ELECTRONICS

M.Sc. PHYSICS

SEMESTER-I, PAPER-VI

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FOREWORD

Since its establishment in 1976, Acharya Nagarjuna University has been forging ahead in the path of progress and dynamism, offering a variety of courses and research contributions. I am extremely happy that by gaining 'A+' grade from the NAAC in the year 2024, Acharya Nagarjuna University is offering educational opportunities at the UG, PG levels apart from research degrees to students from over 221 affiliated colleges spread over the two districts of Guntur and Prakasam.

The University has also started the Centre for Distance Education in 2003-04 with the aim of taking higher education to the door step of all the sectors of the society. The centre will be a great help to those who cannot join in colleges, those who cannot afford the exorbitant fees as regular students, and even to housewives desirous of pursuing higher studies. Acharya Nagarjuna University has started offering B.Sc., B.A., B.B.A., and B.Com courses at the Degree level and M.A., M.Com., M.Sc., M.B.A., and L.L.M., courses at the PG level from the academic year 2003-2004 onwards.

To facilitate easier understanding by students studying through the distance mode, these self-instruction materials have been prepared by eminent and experienced teachers. The lessons have been drafted with great care and expertise in the stipulated time by these teachers. Constructive ideas and scholarly suggestions are welcome from students and teachers involved respectively. Such ideas will be incorporated for the greater efficacy of this distance mode of education. For clarification of doubts and feedback, weekly classes and contact classes will be arranged at the UG and PG levels respectively.

It is my aim that students getting higher education through the Centre for Distance Education should improve their qualification, have better employment opportunities and in turn be part of country's progress. It is my fond desire that in the years to come, the Centre for Distance Education will go from strength to strength in the form of new courses and by catering to larger number of people. My congratulations to all the Directors, Academic Coordinators, Editors and Lesson-writers of the Centre who have helped in these endeavors.

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M.SC. PHYSICS

SYLLABUS

SEMESTER-I, PAPER-VI

106PH24-ELECTRONICS

PRACTICAL-II

- Single Stage R-C Coupled Common Emitter Transistor Amplifier
- I-V Characteristics of UJT
- Astable Multivibrator
- Zener - Diode as Voltage Regulator
- Relaxation Oscillator
- V-I Characteristics of Light Dependent Resistor (LDR).
- RC-Phase Shift Oscillator

CONTENTS

EXPERIMENT - 1

RC-COUPLED AMPLIFER

Aim: To construct a RC coupled amp (Transistor version) and study its frequency response with and without feedback.

Apparatus: Transistor BC 107, resistances 33kΩ, 2.2kΩ, 1kΩ, 10kΩ, Capacitances 2.2μf, 1μf, 50μf/65V, Signal generator, DC Power supply

Theory:

An amplifier is a device by which one parameter like voltage, current or power of the given signal at input circuit can be increased and obtained at the output terminals by proper selection of the operating point of the transistor. There are several types of classifications of amplifiers basing on

1. Purpose: Voltage amplifier, current amplifier. Power amplifier

2. Coupling Circuit: RC Coupled, Inductance coupled, Transformer coupled

3. Operating point: Class A, Class B, Class C, Class AB

In order to increase the amplification we can have multistage amplifiers. Here we take a single stage amplifier and study its performance. If some part of the output (current or voltage) is taken and fed to the transistor along with the input it is called feedback amplifier.

In case of RC coupled amplifier the voltage amplification ($A_v = V_{out}/V_{in}$) is plotted against frequency of the input we get a curve as shown in figure 1.

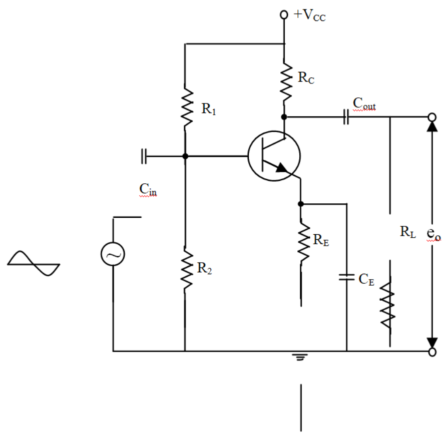
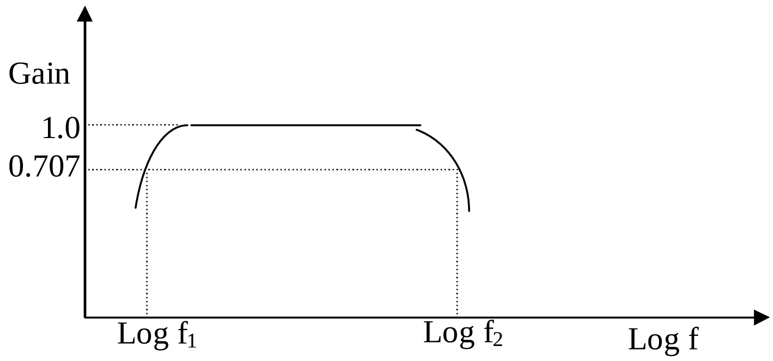


Fig. 1: A Single Stage R-C Coupled Amplifier

In a range of frequencies A_v is found to be constant and will not vary with the frequency. At low frequencies the amplification increases with increase of frequency and at high frequencies it falls with the increase of frequency. The circuit diagram is given below (Fig. 2).



Normalized Gain - Frequency Response Curve

Fig. 2

The behavior can be understood as follows:

Low frequency region: The reactance of coupling capacitor is quite high($1/\omega C$) at low frequencies and thus the output decreases with the decrease of frequency in low frequency region. Further, C_E cannot effectively shunt to emitter resistance R_E. These are the two reasons that cause the fall in amplification in the low frequency region.

High frequency region: At high frequencies, the reactance of C_c is very small and behaves as short circuit. If there is a second stage this increases the loading effect and thus decreases the gain. Further, capacitive reactance of base emitter junction at high frequencies becomes low, which increases the base current. This reduces the amplification factor. By these reasons, gain falls at the high frequency region.

Mid frequency region: The voltage gain in this region remains constant. The effect of coupling capacitance is such that it leads to increase in the gain by offering less reactance with increase of frequency, but at the same time this lower reactance loads the first stage and tends to decrease the gain. Thus these two effects mutually annul each other and maintain uniform gain over the mid frequency region.

The frequencies where the gain is 70.7% of the maximum gain are called cutoff frequencies. There are two such frequencies f_1 and f_2 one on the lower frequency side and the other on the higher frequency side. Bandwidth =($f_2 - f_1$). On decibel scale the power reduction is of three decibels.

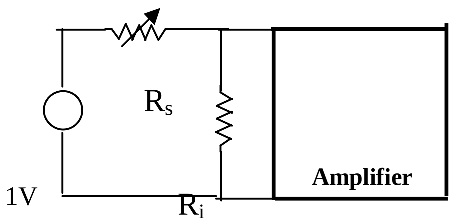
Procedure:

Plotting Frequency Response Curve:

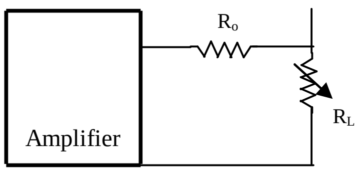
Circuit should be connected as shown in the figure. 30mV (peak to peak) is applied to the base emitter using signal generator. Now measure the output voltage by varying the frequency from 50Hz to 1MHz. Firstly the output voltage increases and reaches a constant value. It remains constant up to a certain frequency and then it decreases. Measure the input and output voltages in the range 50 Hz to 2Mhz and calculate the gain in dB. After completion of taking readings draw graph taking log f on x axis and gain on Y axis. It is called frequency response curve. Note the 3 db points and determine f_1 and f_2.

M**easuring the Input and Output Resistances:**

Connect the circuit as shown in fig. Measure the generator voltage and voltage across R_s. As R_s is varied from zero in steps of 100 ohms the voltage across it increases. Note the value of R_s at which V_i is equal to $V_s/2$. At this value $R_i = R_s$



For output resistance put decade box at output and vary that until it comes to $V_o/2$. It is the output resistance R_o.



Repeat the experiment after removing the condenser C_E for studying frequency response of RC coupled amplifier with feedback

Observations:

FREQUENCY	OUTPUT VOLTAGE(V_o) Volts	Gain V_o/V_i	Gain dB 20 log (V_o/V_i)

Precautions:

1) Loose connections are to be avoided.

2) Readings must be take carefully on C.R.O.

3) At each observations the input voltage magnitude maintain at 30mv peak to peak.

Result:

Band Width obtained from the graph = kHz.

Input resistance R_i = k Ohms.

Output resistance R_o = k Ohms.

EXPERIMENT - 2

I-V CHARACTERISTICS OF UJT

Aim: To study I - V characteristics of the unijunction transistor (UJT) and to find the intrinsic stand - off ratio (η)

Apparatus: UJT 2N 2646
1

Resistors 2.2kΩ
1

100kΩ
1

Regulated power supply (0 –20 V)
1

Ammeter (0 – 50mA)
1

Theory:

UJT is a three terminal device but it has a single p-n junction hence the name uni junction transistor. It was originally called duo (double) base diode due to the presence of two base contacts. The main difference in the construction of the UJT nd that of the FET is that the emitter junction of the former is much smaller than the gate surface of the latter. The FET is always operated with the gate junction reverse biased, where as the UJT is operated with emitter junction forward-biased. The resistance between base1 and base2 is called the inter base resistance, and lies in the range 5k to10k Ohms.

Equivalent circuit of UJT:

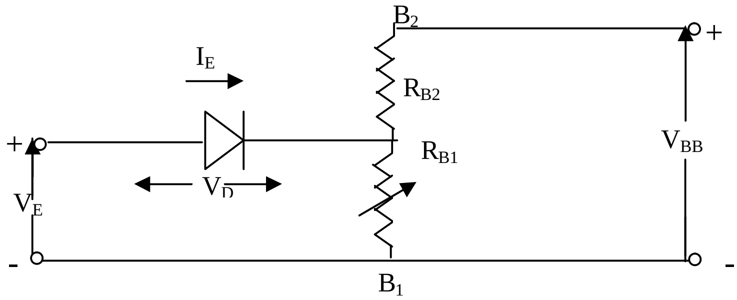


Fig.1: UJT: Equivalent Circuit

Here R_{B1} and R_{B2} represent the resistances of silicon bar R_{B1} is shown variable as it varies with the current $I_{E.}$ When emitter is kept open then the voltage V_1 is that which appears across R_{B1} due to potential division of V_{BB}. Inter base resistance is that between B_1 and B_2 when I_E =0.

$V_1 = V_{RB1} \quad = [R_{B1}/(R_{B1}+R_{B2})].V_{BB}$

$= \eta.V_{BB}$

Where η is called stand of ratio.

$\eta \quad = [R_{B1}/(R_{B1}+R_{B2})].$

Where I_E=0,

Typical value of η is 0.5 to 0.8.

Let the junction voltage be 0.6 (V_B) hence the emitter junction remains reverse biased till V_E is below ($V1+V_D$) Once V_E exceeds (V_1+V_D) the PN junction gets forward biased then holes get injected into the silicon bar and the resistance between E and B_1 get reduced giving negative resistance effect and the emitter current increases causing V_1 to fall. This static emitter characteristic is as shown in FIG 2.

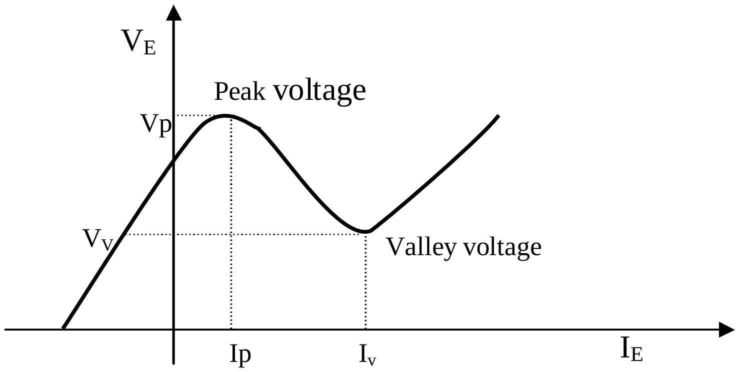


Fig 2: UJT Emitter Characteristics

The peak voltage at which the junction gets which forward biased V_p=V_D+$V_{1.}$

Hence V_{RB1}=V_p-V_D , V_p can be obtained from graph.

V_D depends on the junction (nearly equal to 0.6) Hence η =V_1/V_{BB}

=(Vp-V_D)/V_{BB}

where,

η = intrinsic stand-off ratio

V_p = peak point voltage

V_B = emitter junction voltage drop = 0.7v

V_{BB} = inter base voltage.

Thus stand of ratio η can be calculated.

Main features of UJT:

1. Useful behavior of UJT occurs when the emitter junction is forward biased. A difference can be noticed by comparing this with the operation of JFET where gate is normally operated by reverse biasing.

2. This is a low power-absorbing device and thus becomes a choice in the design of circuits of relatively high efficiency.

3. It has a large number of applications – oscillators, trigger circuits, saw tooth generator, voltage and current regulator, and power supply.

4. UJT is preferred in construction of relaxation oscillator, which can be used to trigger silicon-controlled rectifier.

Construction: A lightly doped n-type silicon bar (high resistance) has two ohmic contact terminals at the two ends of it. Those two terminals are called base 1 and base 2. An aluminum wire which forms emitter terminal is alloyed to silicon bar on the other surface of the bar at a point closer to base 2 terminal than the base 1 terminal. Base 2 is made positive with respect to base1 terminal. Aluminum wire alloyed to silicon bar forms the p-n junction.

The arrow mark indicates the direction of conventional current (flow of holes) when device is forward biased (see Fig 3). The two base terminals are on either side of the emitter terminal. Base 2 is that terminal which is to be connected to higher potential and is closer to the extension lip of the casing.

Procedure: The connections are made as shown in circuit diagram.

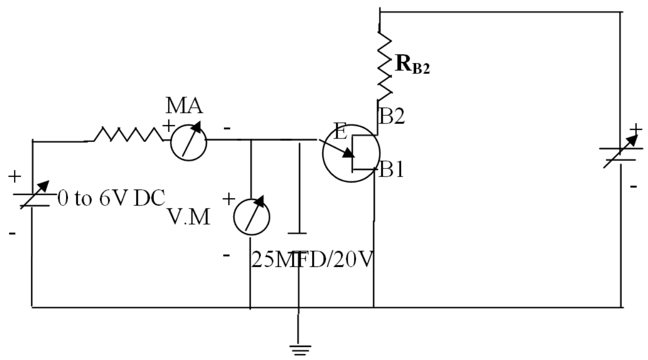


Fig. 3: Circuit for Measurement of I_P, V_P and V_V of UJT

The emitter voltage V_E is increased and the emitter current is noted for a constant V_{BB}. The experiment is repeated for different values of V_{BB}. From graph V_p can be noted. For different values of V_{BB}, we will be able to notice that as V_{BB} increases V_p also increases. The observations are recorded. The experiment is repeated for different values of supply voltage in the range 6-12V.

Observations:

V_{BB} = 6V

V_{EE}	I_E (mA)

V_{BB} = 10V

V_{EE}	I_E (mA)

Precautions:

1) Proper identification of the terminals of UJT is to be done before making connections to those terminals.

2) Check whether the resistance between B_1 and B_2 lies in the range 5k Ohm and 10k Ohm. It is too low or too high; the device may be defective.

3) All maximum voltage of V_E and V_{BB} the current in the device should not exceed values specified in the data manual.

Result:

The calculated value of η=

η value given in manufacture tools =

EXPERIMENT - 3

ASTABLE MULTIVIBRATOR

Aim: To construct an astable multivibrator and to generate square waves of different frequencies and to compare the calculated frequencies with the observed ones.

Apparatus:

Material	**Quantity**
Transistor BC 147 or 547	2
Resistors 68kΩ 2.2kΩ	1
Capacitors 0.01μf, 0.022μf, 0.047μf	1
Dc power supply(0 to 30V)	1
Multimeter	1
CRO	1

Theory: A multivibrator is two transistor amplifier circuit with cross coupling. It is used to produce pulse wave form. One of the outputs of a bistable circuit is always high and that of the other is always low. The system remains like that until a steering pulse applied to the bases of the transistor changes the state. After the change of state the transistor whose output was high goes low and remains like that until another pulse changes the state. Thus a bistable multivibrator has two stable states. This results because of the direct cross coupling. If one of the stages is connected to the other capacitively, on receipt of a external triggering pulse a transistor that has high output goes low for some time determined by the time constant of RC network and after that it goes to high state. So for this transistor there is only one stable state and the other is meta stable. Such a circuit is called monostable multivibrator. It is used as a pulse stretcher. If both the stages are cross coupled capacitively, a transistor which has high at its out put at a given instant goes low depending upon the time constant of the driving transistor and goes low. It cannot stay in that state permanently in that state as in the case of monostable multivibrator because the other time constant forces this transistor to change its state. This process continues indefinitely and we say that it has no stable state or it is an astable multivibrator. An astable multivibrator is some times referred to as free running multivibrator. It is used as square wave generator. Bistable multivibrator remembers in which state it was latched. So, it is also called a flip-flop or latch or 1 bit memory.

Astable multivibrator can be constructed by using different devices:

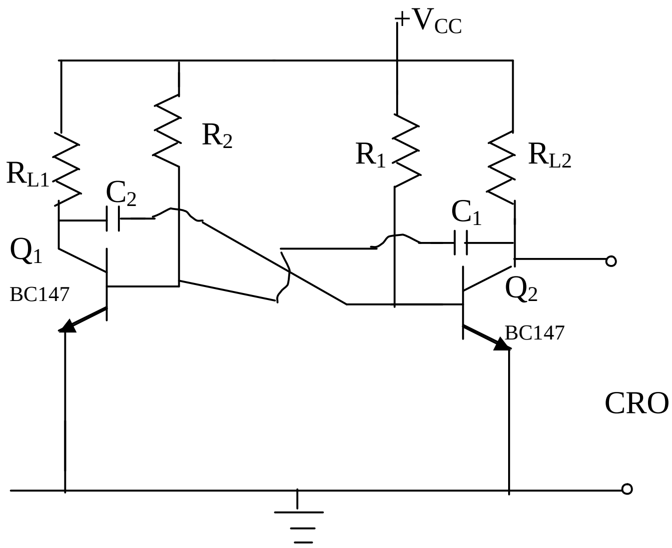
1) Using transistors

2) Using operational amplifier

3) Using 555 timer IC.

4) Using NOR gates (digital astable multivibrator)

Circuit Diagram:



Working:

When the supply voltage V_{CC} is given, both the transistors draw collector current starts and the capacitors C_1 and C_2 start charging up. We know that no two transistors are exactly alike. And hence one transistor conducts more rapidly than the other. The increasing output of Q_1 is connected through a condenser C_1 to the base of Q_2. This establishes reverse bias for the other and thereby collector current of Q_2 decreases. Then the raising output of Q_2 goes to the base of Q_1 and it becomes more forward biased and hence collector current of it increases. Thus depending upon the time constants involved in a very short time one transistor goes to saturation and the other gets cutoff. Let Q_1 be in saturation and Q_2 is cutoff. Then collector of Q1 is at 0 volts, entire supply voltage drops across $R_{L1.}$ Q_2 is driven to negative voltage and Q2 goes to cut-off with no drop across $R_{L2.}$

This process is repeated and Q_1 and Q_2 get on and off alternately. The voltage waveforms at either of the collector are essentially a square wave. It can be shown that the time for Q_1 is

$T_1 = 0.69\ R_2C_2$ and for Q_2, $T_2 = 0.69R_1C_1$ then total time of the wave

$T = T_1 + T_2 = 0.69(R_2C_2+R_1C_1)$

If $C1 = C_2$ and $R_1=R_2$ then $T = 1.38RC$, $f = 1/ 1.38RC = 0.7/RC$

The minimum value is β to ensure oscillations,

$\beta_1 = R_2 / R_{L1}$ $\beta_2 = R_1 / R_{L2}$

If $R_1 = R_2 = R$ and $R_{L1} = R_{L2} = R$

$\beta_1 = \beta_2$

Procedure:

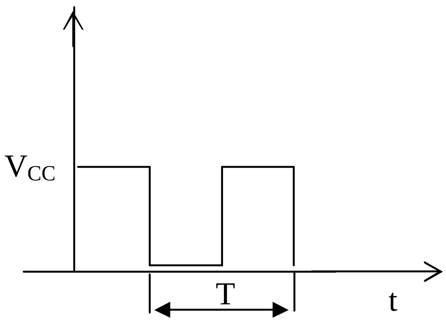
2.2k resistor are used for R_L .68k resistors are used for R. The components are connected as shown in the circuit diagram. Initially the capacitors of value 0.01 μf are used for C1 and C2. The DC Regulated power supply is adjusted to +6 V D C and then connected to the circuit. A CRO is connected between the grounded, and to one of the collector terminals say, to that of Q_1. If the connections are made properly the circuit starts operating. A square waveforms is observed in the CRO. Make adjustments to obtain stationary pattern following the procedure suggested in practical on CRO operation, we can determine the frequency of the waveform for each value of capacitance. The frequencies can also be calculated for these capacitances using the formula given in equation 1.The theoretical and observed values of the frequencies are compared. Similar procedure is followed for different time constants keeping C fixed and R changed in the range --- to ---.

Observations:

Capacitance value(μf)	**Time period T(sec)**	**Observed frequency f_{ob}=1/T Hz**	**Calculated frequency Hz**

For a given R and R_L values in case the D.C supply for 6V to 12V and record the waveform on any tracing paper.

Graph: **Wave form**



Precautions:

1) The connections are checked before giving power supply to circuit.

2) The soldering lead must not spread between two terminals.

3) The terminals of the Transistor should be checked.

Result: The calculated frequencies and observed frequencies are in good agreement.

For a given resistance R as the capacitance increases the wave forms developed overshoot / sag.

EXPERIMENT - 4

ZENER - DIODE AS VOLTAGE REGULATOR

Aim: To study the characteristics of a Zener diode and to study Zener diode as voltage regulator.

Apparatus: 0-20 V DC (variable) source, DC voltmeter (0-15V), Ammeter (0-50mA), Zener diode.

Theory:

If we study the characteristics of a semiconductor diode(p-n junction) in reverse bias we notice that there is a reverse saturation current which is of the order of few micro amperes due to the flow of minority charge carriers. As we increase the reverse bias at a certain voltage called break down voltage the current increases suddenly to milli amperes.

This reverse break down may damage the diode permanently. However in certain heavily doped p-n diodes the break down is reversible. The break down voltage is precise and the device may be operated in the breakdown condition. Such diodes are called Zener diodes and

Silicon is usually preferred in the manufacture of zener diodes because of its higher temperature and current capability. Zener diodes are available in the range of 1.8 to 200 volts zener potentials.

Zener breakdown: If the electric field at the junction is sufficiently high, a very strong force will be exerted on the electrons that exist in the covalent bonds and thus the electrons are picked out of the bonds. Then a large number of electrons and holes are generated whose motion caused a large reverse current .This process is known as zener break down . This process can occur due the fields in range of $2x10^7$ volts/meter.

Avalanche break down: In that process the reverse voltage applied makes the minority charge carries acquire sufficient kinetic energy and collide with atoms and ionization process starts. The valence electron then acquires sufficient energy. Those electrons leave the atom and these additional carries aid further additional ionization process. As a result high avalanche current results.

Properties of the Zener Diode:

1) A zener diode is always used with reverse bias and in the break down region.

2) Zener break down voltage depends on the amount of doping (also on the semiconductor used).

3) A Zener diode is not burnt when it enters into the break down region, where as an ordinary diode may be burnt when the breakdown is reached.

4) The break down in zener diode is sharp.

It is very inefficient. Power is dissipated in both the resistor and in the zener diode if regulation is to be good, inequality must hold good so that the current through it depends on I_z to a great degree. Thus the efficiency will be quite low. The out put voltage cannot be chosen at will but is dependent on the zener diode.

Study of the characteristics of zener diode:

The connection are made is shown in Fig. 1.

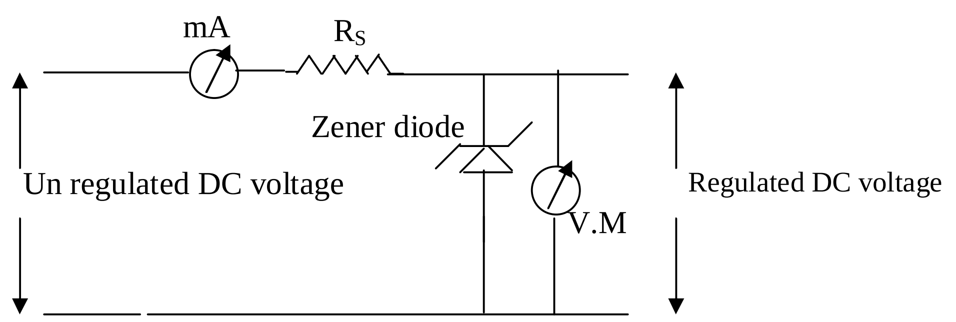


Fig. 1

R_S is called the limiting resistance which limits the current in zener diode to its safe maximum value. The milliammeter records the current and the voltmeter (digital multimer preferable), which is parallel to the zener records the voltage across the zener diode. Varying the supply voltage, the zener current, and the corresponding voltages across the zener are noted. Once the voltage across the zener acquires a value, the current (which previously remained almost at zero) suddenly increases. At different values of the current corresponding voltages across the zener (which almost remained constant) are noted. A graph is plotted between the current through the circuit and the voltage across the zener.

Zener as Voltage Regulator:

The circuit for using zener diode as an voltage regulator is shown in Fig.2.

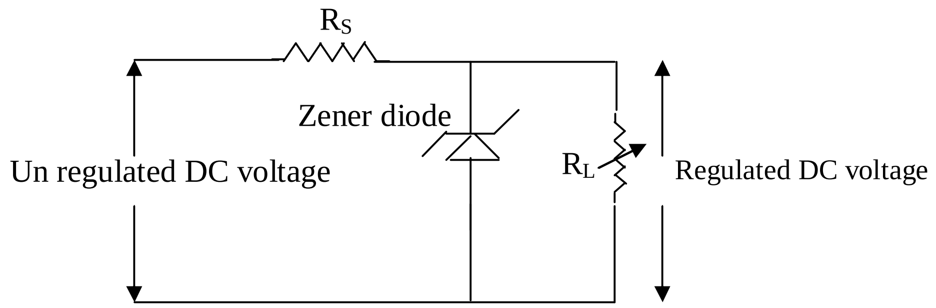


Fig. 2

This circuit provides a constant voltage across the load resistance, which is equal to the breakdown voltage of zener used, irrespective of the variations in the supply voltage.

$I_L=(V_z/R_L)$, $Vs=V_R+V_z$

$V_R=V_s-V_z$, $I_R=V_R/R_s=(V_s-V_z)/R_s$

Select R_s such that $I_L<I_R$.

The value of series resistance R_s is to be selected properly to have regulation across R_L. If the series resistance is such that $V_z/R_L=I_L>I_Z$, then the zener circuit gets open and the fluctuation of supply voltage pass on to the load resistance and no regulation takes place.

Procedure: The load resistance is varied and for different load currents the voltages across the zener are noted.

Characteristics:

Zener 1:

V_Z Voltage across Zener (volts)	I Current through Zener (mA)

Zener 2:

V_Z Voltage across Zener (volts)	I Current through Zener (mA)

Zener 3:

V_Z Voltage across Zener (volts)	I Current through Zener (mA)

Tabular form for Zener as Voltage Regulator:

Current Through Load I_L (mA)	Supply at Load V_{LS} (volts)

Precautions:

1) Do not apply the high voltages that cause current through zener diode more than the safe permissible value to the diode.
2) Diode should be connected in reverse bias only.
3) For regulation load should be varied carefully.
4) Do not disconnect the load before switching off the power source.

Result:

The characteristics and voltage regulation of zener diode are studied.

The given zener diode is giving regulation at voltage --- and in the current range-----.

EXPERIMENT - 5

RELAXATION OSCILLATOR

Aim:

To construct a relaxation oscillator using a uni junctiion transistor (UJT 2N2646), which generate saw tooth waves of different frequencies at emitter and positive pulse at one base and negative pulse at another base.

Apparatus:

1. DC power supply	**+6 to 10V**	**1**
2. Resistances	**470 Ohm, 100 Ohm**	**1 each**
3. Capacitances	**0.002μf, 0.022μf, 0.047μf**	**1 each**
4. CRO		**1**
5. UJT	**2N 2646**	**1**

Theory: A uni junction transistor can be used to construct the relaxation oscillator. The frequency can be set by using the required Rt and Ct taking in to consideration the

Stand–Off ratio of the used UJT.

The frequency $f_0=1/[R_tC_t \ln(1/1-\eta)]$ -------------(1)

Or $T=2.303\ R_tC_t \log(1/1-\eta)$.

The basic unijunction oscillator circuit is given in Fig.1.

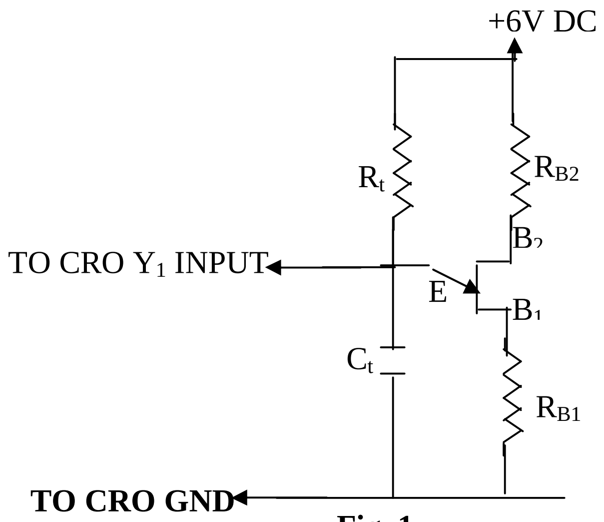


Fig. 1

The output waveform observed on CRO is as shown in figure.

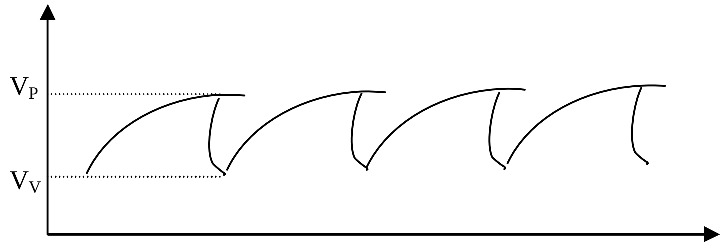


Fig. 2

Procedure: The connections are made as shown in the FIG.1 C_t is a variable capacitor whose value can be changed as desired. A DC power supply of +6V DC is applied to the circuit as shown in the fig.1. For different values of C_t the waveforms are observed in CRO and the values of V_v and V_p are noted. The values are recorded in a tabular form. The frequencies are computed using equation given below. The values of observed frequencies and calculated frequencies are compared. They can be observed to be almost the same within the limits of experimental error.

For 2N2646 Eta Value is 0.689:

The value of $1/1\text{-}\eta = (V_{BB} - V_v)/(V_{BB} - V_p)$ may also be used in the formula for frequency determination.

Tabular Form:

S.No	R_t	C_t	Observed frequency (1/T)	Calculated frequency $F=1/2.303R_tC_t\log(1/1-\eta)$

Precautions:

1) The connections are checked before giving power.
2) The soldering should be made properly
3) The A.C or D.C coupling slide switch of channel on which the waveform is b served, is to be kept at D.C. setting.
4) Measure the d.c voltage accurately using a DMM.
5) Display only one or two cycles of the waveform.
6) Always use very fine waveform for taking the observations.

Result: The calculated frequencies and observed frequencies are given in Table. Out of --- observations in --- observations the calculated values are larger than observed values. --- calculated values are less than observed values. --- observations are agreeing with in 5% of the calculated values.

EXPERIMENT - 6

V - I CHARACTERISTICS OF LIGHT DEPENDENT RESISTOR (LDR)

Aim:

To measure the photoconductive nature and the dark resistance of the givenlight dependent resistor (LDR) and to plot the characteristics of the LDR.

Theory:

A photoresistor or LDR is an electronic component whose resistancedecreases with increasing incident light intensity. It can also be referred to asa light dependent resistor (LDR), photoconductor, or photocell. Aphotoresistor is made of a high-resistance semiconductor. If light falling onthe device is of high enough frequency, photons absorbed by thesemiconductor give bound electrons enough energy to jump into theconduction band. The resulting free electron (and its hole partner) conductelectricity, thereby lowering resistance. Cadmium Sulfide (CdS) cells rely onthe material's ability to vary its resistance according to the amount of lightstriking the cell. The more light that strikes the cell, the lower the resistance. Although notaccurate, even a simple CdS cell can have a wide range of resistance fromless than 100 Ω in bright light to in excess of 10 MΩ in darkness. Manycommercially available CdS cells have a peak sensitivity in the region of500nm - 600nm (green light).

The cells are also capable of reacting to a broad range of frequencies,including infrared (IR), visible light, and ultraviolet (UV). They are oftenfound on street lights as automatic on/off switches.

Apparatus Required:

LDR, Resistor (1 k), ammeter (0 – 10 mA), voltmeter (0 – 10 V), lightsource, regulated power supply.

Formula:

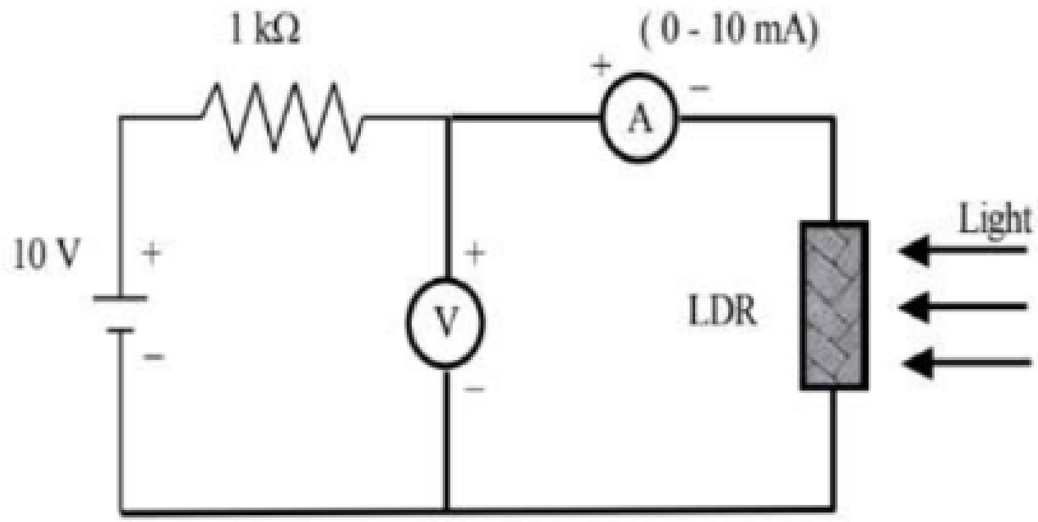
By Ohm’s Law,

$$V = IR \text{ (or) } I = V/R \text{ ohm.}$$

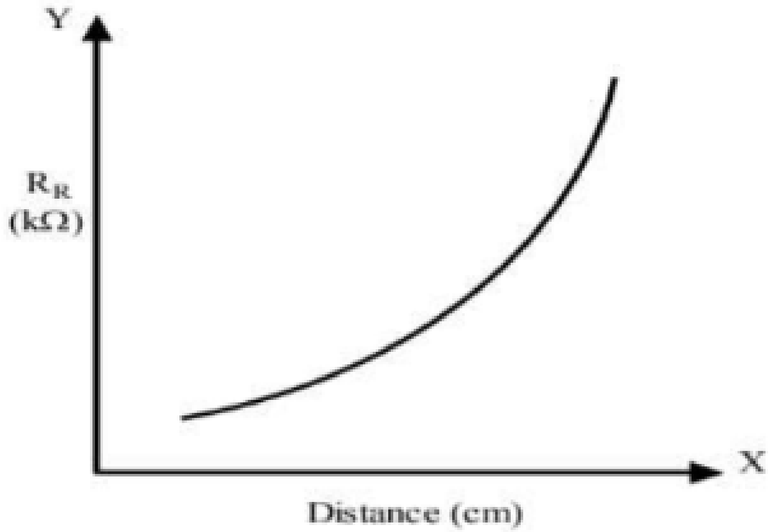
where R is the resistance of the LDR (i.e.) the resistance when the LDR isclosed. V and I represent the corresponding voltage and current respectively.

Principle:

The photoconductive device is based on the decrease in the resistance ofcertain semiconductor materials when they are exposed to both infrared andvisible radiation. The photoconductivity is the result of carrier excitation dueto light absorption and the figure of merit depends on the light absorptionefficiency. The increase in conductivity is due to an increase in the number ofmobile charge carriers in the material.



Circuit diagram



Model graph

To determine the resistances of LDR at different distances:

S.No.	Distance (cm)	Voltmeter Readings V (volt)	Ammeter Readings I (mA)	R (kΩ)
1 2 3 4 5				
1 2 3 4 5				
1 2 3 4 5				

Observations and Calculation:

1) Voltmeter reading when the LDR is closed =
2) Ammeter reading when the LDR is closed =
3) Dark resistance = R = V/I =

V and I represent the corresponding voltage and current.

RESULT:

i) The characteristics of LDR were studied and plotted.
ii) (ii)The dark resistance of the given LDR = ------ K ohm

EXPERIMENT - 7

RC PHASE SHIFT OSCILLATOR

Aim:

To construct a R-C Phase Shift Oscillator and generate sine wave for three different frequencies with various time constant and compare these frequencies with calculated ones.

Apparatus:

DC Power Supply	0-30V	1
C.R.O.		1
Transistor	BC 547	1
Resistors	1 KΩ	3
	100 KΩ	1
Capacitors		
Multimeter		1
Connecting wires		

Theory:

A circuit which produces oscillations of any desired frequency is known as Oscillating circuit. In a phase shift oscillator, a phase shift of 180^o is introduced by transistors propertiesan alternating voltage causes phase shift V_1 across R load applied voltage V_1 by Φ, the value of Φ depends upon value of C and R of the resistance value varies with the value of Φ also changes, if reduces to 0 the V_1 will shift by 90^o i.e., $\Phi = 90^o$. Addressing R to zero would be impactable because it would lead to no voltage across R. There are three RC networks in the circuit each section producses a phase shift of 180^o is introduced one output of amplifier is feedback to RC network.

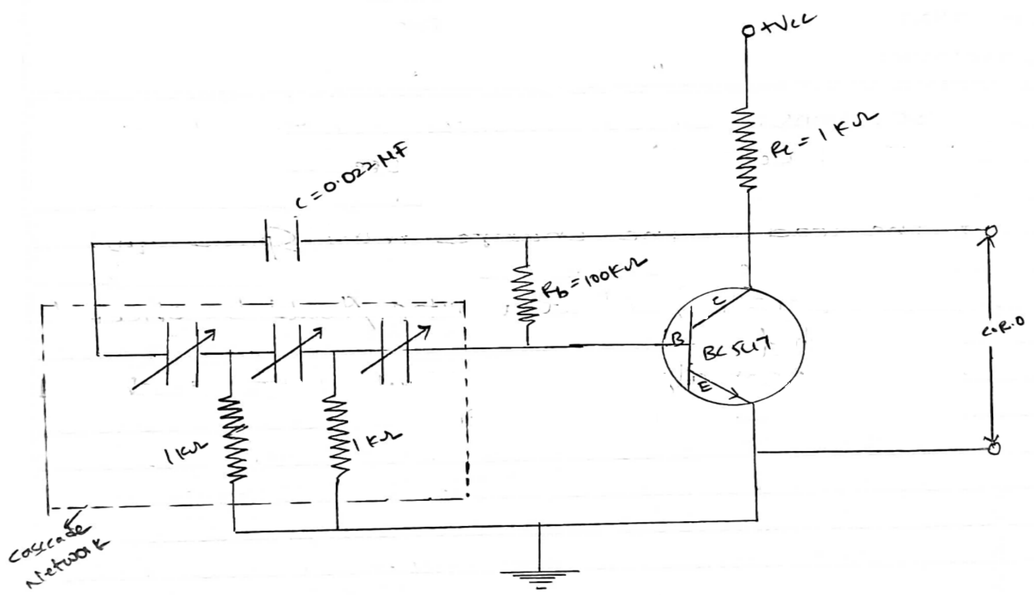
The frequency of oscillations of RC-Phase Shift Oscillator is

$$f = \frac{1}{2\pi RC\sqrt{(6+4K)}}$$

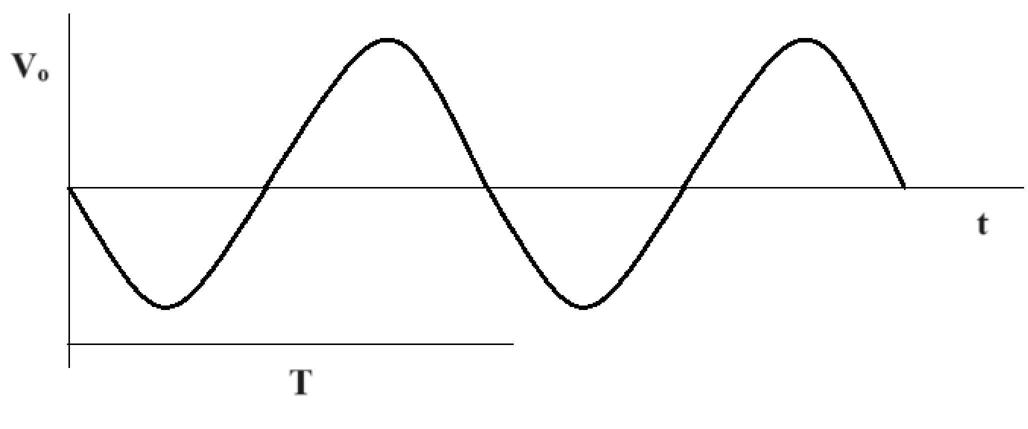
where R is resistance, C capacitance and $K = R_c/f$

Experimental Procedure:

Make the connection as per the circuit diagram as shown in the circuit diagram.



A dc power supply is applied to the circuit. The C.R.O. is connected between the ground terminal and collector terminal. Observe the output signal and note the output amplitude and time period (T). Calculate the frequency of oscillations theoretically and verify it practically (f=1/T). The frequency calculated and observed are compared. For each capacitance follow the same procedure and tabulate the values.



Observations:

Capacitance (μF)	**Time Period (sec)**	**Observed Frequency $f_{obs} = 1/T$ (Hz)**	**Calculated Frequency $f_{cal} = \frac{1}{2\pi RC\sqrt{(6+4K)}}$ (Hz)**

Precautions:

1) Make the connections right and tight; and check the connections before giving power supply tothe circuit.
2) C.R.O. terminals should not be changed during experiment.

Result:

The observed and calculated frequencies are nearly equal for different capacitance.