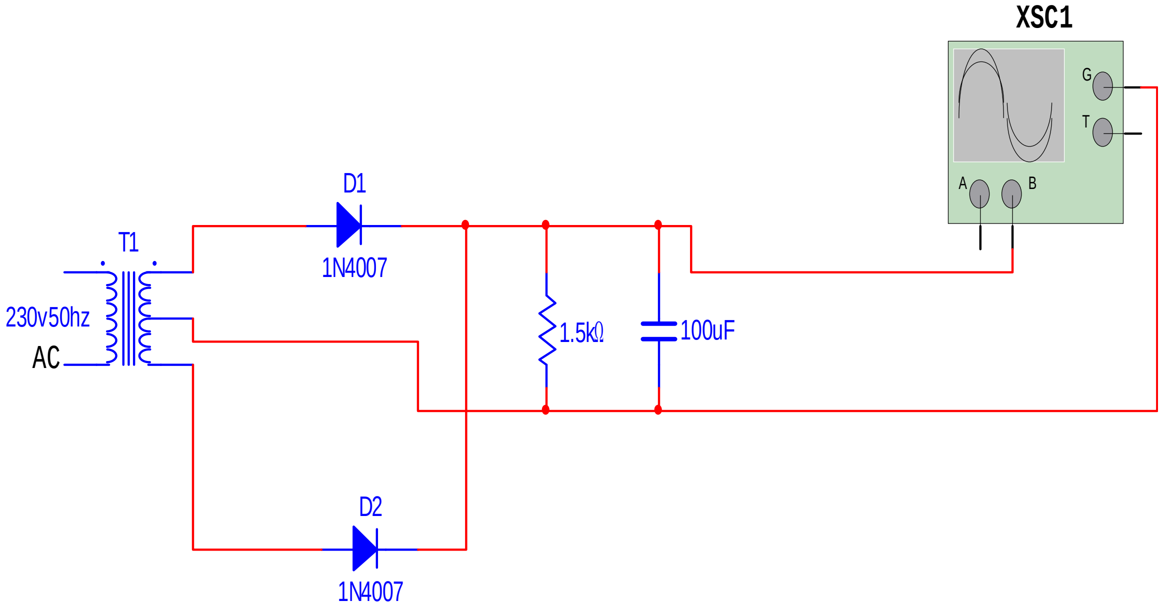
9. What is peak inverse voltage?

For each rectifier, there is a maximum voltage to which the diode is subjected. This potential is called the peak inverse voltage, because it occurs during the part of the cycle when the diode is non-conducting.

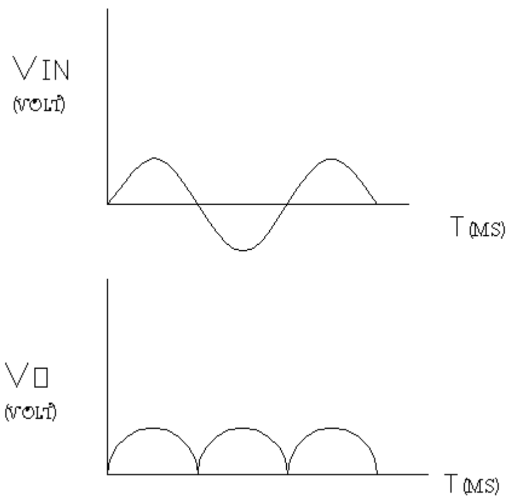
10. What is diode stacking?

Diodes who’s rated PIV is lower than that required by the circuit, more than one diode may be connected m series. The rated PIV of the stack is then equal to n times rated PIV of each one of the diode. This divides voltage equally between all the diodes. This is known as diode stack.

CIRCUIT DIAGRAM FOR FULL WAVE RECTIFIER:



MODEL GRAPH FOR INPUT & OUTPUT VOLTAGE:



Ex.No: **SINGLE PHASE FULL WAVE RECTIFIER**

Date:

AIM:

To construct full wave rectifier with and without filter and draw the waveforms.

APPARATUS REQUIRED:

Apparatus	Range	quantity
Centre tap transformer		1
Diode	IN 4007	2
Resistor	1.5kΩ	1
Capacitor	100μF	1
CRO		1
Bread board		1
Wires		few

FORMULA USED:

1. Ripple factor with filter $\gamma = f / 4\sqrt{3} FCR_L$
2. Ripple factor without filter $\gamma = \sqrt{V_{rms}{}^2 - V_{ac}{}^2} / V_{dc}$

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

THEORY:

It converts an ac voltage into a pulsating d.c voltage using both half cycle of the applied ac voltage. It uses two diodes of which one conducts during one half cycle while the other diode conducts during the other half cycle of the applied ac voltage.

OPERATION:

During positive half of the input signal, anode of diode D_1 becomes positive and at the same time the anode to the diode D_2 becomes negative. Hence, D_1 conducts and D_2 does not conduct. The load current flows through D_1 and the voltage drop across R_L will be equal to the input voltage.

TABULATION FOR FULL WAVE RECTIFIER:

Type	Amplitude (v)	Time (t)
Input With filter Without filter		

MODEL CALCULATION:

During the negative half cycle of the input, the anode of D_1 becomes negative and the anode of D_2 becomes positive. Hence, D1 does not conduct and D_2 conducts. The load current flows through D_2 and the voltage drop across R_L will be equal to the input voltage.

PROCEDURE:

1. Connections are made as per circuit diagram.
2. The transformer is tested for rated voltage of primary and secondary.
3. CRO connected across the load.
4. Note the output waveforms with and without filters.
5. Calculate the ripple factor and compare with theoretical values.

RESULT:

DISCUSSION QUESTIONS:

1. What is the PIV of a bridge wave rectifier?

PIV of a bridge wave rectifier is V_m.

2. What are the advantages of bridge rectifier over centre tapped rectifier?

- No centre tape is needed in transformer secondary.
- TUF is increased to 0.812
- PIV rating per diode in only Vm and is suited to high voltage application.

3. What is meant by full wave rectifier?

Full wave rectifier, current flows through the load in the same direction both half cycles of the input supply.

4. Classify full wave rectifier?

- Centre tap full wave rectifier
- Bridge type full wave rectifier

5. What principle is used in FWR?

A circuit which converts the alternating current into pulsating voltage or current during both half cycle of input

6. What is peak inverse voltage in FWR?

Defined as the maximum voltage at which the diode can with stand in reverse bias condition.

$$\mathbf{PIV = 2V_m}$$

7. What are the disadvantages of full wave rectifier?

- AC output is small
- Difficult to locate the centre tap on the secondary winding.
- Diodes must have high PIV.

8. What are the advantages of bridge rectifier?

- Output current flows for the entire cycle of the input power transformer of small size can be used that reduces the cost of the circuit
- No centre tap is required in the transformer secondary

- Current flow in the secondary of the transformer is in opposite direction in two half cycles. Hence dc component flowing is zero which reduces the losses.
- Pure alternating current in secondary of transformer, the transformer gets utilized effectively and hence the circuit is suitable for large power application.

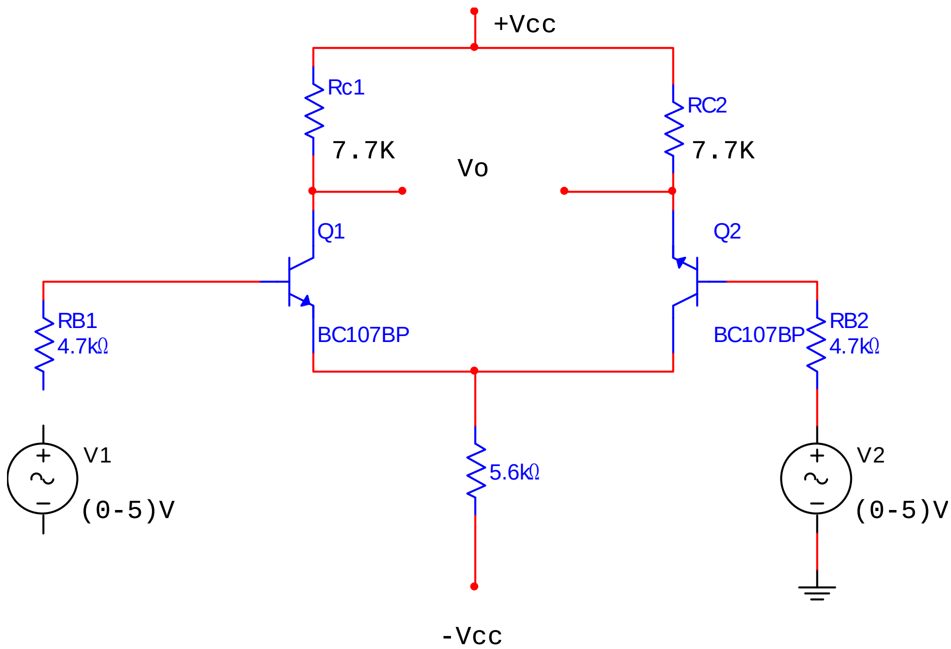
9. What are the disadvantages of bridge rectifier?

It uses four diodes. This causes additional voltage drop as indicated by $2R_f$. This reduces the output voltage.

10. What is bridge rectifier?

The bridge rectifier circuit is a full wave rectifier circuit, using four diodes, forming the four arms of an electrical bridge. The ac voltage is applied to one diagonal of the bridge through a transformer and the rectified dc voltage is taken from the diagonal of the bridge.

CIRCUIT DIAGRAM FOR DIFFERENTIAL AMPLIFIER:



TABULATION FOR COMMON MODE:

V_1(v)	V_2(v)	V_0(v)	$Ac=2V_0/V_1+V_2$

Ex.No: **CHARACTERISTICS OF DIFFERENTIAL AMPLIFIER**

Date:

AIM:

To construct a differential amplifier using BJT and to measure CMRR.

APPARATUS REQUIRED:

Apparatus	Range	quantity
RPS	(0-30)V	2
Transistor	BC107	2
Resistor	7.7KΩ, 4.7KΩ	2
	5.6KΩ	1
Multimeter		1
Bread board		1
Wires		few

DESIGN:

$I_E = (V_{EE} – V_{BE}) / 2R_E$

$V_{EE} = 12V$ $V_{CE} = 5V$ $V_{BE} = O.7\ V$

$I_C = I_{CE}$

TO FIND R_E:

$I_E = (V_{EE} – V_{BE}) / 2R_E$

$R_E = 5.6K\Omega$

TO FIND R_C:

$V_{CE} = V_{CC} + V_{BE} – I_C R_C$

$R_C = 7.7K\Omega$

FORMULA:

$A_c = 2V_0 /V_1+V_2$

$A_d = V_0 / V_1+V_2$

$CMRR = |A_d /A_c|$

TABULATION FOR DIFFERENCE MODE:

V1(v)	V2(v)	V0(v)	Ac=2V0/V1+V2

MODEL CALCULATION:

THEORY:

The differential amplifier uses two transistors in common emitter configuration. If output is taken between the two collectors is called balanced output or double ended called unbalanced output or signal ended output. If the signal is given to both input terminal is called dual input. while if the signal is given to one input terminal is called single ended terminal and it is given to both input terminals and other terminal is grounded.

PROCEDURE:

1. Connections are made as per the circuit diagram.
2. The multimeter is connected to collector of both transistor and voltage is noted.
3. Calculate the difference mode gain (Ad) and common mode gain (Ac) using formula
4. Determine the gain ratio.

RESULT:

DISCUSSION QUESTIONS:

1.What is a differential amplifier?

An amplifier that has two inputs and produces on output signal that is a function of the difference between the two given output.

2. What are the applications of difference amplifier?

- Medical electronic field
- Input stage in the measuring instruments
- Analog computation
- Linear integrated circuit

3. What are the advantages of differential amplifier?

- It uses no frequency dependent coupling or bypassing capacitors.
- It can compare any tow signals and detect the difference.
- It gives higher gain than two cascaded stages of ordinary direct coupling.

4. What is operational amplifier?

An op amp to perform mathematical operation like summation, multiplication, differentiation and integration etc. in analog computers. It is very high directly couple negative fee back amplifier, which can amplify signals having frequency ranging from 0Hz to 1 MHz.

5. What are the specifications for an ideal operational amplifier?

Open loop gain = ∞, Input impedance = ∞

Out put impedance = 0, Band width = ∞, CMRR = ∞

6. What is common mode voltage swing?

The common mode voltage swing is defined as the maximum peak input voltage which may be applied to either input terminal without causing abnormal operation or damage.

7. Define slew rate?

It measure of an operational amplifier's switching speed defined as the maximum time rate of change of the output voltage when subjected to a square wave input signal when the closed loop gain is unity. Unit is V/msec.

8. Define input off set voltage?

The algebraic difference between the currents into the (-) input and (+) input is referred to as input offset current.

9. Is the practical op-amp on ideal op-amp?

A practical op-amp is not ideal and has finite value of input offset voltage input offset current and input bias current. These produce a dc offset voltage at the output.

10. Can op-amp be used to amplify AC as well as DC output?

Op amp can be used to amplify AC and DC for amplifying AC .we use a capacitance coupled amplifier.

Ex.No. **FREQUENCY RESPONSE OF SERIES RESONANCE CIRCUIT**
Date:

AIM:

To obtain the resonance frequency of the given RLC series electrical network.

APPARATUS REQUIRED

S.NO	COMPONENTS	RANGE	QUANTITY
1	Function generator	0-2MHz	1
2	Resistor	1kohm	1
3	Voltmeter	(0-5)v	1
4	Capacitor	1microfarad	1
5	Bread board		1
6	Connecting wires		1
7	Decade inductance box	(0-100)mH	few

Formula used :

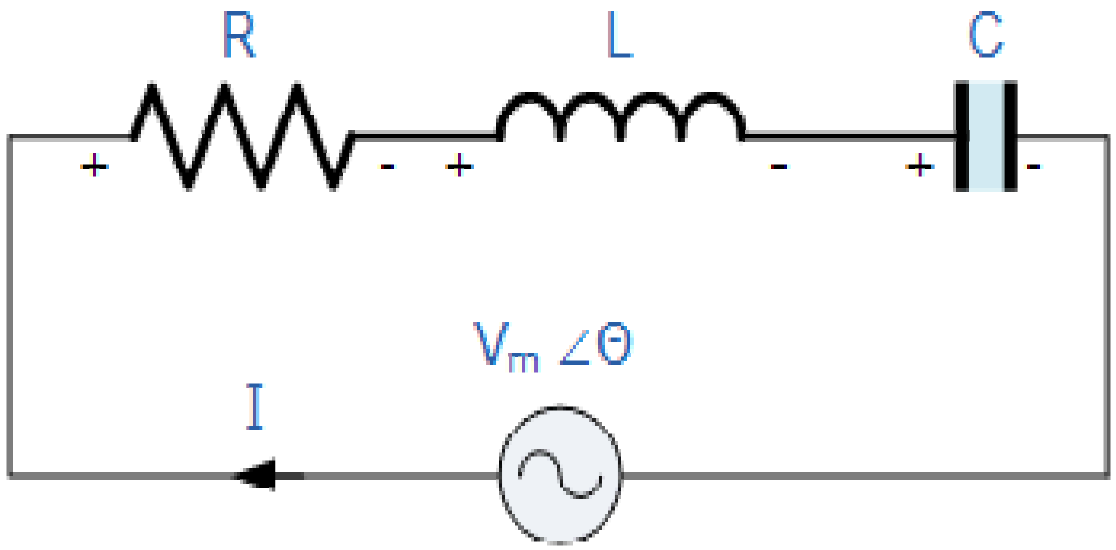
Series resonance frequency F = $1/2\pi\sqrt{lc}$

PROCEDURE:

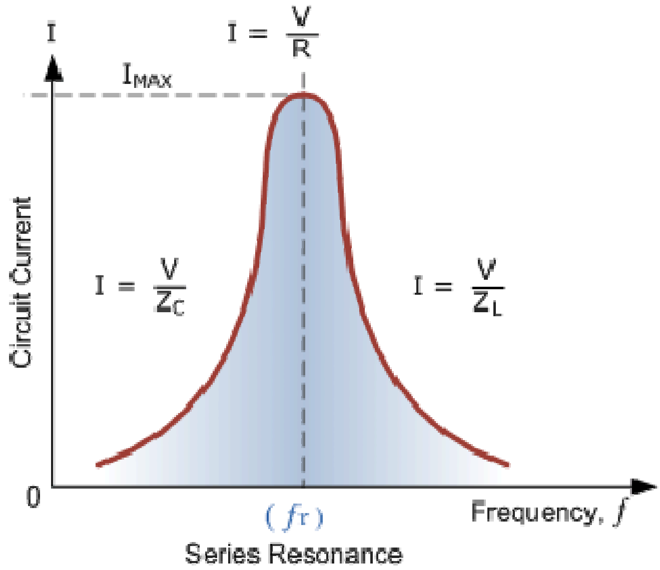
- Connections are made as per the circuit diagram
- Vary the frequency of the function generator from 50 Hz to 20 Hz
- Measure the corresponding value of voltage across the resistor R for series RLC circuit.
- Repeat the same procedure for different value of frequency.
- Tabulate your observation
- Note down the resonance frequency from the graph

RESULT:

CIRCUIT DIAGRAM :



MODEL GRAPH:

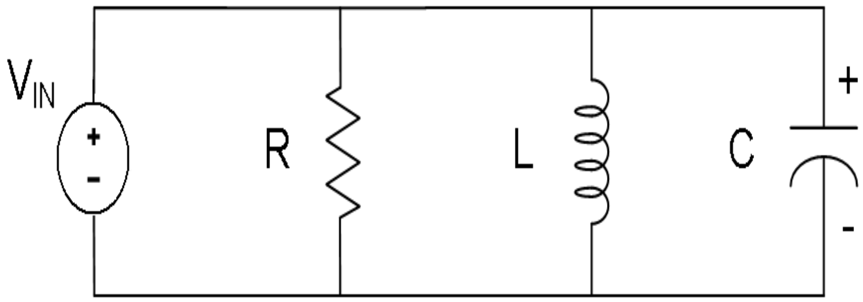


TABULATION:

Frequency(Hz)	Voltage(volt)

MODEL CALCULATION:

CIRCUIT DIAGRAM



MODEL GRAPH:

TABULATION:

Frequency(Hz)	Voltage(volt)

Ex.No. **FREQUENCY RESPONSE OF PARALLEL RESONANCE CIRCUIT**
Date:

AIM:
To obtain the resonance frequency of the given RLC parallel electrical network.

APPARATUS REQUIRED

S.NO	COMPONENTS	RANGE	QUANTITY
1	Function generator	0-3MHz	1
2	Resistor	1kohm	1
3	Voltmeter	(0-5)v	1
4	Capacitor	1microfarad	1
5	Bread board		1
6	Connecting wires		1
7	Decade inductance box	(0-100)mH	few

Formula used :
Series resonance frequency F = 1/2л $\sqrt{lc}$

PROCEDURE:
- Connections are made as per the circuit diagram
- Vary the frequency of the function generator from 50 Hz to 20 Hz
- Measure the corresponding value of voltage across the resistor R for series RLC circuit.
- Repeat the same procedure for different value of frequency.
- Tabulate your observation
- Note down the resonance frequency from the graph

RESULT: