LABORATORY MANUAL

PROGRAMME: B.Tech

SEMESTER /YEAR : II / I

SUBJECT CODE: BM0110

SUBJECT NAME: DEVICES LAB

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DEPARTMENT OF BIOMEDICAL ENGINEERING

SCHOOL OF BIOENGINEERING,
FACULTY OF ENGINEERING & TECHNOLOGY

SRM UNIVERSITY

(UNDER SECTION 3 of UGC ACT 1956)
KATTANKULATHUR-603203
Tamil Nadu, India

LIST OF EXPERIMENTS

BM0110 DEVICES LABORATORY

S. No.	Experiment Name
1.	Characteristics of PN Junction diode
2	Characteristics of Zener diode
3	Characteristics of BJT in CE configuration.
4	Characteristics of BJT in CB configuration.
5	Characteristics of BJT in CC configuration
6	Characteristics of Field effect transistor.
7	Characteristics of Uni-junction transistor.
8	Characteristics of Silicon controlled rectifier
9	Characteristics of DIAC
10	Characteristics of TRIAC
11	Characteristics of LDR, Photodiode
12	Study of CRO.

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Ex.No.1

Date:

CHARACTERISTICS OF PN JUNCTION DIODE

AIM:

To study the PN junction diode characteristics under Forward & Reverse bias conditions.

APPARATUS REQUIRED

S.No.	Name	Range	Type	Qty
1	R.P.S	(0-30)V		1
2	Ammeter	(0–100)µA		1
3	Voltmeter	(0–1)V		1

COMPONENTS REQUIRED

S.No.	Name	Range	Type	Qty
1	Diode	IN4001		1
2	Resistor	1kΩ		1
4	Wires			

THEORY:

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

FORWARD BIAS:

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

REVERSE BIAS:

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

PROCEDURE:

FORWARD BIAS:

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

OBSERVATIONS

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

REVERSE BIAS:

1. Connect the circuit as per the diagram.
2. Vary the applied voltage V_r in steps of 0.5V.
3. Note down the corresponding Ammeter readings I_r.
4. Plot a graph between V_r & I_r
5. Find the dynamic resistance **r = δV / δI.**

FORMULA FOR REVERSE SATURATION CURRENT (I_O):

$I_o = \partial I/[\exp(\partial V/\eta V_T)]-1=$

Where V_T is the voltage equivalent of Temperature = kT/q

k is Boltzmann's constant, q is the charge of the electron and T is the temperature in degrees Kelvin.

η =1 for Silicon and 2 for Germanium

Specification for 1N4001: Silicon Diode

Peak Inverse Voltage: 50V

Maximum forward voltage drop at 1 Amp is 1.1 volts

Maximum reverse current at 50 volts is 5μA

RESULT:

Forward and Reverse bias characteristics of the PN junction diode was Studied and the dynamic resistance under

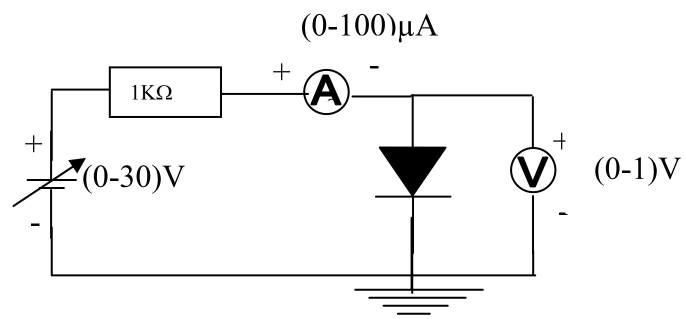
Forward bias = ---------------------

Reverse bias = ----------------------.

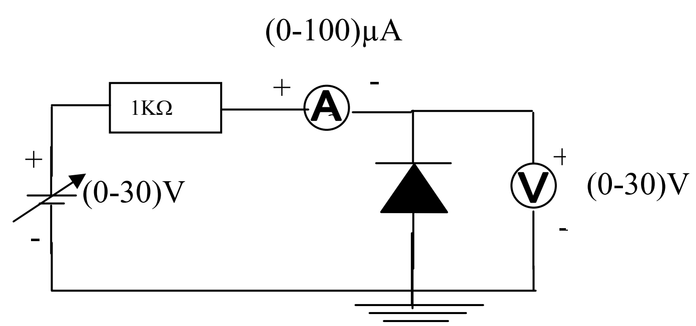
Reverse Saturation Current = ----------------.

CIRCUIT DIAGRAM:

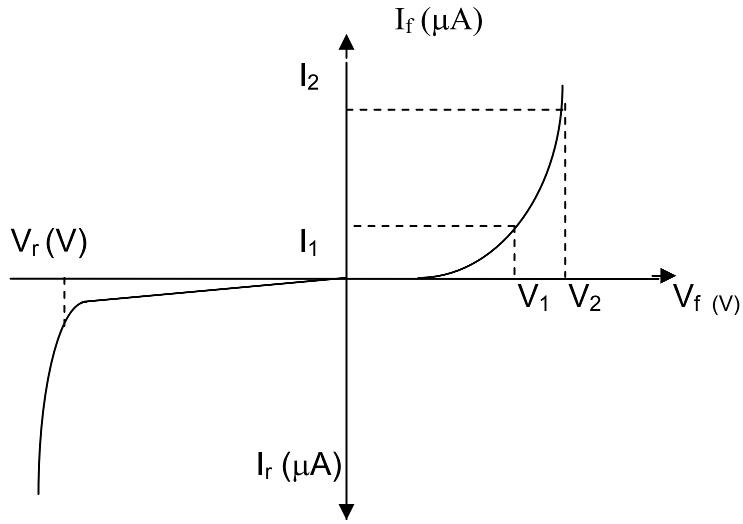
FORWARD BIAS:



REVERSE BIAS:



MODEL GRAPH



TABULAR COLUMN:

FORWARD BIAS:

S.No.	VOLTAGE(V_f) (In Volts)	CURRENT(I_f) (In μA)

REVERSE BIAS:

S..No.	VOLTAGE(V_r) (In Volts)	CURRENT(I_r) (In μA)

Ex.No.2

Date:

CHARACTERISTICS OF ZENER DIODE

AIM:

To study the characteristics and to determine the breakdown voltage of a zener diode.

APPARATUS REQUIRED

S.No.	Name	Range	Qty
1	R.P.S	(0-30)V	1
2	Ammeter	(0–100)µA	1
3	Voltmeter	(0–30)V	1
		(0–1V	1

COMPONENTS REQUIRED

S.No	Name	Range	Qty
1	zener diode	$I_2$7.5 V	1
2	Resistor	1KΩ	1
3	Breadboard		1
4	Wires		

THEORY:

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

FORWARD BIAS:

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

REVERSE BIAS:

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

ZENER EFFECT:

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

PROCEDURE:

FORWARD BIAS:

1. Connect the circuit as per the circuit diagram.
2. Vary the power supply in such a way that the readings are taken in steps of 0.1V.
3. Note down the corresponding ammeter readings.
4. Plot the graph : V_f (vs) I_f.
5. Find the dynamic resistance **r = δV / δI.**

REVERSE BIAS:

1. Connect the circuit as per the diagram.
2. Vary the power supply in such a way that the readings are taken in steps of 0.5V.
3. Note down the corresponding Ammeter readings I_r.
4. Plot a graph between V_r & I_r
5. Find the dynamic resistance **r = δV / δI.**

RESULT:

Forward and Reverse bias characteristics of the zener diode was studied and the values of the various parameters were found to be:

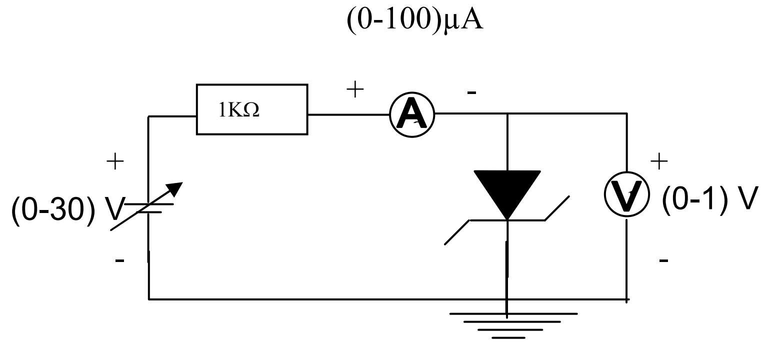
Forward bias dynamic resistance = ---------------------

Reverse bias dynamic resistance = ----------------------

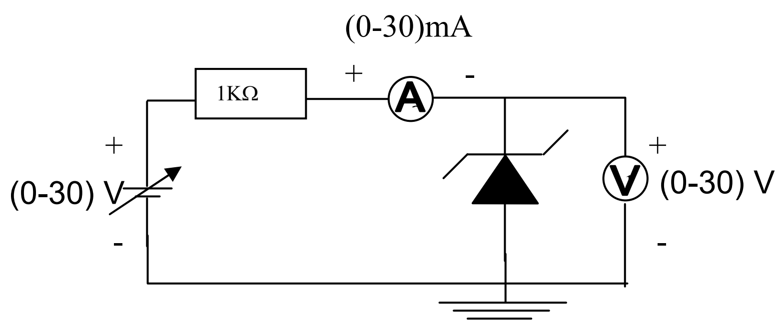
The reverse Breakdown voltage = ----------------------

CIRCUIT DIAGRAM:

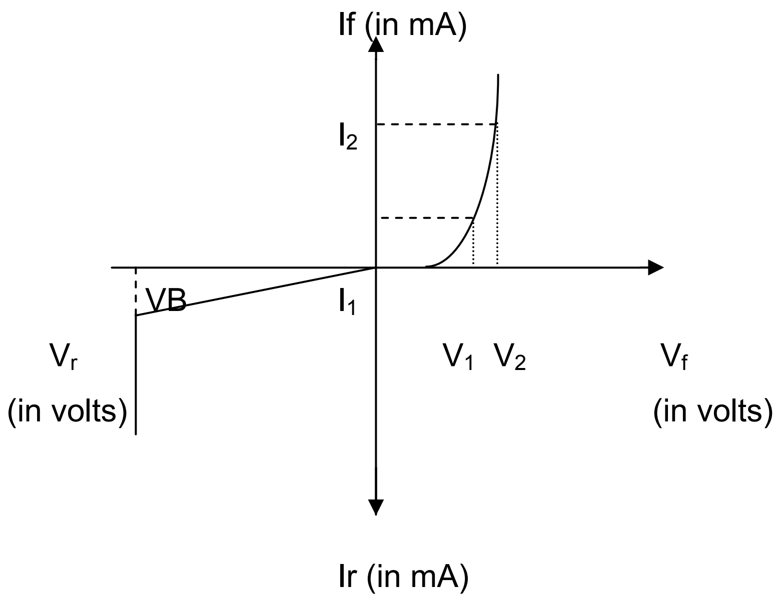
FORWARD BIAS:



REVERSE BIAS:



ZENER DIODE:



TABULAR COLUMN:

FORWARD BIAS:

S.No	VOLTAGE(V_f) (V)	CURRENT (If) (mA)

REVERSE BIAS:

S.No.	VOLTAGE (V_r) (V)	CURRENT(I_r) (mA)

Ex.No.3

Date:

CHARACTERISTICS OF BJT IN CE CONFIGURATION

AIM:

To study and plot the transistor characteristics in CE configuration.

APPARATUS REQUIRED:

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

COMPONENTS REQUIRED:

S.No.	Name	Range	Type	Qty
1	Transistor	BC 147		1
2	Resistor	10kΩ 1KΩ		1
3	Bread Board			1
4	Wires			

THEORY:

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

In transistor, the current is same in both junctions, which indicates that there is a transfer of resistance between the two junctions. Hence known as transfer resistance of transistor.

PROCEDURE:

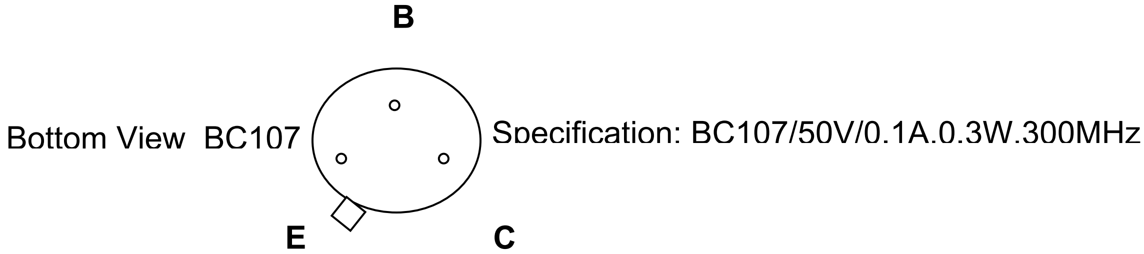
INPUT CHARECTERISTICS:

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

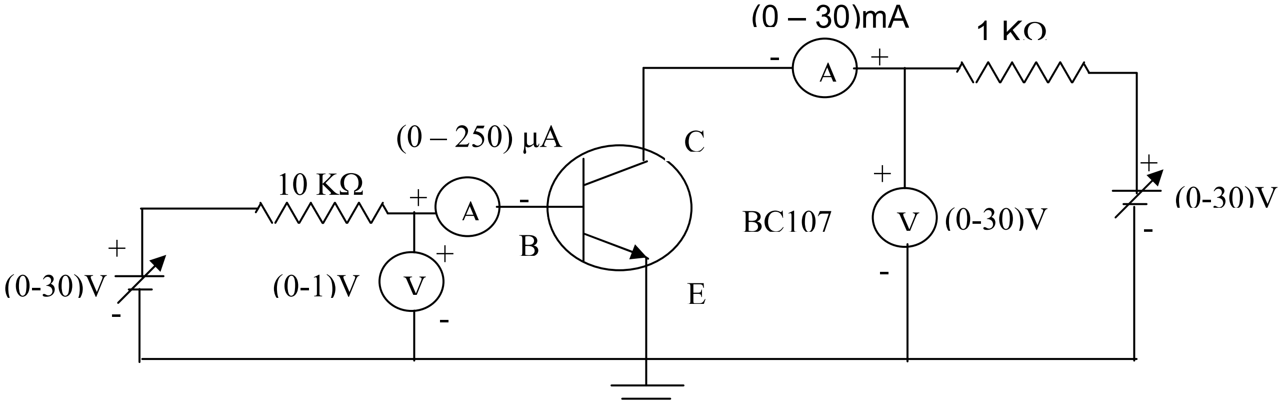
OUTPUT CHARACTERISTICS:

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

PIN DIAGRAM:

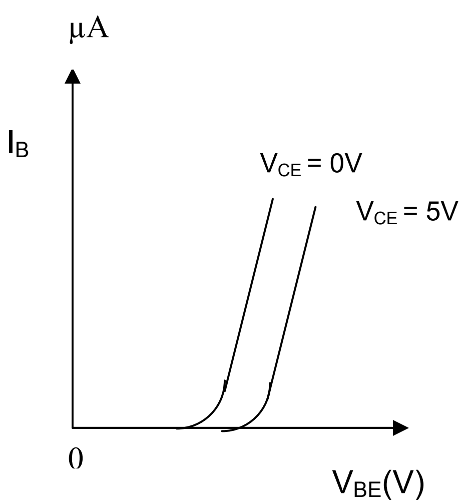


CIRCUIT DIAGRAM:

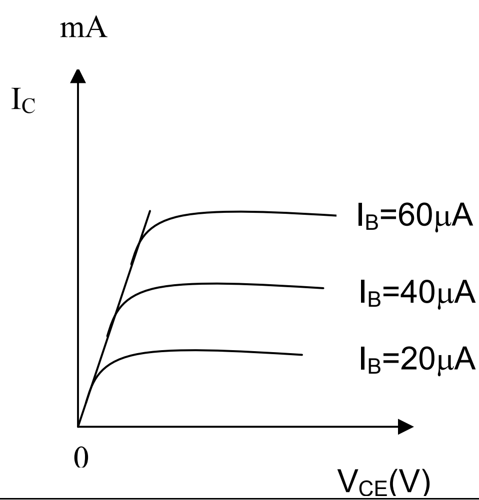


MODEL GRAPH:

INPUT CHARACTERISTICS:



OUTPUT CHARACTERISTICS:



TABULAR COLUMN:

INPUT CHARACTERISTICS:

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

OUTPUT CHARACTERISTICS:

I_B=20μA		I_B=40μA	
V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)

RESULT:

The transistor characteristics of a Common Emitter (CE) configuration were plotted

Ex.No:4

Date:

CHARACTERISTICS OF BJT IN CB CONFIGURATION

AIM:

To study and plot the transistor characteristics in CB configuration.

APPARATUS REQUIRED:

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

COMPONENTS REQUIRED:

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

THEORY:

In this configuration the base is made common to both the input and out. The emitter is given the input and the output is taken across the collector. The current gain of this configuration is less than unity. The voltage gain of CB configuration is high. Due to the high voltage gain, the power gain is also high. In CB configuration, Base is common to both input and output. In CB configuration the input characteristics relate I_E and V_{EB} for a constant V_{CB}. Initially let $V_{CB} = 0$ then the input junction is equivalent to a forward biased diode and the characteristics resembles that of a diode. Where $V_{CB} = +V_I$ (volts) due to early effect I_E increases and so the characteristics shifts to the left. The output characteristics relate I_C and V_{CB} for a constant I_E. Initially I_C increases and then it levels for a value $I_C = \alpha I_E$. When I_E is increased I_C also increases proportionality. Though increase in V_{CB} causes an increase in α, since α is a fraction, it is negligible and so I_C remains a constant for all values of V_{CB} once it levels off.

PROCEDURE:

INPUT CHARACTERISTICS:

It is the curve between emitter current I_E and emitter-base voltage V_{BE} at constant collector-base voltage $V_{CB.}$

1. Connect the circuit as per the circuit diagram.
2. Set V_{CE}=5V, vary V_{BE} in steps of 0.1V and note down the corresponding I_B. Repeat the above procedure for 10V, 15V.
3. Plot the graph V_{BE} Vs I_B for a constant V_{CE}.
4. Find the h parameters.

OUTPUT CHARACTERISTICS:

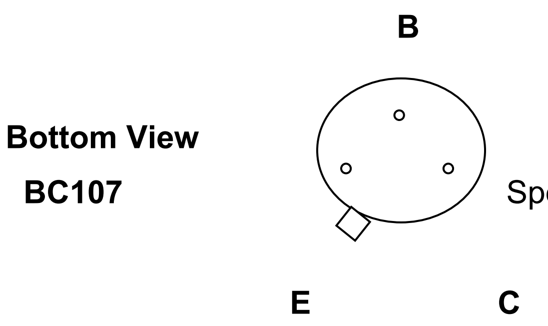
It is the curve between collector current I_C and collector-base voltage V_{CB} at constant emitter current $I_{E.}$

1. Connect the circuit as per the circuit diagram.
2. Set I_B=20μA, vary V_{CE} in steps of 1V and note down the corresponding I_C. Repeat the above procedure for 40μA, 80μA, etc.
3. Plot the graph V_{CE} Vs I_C for a constant I_B.
4. Find the h parameters

RESULT:

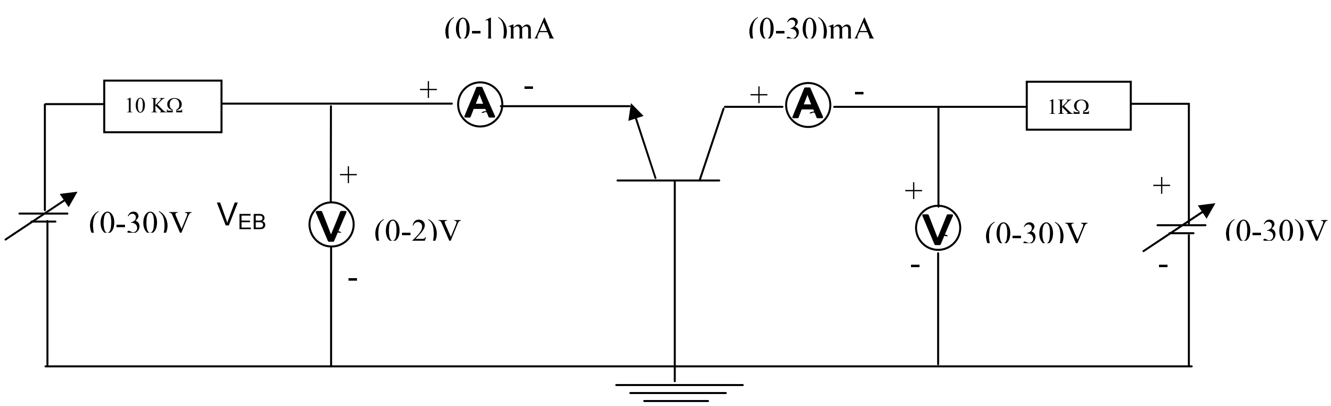
The transistor characteristics of a Common Base (CB) configuration were plotted and studied.

PIN DIAGRAM:



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

CIRCUIT DIAGRAM:



TABULAR COLUMN:

INPUT CHARACTERISTICS:

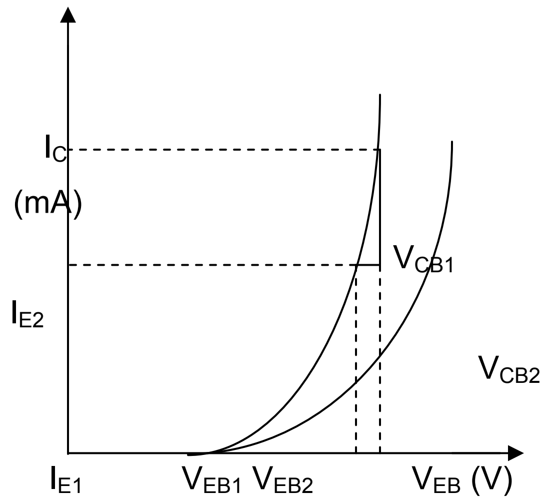
S.No.	V_{CB} = V		V_{CB} = V		V_{CB} = V	
	V_{EB} (V)	I_E (μA)	V_{EB} (V)	I_E (μA)	V_{EB} (V)	I_E (μA)

OUTPUT CHARACTERISTICS:

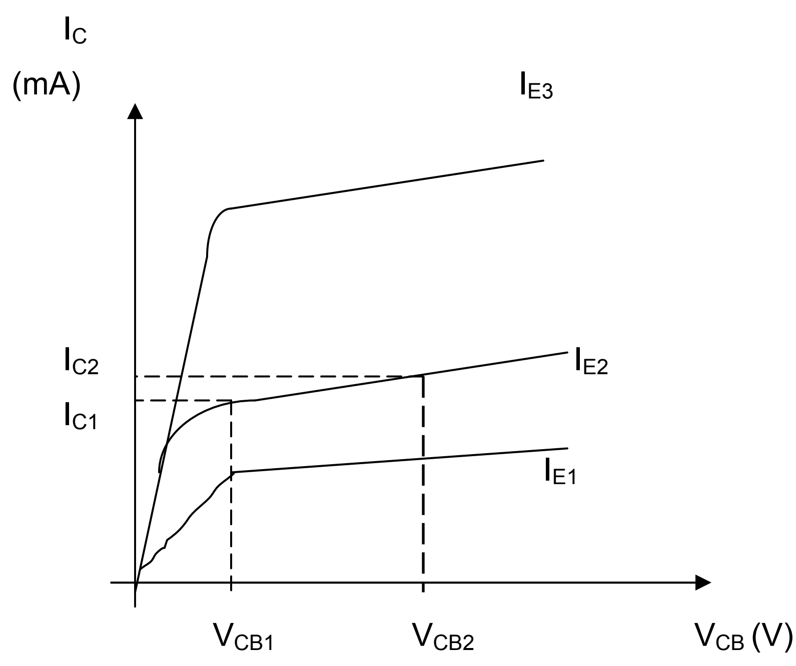
S.No.	I_E= mA		I_E= mA		I_E= mA	
	V_{CB} (V)	Ic (mA)	V_{CB} (V)	Ic (mA)	V_{CB} (V)	Ic (mA)

MODEL GRAPH:

INPUT CHARACTERISTICS:



OUTPUT CHARACTERISTICS:



Ex.No:5

Date:

CHARACTERISTICS OF BJT IN CC CONFIGURATION

AIM:

To plot and study the transistor characteristics in CC configuration.

APPARATUS REQUIRED:

S.No.	Name	Range	Type	Qty
1	R.P.S	(0-30)V		2
2	Ammeter	(0–30)mA		1
		(0–250)µA		1
3	Voltmeter	(0–30)V		1
		(0–5)V		1

COMPONENTS REQUIRED:

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

THEORY:

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

In transistor, the current is same in both junctions, which indicates that there is a transfer of resistance between the two junctions. One to this fact the transistor is known as transfer resistance of transistor.

PROCEDURE:

INPUT CHARECTERISTICS:

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

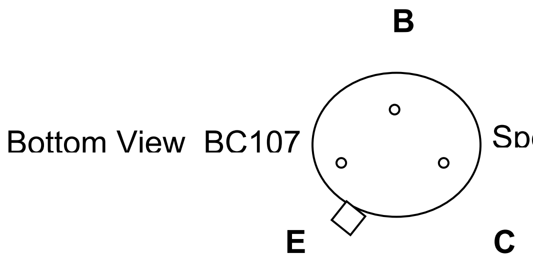
OUTPUT CHARECTERISTICS:

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

RESULT:

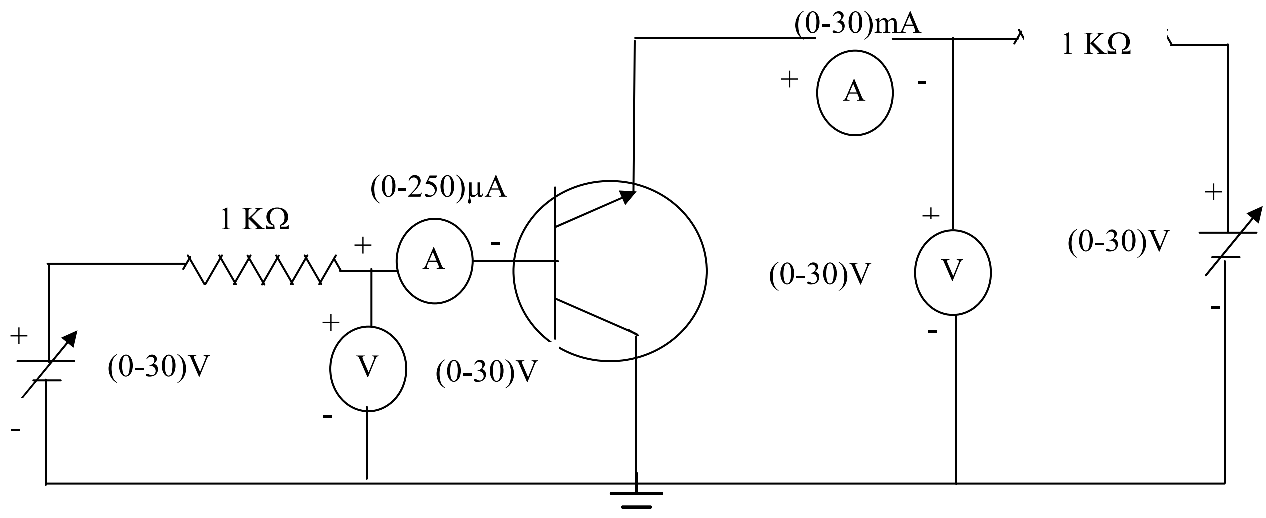
The transistor characteristics of a Common Emitter (CC) configuration were plotted.

PIN DIAGRAM:



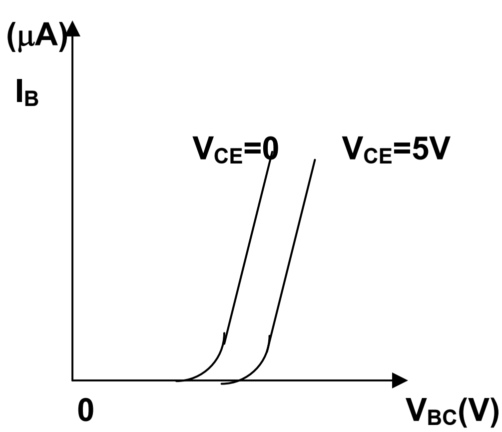
Specification: BC107/50V/0.1A.0.3W.300MHz

CIRCUIT DIAGRAM:

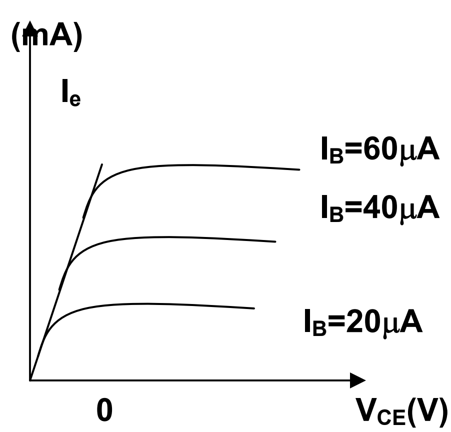


MODEL GRAPH:

INPUT CHARACTERISTICS:



OUTPUT CHARACTERISTICS:



TABULAR COLUMN:

INPUT CHARACTERISTICS:

V_{CE}=1V		V_{CE}=2V	
V_{BC}(V)	I_B(μA)	V_{BC}(V)	I_B(μA)

OUTPUT CHARACTERISTICS:

I_B=20μA		I_B=40μA	
V_{CE}(V)	I_E(mA)	V_{CE}(V)	I_E(mA)

Ex.No:6

Date:

CHARACTERISTICS OF JUNCTION FIELD EFFECT TRANSISTOR

AIM:

To Plot the characteristics of FET & determine r_d, g_m, μ, I_{DSS}, V_P.

APPARATUS REQUIRED:

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

COMPONENTS REQUIRED:

S.No.	Name	Range	Type	Qty
1	FET	BFW10		1
2	Resistor	1kΩ 68KΩ		1 1
3	Bread Board			1
4	Wires			

THEORY:

FET is a voltage operated device. It has got 3 terminals. They are Source, Drain & Gate. When the gate is biased negative with respect to the source, the pn junctions are reverse biased & depletion regions are formed. The channel is more lightly doped than the p type gate, so the depletion regions penetrate deeply in to the channel. The result is that the channel is narrowed, its resistance is increased, & I_D is reduced. When the negative bias voltage is further increased, the depletion regions meet at the center & I_D is cutoff completely.

PROCEDURE:

DRAIN CHARACTERISTICS:

1. Connect the circuit as per the circuit diagram.
2. Set the gate voltage V_{GS} = 0V.
3. Vary V_{DS} in steps of 1 V & note down the corresponding I_D.

4. Repeat the same procedure for V_{GS} = -1V.
5. Plot the graph V_{DS} Vs I_D for constant V_{GS}.

OBSERVATIONS

1. d.c (static) drain resistance, $r_D = V_{DS}/I_D$.
2. a.c (dynamic) drain resistance, $r_d = \Delta \mathbf{V_{DS}}/\Delta \mathbf{I_D}$.
3. Open source impedance, $Y_{OS} = 1/ r_d$.

TRANSFER CHARACTERISTICS:

1. Connect the circuit as per the circuit diagram.
2. Set the drain voltage V_{DS} = 5 V.
3. Vary the gate voltage V_{GS} in steps of 1V & note down the corresponding I_D.
4. Repeat the same procedure for V_{DS} = 10V.

Plot the graph V_{GS} Vs I_D for constant V_{DS}.

FET PARAMETER CALCULATION:

Drain Resistancd rd = $\left.\frac{\Delta V_{DS}}{\Delta I_D}\right| V_{GS}$

Transconductance g_m = $\left.\frac{\Delta I_D}{\Delta V_{GS}}\right| V_{DS}$

Amplification factor μ=rd . gm

RESULT:

Thus the Drain & Transfer characteristics of given FET is Plotted.

R_d =

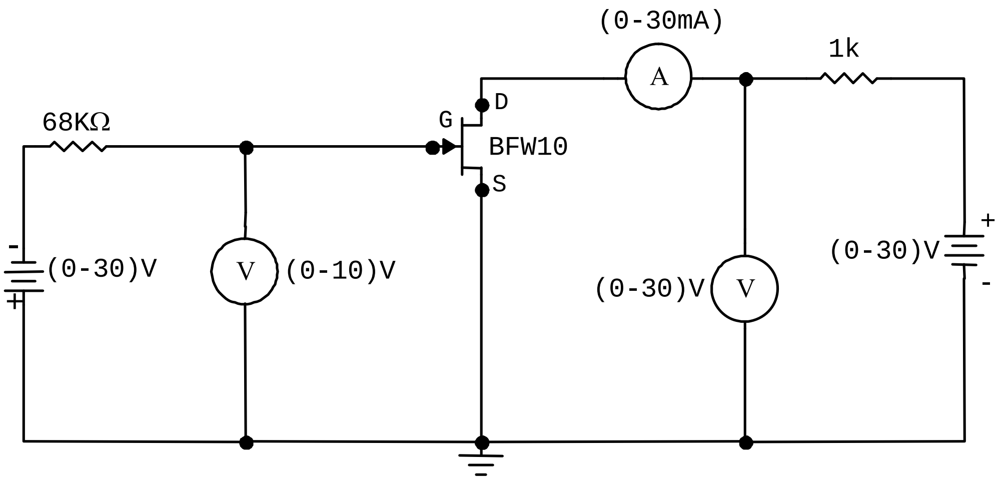
g_m =

μ =

I_{DSS} =

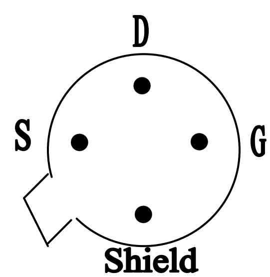
Pinch off voltage V_P =

CIRCUIT DIAGRAM:



PIN DIAGRAM:

BOTTOM VIEW OF BFW10:

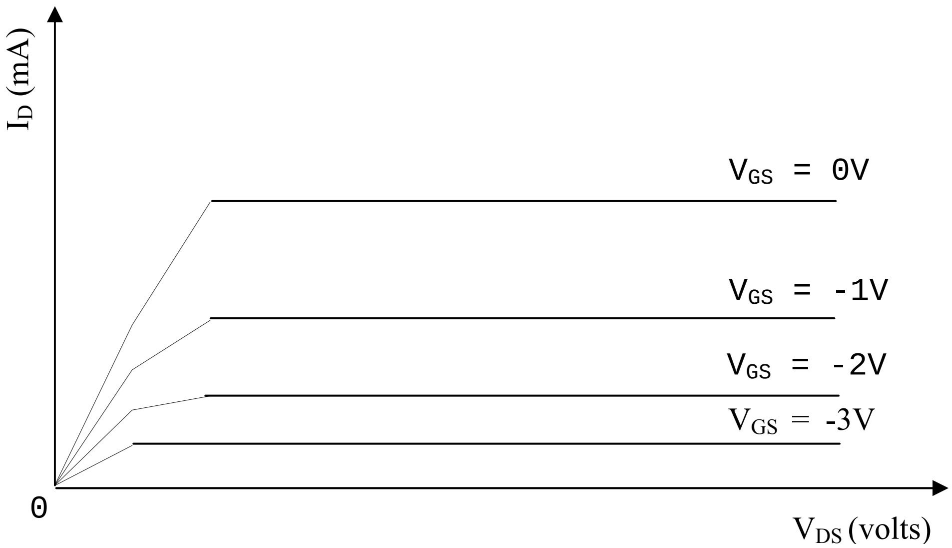


SPECIFICATION:

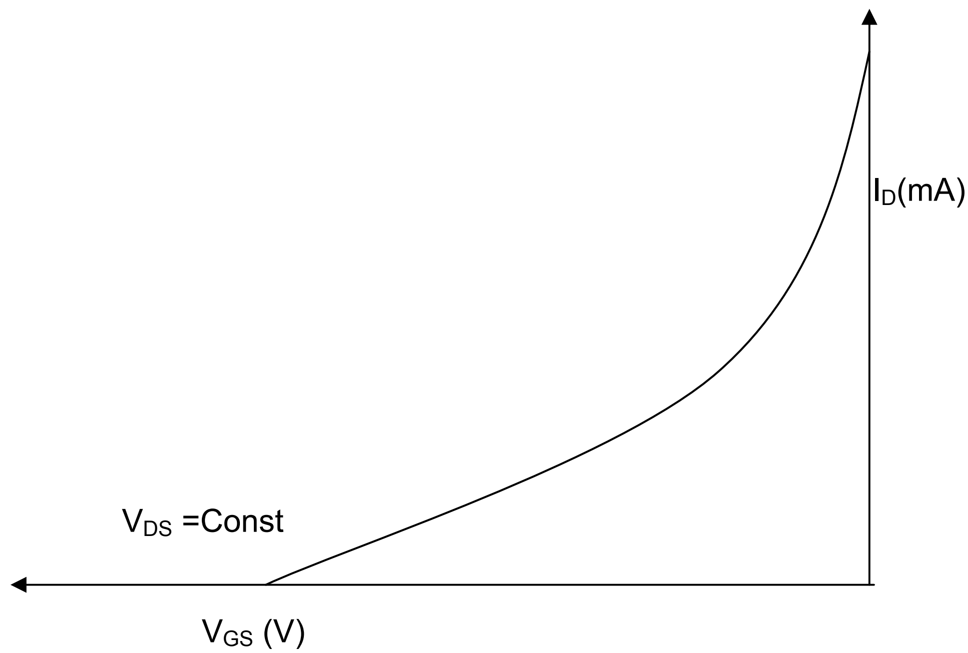
Voltage : 30V, I_{DSS} > 8mA.

MODEL GRAPH:

DRAIN CHARACTERISTICS:



TRANSFER CHARACTERISTICS:



TABULAR COLUMN:

DRAIN CHARACTERISTICS:

V_{GS} = 0V		V_{GS} = -1V	
V_{DS} (V)	I_D(mA)	V_{DS} (V)	I_D(mA)

TRANSFER CHARACTERISTICS:

V_{DS} =5volts		V_{DS} = 10volts	
V_{GS} (V)	I_D(mA)	V_{GS} (V)	I_D(mA)

Ex.No:7

Date:

CHARACTERISTICS OF UNIJUNCTION TRANSISTOR

AIM:

To Plot and study the characteristics of UJT & determine it's intrinsic standoff Ratio.

APPARATUS REQUIRED:

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

COMPONENTS REQUIRED:

S. No.	Name	Range	Type	Qty
1	UJT	2N2646		1
2	Resistor	1KΩ		2
3	Bread Board			1

THEORY:

UJT(Double base diode) consists of a bar of lightly doped n-type silicon with a small piece of heavily doped P type material joined to one side. It has got three terminals. They are Emitter(E), Base1(B1),Base2(B2).Since the silicon bar is lightly doped, it has a high resistance & can be represented as two resistors, r_{B1} & r_{B2}. When $V_{B1B2} = 0$, a small increase in V_E forward biases the emitter junction. The resultant plot of V_E & I_E is simply the characteristics of forward biased diode with resistance. Increasing V_{EB1} reduces the emitter junction reverse bias. When $V_{EB1} = Vr_{B1}$ there is no forward or reverse bias. & $I_E = 0$. Increasing V_{EB1} beyond this point begins to forward bias the emitter junction. At the peak point, a small forward emitter current is flowing. This current is termed as peak current(I_P). Until this point UJT is said to be operating in cutoff region. When I_E increases beyond peak current the device enters the negative resistance region. In which the resistance r_{B1} falls rapidly & V_E falls to the valley voltage.Vv. At this point I_E = Iv. A further increase of I_E causes the device to enter the saturation region.

PROCEDURE:

1. Connect the circuit as per the circuit diagram.
2. Set V_{B1B2} = 0V, vary V_{EB1} , & note down the readings of I_E & V_{EB1}
3. Set V_{B1B2} = 10V , vary V_{EB1} , & note down the readings of I_E & V_{EB1}
4. Plot the graph : I_E Versus V_{EB1} for constant V_{B1B2}.
5. Find the intrinsic standoff ratio.

FORMULA FOR INTRINSIC STANDOFF RATIO:

$\eta = V_P - V_D / V_{B1B2}$., where V_D = 0.7V.

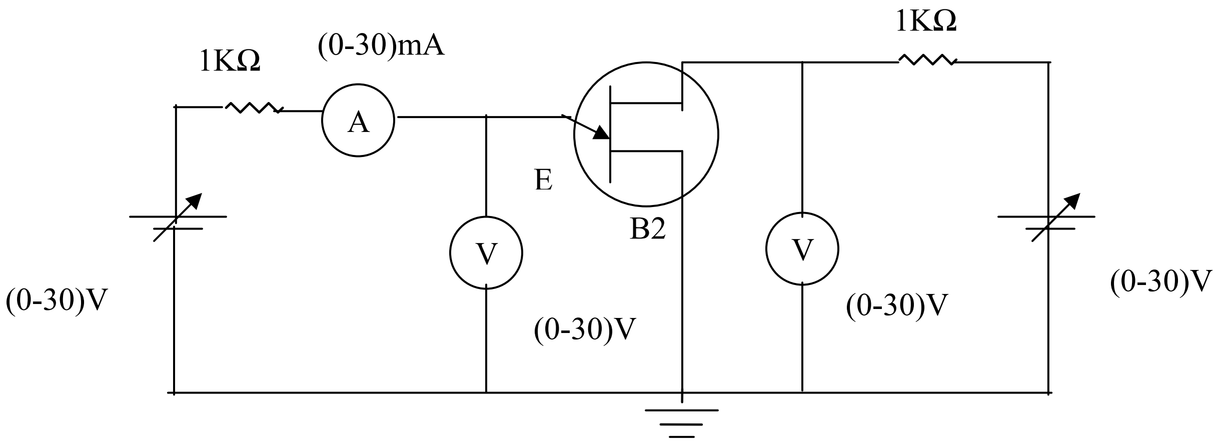
PROCEDURE:

1. Give the circuit connections as per the circuit diagram.
2. The dc input voltage is set to 20 V in RPS.
3. The output sweep waveform is measured using CRO.
4. The graph of output sweep waveform is plotted

RESULT:

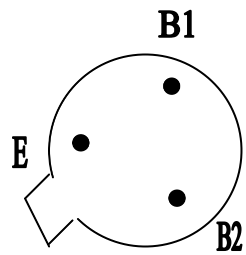
1. Thus the characteristics of given UJT was Plotted & its intrinsic standoff Ratio = ----.

CIRCUIT DIAGRAM:



PIN DIAGRAM:

BOTTOM VIEW OF 2N2646:



SPECIFICATION FOR 2N2646:

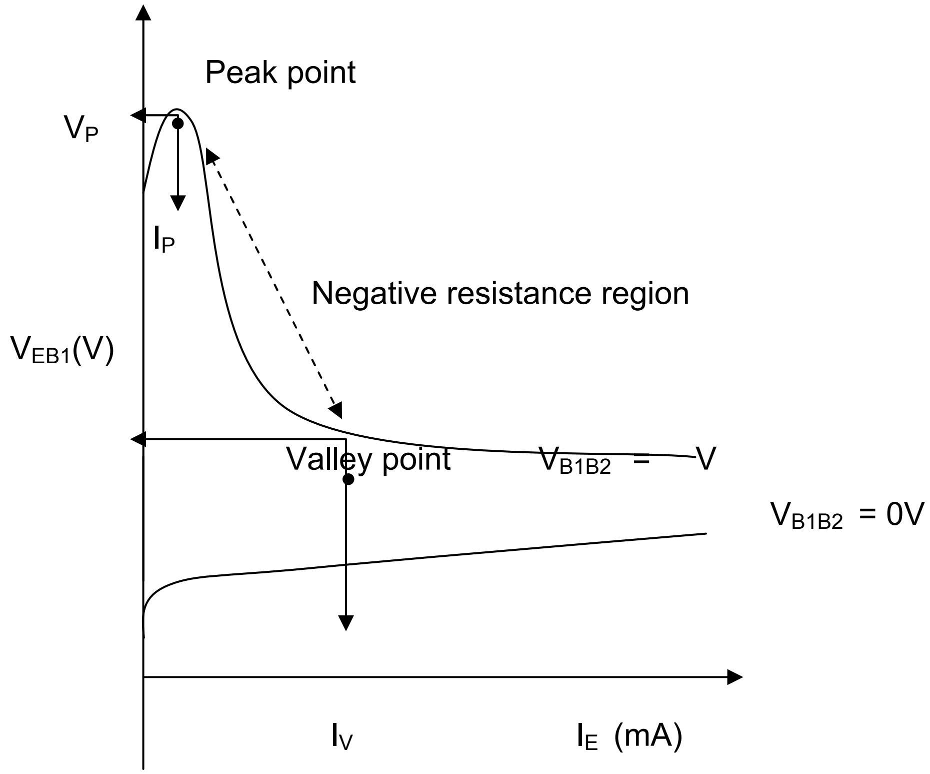
* Inter base resistance R_{BB} = 4.7 to 9.1 KΩ

* Minimum Valley current = 4 mA

* Maximun Peak point emitter current 5 μA

*Maximum emitter reverse current 12 μA.

MODEL GRAPH:



TABULAR COLUMN:

V_{B1B2} = 0V		V_{B1B2} = 10V	
V_{EB1} (V)	I_E (mA)	V_{EB1} (V)	I_E (mA)

Ex.No.8

Date:

CHARACTERISTICS OF SCR

Aim:
To obtain the V-I characteristics of SCR and find the break over voltage and holding current.

APPARATUS REQUIRED:

S.No.	Name	Range	Type	Qty
1	R.P.S	(0-30)V		2
2	Ammeter	(0–10)mA (0–100)mA		1
3	Voltmeter	(0–30)V		1

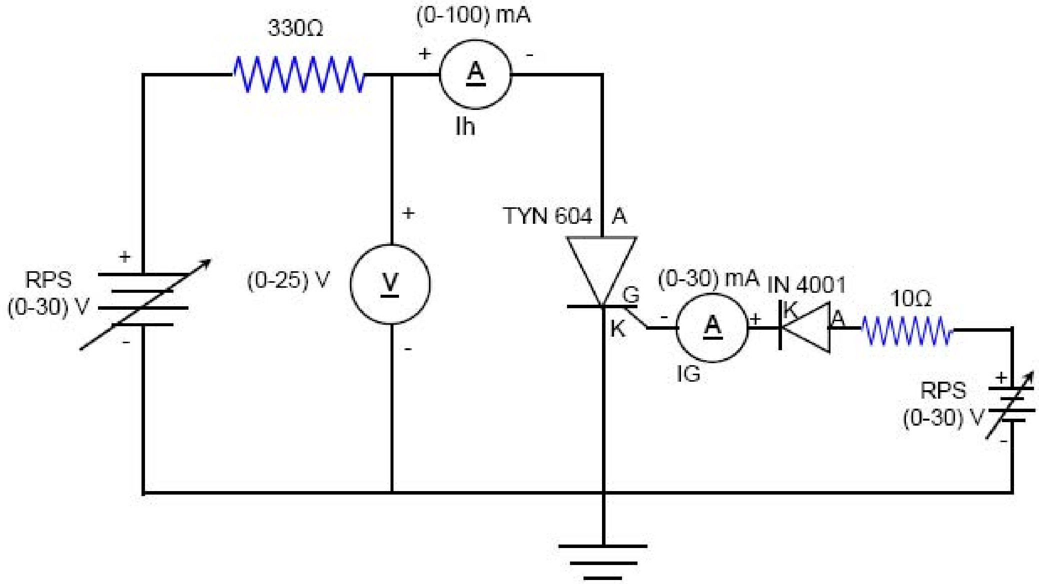
COMPONENTS REQUIRED:

S.No.	Name	Range	Type	Qty
1	SCR	TYN604		1
2	Resistor	330Ω		1 1
3	Bread Board			1
4	Wires			
5	Diode	IN4001		1

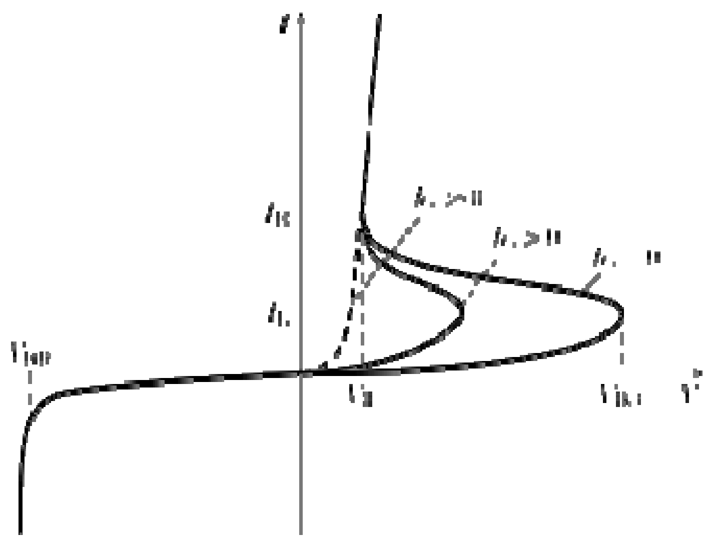
Theory:

A silicon controlled rectifier (SCR) is a semiconductor device that acts as a true electronic switch.
It can change the alternating current in to direct current. It can control the amount of power fed to the load. Thus the SCR combines the features of rectifier and a transistor.
If the supply voltage is less than the break over voltage, the gate will open (IG = 0). Then increase the supply voltage from zero, a point is reached when the SCR starts conducting.
Under this condition, the voltage across the SCR suddenly drop and most of the supply voltage appears across the load resistance RL.
If proper gate current is made to flow the SCR can close at much smaller supply voltage.

Characteristics of SCR:
Circuit Diagram:



Model Graph



Procedure:

- The connections are made as per in the circuit diagram.
- First by varying RPS 2 then gate current (I_G) is kept constant.
- The voltage between anode and cathode is increased in step by step by varying the RPS 1.
- The corresponding anode current (I_A) is noted.
- The process is repeated for two more constant value of I_G, the readings are tabulated.

Tabulation:

S. No	Anode-Cathode Voltage V_{ak} (Volts)	Gate Current I_g (mA)	Anode Current I_a (mA)	Anode – Cathode volt when SCR in ON (volts)

Result:

Thus the V-I characteristics of SCR was obtained and graph was drawn.

Ex.No.9

Date:

Characteristics of DIAC

Aim:

To draw the V-I characteristics of DIAC and obtain the break over voltage (V_{BO}).

APPARATUS REQUIRED:

S.No.	Name	Range	Type	Qty
1	R.P.S	(0-30)V (0-300)V		1
2	Ammeter	(0–50)mA (0–30)mA (0–10)mA		1
3	Voltmeter	(0–50)V (0-15)V		1

COMPONENTS REQUIRED:

S.No.	Name	Range	Type	Qty
1	DIAC	SSD3A		1
2	Resistor	5K Ω, 1K Ω		1 1
3	Bread Board			1
4	Wires			

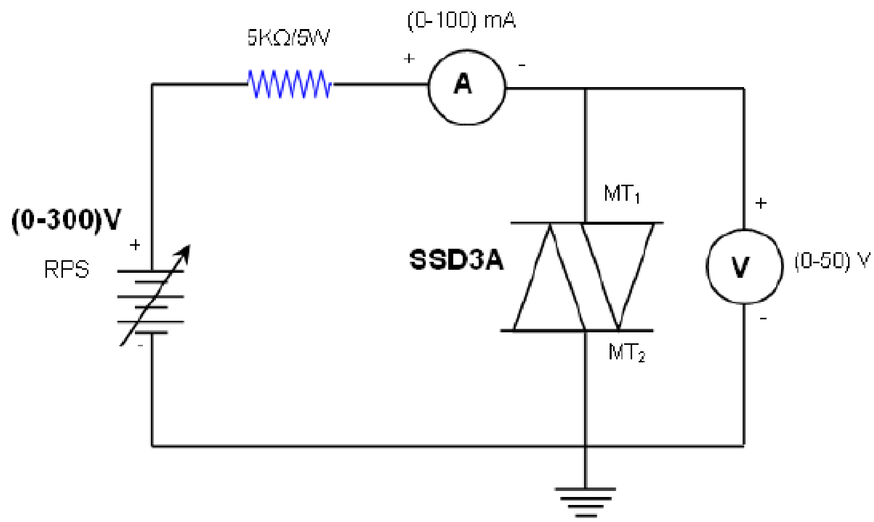
Theory:

A DIAC is a two terminal three layer bidirectional device which can be switched from its off state to on state for either polarity of applied voltage. The operation of DIAC is identical both in forward and reverse conduction. The DIAC does not conduct until the applied voltage of either polarity reaches the break over voltage VBO.

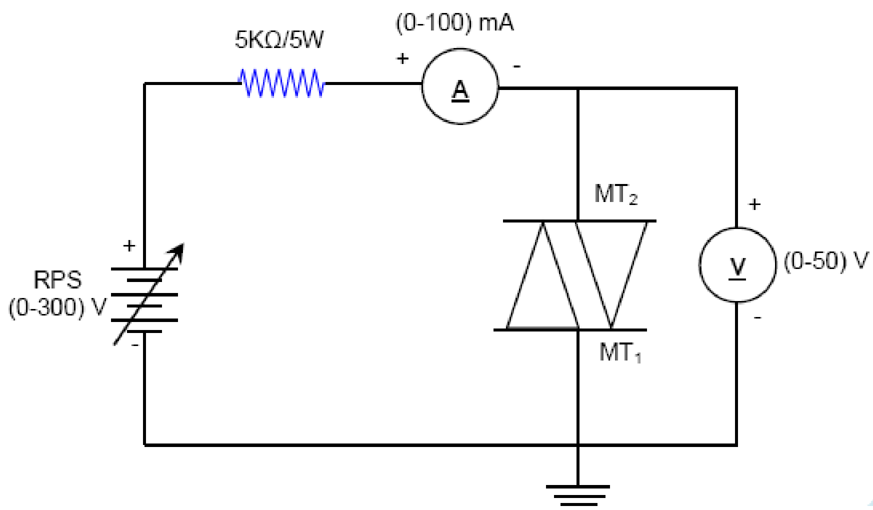
Characteristics of Diac:

Circuit Diagram:

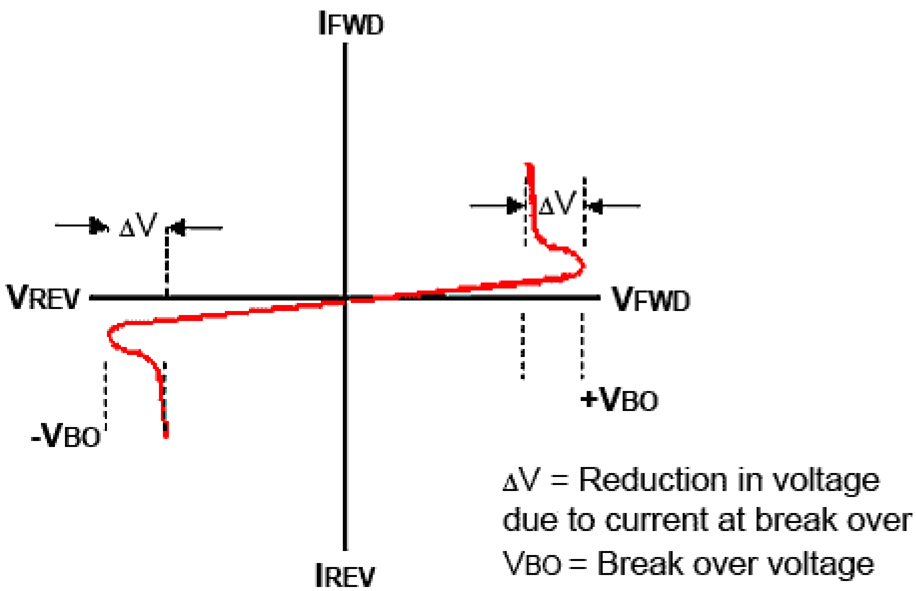
Forward Direction:



Reverse Direction:



Model Graph



Procedure:

Diac Characteristics:

o The connections are made as shown in the circuit diagram.
o First DIAC is connected in forward direction
o The input supply is increased in step by step by varying the RPS
o The corresponding ammeter and voltmeter readings are noted
and tabulated.
o Then the DIAC is connected in reverse condition.
o The above process is repeated

Tabulation:

DIAC Characteristics:

S.NO	Forward direction		Reverse direction	
	Voltage (volts)	Current (ma)	Voltage (volts)	Current (ma)

Result:
Thus the V-I characteristics of DIAC was obtained and graph was drawn.

Ex.No.10

Date:

Characteristics of TRIAC

Aim:
To draw the V-I characteristics of TRIAC and obtain the breakover voltage (V_{BO}).

APPARATUS REQUIRED:

S.No.	Name	Range	Type	Qty
1	R.P.S	(0-30)V (0-300)V		1
2	Ammeter	(0–50)mA (0–30)mA (0–10)mA		1
3	Voltmeter	(0–50)V (0-15)V		1

COMPONENTS REQUIRED:

S.No.	Name	Range	Type	Qty
1	TRIAC	BTM36		1
2	Resistor	5K Ω, 1K Ω		1 1
3	Bread Board			1
4	Wires			

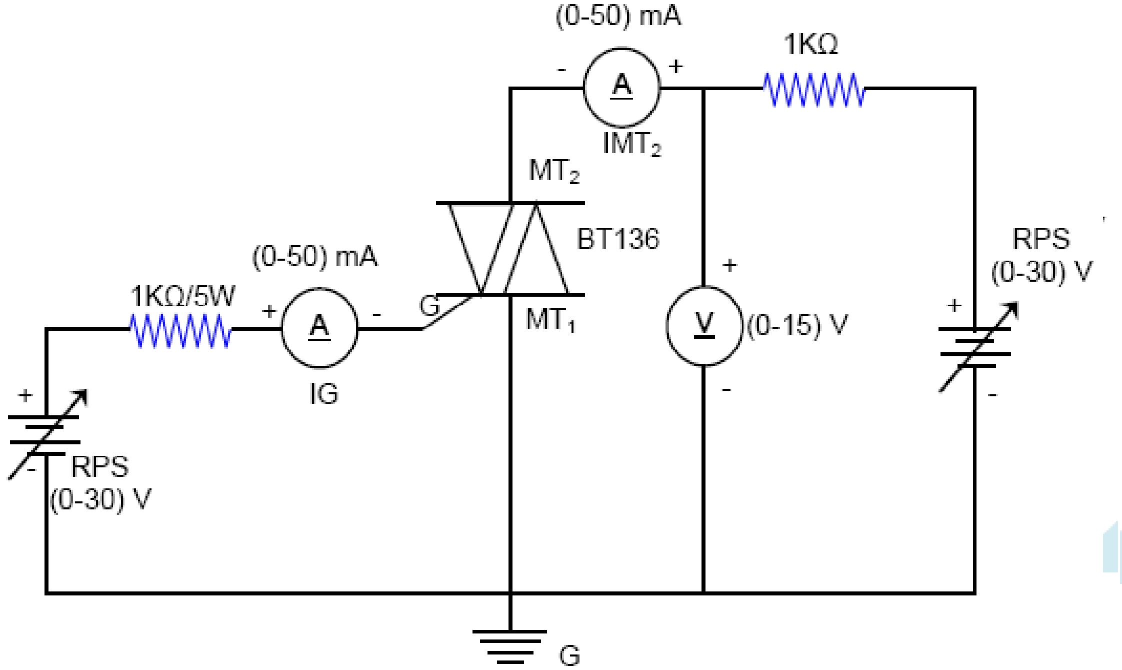
Theory:

A TRIAC is a three terminal semiconductor switching device which can control alternating current in a load.
A TRIAC can control conduction of both positive and negative half cycles of A.C supply. It is sometimes called a bidirectional semiconductor triode switch.

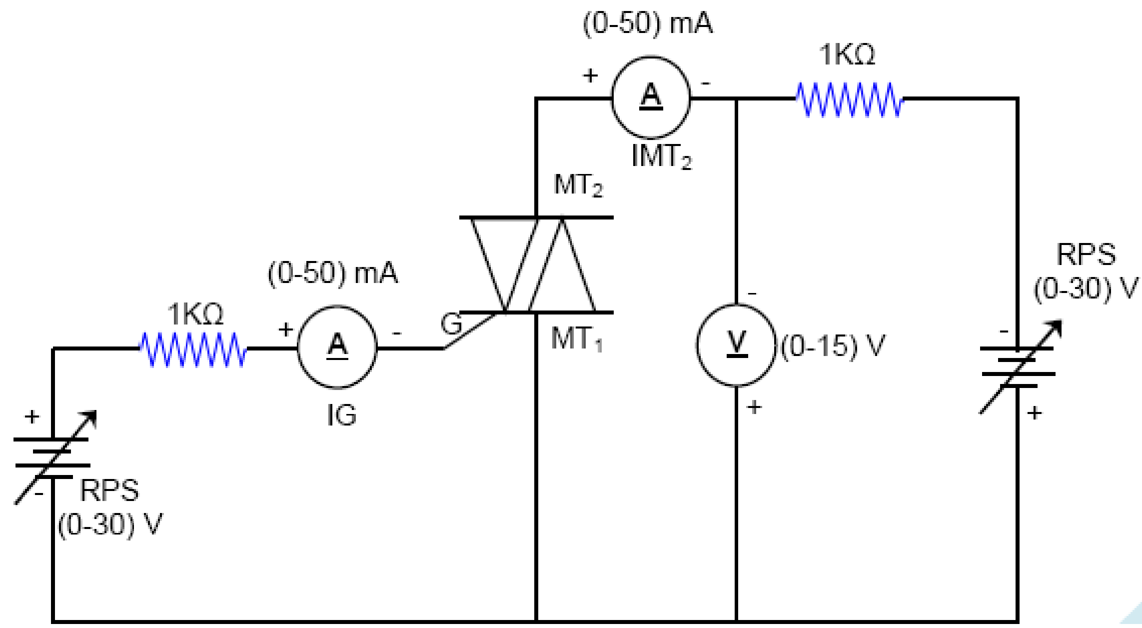
CIRCUIT DIAGRAM

Characteristics of Triac:

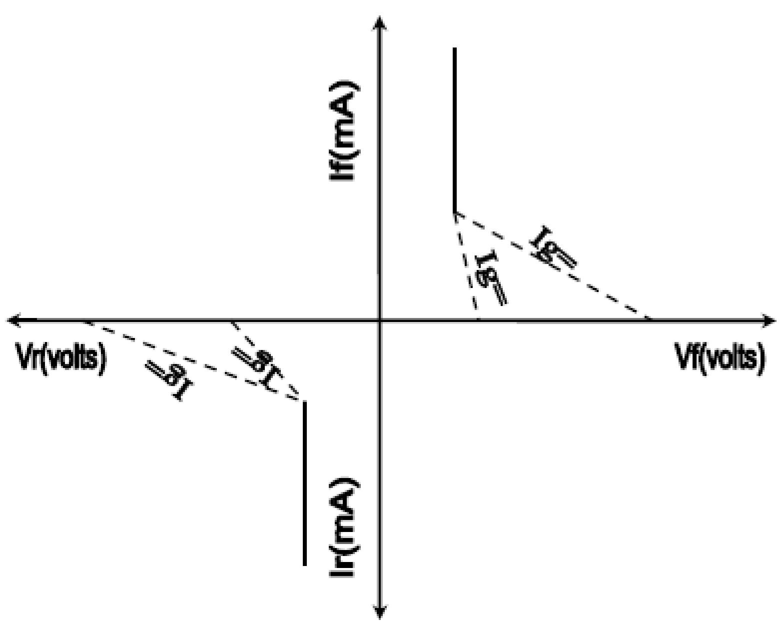
Forward Direction:



Reverse Direction:



Model Graph:



Procedure:

TRIAC Characteristics:

- The connections are made as shown in the circuit diagram.
- The TRIAC is connected in forward direction and supply is switched 'ON'.
- V_{MT1MT2} is constant by varying RPS2 and then varying I_G by varying RPS1.
- The corresponding ammeter and voltmeter readings are noted and tabulated.
- Next the TRIAC is connected in reverse direction.
- The above process is repeated.

Tabulation:

TRIAC Characteristics:

S. No	VMT1MT2 (V) when Triac is 'OFF'	IG (mA)	VMT1MT2 when Triac is 'ON	IMT2 (mA)

Result:

Thus the V-I characteristics of TRIAC was obtained and graph was drawn.

Ex.No.11

Date:

Characteristics of LDR and PHOTODIODE

Aim: To plot distance Vs Photocurrent Characteristics of LDR and Photodiode

APPARATUS REQUIRED:

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

COMPONENTS REQUIRED:

S.No.	Name	Range	Type	Qty
1	Photodiode			1
2	LDR	1K Ω		1 1
3	Bread Board			1
4	Wires			

Theory:

LDR

A photoresistor or light dependent resistor or cadmium sulfide (CdS) cell is a resistor hose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor.

A photoresistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound lectrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance

Photodiode

A silicon photodiode is a solid state light detector that consists of a shallow diffused P-N junction with connections provided to the out side world. When the top surface is illuminated, photons of light penetrate into the silicon to a depth determined by the photon energy and are absorbed by the silicon generating electron-hole pairs.

The electron-hole pairs are free to diffuse (or wander) throughout the bulk of the

photodiode until they recombine. The average time before recombination is the "minority carrier lifetime".
At the P-N junction is a region of strong electric field called the depletion region. It is formed by the voltage potential that exists at the P-N junction. Those light generated carriers that wander into contact with this field are swept across the junction.
If an external connection is made to both sides of the junction a photo induced current will flow as long as light falls upon the photodiode. In addition to the photocurrent, a voltage is produced across the diode. In effect, the photodiode functions exactly like a solar cell by generating a current and voltage when exposed to light.

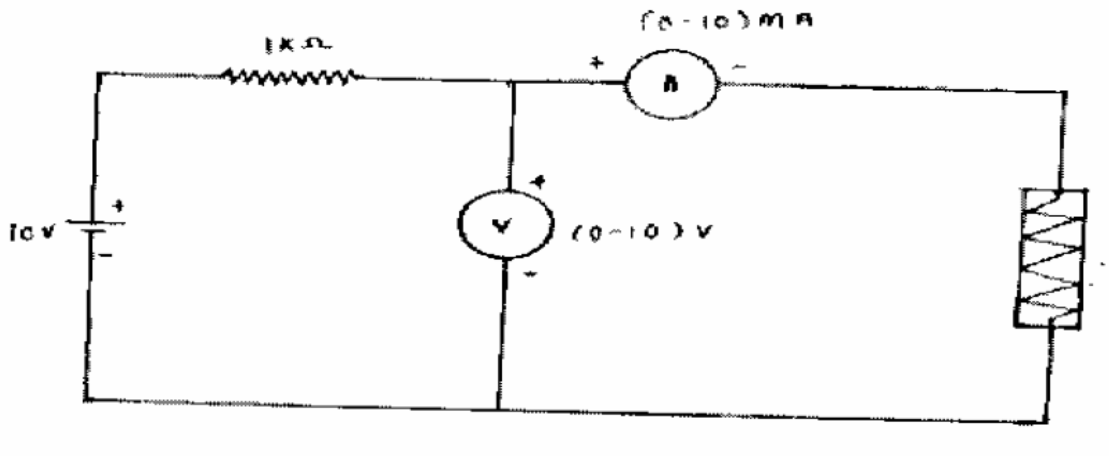
Procedure:

LDR:
Connect circuit as shown in figure
Keep light source at a distance and switch it ON,so that it falls on the LDR
Note down current and voltage in ammeter and voltmeter.
Vary the distance of the light source and note the V & I.
Sketch graph between R as calculated from observed V and I and distance of light source.

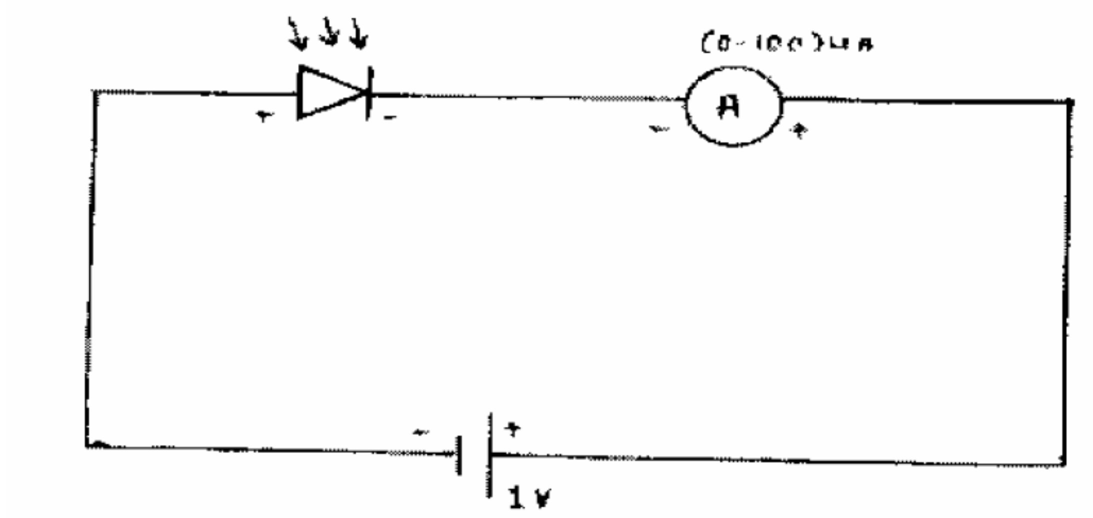
Photodiode:
Connect circuit as shown in figure
Maintain a known distance between the bulb and photodiode say 5cm
Set the voltage of the bulb,vary the voltage of the diode in steps of 1 volt and note down the diode current Ir.
Repeat above procedure for VL=4V,6V,etc.
Plot the graph :Vd Vs Ir for constant VL

Circuit diagram:

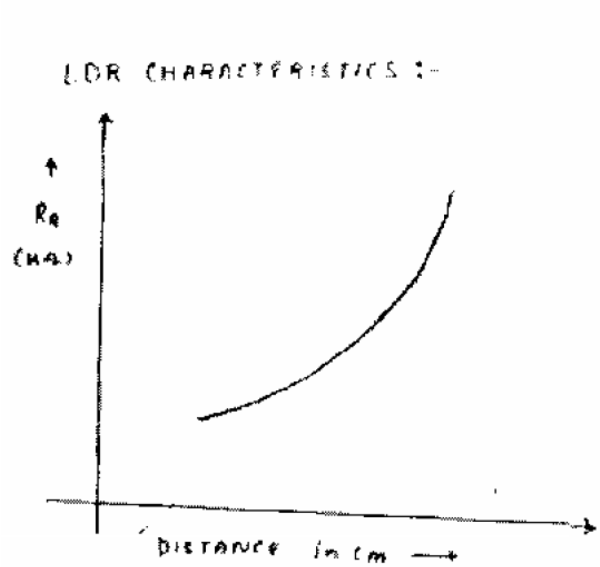
LDR:

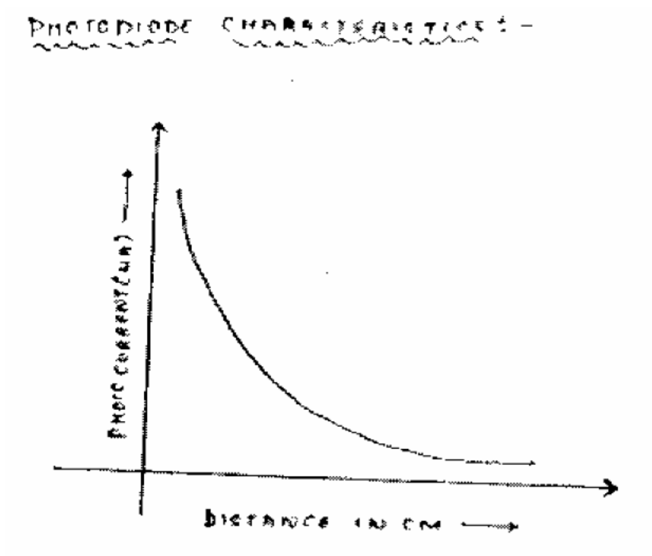


Photodiode:



Graph:


LDR CHARACTERISTICS :-
DISTANCE in cm


PHOTODIODE CHARACTERISTICS :-
DISTANCE IN CM

Tabulation

LDR

S. No	Distance (Cm)	Voltage(V)	Current(mA)	R=V/I(Ω)

Photodiode

Distance-constant, VL-Constant

S. No	VD(V)	IR (mA)

Result:

The characteristics of LDR,Photodiode,Phototransistor is to be tabulated and the graphs are plotted

Ex.No:12
Date:

STUDY OF CRO

Aim:

To study cathode Ray Oscilloscope (CRO)

Apparatus required:

S.No	Name of the apparatus	Quantity
1.	CRO	1

Theory:

The cathode ray oscilloscope is the most versatile measuring instrument available. We can measure following parameters using the CRO:

1. AC or DC voltage.
2. Time (t=1/f).
3. Phase relationship
4. Waveform calculation: Rise time; fall time; on time; off-time Distortion, etc.

We can also measure non-electrical physical quantities like pressure, strain, temperature, acceleration, etc., by converting into electrical quantities using a transducer.

Major blocks:

1. Cathode ray tube (CRT)
2. Vertical amplifier
3. Horizontal amplifier
4. Sweep generator
5. Trigger circuit
6. Associated power supply.

1. **The cathode ray tube** is the heart of CRO. The CRT is enclosed in an evacuated glass envelope to permit the electron beam to traverse in the tube easily. The main functional units of CRO are as follows.

   Electron gun assembly

   Deflection plate unit

   Screen.

2. **Vertical Amplifier** is the main factor in determining the bandwidth and sensitivity of an oscilloscope. Vertical sensitivity is a measure of how much the electron beam will be deflected for a specified input signal. On the front panel of the oscilloscope, one can see a knob attached to a rotary switch labeled volts/division. The rotary switch is electrically connected to the input attenuation network. The setting of the rotary switch indicates what amplitude signal is required to deflect the beam vertically by one division.
3. **Horizontal amplifier** Under normal mode of operation, the horizontal amplifier will amplify the sweep generator input. When the CRO is being used in the X-Y mode, the horizontal amplifier will amplify the signal applied to the horizontal input terminal. Although the vertical amplifier mush be able to faithfully reproduce low-amplitude and high frequency signal with fast rise-time, the horizontal amplifier is only required to provide a faithful reproduction of the sweep signal which has a relatively high amplitude and slow rise time.
4. **Sweep generator and Trigger circuit** These two units form the **Signal Synchronization unit of the CRO.**
5. **Associated Power Supply:** The input signal may come from an external source when the trigger selector switch is set to EXT or

from low amplitude AC voltage at line frequency when the switch is set to LINE or from the vertical amplifier when the switch is set to INT. When set for INT (internal triggering), the trigger circuit receives its inputs from the vertical amplifier.

Major Blocks in a Practical CRO

A CRO consists of a cathode ray tube (CRT) and additional control knobs. The main parts of a CRT are:

1. Electron gun assembly.
2. Deflection plate assembly.
3. Fluorescent screen.

Electron Gun Assembly: The electron gun assembly produces a sharp beam of electrons, which are accelerated to high velocity. This focused beam of electrons strike the fluorescent screen with sufficient energy to cause a luminous spot on the screen.

Deflection plate assembly: This part consists of two plates in which one pair of plates is placed horizontally and other of plates is placed vertically. The signal under test is applied to vertical deflecting plates. The horizontal deflection plates are connected to a built-in ramp generator, which moves the luminous spot periodically in a horizontal direction from left to right over the screen. These two deflection plates give stationary appearance to the waveform on the screen. CRO operates on voltage. Since the deflection of the electron beam is directly

proportional to the deflecting voltage, the CRT may be used as a linear measuring device. The voltage being measured is applied to the vertical plates through an iterative network, whose propagation time corresponds to the velocity of electrons, thereby synchronizing the voltage applied to the vertical plate with the velocity of the beam.

Synchronization of input signal: The sweep generator produces a saw tooth waveform, which is used to synchronize the applied voltage to obtain a stationary-applied signal. This requires that the time base be operated at a submultiples frequency of the signal under measurement. If synchronization is not done, the pattern is not stationary, but appears to drift across the screen in a random fashion.

Internal synchronization This trigger is obtained from the time base generator to synchronize the signal.

External synchronization An external trigger source can also be used to synchronize the signal being measured.

Auto Triggering Mode The time base used in this case in a self-oscillating condition, i.e., it gives an output even in the absence of any Y-input. The advantage of this mode is that the beam is visible on the screen under all conditions, including the zero input. When the input exceeds a certain magnitude then the internal free running oscillator locks on to the frequency.

Result: Thus the various parts of the CRO and their working was studied.