SYLLABUS

EI8461 DEVICES AND MACHINES LABORATORY **L T P C**
0 0 4 2

OBJECTIVES:
1. To facilitate the students to study the characteristics of various semiconductor devices.
2. To provide practical knowledge on the analysis of regulators, amplifiers and oscillators.
3. To obtain the no load and load characteristics of D.C machines.
4. To obtain the speed characteristics of D.C motor.
5. To find out regulation characteristics of Transformer.

LIST OF EXPERIMENTS FOR DEVICES LAB:
1. Simulation and experimental Characterisation of Semiconductor diode and Zener diode.
2. Simulation and experimental Characterisation of a NPN Transistor under common emitter configurations.
3. Simulation and experimental Characterisation of FET and JFET(Draw the equivalent circuit)
4. Simulation and experimental Characterisation of UJT and generation of saw tooth waveforms
5. Simulation and experimental Characterisation of RC and LC phase shift oscillators.
6. Simulation and experimental Characterisation of Monostable and Astable multivibrators.
7. Simulation of passive filters.
8. Simulation of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
9. Characteristics of SCR and application as a controlled rectifier.

ADDITIONAL EXPERIMENTS:
10. Study of CRO for frequency and phase measurements
11. Characteristics of photo diode & photo transistor.

LIST OF EXPERIMENTS FOR MACHINES LAB:

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Speed control of D.C. shunt motor.
5. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
6. Load test on single phase induction motor.

ADDITIONAL EXPERIMENTS:

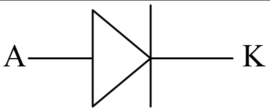
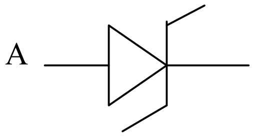
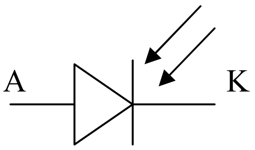
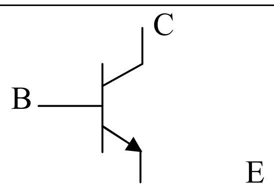
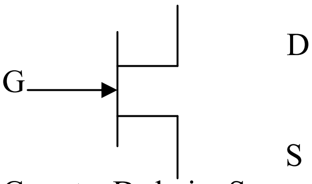
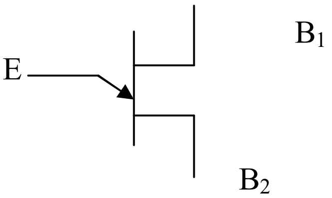
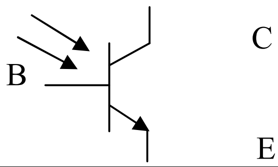
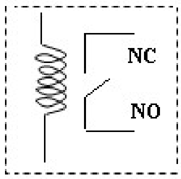
7. Load test on single phase Transformer.
8. Study of Starters

TOTAL: 45 PERIODS

OUTCOMES:

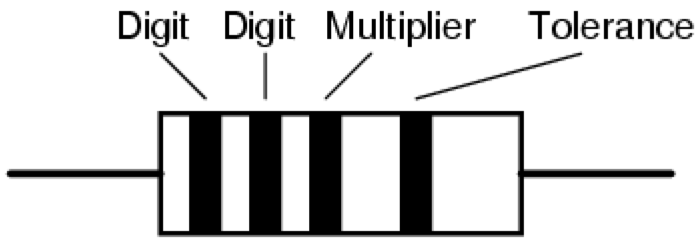
1 Gain knowledge on the proper usage of various electronic equipment and simulation tools for design and analysis of electronic circuits.
2 Get hands-on experience in studying the characteristics of semiconductor devices.
3 Ability to analyze various electronic circuits such as voltage regulators, transistor amplifiers and oscillators.
4 Ability to make use of basic concepts to obtain the no load and load characteristics of D.C machines.
5 Analyze and draw conclusion from the characteristics obtained by conducting experiments on machines.
6 Ability to carry out the Experiments in batches to motivate the Team work.

INDEX

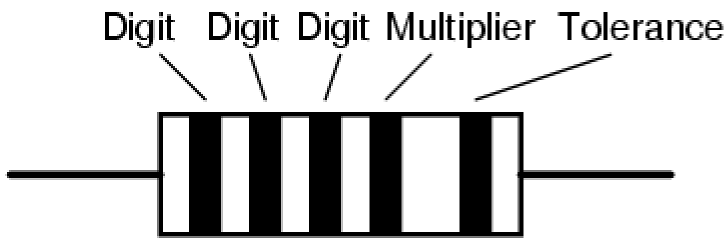
S.No	DEVICE	SPECIFICATION	SYMBOL
1.	PN junction Diode	1N4007	 A – anode, K- cathode
2.	Zener diode	Z9.1V	
3.	Photo diode	IPL 34C	
4.	Transistor	BC 107 / Q2N2222	 E- emitter, B-base,C- collector
5.	FET	BFW10	 G- gate, D-drain, S- source
6.	UJT	2N2646	 E-emitter, B_1-base1, B_2-base2
7.	Photo transistor	L14G3	
8.	Relay	12V	NC – normally closed  NO – normally open

RESISTOR COLOUR CODES

COLOR	DIGIT	MULTIPLIER	TOLERANCE (%)
BLACK	0	10^0 (1)	
BROWN	1	10^1	1
RED	2	10^2	2
ORANGE	3	10^3	
YELLOW	4	10^4	
GREEN	5	10^5	0.5
BLUE	6	10^6	0.25
VIOLET	7	10^7	0.1
GREY	8	10^8	
WHITE	9	10^9	
GOLD		10^{-1}	5
SILVER		10^{-2}	10
(NONE)			20

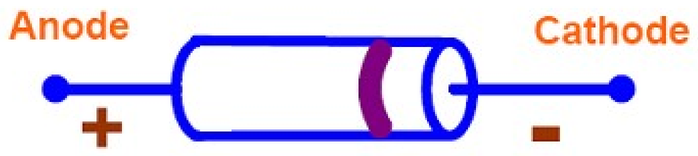


4-band code



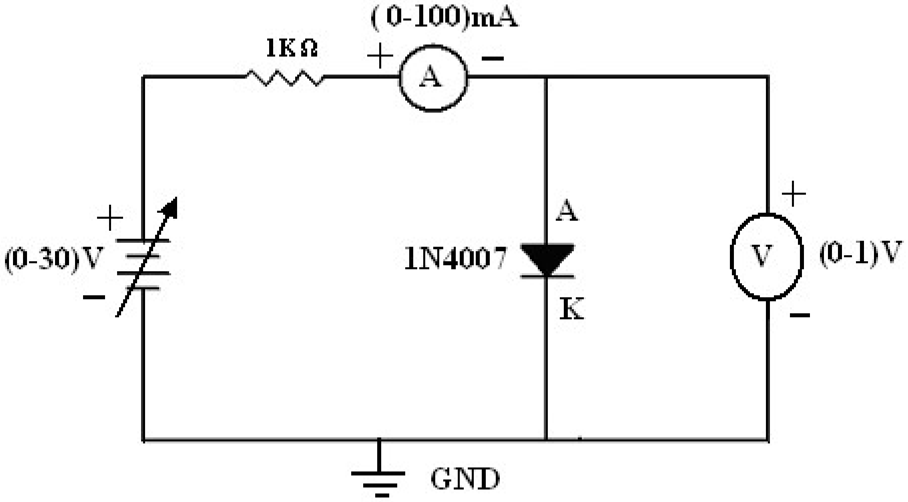
5-band code

DIODE TERMINAL CONVENTION

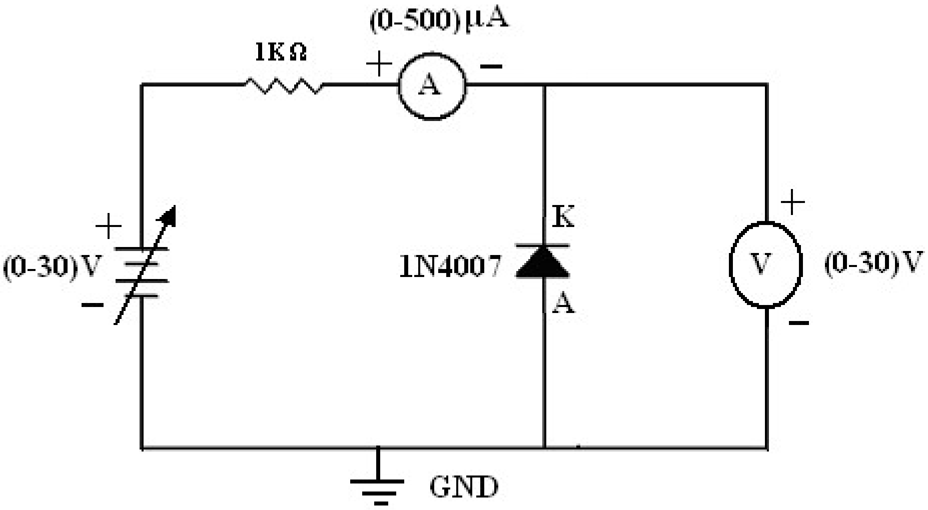


CIRCUIT DIAGRAM :

FORWARD BIAS



REVERSE BIAS



EX.NO: 1.A	CHARACTERISTICS OF PN JUNCTION DIODE
DATE:	

AIM:

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

APPARATUS REQUIRED:			
S.NO	**NAME**	**RANGE**	**QTY**
1	R.P.S	(0-30) V	1
2	Ammeter	(0–100) mA	1
		(0-500)µA	1
3	Voltmeter	(0–1) V	1
		(0-10) V	1
COMPONENTS REQUIRED			
1	Diode	IN4007	1
2	Resistor	1KΩ	1
3	Bread Board		1
4	Wires	As required	

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.

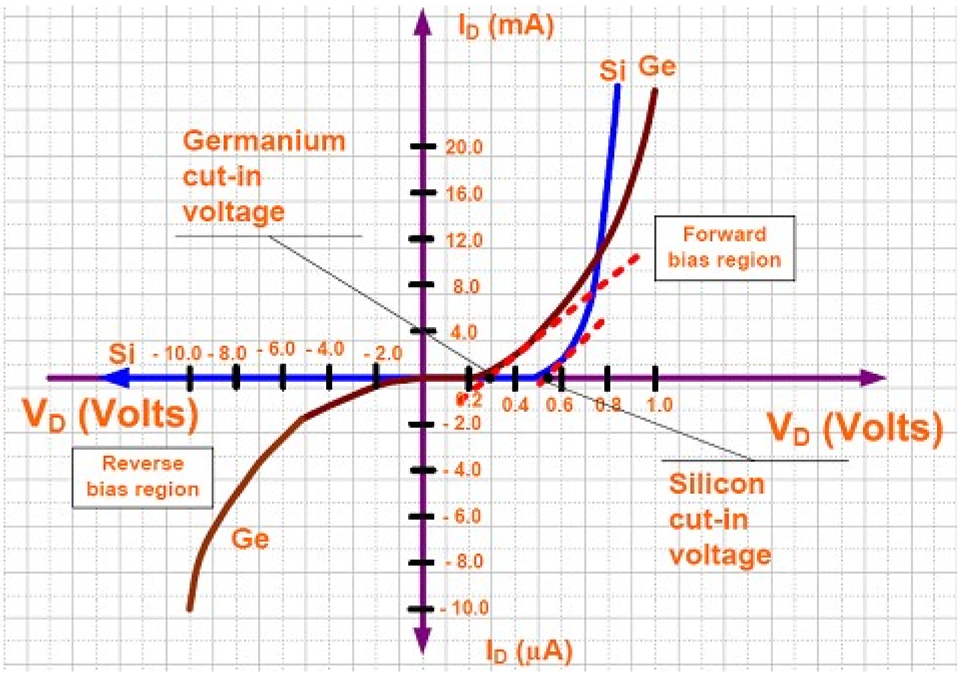
REVERSE BIAS:

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.

TABULATION:

Forward bias:		Reverse bias:	
V_D (volts)	I_D (mA)	V_D (volts)	I_D (µA)

MODEL GRAPH



MODEL CALCULATION:

1. Find the static resistance = V/I.
2. Find the dynamic resistance r = δV / δI.
3. Find the cut in voltage (or)Knee voltage =

   [Hint: it is equal to 0.7 for Si and 0.3 for Ge]

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 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. Connections are given as per the circuit diagram.
2. For forward bias, the RPS +ve is connected to the anode of diode(A) and RPS –ve is connected to cathode(K) of diode.
3. Vary the supply voltage in steps of **0.1 V** and voltage across the diode is measured by voltmeter and current by ammeter.
4. The readings are tabulated.
5. Graph is plotted between forward voltage (in X-axis) and Forward current (in Y-axis)
6. Forward Static and Dynamic Resistance is calculated from this graph.

REVERSE BIAS:

1. Connections are given as per the circuit diagram.
2. For reverse bias, the RPS + ve is connected to cathode(K) and RPS – ve is connected to anode (A) of diode.
3. Vary the supply voltage in steps of **1 V** and voltage across the diode is measured by voltmeter and the current by ammeter.
4. The readings are tabulated.
5. Graph is plotted between reverse voltage (in X-axis) and reverse current (in Y- axis)
6. Reverse Static and Dynamic Resistance is calculated from this graph.

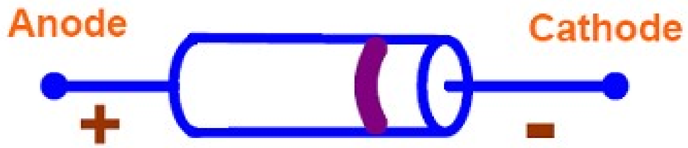
APPLICATIONS:

Power conversion, logic gate, Diode clamps, Limiter, temperature measurement, Over voltage protection etc.

RESULT:

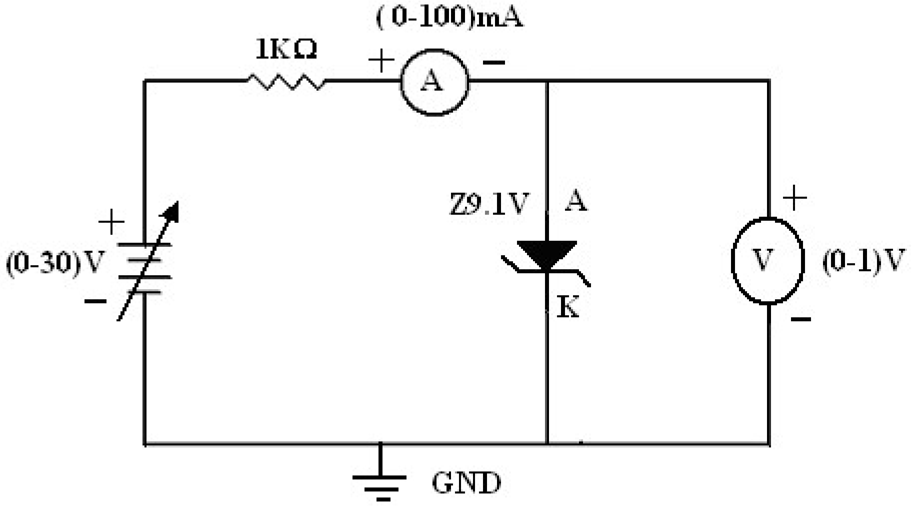
Thus the V-I characteristics of PN junction diode are studied and the static and dynamic resistances are calculated.

DIODE TERMINAL CONVENTION

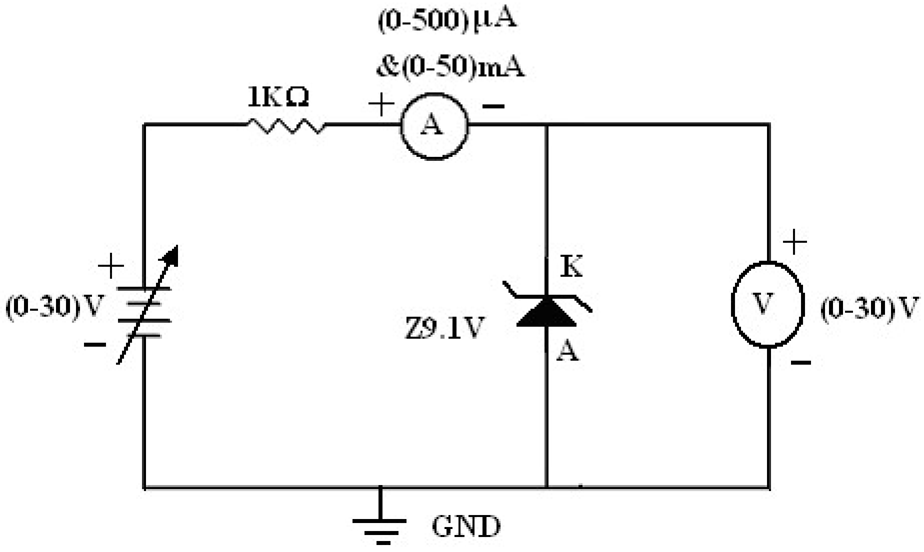


CIRCUIT DIAGRAM:

FORWARD BIAS



REVERSE BIAS



EX.NO: 1.B	CHARACTERISTICS OF ZENER DIODE
DATE:	

AIM:

To study the characteristics of Zener diode.

APPARATUS REQUIRED			
S.NO.	**NAME**	**RANGE**	**QTY**
1	R.P.S	(0-30)V	1
2	Ammeter	(0–100)mA	1
		(0–500)µA	1
		(0–50)mA	1
3	Voltmeter	(0–30)V	1
		(0–1)V	1
COMPONENTS REQUIRED:			
1	Zener diode	Z9.1V	1
2	Resistor	1KΩ	1
3	Bread Board	-	1
4	Wires	As required	

THEORY: A Zener diode is heavily doped PN junction diode, specially made to operate in the breakdown region.

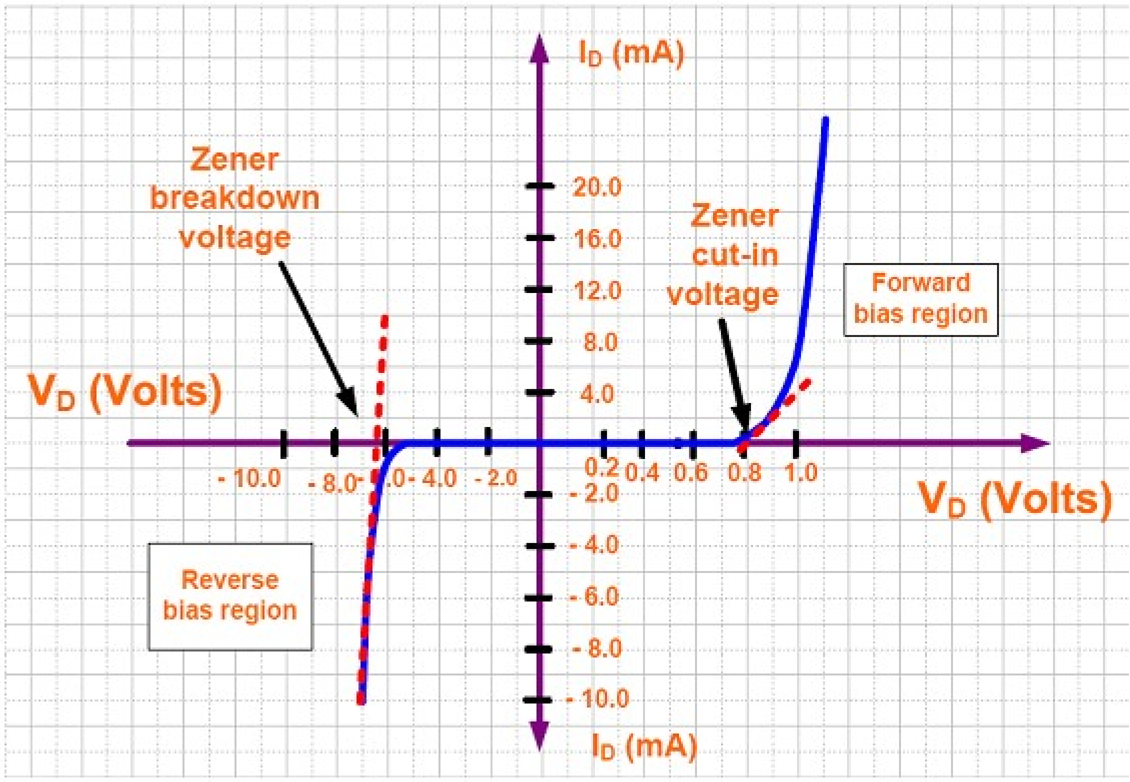
FORWARD BIAS:

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, entering the N-regions and electrons, which are the majority carriers in the N-regions entering the P-region. This injection of minority carriers results current, opposite to the direction of electron movement.

TABULAR COLUMN

FORWARD BIAS:		REVERSE BIAS:		
V_D (volts)	I_D (mA)	V_D (volts)	I_D (μA)	I_D(mA)

MODEL GRAPH



REVERSE BIAS:

If the reverse bias is increased at a particular voltage it starts conducting. This is called breakdown region. We connect a resistor in series with zener diode. Once the diode starts conducting it maintains almost constant voltage across the terminals whatever may be the current through it, also it has very low dynamic resistance. It is used in voltage regulators.

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. Connections are given as per the circuit diagram.
2. Vary the supply voltage in steps of **0.1 V** and voltage across the diode is measured by voltmeter and current by ammeter.
3. The readings are tabulated.
4. Graph is plotted between forward voltage (in X-axis) and Forward current (in Y-axis)
5. Forward Static and Dynamic Resistance are calculated from this graph.

REVERSE BIAS:

1. Connections are given as per the circuit diagram.
2. Vary the supply voltage in steps of **1 V** and voltage across the diode is measured by voltmeter and current by ammeter.
3. The readings are tabulated.
4. For Zener diode, after getting constant voltage replace Micro ammeter into Millimeter and tabulate the reading.
5. Graph is plotted between reverse voltage (in X-axis) and reverse current (in Y-axis)
6. Reverse Static and Dynamic Resistance are calculated from this graph.

MODEL CALCULATION

a. Find the static resistance = V/I

b. Find the dynamic resistance $r = \delta V / \delta I$

c. Find the breakdown voltage =

APPLICATIONS:

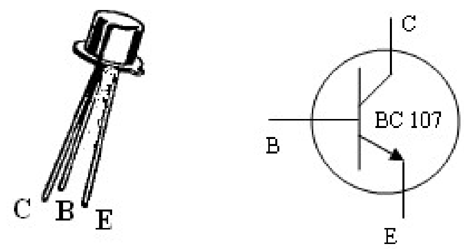
- ❖ Voltage shifter
- ❖ Voltage regulator
- ❖ Waveform clipper
- ❖ Preventing surges from damaging electronics circuits
- ❖ Over voltage protection circuit

RESULT:

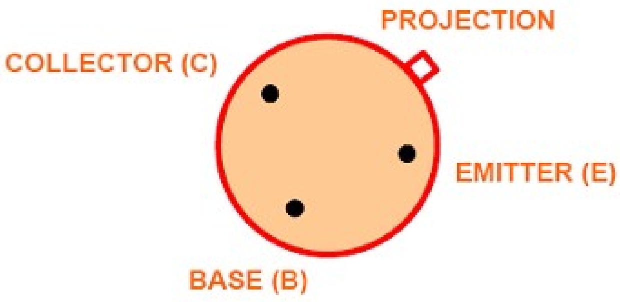
Thus the V-I characteristics of Zener Diode are studied.

BJT TERMINAL CONVENTION

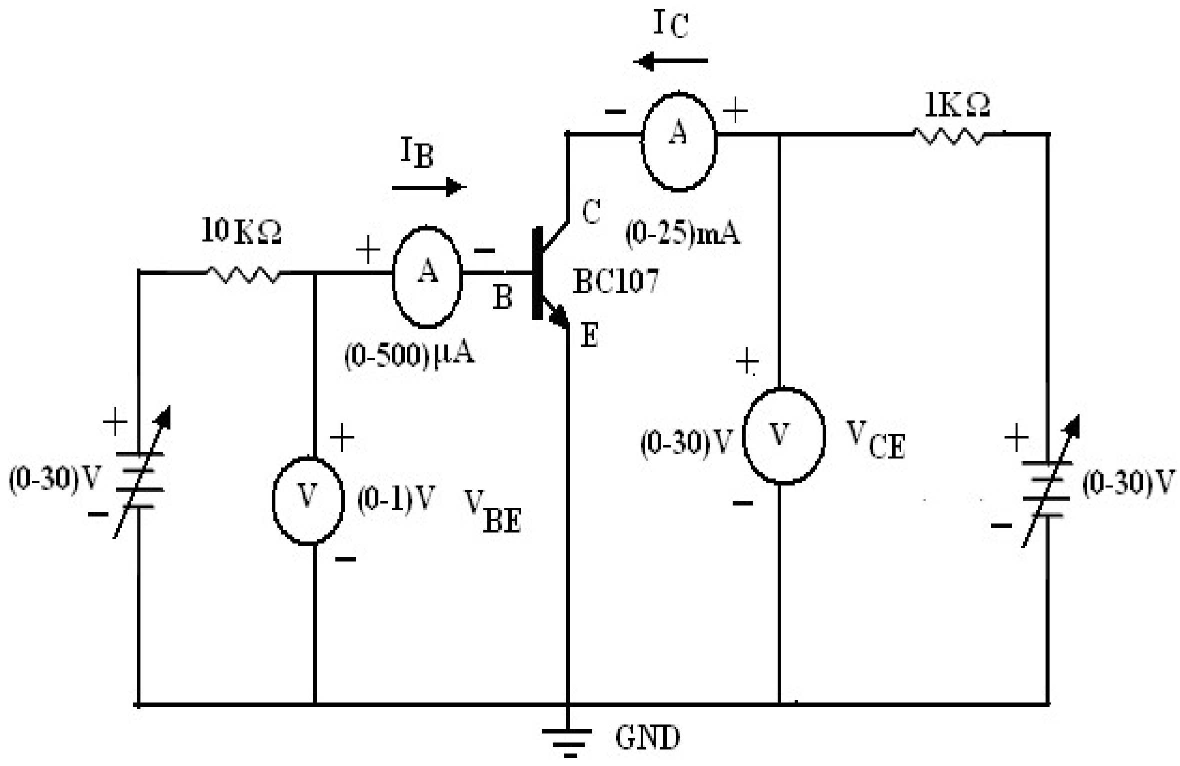
BC107



Bottom-up view



CIRCUIT DIAGRAM



EX.NO: 2	CHARACTERISTICS OF CE CONFIGURATION USING BJT
DATE:	

AIM:

To draw the input and output characteristics of transistor in CE configuration.

APPARATUS REQUIRED:			
S.NO.	**NAME**	**RANGE**	**QTY**
1	R.P.S	(0-30)V	2
2	Ammeter	(0–25) mA	1
		(0–500)µA	1
3	Voltmeter	(0–30)V	1
		(0–1)V	1
COMPONENTS REQUIRED			
1	Transistor	BC 107	1
2	Resistor	10kΩ	1
		1KΩ	1
3	Bread Board	-	1
4	Wires	As required	

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.

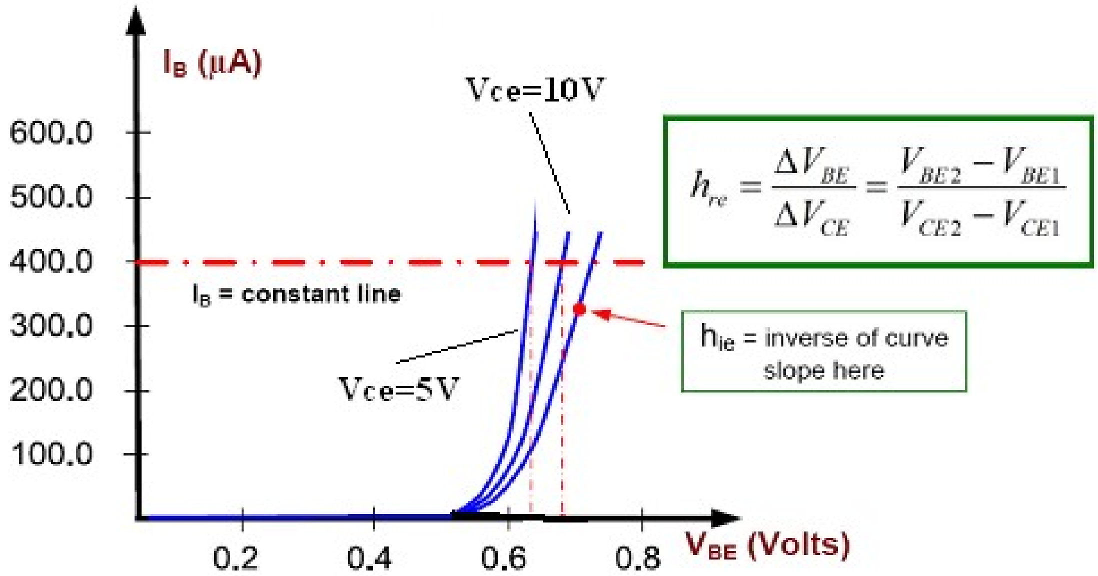
TABULATON:

INPUT CHARACTERISTICS

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

MODEL GRAPH:

INPUT CHARACTERISTICS



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 CHARACTERISTICS:

1. Connect the circuit as per the circuit diagram.
2. Set **V_{CE} = 5V**, vary V_{BE} in regular interval of steps and note down the corresponding I_B reading.
3. Repeat the above procedure for different values of **$V_{CE=10V}$**.
4. Plot the graph: V_{BE} Vs I_B for a constant V_{CE}.

   h- Parameter Calculation

   Input Resistance $hie = \dfrac{V_{BE2} - V_{BE1}}{I_{B2} - I_{B1}}$ at Constant V_{CE}

   Reverse Voltage gain $hre = \dfrac{V_{BE2} - V_{BE1}}{V_{CE2} - V_{CE1}}$ at Constant I_B

OUTPUT CHARECTERISTICS:

1. Connect the circuit as per the circuit diagram.
2. Set **I_B = 50µA**, Vary V_{CE} in regular interval of steps and note down the corresponding I_C reading.
3. Repeat the above procedure for different values of **I_B=100µA**.
4. Plot the graph: V_{CE} Vs I_C for a constant I_B.

   h- Parameter Calculation:

   Forward Current Gain (h_{fe}) = $\dfrac{I_{C2} - I_{C1}}{I_{B2} - I_{B1}}$ Constant V_{CE}

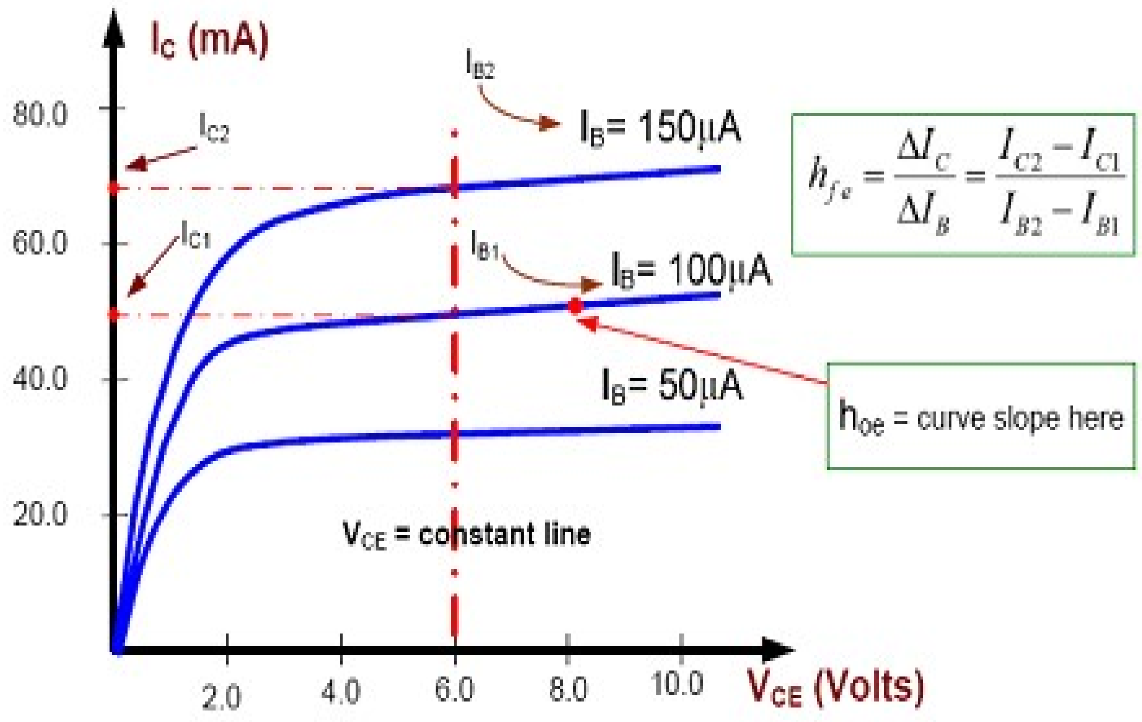
   Output Conductance (h_{oe}) = $\dfrac{I_{C2} - I_{C1}}{V_{C2} - V_{C1}}$ Constant I_B

OUTPUT CHARACTERISTICS

$I_{B=}$ μA		$I_{B=}$ μA	
V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)

MODEL GRAPH:

OUTPUT CHARACTERISTICS



APPLICATIONS:

- **Audio amplifier** -Common emitter has a gain that is positive and greater than unity.
- Used in small **class A linear amplifier** stages as well as **logic outputs**
- It is used to make **logic gates, microcontrollers, microprocessors, and other integrated circuits.**
- Used as a Switch.

MODEL CALCULATION:

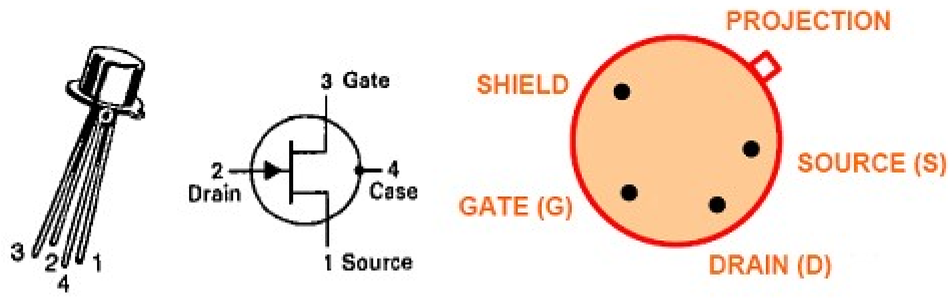
RESULT:

The transistor characteristics of a Common Emitter (CE) configuration were plotted and uses studied.

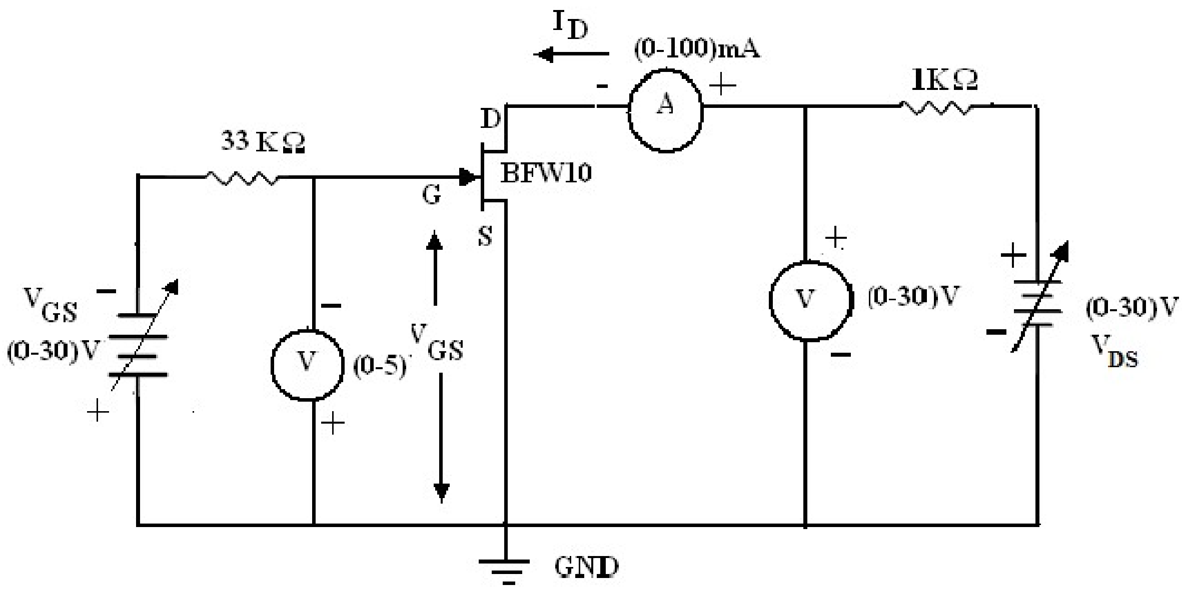
Practical values of h- parameters are as follows:

i. Input resistance (with output short circuited) h_{ie}= ------------- ohms
ii. Reverse voltage transfer ratio (with input short circuited) h_{re}= ---------
iii. Forward current transfer ratio (with output short circuited) h_{fe}= ----
iv. Output admittance (with input short circuited) h_{oe}= ----------mhos.

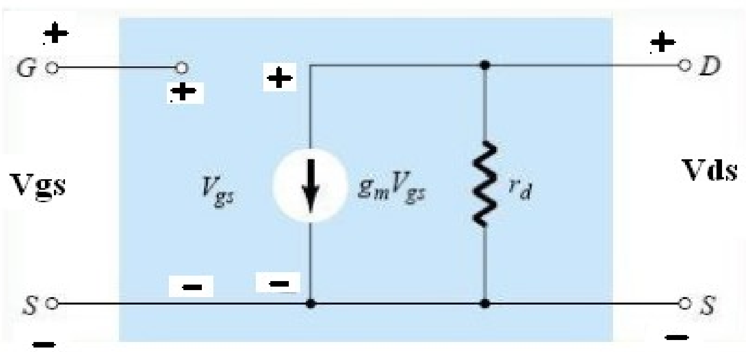
JFET TERMINAL DIAGRAM



CIRCUIT DIAGRAM



EQUIVALENT CIRCUIT:



EX.NO: 3	CHARACTERISTICS OF JFET
DATE:	

AIM:

To Plot the characteristics of given FET and draw the equivalent circuit.

APPARATUS REQUIRED			
S.NO.	**NAME**	**RANGE**	**QTY**
1	R.P.S	(0-30)V	2
2	Ammeter	(0–100)mA	1
3	Voltmeter	(0–30)V	1
		(0-5)V	1
COMPONENTS REQUIRED:			
1	FET	BFW10	1
2	Resistor	1kΩ	1
		33KΩ	1
3	Bread Board	-	1
4	Connecting Wires	As required	

THEORY:

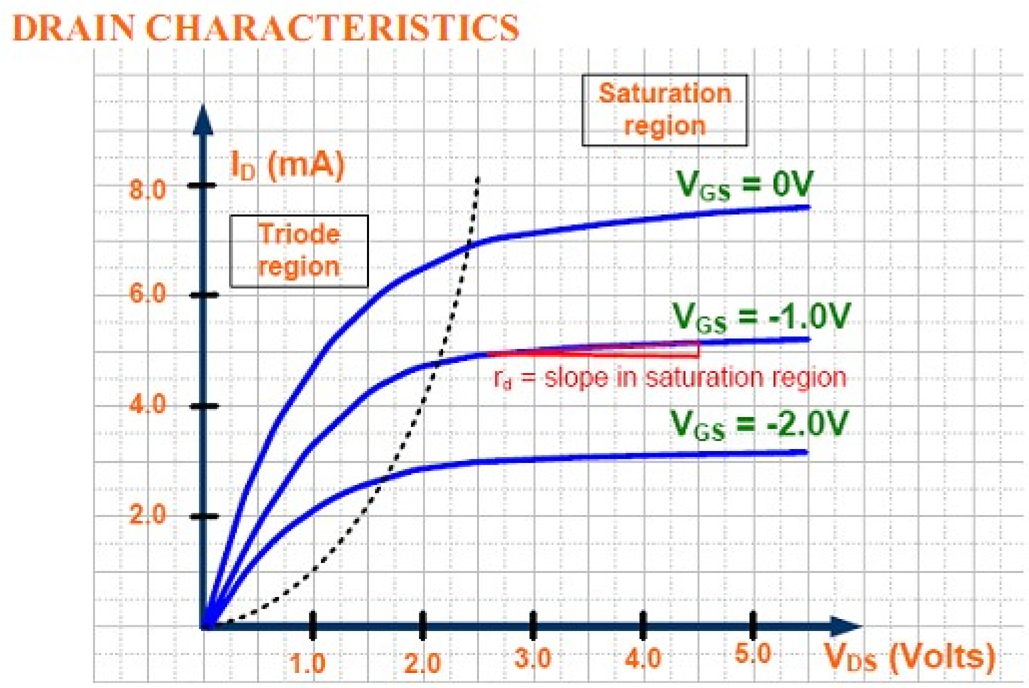
FET is a voltage-operated device. It has got 3 terminals. They are Source, Drain & Gate. When the gate is biased negative with respect to the source, the PN junctions are reverse biased & depletion regions are formed. The channel is more lightly doped than the p type gate, so the depletion regions penetrate 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.

TABULATION:

DRAIN CHARACTERISTICS

V_{GS} = 0 V		V_{GS} = -1V		V_{GS} = -2 V	
V_{DS}(V)	I_D(mA)	V_{DS}(V)	I_D(mA)	V_{DS}(V)	I_D(mA)
1		1		1	
2		2		2	
3		3		3	
4		4		4	
5		5		5	
6		6		6	
7		7		7	

MODEL GRAPH



PROCEDURE:

DRAIN CHARACTERISTICS

1. Connections are given as per the circuit diagram.
2. V_{GS} is kept constant by adjusting the input power supply.
3. Varying the supply voltage at the output side in steps of 1 volt.
4. Note down the corresponding V_{DS} and I_D.
5. Repeat the same procedure for various constant values of V_{GS}.
6. Plot the graph between V_{DS} and I_D.

TRANSFER CHARACTERISTICS:

1. Connections are given as per the circuit diagram.
2. V_D is kept constant by adjusting the output power supply.
3. Varying the supply voltage at the input side in steps of 1 volt.
4. Note down the corresponding V_{GS} and I_D.
5. Repeat the same procedure for various constant values of V_D.
6. Plot the graph between V_{GS} and I_D.

EQUIVALENT CIRCUIT:

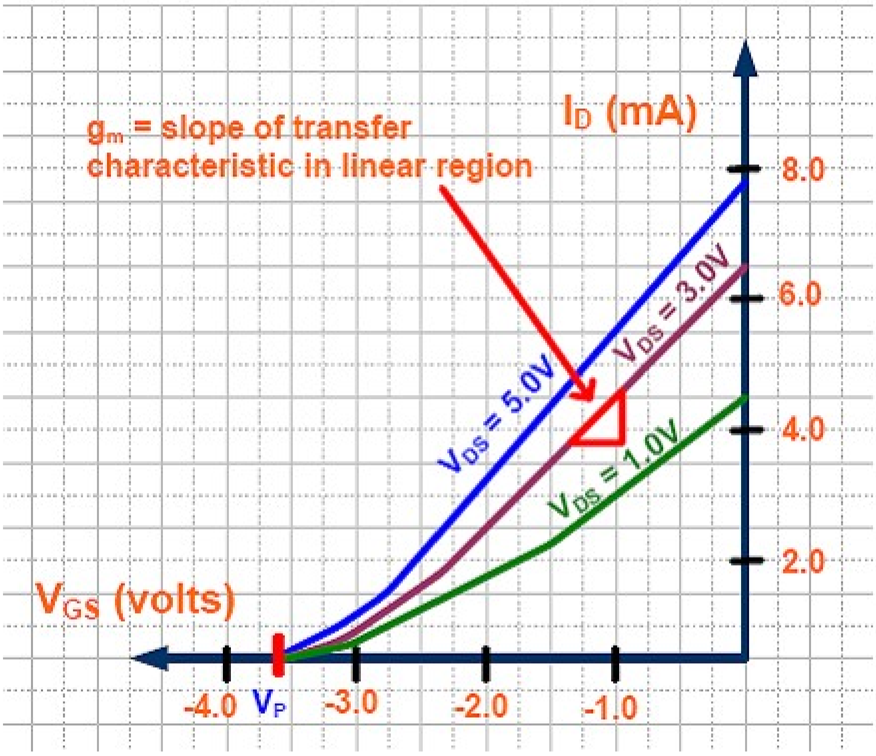
1. From the drain and transfer characteristics obtain the equivalent parameters g_m , r_d.
2. Draw the equivalent circuit of FET.

TABULATION:

TRANSFER CHARACTERISTICS:

V_{DS} = 3 V		V_{DS} = 5 V	
V_{GS}(V)	I_D(mA)	V_{GS}(V)	I_D(mA)
0		0	
1		1	
2		2	
3		3	
4		4	

MODEL GRAPH



FORMULAS:

1. DC Drain resistances $R_{DS} = \frac{V_{DS}}{I_D}$

2. AC Drain resistances $r_D = \frac{\Delta V_{DS}}{\Delta I_D}$

3. Tran conductance $g_m = \frac{\Delta I_D}{\Delta V_{GS}}$

4. Amplification factor $\mu = g_m \times r_D$

APPLICATIONS :

FETs are widely used as input amplifiers in oscilloscopes, electronic voltmeters and other measuring and testing equipment because of their **high input impedance**.

RESULT:

Thus the drain and transfer characteristics of FET has been studied and its parameters are calculated, equivalent circuit is drawn.

(i) Dc drain resistances (R_{DS}) =…………….. Ω

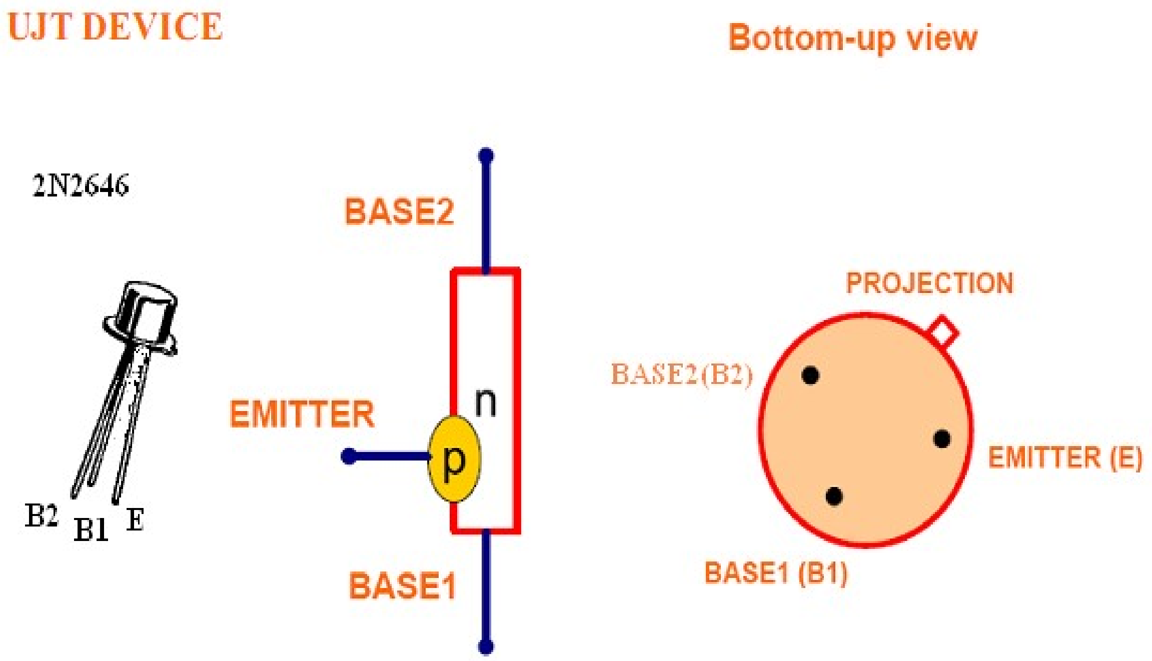
(ii) Ac drain resistances (r_D) =…………….. Ω

(iii) Transconductances (G_m) =…………….. mho

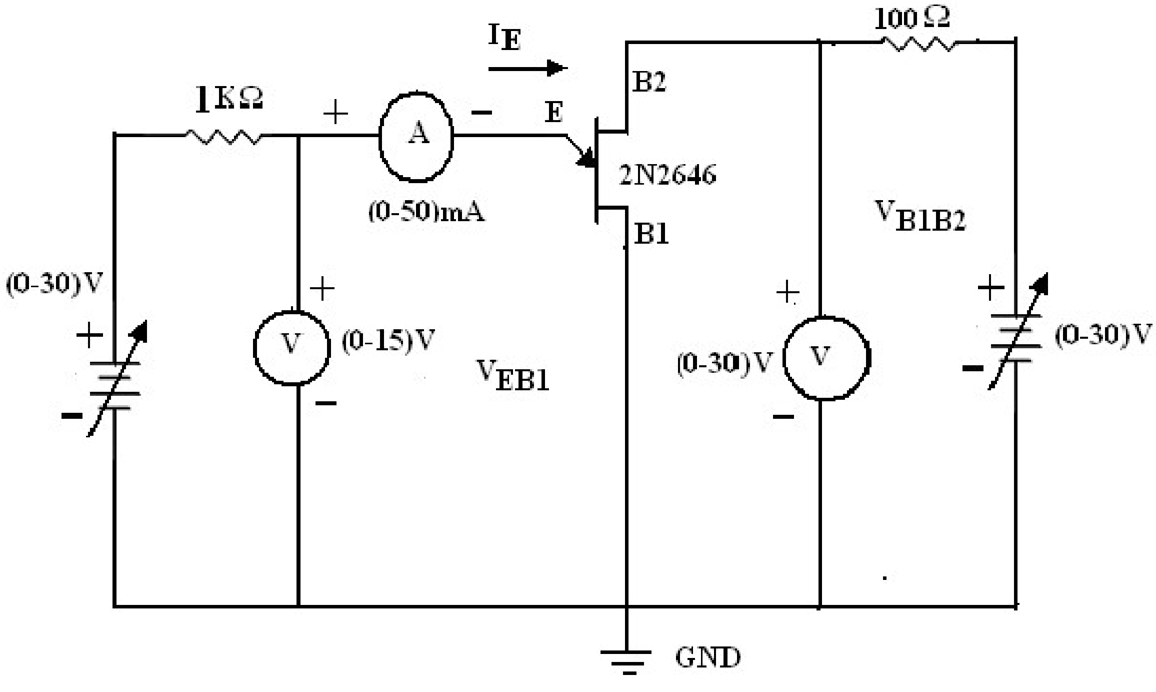
(iv) Amplification factor (μ) = ……………..

(v) Pinch of voltage (V_p) =…………….. V

(vi) Saturation state drain current (I_{DSS}) =…………….. mA



CIRCUIT DIAGRAM



EX.NO: 4	CHARACTERISTICS OF UJT
DATE:	

AIM:

To Plot the characteristics of UJT &generate saw tooth waveform.

APPARATUS REQUIRED:			
SL.NO.	**NAME**	**RANGE**	**QTY**
1	R.P.S	(0-30)V	2
2	Ammeter	(0–50)mA	1
3	Voltmeter	(0–30)V	1
		(0–15)V	1
COMPONENTS REQUIRED:			
1	UJT	2N2646	1
2	Resistor	1KΩ	1
		100Ω	1
3	Bread Board		1
4	Wire	As required	

THEORY:

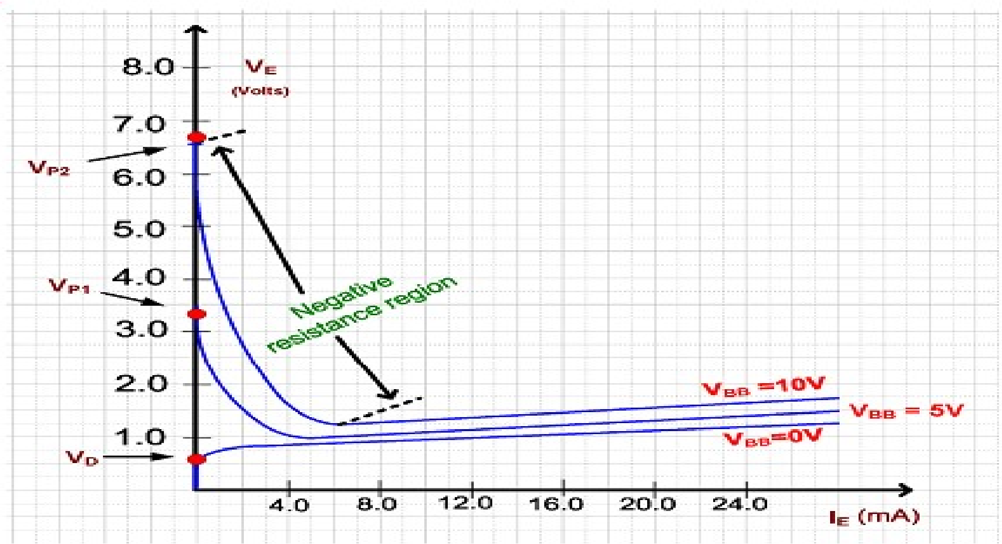
UJT (Double base diode) consists of a bar of lightly doped n-type silicon with a small piece of heavily doped P type material joined to one side. It has got three terminals. They are Emitter (E), Base1 (B_1), Base2 (B_2).Since the silicon bar is lightly doped, it has a high resistance & can be represented 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.

TABULATION (characteristics of UJT) **(saw tooth waveform)**

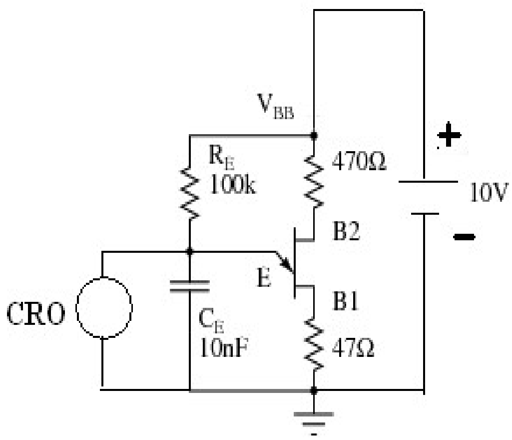
V_{B1B2} = 0 V		V_{B1B2} = 5 V		V_{B1B2} = 10 V	
I_E(mA)	V_{BE1}(V)	I_E(mA)	V_{BE1}(V)	I_E(mA)	V_{BE1}(V)

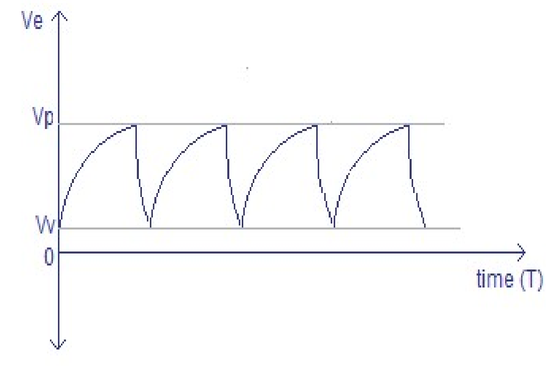
V_E(V)	Time period	
	T_c(ms) charging	T_d(ms) discharging

MODEL GRAPH



GENERATION OF SAWTOOTH WAVEFORM (UJT relaxation oscillator)





Wave form across the capacitor in a UJT relaxation oscillator

UJT relaxation oscillator:

The relaxation oscillator in Figure is an application of the unijunction oscillator. R_E charges C_E until the peak point. The unijunction emitter terminal has no effect on the capacitor until this point is reached. Once the capacitor voltage, V_E, reaches the peak voltage point V_P, the lowered emitter-base1 E-B1 resistance quickly discharges the capacitor. Once the capacitor discharges below the valley point V_V, the E-RB1 resistance reverts back to high resistance, and the capacitor is free to charge again. During capacitor discharge through the E-B1 saturation resistance, a pulse may be seen on the external B1 and B2 load resistors. The load resistor at B1 needs to be low to not affect the discharge time. The charging resistor R_E must fall within certain limits. It must be small enough to allow I_P to flow based on the V_{BB} supply less V_P. It must be large enough to supply I_V based on the V_{BB} supply less V_V.

PROCEDURE:

1. Connections are given as per the circuit diagram.
2. The voltage V_{B1B2} is kept constant.
3. By varying the supply voltage at the input side corresponding voltage V_{EB1} and current I_E is noted.
4. Repeat the same procedure for various constant value of V_{B1B2} .
5. Plot the graph between V_{BE} and I_E
6. From the graph note down the peak point V_P and valley point V_V =V_D and calculate the intrinsic stand of ratio η.

$$\eta = \frac{V_{P}-V_{V}}{V_{B1B2}}$$

GENERATION OF SAWTOOTH WAVEFORM (UJT relaxation oscillator)

1. Connections are given as per the circuit diagram.
2. The voltage V_{B1B2} is kept constant.
3. Obtain the waveform across the capacitor C_E.
4. Draw the graph between V_E and time period.

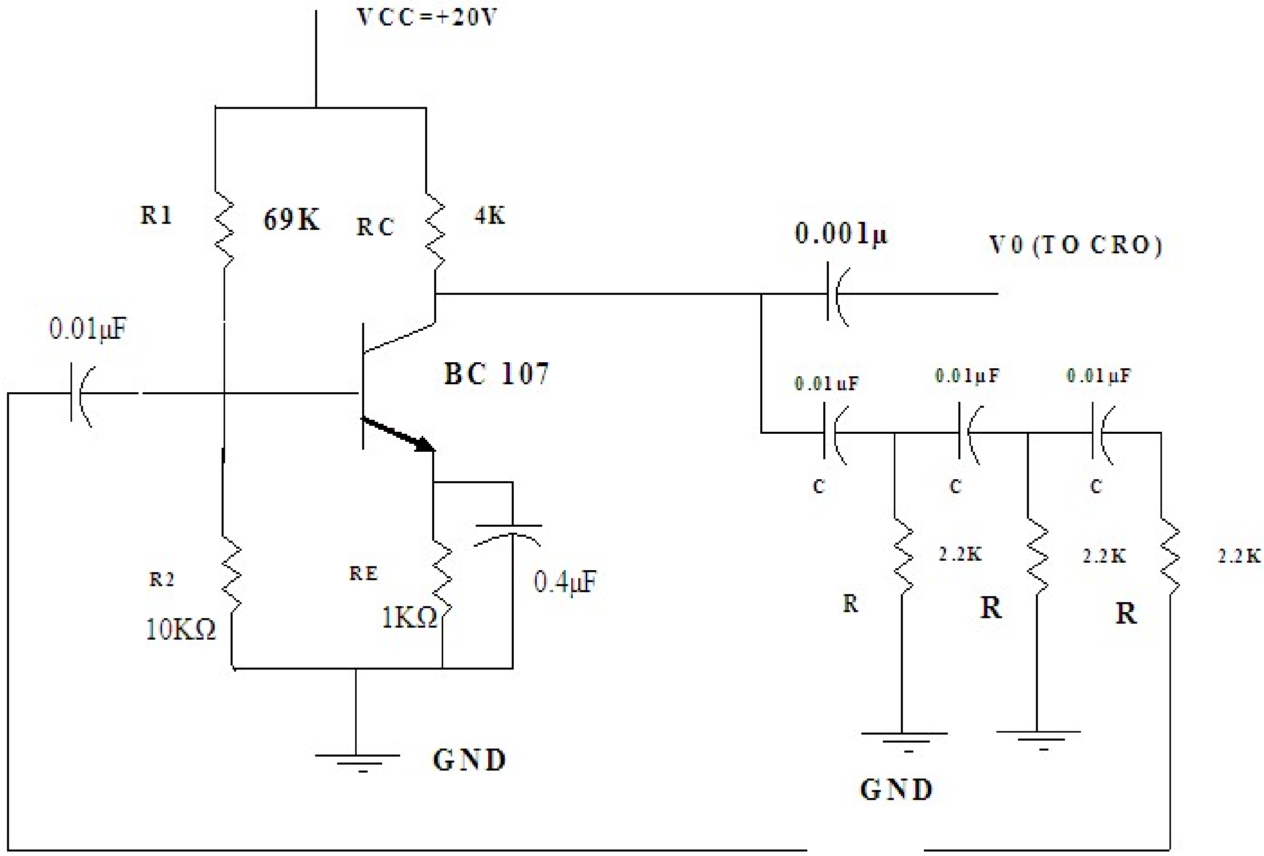
APPLICATIONS :

❖ Switching device, Oscillators, pulse generators, saw-tooth generators, triggering circuits, phase control, timing circuits, and voltage-or current-regulated supplies.

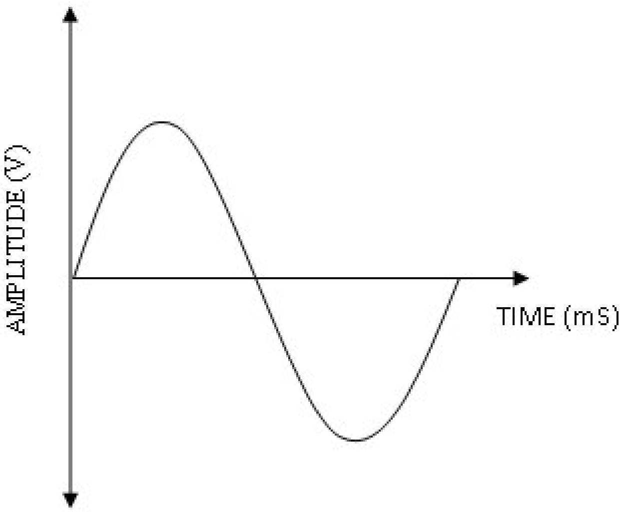
RESULT:

Thus the static characteristic of UJT is obtained and saw tooth waveform is generated.

CIRCUIT DIAGRAM



MODEL GRAPH:



EX.NO: 5A.	RC PHASE SHIFT OSCILLATOR
DATE:	

AIM:

To design a fixed frequency oscillator to generate oscillation of 2.9 KHz for the given specifications V_{cc} = 20V, Ic =2mA, S=10.

APPARATUS REQUIRED:			
S.NO	**NAME**	**RANGE**	**QTY**
1	R.P.S	(0-30)V	1
2	CRO	20MHz	1
COMPONENTS REQUIRED			
1	Transistor	BC 107	1
2	Resistor	2.2KΩ,1KΩ,10KΩ,20KΩ,4 KΩ,68KΩ	Each 1
3	Capacitor	0.4µf,0.01 µf, 0.004 µf	Each 1
4	Bread Board	-	1
5	Wire		

THEORY:

It is one of the RC Oscillator by using resistor and capacitor as a component in the feedback network. It consists of 3 RC sections providing phase shift of 180º. The amplifier produced an additional 180º making 360º and satisfying the Barkhausen criterion. The R and C values should be same in the feedback network and must be changed simultaneously to change the value of the frequency which is impossible practically and so it is mostly fixed frequency oscillator.

PROCEDURE:

1. Connections are given as shown in the circuit diagram

2. Observe the output voltage (V_o) time period (t), from the CRO.

DESIGN:

$V_{CC} = 20V$, $I_C = 2mA$

1. $I_C = I_E$
2. $V_E = \frac{V_{CC}}{10} = \frac{20}{10} = 2V$
3. $V_{CE} = \frac{V_{CC}}{2} = \frac{20}{2} = 10V$
4. $V_E = I_E R_E$ $\quad R_E = \frac{V_E}{I_E} = 1K\Omega$
5. **Applying KVL at output loop**

   $V_{CC} = I_C R_C + I_E R_E + V_{CE}$

   $20 = 2\times 10^{-3} R_C + 2+10$

   $8 = 2\times 10^{-3} R_C$

   $R_C = 4K\Omega$
6. **Stability factor where S = 10**

   $S = 1+\frac{R_B}{R_E}$

   $10 = 1+\frac{R_B}{1K\Omega}$

   $R_B = 9K\Omega$

   $R_B = R_1 \parallel R_2 = \frac{R_1\times R_2}{R_1+R_2}$

   Let $R_2 = 10K\ \Omega$

   $9K = \frac{R_1\times 10K}{R_1+10K}$

   $R_1 = 69K\ \Omega$
7. $f = \frac{1}{2\pi RC\sqrt{6}}$

   let C = 0.01µf, f = 2.9 KHz

   $2.9\times 10^3 = \frac{1}{2\times\pi\times R\times 0.01\mu f\times\sqrt{6}}$

R_2 **=2.2K Ω**

3. Calculate the theoretical frequency

$$f = \frac{1}{2\pi RC\sqrt{6}}$$

4. Calculate the practical frequency by using step 2.

$$f = \frac{1}{t}$$

1. Plot the graph between the output voltages (V_o) time period (t).

Compare the practical frequency with theoretical frequency which is approximately equal.

APPLICATIONS:

RC phase shift oscillators are used for musical instruments, oscillators, voice synthesis, and GPS units. They work at all audio frequencies.

TABULATION:

S.NO	AMPLITUDE	TIME PERIOD		FREQUENCY F = 1\T (H_Z)
		T_{ON} (ms)	T_{OFF} (ms)	

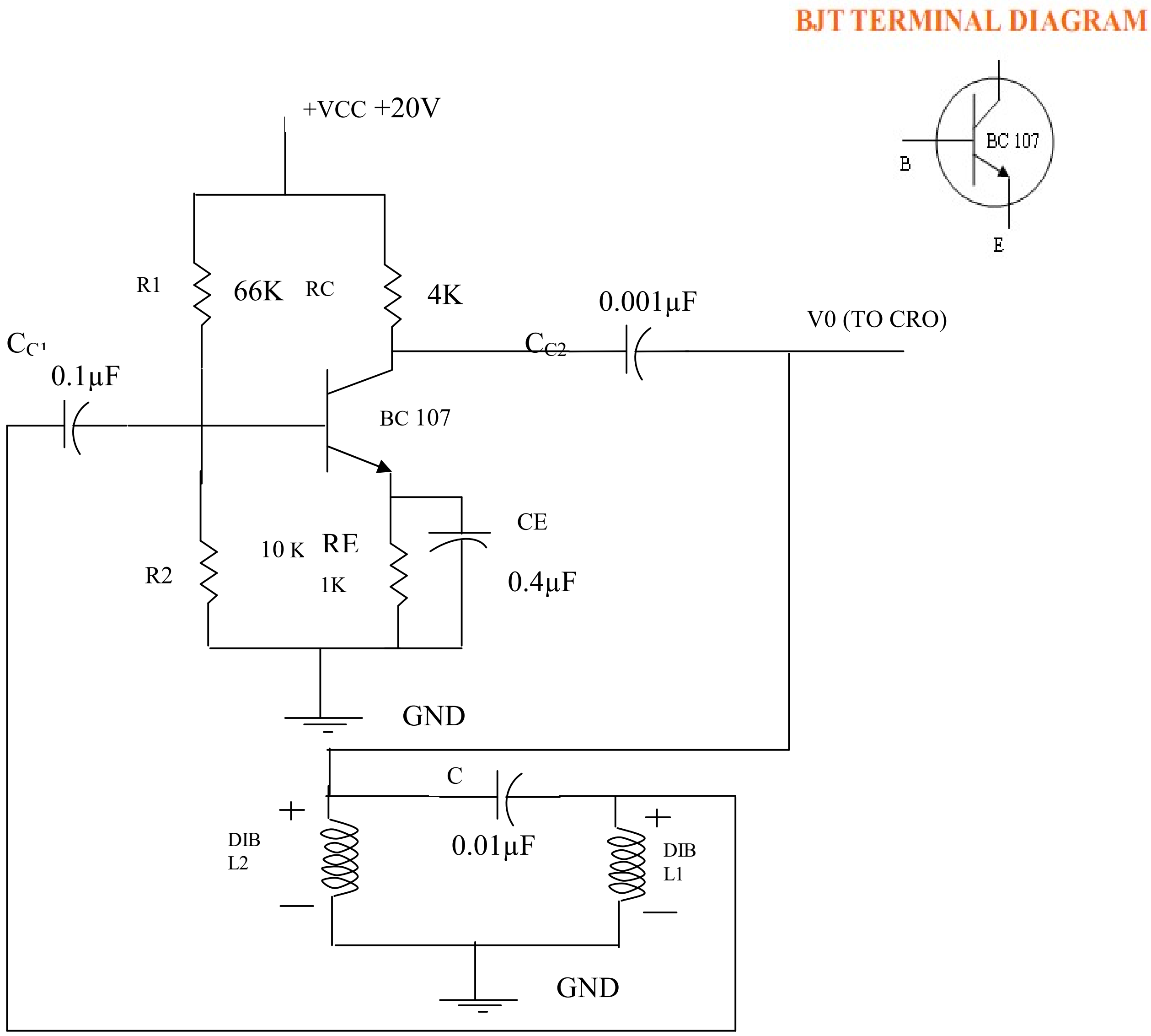
RESULT:

Thus RC phase shift oscillator was designed for the given frequency

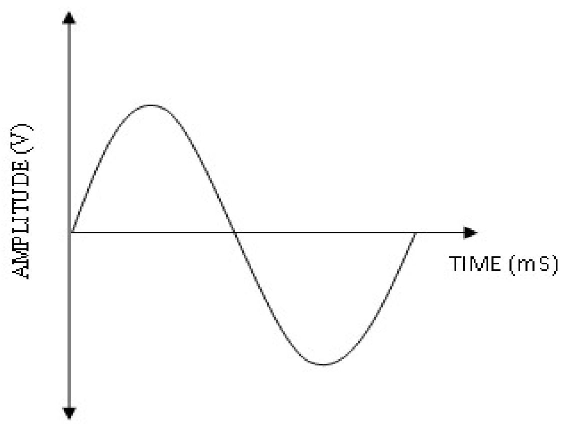
Theoretical frequency =

Practical frequency =

CIRCUIT DIAGRAM



MODEL GRAPH



EX.NO: 5B.	HARTLEY OSCILLATOR
DATE:	

AIM

To design a Hartley oscillator with tank elements being of inductance (L1, L2), capacitance (C) for the given specifications. Vcc = 20V, V_{BE} = 0.7V, Ic =2mA, S=10, V_E = 2V.

APPARATUS REQUIRED:

S.NO	NAME	RANGE	QTY
1	R.P.S	(0-30)V	1
2	CRO	20MHz	1
3	Decade Inductance Box	-	2
4	Decade Capacitance Box	-	1

COMPONENTS REQUIRED

S.NO	NAME	RANGE	QTY
1	Transistor	BC 107	1
2	Resistor	1KΩ,10KΩ,4KΩ,66KΩ	Each 1
3	Capacitor	0.4µf,0.001 µf, 0.01 µf	Each 1
4	Bread Board	-	1
5	Wire	As required	

THEORY:

Resistors R_1 and R_2 and R_E provide the necessary DC bias to the transistor. CE is a bypass capacitor. C_{C1} and C_{C2} are coupling capacitors. The feedback consisting of inductors L1 and L2 and capacitor c determines the frequency of oscillator.

When the supply voltage +VCC is switched on the transistor current is produced in the tank circuit and damped oscillation set up in the circuit. The oscillator current in the tank circuit.

DESIGN:

V_{CC} =20V, I_C =2mA, S=10, V_{BE} =0.7V, V_E=2V

1. $V_E = I_E R_E$

   $R_E = \frac{VE}{I_E}$ $I_C = I_E$

   R_E=1KΩ

2. $V_B = V_{BE} + V_E = 0.7+2 = 2.7V$

4. $V_{CC} = I_C R_C + V_{CE} + V_E$

   $R_C = \frac{V_{CC}-V_{CE}-V_E}{I_C} = \frac{20-10-2}{2\times10^{-3}} = 4K\Omega$

   $V_B = \frac{V_{CC}R_2}{R_1+R_2}$

5. $\frac{R_2}{R_1+R_2} = \frac{V_B}{V_{CC}} = \frac{2.7}{20} = 0.135$

6. $S = 1 + \frac{R_B}{R_E}$

   $10 = 1 + \frac{R_B}{1}$

   $R_B = 9K\Omega$

   $R_B = \frac{R_1R_2}{R_1+R_2}$

   9K=R_1 (0.135)

   R_1=66KΩ

   $R_2 = \frac{R_B R_1}{R_1 - R_B}$=10kΩ

   R_2=10KΩ

7. EX: L_1=18mH, L_1=10mH, C=0.01µf

$$f_0 = \frac{1}{2\pi\sqrt{C(L1+L2)}} = 9.5KHZ$$

produces a.c. voltage L1 and L2. As terminal 3 is earthed it is at zero potential. If terminal 1 is positive with respect to 3, terminal 2 will be negative with respect to 3 at the same instant. Thus the phase difference between the terminals 1 & 2 is 180°. In CE mode the transistor provides phase difference of 180° between input & output. Thus total phase shift is 360°.Thus frequency determined for the tank circuit, necessary condition for oscillation is satisfied.

PROCEDURE:

1. Connections are given as shown in the circuit diagram.
2. Set the L_1 L_2 , C with the help of Decade Inductance Box (DIB) & Decade Capacitance Box (DCB) as 18mH, 10mH, and 0.01 µf respectively.
3. Observe the output voltage (V_o) time period (t), from the CRO.
4. Calculate the theoretical frequency

$$f = \frac{1}{2\pi\sqrt{C(L_1 + L_2)}}$$

5. Calculate the practical frequency by using step 2.

$$f = \frac{1}{t}$$

6. Plot the graph between the output voltages (V_o) time period (t).
7. Compare the practical frequency with theoretical frequency, which are approximately equal.

APPLICATIONS:

Mainly used in radio receivers. Also due to its wide range of frequencies it is the most popular oscillator

TABULATION:

AMPLITUDE	L1 (mH)	L2 (mH)	C (µF)	Time period		TIME PERIOD $T = T_{on}$(ms) + T_{off}(ms)	FREQUENCY $F = 1\backslash T$ (H_Z)
				T_{on}(ms)	T_{off}(ms)		

MODEL CALCULATION:

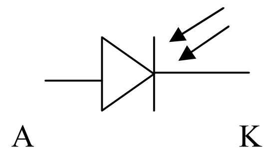
RESULT:

Thus the Hartley oscillator was designed and graph was plotted.

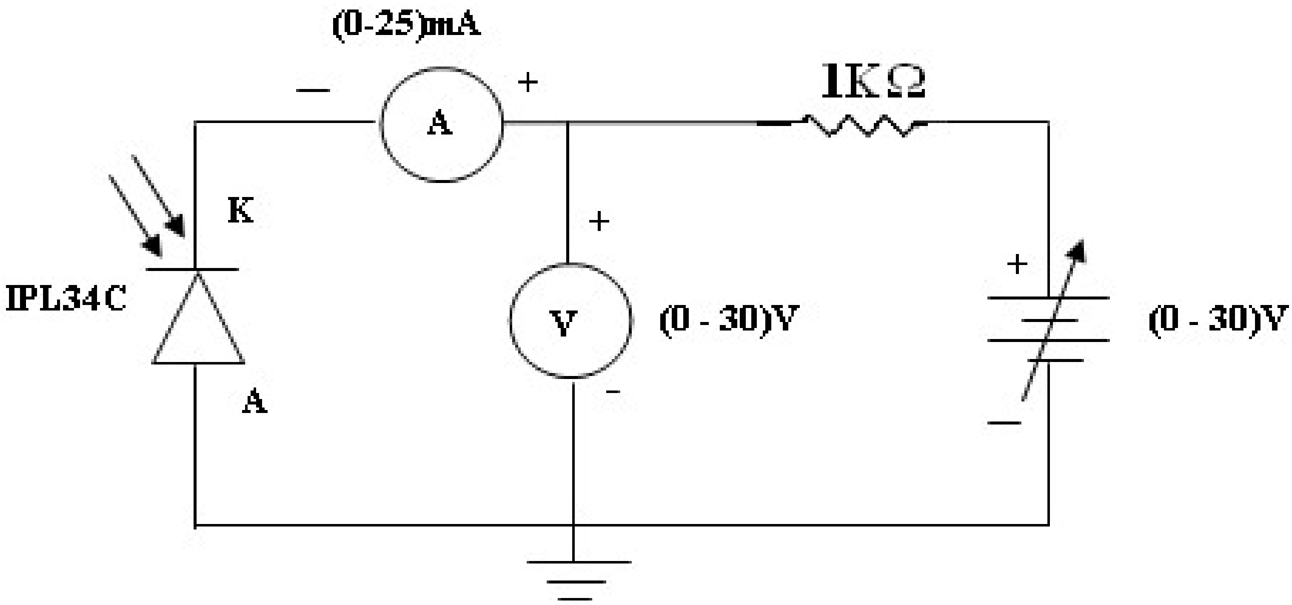
S.NO	Theoretical frequency	Practical frequency
1.		
2.		
3.		

PHOTO DIODE

SYMBOL



CIRCUIT DIAGRAM



ADDITIONAL EXPERIMENTS

EX.NO: 18.A	CHARACTERISTICS OF PHOTODIODE
DATE:	

AIM:

To determine the characteristics of Photodiode

APPARATUS REQUIRED:			
S.NO	**EQUIPMENT**	**RANGE**	**QUANTITY**
1.	Ammeter	(0-25)mA	1
2.	Voltmeter	(0-30)V	1
3.	Dual Power Supply	(0-30)V	2
COMPONENTS REQUIRED			
4.	Photodiode	IPL 34C	1
5.	Resistor	1kΩ	Each 1
6.	Bread Board	-	1
7.	Connecting Wires	As required	

THEORY:

Both Photo diode and Photo transistor operates based on the principle of " **Photo conductive effect".** When radiation is incident on a semiconductor, it absorbs some light, as a result its conductivity varies directly with the intensity of light and its resistances varies inversely with the intensity of light. This effect is called as **Photo conductive effect**.

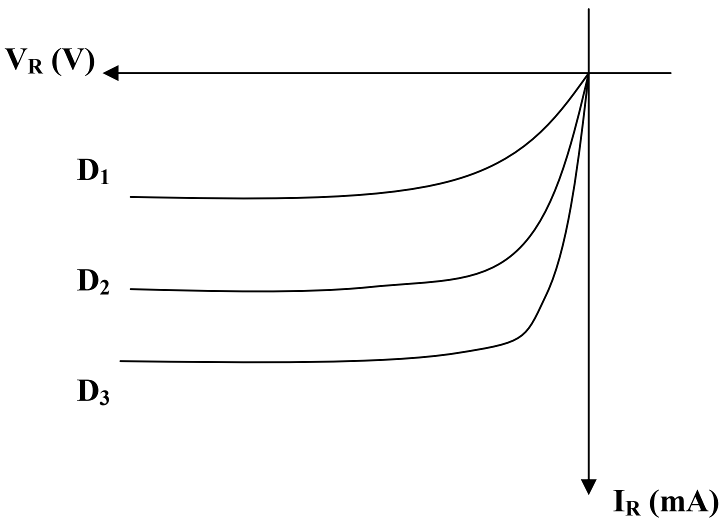
Photo diode:

It is a semiconductor PN-junction device whose region of operation is limited to the reverse biased region. Photo diode is connected in reverse biased condition .The depletion region width is large under normal condition, it carries small reverse current due to the minority charge carriers in μA. If the Photo diode is forward biased, the current flowing through it is in mA. The applied forward biased voltage takes the control of the current

TABULATION

D_1 = (cm)		D_2 = (cm)	
V_R (V)	I_R (mA)	V_R (V)	I_R (mA)

MODEL GRAPH



instead of the light. The change in current due to light is negligible and cannot be noticed. The resistances of forward biased diode are not affected by the light. Hence to have significant effect of light on the current and to operate photo diode as a variable resistor, it is always operated (or) connected in reverse bias. When there is no light, it is called as dark current because there is no current flow due to infinite résistance. When there is a light, more current flows doe to very less resistance. Under reverse bias current control due to light only instead of applied voltage.

PROCEDURE:

1. Connections are given as per the circuit diagram.
2. Place the photo diode at a particular distance from the illumination.
3. Voltage is varied using R.P.S insteps of 1V and corresponding current is noted.
4. Readings are tabulated for various distances and the graph is drawn between voltage and current.

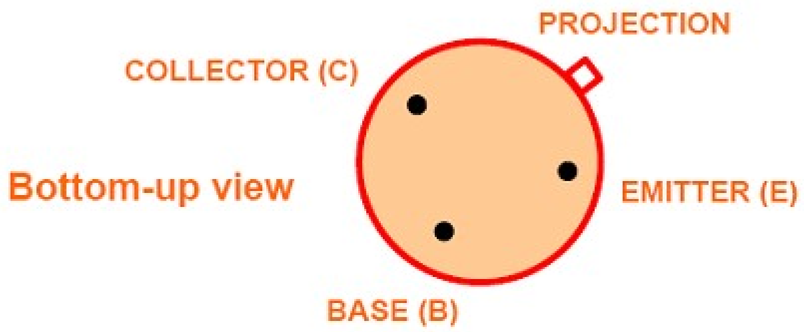
APPLICATIONS:

- Cameras
- Medical devices
- Safety equipment
- Optical communication devices
- Position sensors
- Bar code scanners
- Automotive devices
- Surveying instruments

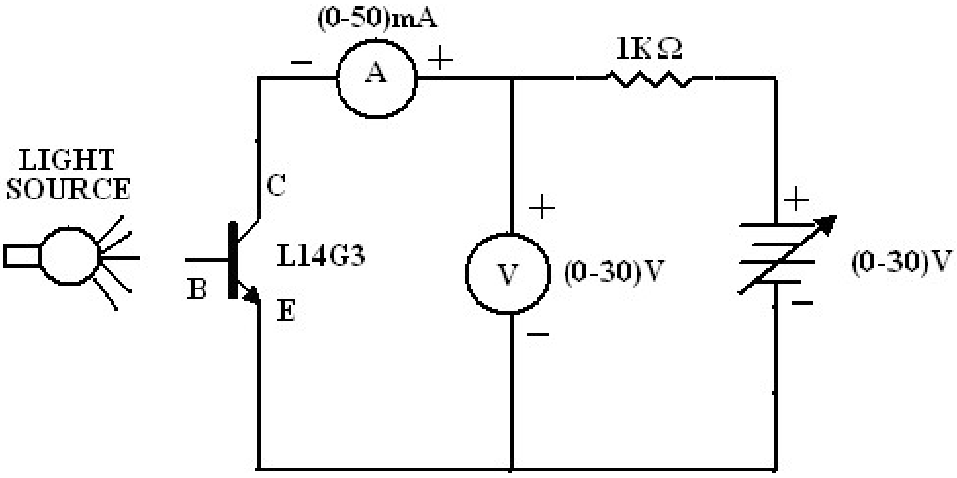
RESULT:

Thus the characteristic of photodiode were obtained and the graph was plotted for various distances

PHOTO TRANSISTOR TERMINAL CONVENTION



CIRCUIT DIAGRAM



EX.NO: 18.B	CHARACTERISTICS OF PHOTOTRANSISTOR
DATE:	

AIM:

To determine the characteristics of Phototransistor

APPARATUS REQUIRED:			
S.NO	**EQUIPMENT**	**RANGE**	**QUANTITY**
1.	Ammeter	(0-50)mA	1
2.	Voltmeter	(0-30)V	1
3.	Dual Power Supply	(0-30)V	1
COMPONENTS REQUIRED			
4.	Phototransistor	L14G3	1
5.	Resistor	1kΩ	1
6.	Bread Board	-	1
7.	Connecting Wires	As required	

THEORY:

Both Photo diode and Photo transistor operates based on the principle of" **Photo conductive effect".** When radiation is incident on a semiconductor, it absorbs some light, as a result its conductivity varies directly with the intensity of light and its resistances varies inversely with the intensity of light. This effect is called as **Photo conductive effect**.

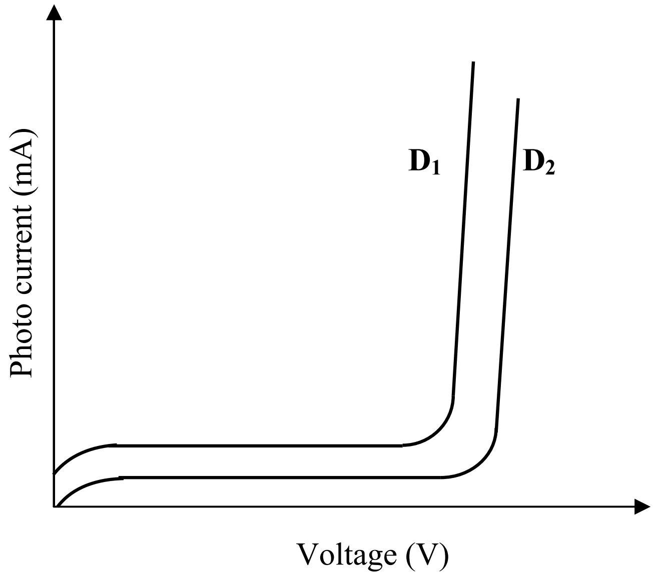
The photo transistor has a light sensitive collector to base junction .A lens is used in transistor package to expose to an incident ligh. When no light is incident, a small leakage current flow from collector to emitter called I_{CEO}, due to small thermal generation .This is very small current, of the order of nA this is called a dark current.

When the base is exposed to the light, the base current is produced which is proportional to the light intensity. As light intensity increases, the base current increases

TABULATION

S.No	Voltage (V)	Photo current (mA)	
		D = (cm)	D = (cm)

MODEL GRAPH



exponentially .Similarly the collector current also increases corresponding to the increase in the light intensity.

Photo transistor can be both a two lead (and) three lead devices. For two lead devices, the base is not electrically available and the device use is totally light dependent.

PROCEDURE

2. Connections are given as per the circuit diagram.
3. Phototransistor is placed at a particular distance from the illumination.
4. Voltage is varied using RPS in steps of 1 volts and corresponding current is noted.
5. Readings are tabulated for various distances and the graph is drawn between voltage and current.

APPLICATIONS:

- ❖ Punch-card readers.
- ❖ Security systems
- ❖ Encoders – measure speed and direction
- ❖ IR detectors photo
- ❖ electric controls
- ❖ Computer logic circuitry.
- ❖ Relays
- ❖ Lighting control (highways etc)
- ❖ Level indication
- ❖ Counting system

RESULT:

Thus the characteristic of phototransistor were obtained and the graph was plotted for various distances.

SAMPLE VIVA –VOCE QUESTIONS

1. **Distinguish between intrinsic and extrinsic semiconductors.**

Intrinsic semiconductors are pure form of semiconductor. Where as extrinsic semiconductors is the impure form of semiconductor. Extrinsic semiconductors are formed by doping. There are two types of semiconductors are N type and P type semiconductor.

2. **What is N type semiconductor?**

When a small amount of a pentavalent impurity (eg.Antimony, Arsenic) is added to a pure semiconductor crystal the resulting extrinsic semiconductor is known as N-type semiconductor.

3. **What s P-type semiconductor?**

When a small amount of a trivalent impurity (eg.Gallium, Indium) is added to a pure semiconductor crystal the resulting extrinsic semiconductor is known as P-type semiconductor.

4. **What is meant by life time of a carrier in semiconductor?**

On an average an electron exists ι_n seconds before recombination. This time period ι_n is called the mean life time of electron. Similarly ι_p indicates the mean life time of holes. Hence the sum of ι_n and ι_p gives the resultant mean life time of carriers in semiconductors.

5. **Define a semiconductor.**

The materials, whose electrical properties lie between that of conductors and insulators, are known as semiconductor.

6. **Define the term knee voltage.**

The forward voltage at which the current through the PN junction starts increasing rapidly is known as knee voltage. It is also called as cut in voltage or threshold voltage.

7. **What is Avalanche breakdown?**

When PN junction diode is reverse biased, strong depletion region is formed across the junction results in small current flows due to minority carriers. Breaking of covalent bonds is due to collision of thermally generated charge carriers having high velocity and kinetic energy with adjacent atom, this process is a cumulative process hence the charge carriers are multiplied hence it is known as carrier multiplication or avalanche multiplication.

8. **What is depletion region?**

The region around the junction from which the carriers are completely depleted is known as depletion region. Since this region has immobile ions which are electrically charged. The depletion region is also called as space charge region.

9. **Define peak inverse voltage in a diode.**

Peak inverse voltage is the maximum voltage applied across the diode when it is reverse biased without destroying it.

10. **Define barrier potential at the junction.**

Potential barrier is defined as the potential difference built up across the PN junction which restricts further movement of charge carriers across the junction.

Potential barrier for silicon diode = 0.7 V

Potential barrier for Germanium diode = 0.3 V

11. **What is a PN junction diode?**

A PN junction diode is a semiconductor device that is fabricated by sandwiching a P-type material with an N- type material. The plane dividing the two zones is known as a junction.

12. **Define the term break down voltage**

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

13. **List the applications of PN junction diode.**

(i).They are used as rectifier diodes in DC power supplies.

(ii).They are used as signal diodes in communication circuits for modulation and demodulation.

(iii).They are used in clipper and clamper circuits.

(iv).They are used as a switch in logic circuits used in computers.

14. **What is zener diode?**

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

15. **What is meant by zener breakdown?**

Zener breakdown takes place when both sides of the junction are very heavily doped and consequently the depletion layer is thin. When a small reverse bias voltage is applied, a very strong electric field is set up across the thin depletion layer. This electric field is enough to break the covalent bonds. Now extremely large number of free charge carriers are produced which constitute the Zener current. This process is known as Zener breakdown.

16. **List the applications of Zener diode**

(i).It can be used as a voltage regulator.

(ii).It can be used as a limiter in wave shaping circuits.

(iii).It can be used as a protection circuit against damage from accidental over voltage.

(iv).It can be used as a fixed reference voltage in a network for calibrating voltmeters

17. **What are the three different regions of transistor?**

Active region: It is the region in which the emitter base junction is forward biased and collector base junction is reverse biased. Transistor act as amplifier.

Cutoff region: It is the region in which both the emitter base junction and collector base junction are reverse biased. Transistor act as switch (OFF position).

Saturation region: It is the region in which both the emitter base junction and collector base junction are forward biased. Transistor act as switch (ON position).

18. **What is early effect (or) what is meant by base width modulation?**

When the collector base junction is reverse biased it increases 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.

19. **What are the types of configuration in BJT?**

(i).Common emitter configuration.

(ii). Common base configuration.

(iii). Common collector configuration.

20. **Why is CE configuration considered to be most versatile one?**

Since the current gain is very high, CE configuration is used in all transistor application.

21. **Which of the BJT configuration is suitable for impedance matching applications? Why?.**

CC configuration is suitable for impedance matching application (i.e. for driving a low impedance load from a high impedance source). Because it has unity voltage gain) .It also used as a voltage follower (or) buffer.

22. **What is meant by thermal run away?**

The continuous increase in collector current due to biasing causes the temperature at collector to increase .If stabilization is done, the collector leakage current also increases due to the transistor parameters (β, Ico, Vbe). This further increases the temperature. This action is cumulative and ultimately the transistor burns out. The self destruction of an unstabilised transistor is known as thermal runaway.

23. **What is the use of Heat sink?**

The heat sink is a relatively large black metallic heat conducting devices placed in close contact with transistor case so that the effective surface area is increased and resistance to heat flow is decreased hence heat can be effectively discharged.

24. **List the applications of BJT.**

(i).Acts as a switch.

(ii).Acts as a amplifier.

25. **What is FET?**

A field effect transistor is a semiconductor devices, it has three terminals such as source, drain and gate. In which current conduction is by any one type of carriers, (either electrons or holes) and is controlled by an electric field. Hence it is named as Field Effect Transistor (FET).

26. **State the advantages of FET over the BJT.**

i. FET is unipolar devices.
ii. FET is less noisy than BJT.
iii. It is a voltage control devices.
iv. FET has very high voltage gain.

27. **Mention the applications of FET**

i. As a amplifiers
ii. As a modulators
iii. As a oscillators.
iv. As a Switch in digital circuits.

28. **Difference between BJT and FET.**

SL.NO	FET	BJT
1.	It is a unipolar devices (current in the device is carried either by electrons (or) holes)	It is a bipolar devices (current in the device is carried either by both electrons and holes)
2.	It is a voltage control device (gate voltage controls the amount of current through the devices)	It is a current control device (base current controls the amount of current through the devices)
3.	Input resistance is very high	Input resistance is low
4.	It has negative temperature co-efficient. It means that collector current decreases with the increase in temperature. This characteristic prevents the FET from thermal breakdown.	It has positive temperature co-efficient. It means that collector current increases with the increase in temperature. This characteristic leads the BJT to thermal breakdown.
5.	Less noisy	More noisy
6.	Cost is high	Cost is low

29. **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 junction of FET is reverse biased whereas the input junction of BJT is forward biased.

30. **What is MOSFET?**

The MOSFET is an abbreviation of Metal Oxide Semiconductor Field Effect Transistor. It is three terminal semiconductor devices similar to a FET with gate insulated from the channel. Therefore it is also known as Insulated Gate field effect transistor (IGFET).

31. **How the MOSFET does has high input impedance?**

The input impedance of a MOSFET is higher than that of FET since the gate is insulated from the channel by thin layer of silicon di-oxide.

32. **Why is FET preferred as a buffer amplifier?**

FET has high input impedance and low output impedance. Therefore it can be used as buffer amplifier.

33. **What are the advantages of MOSFET over FET?**

a. Very high input impedance
b. Small size and well suited for integrated circuits

34. **Define the four h-parameters.**

h_i = input impedance

h_o = output impedance

h_f = forward current gain

h_r = reverse voltage gain

35. **Differentiate JFET and MOSFET.**

SL.NO	JFET	MOSFET
1.	Reverse bias for gate	Positive or negative gate voltage
2.	Gate is formed as a diode	Gate is made as a capacitor
3.	Operated only in depletion mode	Can be operated either in depletion or in enhancement mode.
4.	High input impedance	Very high input impedance due to capacitive effect.

36. **What is UJT?**

UJT is a 3 terminal (uni-junction) semiconductor switching devices. Three terminals are Emitter, Base1 and Base2, emitter is always nearer to B2 than B1.UJT is also called as double base diode.

37. **What are the applications of UJT?**

(i).UJT can be used as oscillator

(ii).UJT can be used as Saw tooth generator

iii).UJT can be used for phase control

(iv).UJT can be used as limiting circuit

(v).UJT can be used as multivibrator

vi).UJT can be used for triggering devices such as SCR and TRIAC.

38. **Differentiate BJT and UJT.**

SL.NO	**BJT**	**UJT**
1.	It has two PN junctions	Only one PN junction
2.	Three terminals& emitter, base, collector.	Emitter, Base1 and Base2.
3.	Basically amplifying device	Switching devices.

39. **Why RC coupling is popular?**

RC coupling is popular because it is simple, less expensive, less distortion and it Provides uniform bandwidth.

40. **State the reason for fall in gain at low frequencies in the RC coupled amplifier.**

a. The coupling capacitance (input) has very reactance at low frequency.

Therefore it will allow only a small part signal from one stage to next stage.

b. The bypass capacitor cannot bypass or shunt the emitter resistor effectively.

As a result of these factors, the voltage gain rolls off at low frequency.

41. **What are all the drawbacks of a full wave rectifier?**

The draw backs of full wave rectifier are,

- ❖ Centre tapped transformer is required.
- ❖ Diodes having twice the piv rating are necessary in this rectifier.

42. **What are all the disadvantages of half wave rectifier?**

The disadvantages of half wave rectifier are,

- ❖ Excess ripple (r=1.21)
- ❖ Low rectification efficiency (40.6%)

- Low transformer utilization factor.
- DC saturation of transformer secondary winding.

43. **Define transformer utilization factor of a rectifier circuit.**

The transformer utilization factor TUF is defined as,

TUF = DC power delivered to the load

AC rating of the transformer secondary

44. **What is filter circuit?**

Filter circuits are used to reduce the rectifier output ripple. Either bypassing the AC output components around the load by a shunt capacitance or limiting this magnitude to a low value in the load by a series inductance or a combination of these two for more efficient circuits achieves this.

45. **What are all the different types of filters?**

The different types of filters are,

a. Capacitor filter
b. Series inductor filter
c. LC filters
   i. Capacitance input filter
   ii. Inductance input filter.
d. RC filters.

46. **How ripples are minimized in the capacitor filters?**

In these types of filters a high value of capacitor is placed across directly to the load resistor. This capacitor gets charged during the conduction period of the rectifier and when Vm decreases C gets discharged through RL with a time constant CRL. The capacitor offers only low impedance of 1/2fc. This ripple component of current gets bypassed through 'C'.

47. **What are all the advantages and disadvantages of capacitor filters?**

The advantages of capacitor filters are At high loads,

- Small ripple voltage,
- High output voltage.

The disadvantages are,

- Poor regulation.
- High peak diode current.

48. **Why we go for LC filter?**

The simple shunt capacitor filter reduces ripple voltage but increase the current through the diode. This large current may damage the diode. The simple L filter reduces both peak value of output current and output voltage. So we go for LC filters. This LC filters causes

49. **Define Resonance.**

Resonance is defined as a phenomenon in which applied voltage and resulting current are in phase .In other words, an AC circuit is said to be in resonance if it exhibits unity power factor. At resonances inductive reactance is equal to the capacitive reactance ($X_L = X_C$).

50. **What are the disadvantages of series inductor filter?**

i. The disadvantages of series inductor filter are,
ii. Ripple increases with load resistance.
iii. It requires a high input voltage of transformer for a given DC output and this will increase the cost of the unit.
iv. Inductor is also expensive and bulky.

51. **What are the advantages of shunt capacitor filter?**

The advantages of shunt capacitor filter are,

i. Low ripple voltage for small load currents.
ii. Output voltage is high for small load currents.

52. **What are the disadvantages of shunt capacitor filter?**

The disadvantages of shunt capacitor filter are,

i. Voltage regulation is relatively poor.
ii. High ripple voltage for large load current.
iii. Peak diode current may damage the diodes.

53. **What is a Multivibrator?**

The electronic circuits which are used to generate non sinusoidal waveforms are called Multivibrators.

54. **Name the types of Multivibrators?**

Bistable Multivibrator, Monostable Multivibrator, Astable Multivibrator

55. **How many stable states do bistable Multivibrator have?**

Two stable states.

56. **When will the circuit change from stable state in bistable Multivibrator ?**

When an external trigger pulse is applied, the circuit changes from one stable state to another.

57. **What are the different names of bistable Multivibrator?**

Eccles Jordan circuit, trigger circuit, scale-of-2 toggle circuit, flip-flop and binary.

58. **What are the applications of bistable Multivibrator?**

It is used in the performance of many digital operations such as counting and storing of the Binary information. It also finds applications in the generation and processing of pulse type waveforms.

59. **What are the other names of monostable Multivibrator?**

One-shot, Single-shot, a single-cycle, a single swing, a single step Multivibrator, Univibrator.

60. **Why is monostable Multivibrator called gatting circuit?**

The circuit is used to generate the rectangular waveform and hence can be used to gate other. Circuits hence called gating circuit.

61. **Why is monostable Multivibrator called delay circuit?**

The time between the transitions from quasi-stable state to stable state can be predetermined and hence it can be used to introduce time delays with the help of fast transition. Due to this application is Called delay circuit.

62. **What is the main characteristics of Astable Multivibrator**?

The Astable Multivibrator automatically makes the successive transitions from one quasi- stable State to other without any external triggering pulse.

63. **What is the other name of Astable Multivibrator- why is it called so?**

As it does not require any external pulse for transition, it is called free running Multivibrator.

64. **What are the applications of astable Multivibrator?**

- used as a clock for binary login signals
- used as a square wave generator, voltage to frequency converter.

64. **What is Series resonance and parallel resonance?**

Resonance occurs in series RLC –circuit is referred to as **“series Resonance”** or simply resonances. Resonance occurs in parallel RLC circuit is referred to as “**parallel resonances**”

Resonance frequency is defined as $f_0 = \frac{1}{2\pi\sqrt{lc}} Hz$

65. **Define Band width.**

Bandwidth of RLC resonance circuit is defined circuit is defined as the width of resonance curve up to frequency at which the power in the circuit is half of it's maximum value.

Bandwidth (BW) = $f_2 - f_1$

f_2 = upper cut – off frequency

f_1 = lower cut – off frequency

66. **State the principle of " Photo conductive effect"**

When radiation is incident on a semiconductor, it absorbs some light, as a result its conductivity varies directly with the intensity of light and its resistances varies inversely with the intensity of light. This effect is called as **Photo conductive effect**.

67. **Why the Photo diode is always connected (or) operated in reverse bias?**

If the Photo diode is forward biased, the current flowing through it is in mA.The applied forward biased voltage takes the control of the current instead of the light. The change in current due to light is negligible and cannot be noticed .The resistances of forward biased diode is not affected by the light. Hence to have significant effect of light on the current and to operate photo diode as a variable resistor, it is always operated (or) connected in reverse bias.

69**. What is an oscillator?**

It is a circuit which basically acts as generator, generating the output signal which oscillates with constant amplitude & constant desired frequency.

70. **Give the example for low frequency oscillator?**

- RC phase shift
- Wein bridge

71. **Give few examples of sine wave oscillators?**

- LC oscillator
- RC oscillator
- CRYSTAL oscillator

72. **Give the example for LC oscillator**

- HARTLEY oscillator
- COLPITTS oscillator