INTERMEDIATE FIRST YEAR

ELECTRONICS ENGINEERING TECHNICIAN VOCATIONAL COURSE

A MANUAL ON ELECTRONIC DEVICES AND CIRCUITS LAB

Compiled by

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PREFACE

To be in tune with the National Curriculum for Vocational Education, the syllabus for I year Intermediate Electronics Engineering Technician Vocational Course has been thoroughly revised with effect from 2005 – 2006.

For the first time an attempt has been made by the Board of Intermediate Education to prepare a Manual on Electronic Devices and Circuits Lab, having in mind the needs and standards of students.

The manual has been divided into 25 Experiments to enable the student to acquire the skill and practical knowledge in the field of Electronic Devices and Circuits with a special stress on Rectifiers, Amplifiers, Oscillators and basic measurements like Resistance, Capacitance and Inductance. In the last page a Model question paper is also enclosed .

A sincere attempt has been made to present the book, error – free. However there is always a scope for improvement, suggestions from teachers as well as students for the improvement of the book will be received in all humility.

CONTENTS

Expt. No. 1 **Date : ………………**

Aim: To find the value of unknown Resistance by V and I method and to verify it by colour code.

Apparatus:

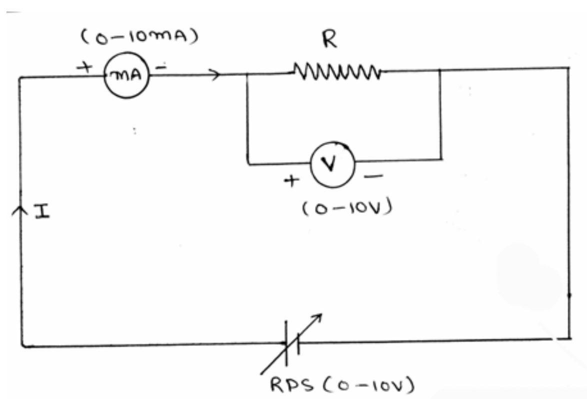
1.	Regulated power supply (R.P.S) (0-10V)	-1
2.	Ammeter (0- 10 mA)	-1
3.	Voltmeter (0- 10 V)	-1
4.	Unknown resistor	-1
5.	Connecting wires	

Theory:

Resistance is the property of a substance due to which it opposes the flow of current through it. Resistance obeys ohms law. Ohms law states that at constant temperature the current (I) flowing through a conductor is directly proportional to the potential difference (v) across the ends. According to ohm's law

Resistance R= V/I where V = voltage across resistance
I = current flowing through the resistance

Circuit Diagram :



Procedure:

1. Connections are made as per the circuit diagram
2. Switch on the power supply
3. By varying the R.P.S voltage step by step the ammeter and voltmeter readings are noted in the table shown below.
4. The value of the resistor is calculated by using ohm's law.
5. The resistance value is also found by using colour code.
6. From the above result I came to know that both the values are equal

Table :V-I method

S. No.	V (Volts)	I (mA)	R = V/I (KΩ)
1	1	1	1
2	2	2	1
3	3	3	1
4	4	4	1
5	5	5	1
6	6	6	1
7	7	7	1
8	8	8	1

Average Value : R = 8/8 = 1 KΩ

By Colour code:

I Band	II Band	III Band	IV Band
Brown	Black	Red	Gold
1	0	10^2	± 5%

$R = 10 \times 10^2 \pm 5\%$

$= 1000 \pm 5\%$

$= 1\ k\Omega \pm 5\%$

Precautions:

1. Ammeter and voltmeter are connected with correct polarity.
2. The readings are observed without any parallax error
3. No loose connections are allowed.

Result :- The value of unknown resistance is found by using V and I method and verified by colour code. The value of Resistance R = 1 K Ω

Expt. No. 2 **Date : ………………**

Aim: To measure the value of inductance (L) of a given coil by V – I method.

Apparatus:

1. Auto transformer: 230V/ (0-270V) - 1 No.
2. Ammeter (0 – 10 A) M.I -1 No.
3. Voltmeter (0-150 V) M.I -1 No.
4. Watt meter 150 V, 10 A, LPF -1 No.
5. Connecting wires
6. Unknown Inductance coil -1 No.
   (Decade Inductance box)

Theory:

The property of a coil due to which it opposes any increase or decrease of current or flux through it is known as self inductance. It is quantitatively measured in terms of coefficient of self inductance L. It is measured in henry (H)

$X_L = \sqrt{Z^2 + R^2}$ Inductance $L = X_L / 2\pi f$

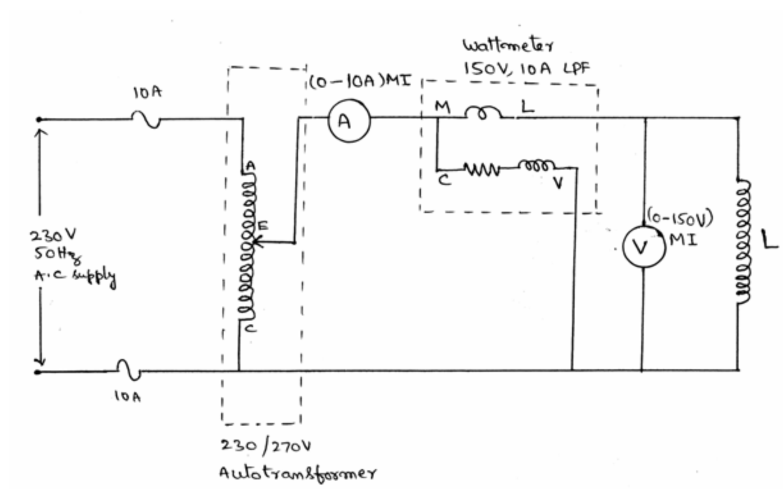
Where X_L = Inductive reactance

f = frequency = 50 H_Z

$Z = V/I$ Impedance of the coil

R = Resistance of the coil = W/I^2

Circuit Diagram :



Procedure:

1. Connections are made as per the circuit diagram
2. Switch ON the power supply
3. The voltage across the coil is varied in steps with the help of Autotransformer. The readings of Voltmeter (V), Ammeter (I) and Watt meter (w) are noted in the table.
4. Impedance (Z), Inductive reactance (X_L) and unknown inductance (L) Values are calculated using the formulae as given in the table.

Table :

S. No	V (volts)	I (Amps)	W watts	Z = V/I ohms	R=W / I^2 ohms	X= $\sqrt{Z^2 - R^2}$ ohms	L=$X_L/2\pi f$ (mH)
1	20	2.1	11	9.52	2.49	9.18	29.22
2	30	3.35	20	8.95	1.78	8.77	27.91
3	40	4.7	32	8.51	1.44	8.38	26.67
4	50	6.16	47	8.11	1.23	8.02	25.52

Average Value of L = 27.33 mH

Precautions:

1. Ammeter and voltmeter are connected with correct polarity.
2. The readings are observed without any parallax error
3. No loose connections are allowed.

Result :- The value of unknown inductance is found to be 27.33 mH

Expt. No. 3 **Date : ………………**

Aim: To determine the unknown capacitance of a given capacitor.

Apparatus:

1.	Audio Frequency generator	-1
2.	Decade Resistance boxes	-4
3.	Decade capacitance box	-1
4.	Head Phone set	-1
5.	Un Known capacitor	-1

Theory:- De sauty's Bridge can be used to measure the value of a capacitor. This bridge is very simple. Let

$C_1 = C_X$ == Un known capacitor

C_2 = A Standard capacitor

R_1, R_2, R_3, R_4 are Standard Resistances.

At bridge balance condition.

$$C_1 / C_2 = R_2 / R_4 = R_1 / R_3$$

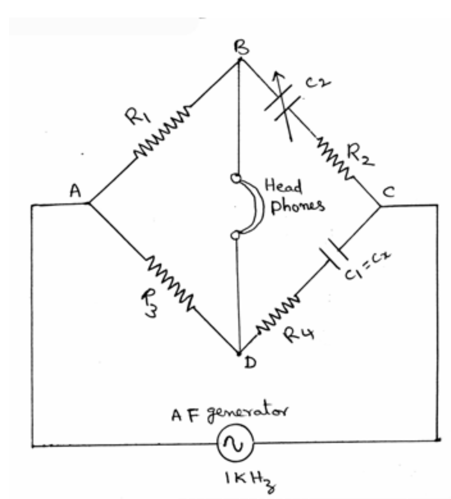
(or)

$$C_x / C_2 = R_1 / R_3 \quad \text{and} \quad R_2 / R_4 = R_1 / R_3$$

Bridge balance can be obtained in two ways (i) Keeping C_1, C_2 Constant and varying R_1 or R_3 (ii) Keep the values of R_1, R_2, R_3, R_4 so that $R_1/R_3 = R_2/R_4$ is satisfied and vary the capacitor C_2. The value of unknown capacitance is found by using the formula

$C_x = C_2 \ R_1/R_3$

Circuit Diagram :De Sauty's Bridge



Procedure:

1. Connections are made as per the circuit diagram
2. Arrange the values of the resistances R_1, R_2, R_3 and R_4 so that the condition $R_1/R_3 = R_2/R_4$ is satisfied.
3. Apply a sinusoidal signal of fixed amplitude and fixed frequency of 1 KH_Z using A.F. generator (A.F.O) between terminals A and C.
4. The Capacitance value of C_2 is varied to obtain bridge balance condition. i.e., At this condition minimum sound is heard from head phones or ear phones.
5. Note down the values of R_1, R_2, R_3, R_4 and C_2 in the table .
6. Repeat the same procedure for different sets of values of R1, R_2, R_3, R_4 and C_2
7. Calculate the unknown capacitance using the formula given in the table .

Table :

S. No	$R_1(\Omega)$	$R_2\ (\Omega)$	$R_3\ (\Omega)$	$R_4\ (\Omega)$	C_2 (µf)	$C_x= C_2 R_1 / R_3$ (µf)
1	100	200	100	200	0.08	0.08
2	100	200	50	100	0.04	0.08
3	50	100	50	100	0.08.	0.08
4	200	400	5.0	100	0.02	0.08
5	600	200	300	100	0.04	0.08
6	300	400	150	200	0.04	0.08

Average value (C_x) = 0.08 µf

Precautions:

1. Ammeter and voltmeter are connected with correct polarity.
2. The readings are observed without any parallax error
3. No loose connections are allowed.

Result :- The capacitance value of the given un known capacitor is found to be 0.08 µf

Expt. No. 4 **Date : ………………**

Aim:- To find the values of two unknown resistances connected in series by V and I method and to find their resultant resistance.

Apparatus:

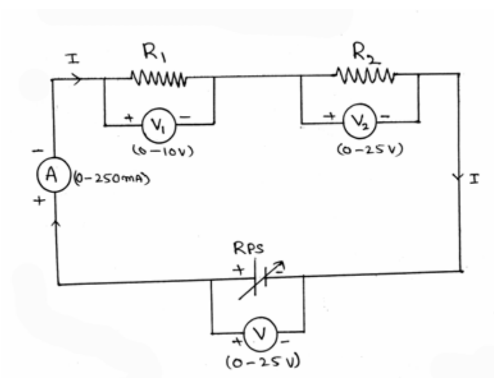
1. Ammeter (0-250 mA) -1
2. Voltmeter (0-10V) -1
3. Voltmeter (0-25 V) -2
4. Regulated power supply (0-30V) -1
5. Unknown Resistors -2
6. Connecting wires

Theory :- If two or more resistors are connected one after the another such type of connection is known as series connection. In series connection the current flowing through the resistors is the same and voltage drops across each resistor is different let the voltage drops across two resistors R_1 and R_2 connected in series is V_1 and V_2 and current flowing through them is I. From Ohm's law

$$\mathbf{R_1 = V_1 / I}, \quad \mathbf{R_2 = V_2 / I} \quad R = R_1 + R_2, \quad V = V_1 + V_2$$

Resultant resistance R= V / I where 'V' is the applied voltage

Circuit Diagram :



Procedure:

1. Connections are made as per the circuit diagram
2. The regulated power supply is switched ON.
3. By Varying the R.P.S voltage step by step (0 to 25 V) the voltmeter and ammeter readings were noted in the table shown below .
4. The values of R_1, R_2 ,R and $R=R_1+R_2$ are calculated using the formulae given in the table

Table :

S. No	V (Volts)	V_1 (Volts)	V_2 (Volts)	I (mA)	$R_1=V_1/I$ (Ω)	$R_2=V_2/I$ (Ω)	$R = R_1+R_2$ (Ω)	R=V/I (Ω)
1	1.5	0.33	0.74	7.1	47	103	150	211
2	3	.09	1.98	19.1	47	103	150	157
3	4.5	1.41	3.09	29.8	47	103	150	151
4	6	1.97	4.31	41.7	47	103	150	143
5	7.5	2.49	5.42	52.5	47	103	150	142
6	9	2.94	6.40	62.2	47	103	150	144
7	12	4.24	9.20	90.2	47	102	149	133
Average value :					47	103	150	154

Precautions:

1. Ammeter and Voltmeters must be connected with correct polarity.
2. The readings are noted without parallax error
3. No loose connections are allowed
4. The ammeter and Voltmeter readings should not exceed maximum range

Result :- The values of the resistors connected in series and their resultant resistance is found to be

R_1 = 47 Ω

R_2 = 103 Ω

R = R_1+R_2 = 150 Ω

Expt. No. 5 **Date : ………………**

Aim:- To find the values of two unknown resistances connected in parallel by V and I method and to find their resultant resistance.

Apparatus:

1.	Volt meter (0-25V)	-1
2.	Ammeter (0- 50 mA)	-2
3.	Ammeter (0- 25 mA)	-1
4.	Unknown resistors	-2
5.	Regulated power supply (0-30 V)	-1
6.	Connecting wires	

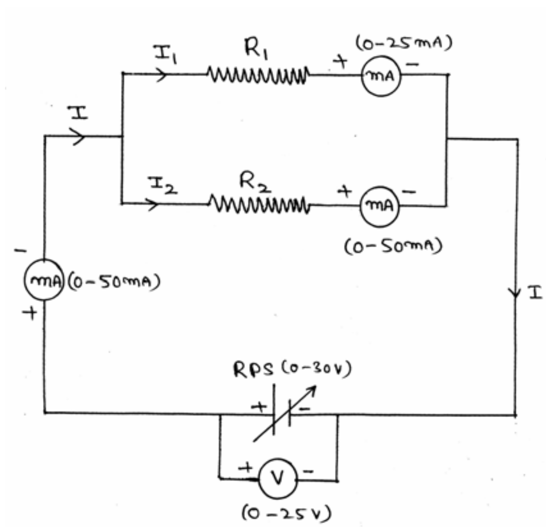
Theory:- When one side of all the resistors is connected to one terminal and the remaining side of all the resistors to other terminal then such type of connection is known as parallel connection. In parallel connection voltage across each resistor is same and current flowing through each resistor is different. Let the applied voltage is 'V", current flowing through each resistor is I_1, I_2 when two resistances R_1 and R_2 are connected in parallel then the total current $I = I_1 + I_2$

Voltage across each Resistor $V_1 = V_2 = V$

From Ohm's law

Resultant resistance $R=V/I$, $R_1= V / I_1$ $R_2= V/ I_2$ then $R = R_1 R_2 / R_1+R_2$

Circuit diagram :



Procedure:

1. Connections are made as per the circuit diagram
2. The regulated power supply is switched ON
3. By Varying the R.P.S Voltage step by step (not exceeding 25 V) the voltmeter and ammeter readings were noted in the table.
4. The values of R_1, R_2, R and R= $R_1.R_2$ / R_1+R_2 are calculated using the formulae given in the table .

Table :

S. No	V (Volts)	I mA	I_1 mA	I_2 mA	$R_1=V_1/I_1$ (Ω)	$R_2= V_2/I_2$ (Ω)	$R=R_1.R_2/R_1+R_2$ (Ω)	R=V/I (Ω)
1	1.0	3.0	0.9	2.6	1111.11	384.6	285.70	333.33
2	2.83	8.7	2.6	4.5	1088.46	628.88	398.58	325.28
3	4.37	13.5	4	8	1092.5	546.25	370.33	323.70
4	6.19	19.1	05.7	12.3	1085.96	503.25	343.88	324.08
5	7.77	24.0	7.2	15.7	1079.16	494.9	339.13	325.75
6	9.37	28.9	8.7	19.2	1077.01	488.02	335.85	324.22
7	13.84	42.9	12.9	25.3	1072.86	547.03	362.30	322.61
Average Value :					1086.72	513.27	347.96	325.28

Precautions:

1. Ammeter and voltmeter should be connected with correct polarity.
2. The readings are noted without parallax error.
3. No Loose connections are allowed.
4. The ammeter and voltmeter readings should not exceed maximum range.

Result : The values of two resistors connected in parallel and their resultant resistance is found to be

R_1 = 1086.72 Ω

R_2 = 513.27 Ω

R = 347.96 Ω

Expt. No. 6 **Date : ………………**

Aim :- To measure the co-efficient of coupling 'K' of a given iron core Transformer

Apparatus:

1. Variac (0- 230 V, 5O Hz) or Dimmer stat -1 No.
2. Transformer (6-0-6V, 500 mA) -1 No.
3. Digital multi meter (DMM) (To measure V) -1 No.
4. Ammeter (0-25 mA) A.C -1 No.

Theory :- Self inductance (L) is defined as the property of the coil due to which it opposes any increase or decrease of current or flux through it. Mutual inductance (M) is defined as the ability of one coil (or circuit) to produce an emf in a nearby coil by induction when the current in the first coil changes. This action being reciprocal the second coil can also induce an e m f in the first when current in the second coil changes. If the inductance of two coils is L_1 and L_2 then co-efficient of coupling $K = M / \sqrt{L_1 . L_2}$

1. When two coils L_1,L_2 are connected in series such that their fluxes are in the same direction then equivalent inductance $L_{SA} = L_1 + L_2 + 2M$
2. When two coils are connected in series such that their fluxes are in opposite direction then equivalent inductance

$$L_{SO} = L_1 + L_2 - 2M \quad M = (L_{SA} - L_{SO}) / 4$$

Circuit Diagram :

Fig.1: Measurement of Inductance (L_1)

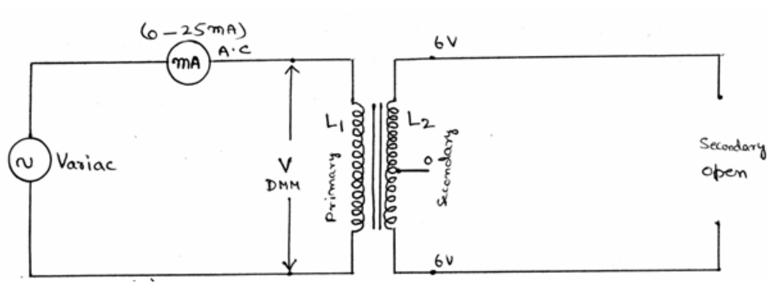


Fig.2: Measurement of Inductance (L_2)

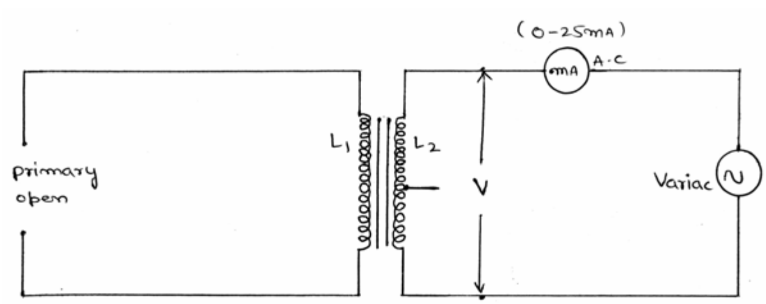


Fig. 3: Measurement of Series Aiding Inductance (L_{SA})

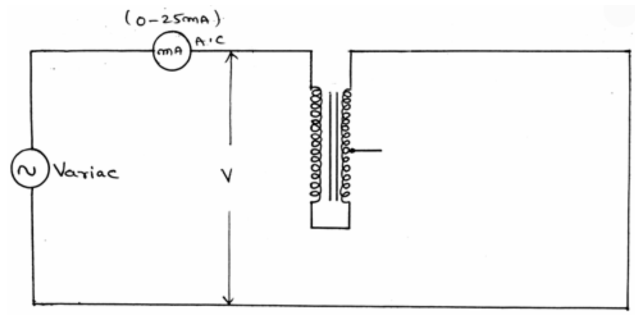
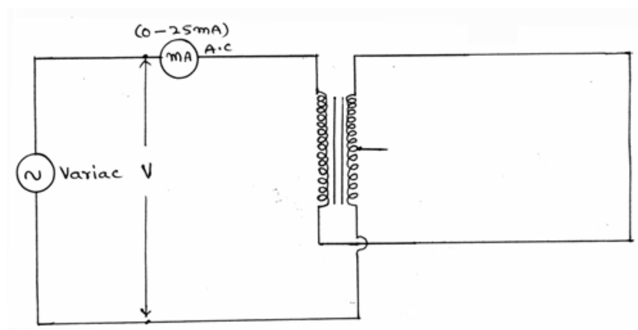


Fig. 4: Measurement of Series Opposing Inductance (L_{SO})



Procedure :- The mutual inductance is measured as below

1. Connections are made as per the fig (1) to measure the self inductance L_1 of the Transformer primary. Keep the secondary winding open.
2. The input voltage in the variac is varied in steps and the ammeter readings are noted and the voltages are measured with digital multi meter.
3. The inductive reactance is calculated using $X_{L1} = V/I$
4. The Value of inductance L_1 of primary winding is calculated as $L_1 = X_{L1}/2\pi f$
5. The procedure is repeated to find the inductance of secondary winding (L_2) by keeping primary as open as in fig (2)
6. Next the Transformer is connected in series aiding mode as in (fig 3)
7. Repeating the step2 find the values of $X_{LSA} = V/I$ and $L_{SA} = X_{LA}/2\pi f$
8 Similarly the series opposing inductance is determined as in fig (4) $X_{LSO}) = V/I$ and $L_{SO} = X_{Lso}/2\pi f$
9. Mutual inductance is determined using $M= (L_{SA} - L_{SO}) / 4$
10. Co-efficient of coupling is determined from the values of M, L_1 and L_2 using Formula $K= M / \sqrt{L_1 L_2}$.

I

1. Measurement of Inductance (L_1) f=50 H_Z

S. No.	Input voltage V (Volts)	Current I (mA)	X_{L1} = V/I (KΩ)	$L_1 = X_{L1}/2\pi f$
1	5	0.6	8.33	26.51 m H
2	8	0.8	10.0	31.83 m H
3	10	1.0	10.0	31.83 m H

L_1 = 29. 17 m H

2. Measurement of Inductance (L_2) f = 50 H_Z

S.No.	V (Volts)	I (ma)	X_{L2} = V/I (KΩ)	$L_2 = X_{L2}/2\pi f$
1	1	2.5	0.4	1.27 m H
2	3	7	0.42	1.33 m H

L2 = 1.3 m H

3. Measurement of Series Aiding Inductance (L_{SA}) f= 50 H_Z

S.No.	V (Volts)	I (mA)	X_{LSA} = V/ I (KΩ)	$L_{SA} = X_{LSA} / 2\pi f$
1	6	0.4	15	47.74 m H
2	8	0.8	10	31.83 m H
3	10	1.0	10	31.83 m H

L_{SA} = 37.13 mH

S.No	Voltage V (Volts)	Current I (mA)	X_{LSO} = V/I (KΩ)	$L_{SO} = XL_{SO} / 2\pi f$
1	8	1.0	8	25.46 m H
2	10	1.2	8.3	26.41 m H

L_{SO} = 25.93 m H

Calculations:

1. Inductance of primary coil L_1 = 29.17 m H
2. Inductance of Secondary coil L_2 = 1.3 m H
3. Series aiding Inductance L_{SA} = 37.13 m H
4. Series opposing Inductance L_{SO} = 25.93 m H
5. Mutual Inductance M= $L_{SA} - L_{SO}$ **/ 4** = 37.13—25.93 / 4 = 2.8 mH

6. Co-efficient of coupling of the Transformer is found to be K= M / $\sqrt{L_1 L_2}$.

K= 2.8 / √29.17 x1.3 = 0.454.

Result :- Co-efficient of coupling of the Transformer is found to be K= M / $\sqrt{L_1 L_2}$.

K= 2.8 / √29.17 x1.3 = 0.454.

Expt. No. 7 **Date : ………………**

Aim:- To determine the resonant frequency and bandwidth of RLC series circuit.

Apparatus:

1. Function generator (AFO) -1
2. Ammeter (0-10 mA) A.C -1
3. Decade Resistance box (1 KΩ) -1
4. Decade Inductance box (0.1H) -1
5. Decade capacitance box(0.03 μf) -1
6. Connecting wires

Theory:- A Series circuit is said to be in resonance when its net reactance is zero. The frequency at which this happens is known as resonant frequency (f_o). At resonance the inductive reactance is equal to capacitive reactance, the impedance of the circuit is minimum and the current is maximum. Band width of a series circuit is given by the band of frequencies which lie between two points on either side of the resonant frequency where current falls to $1/\sqrt{2}$ or 0.0707 of its maximum value at resonance (I max).

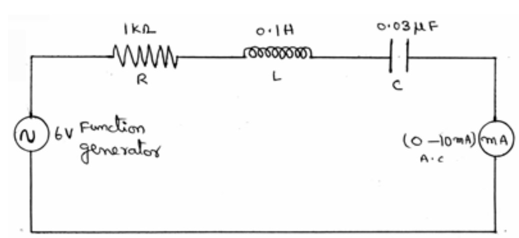
At resonance $X_L = X_C$, $Z = R$

Resonant frequency $fo = 1 / 2\pi\sqrt{LC}$

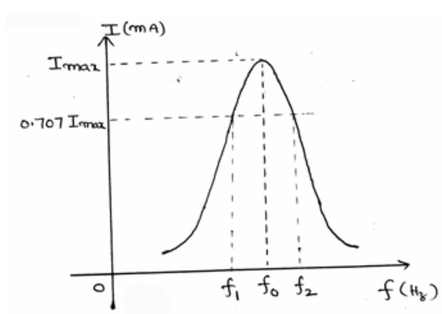
Band width $B.W = f_2 - f_1$

f_1 = Lower half power frequency, f_2 = Upper half power frequency

Circuit Diagram :



Model graph:



Procedure:

1. Connections are made as per the circuit diagram
2. Signal generator is switched to sin wave mode
3. The output voltage of signal generator is kept at a constant value (say 4V or 6V)
4. By Varying the frequency of the signal generator in steps the frequency and ammeter readings are noted in the table.
5. At resonant frequency maximum current flows in the circuit (I max)
6. Readings are taken on both the sides of resonant frequency.
7. A graph is drawn between frequency and current.
8. From the graph the values of resonant frequency f_o, f_1 and f_2 are noted and Band width is calculated.

Table :

S.No	**Frequency (HZ)**	**Current I (mA)**
1	100	0.137
2	200	0.2863
3	400	0.612
4	600	0.922
5	800	1.3
6	1000	1.52
7	1200	1.98
8	1400	2.46
9	1600	3.04
10	1800	3.8
11	2000	4.58
12	2200	5.24
13	2400	5.63
14	2450	5.67
15	2475	5.68
16	2500	5.64
17	2750	5.3
18	2875	5.03
19	3000	4.71
20	4000	2.9
21	5000	2.15
22	6000	1.64

Theoretical calculations:

R = 1 K , L = 0.1H, C= 0.03 μF

Resonant frequency $f_o = 1 / 2\pi\sqrt{LC} = 2905.76$ Hz

Band width - B.W. = $R / 2\pi L$ = 1.591 KHz

Practical Calculations from the graph:

Resonant frequency	f_o	=	2475 H_Z
Lower half power frequency	f_l	=	1900 H_Z
Upper half power frequency	f_2	=	3400 H_Z
Bandwidth B.W	$f_2 - f_l$	=	3400 – 1900
		=	1500 H_Z = 1.5 KH_Z

Precautions :

1. No loose connections are allowed.
2. Readings should be taken without parallax error.
3. The apparatus should be handled carefully.
4. Remove the components only after the supply is switched off.

Result :-The resonant frequency and band width of the series resonant circuit are found to be f_0 = 2475 HZ B.W.= $f_2 – f_l$ = 1500 HZ = 1.5 KHZ

Expt. No. 8 **Date : ………………**

Aim: To determine the resonant frequency and band width of a parallel resonant circuit.

Apparatus:

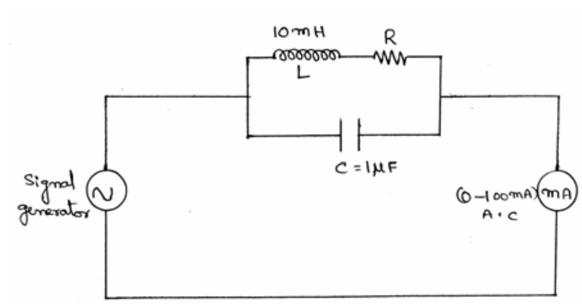
1. Function generator (AFO) -1
2. Ammeter (0-100 mA) A.C -1
3. Decade Inductance box (10 mH) -1
4. Decade capacitance box (1 μ f) -1
5. Decade resistance box (10KΩ) -1
6. Connecting wires

Theory:- A Circuit is said to be in parallel resonance when the current is minimum at a particular frequency. This frequency is known as resonance frequency, when the voltage and current are in phase. At resonant frequency impedance (Z) is maximum and current (I) is minimum.

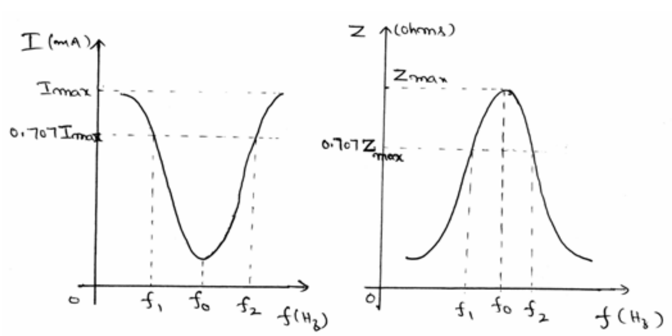
Resonant frequency $f_o = 1 / 2\pi\sqrt{LC}$

Band width is defined as band of frequency which lie between two points on either side of the resonant frequency where falls to $1/\sqrt{2}$ times of its maximum value. Band width $B.W = f_2 - f_1$

Circuit Diagram :



Model graphs:



Procedure:

1. Connections are made as per the circuit diagram
2. Signal generator is switched to sine wave mode.
3. The output amplitude of the sine wave is fixed at some value (i.e. 3 V)
4. The frequency of the sine wave is varied in steps and note down the frequency, ammeter readings in each case.
5. Readings are tabulated.
6. A graph is drawn between frequency and current
7. From the graph the values of resonant frequency f_o, f_1 and f_2 are noted and band width is calculated.

Table :

S.No	Frequency (HZ)	Current I (mA)	Impedance Z=V/I
1	50	57.2	17.48
2	100	54.1	18.48
3	200	43.2	23.14
4	400	29.0	28.52
5	600	19.8	50.50
6	800	13.2	75.75
7	1000	8.6	116.27
8	1200	5.0	200.00
9	1400	2.3	434.78
10	1500	1.5	666.66
11	1600	1.3	764.23
12	1700	1.7	588.23
13	1800	2.4	416.66
14	2000	4.1	243.90
15	3000	12.2	81.96
16	4000	19.2	52.08
17	5000	26.0	38.46
18	6000	32.1	31.15
19	7000	38.3	26.10
20	8000	44.2	22.62
21	9000	50.3	19.88
22	10000	58.0	17.24

Theoretical calculations:

$L = 10\ mH$, $C = 1\ \mu F$, R = internal resistance of Inductor = $16.5\ \Omega$

Resonant frequency $f_o = 1 / 2\pi\sqrt{LC} = 1592.35$ Hz

$Q = 2\pi f_o L / R = 6.0608$

Band width B.W $= f_o/Q = 1592 .35 / 6.060 = 262.73$

Practical calculations using graph:

Imax = 58 mA, 0.707 x I max = 41.006 mA

Resonant frequency $f_o = 1600$ Hz

$f_1 = 1450$ Hz

$f_2 = 1700$ Hz

Band width B.W $f_2 - f_1 = 250$ Hz

Precautions:

1. No loose connections are allowed.
2. Readings should be taken without parallax error.
3. The apparatus should be handled carefully.
4. Remove the components only after the supply is switched off.

Result:- The resonant frequency and bandwidth of the parallel circuit is determined.

$f_0 = 1600\ H_Z$

$B.W = f_2 - f_1 = 250\ H_Z$

Expt. No. 9 **Date : ………………**

Aim : To plot the frequency response curve of the low pass RC filter and determination of cut off frequency.

Apparatus :

1.	Signal generator (or) AFO	-	1
2.	Decade resistance Box (or) 1KΩ resistor	-	1
3.	Decade capacitance Box (or) 0.1 µF capacitor	-	1
4.	A.C. Voltmeter (DMM) (0-10V)	-	1
5.	Connecting wires	-	1

Theory :

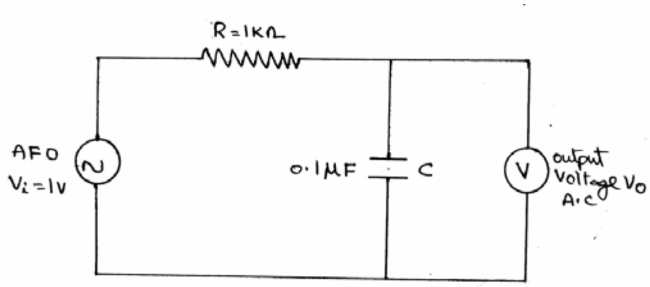
A filter is said to be a low-pass filter if it passes all the frequencies from zero upto the cut off frequency fc and attenuates all other higher frequencies beyond fc. It is abbreviated as LPF. A RC low pass filter is shown in the circuit .At low frequencies the capacitive reactance is very high. Therefore the capacitor can be considered as open circuit and Vo = Vi. At very high frequencies (beyond fc) the capacitive reactance is very low. Therefore the output voltage Vo is small. Thus the output voltage drops off gradually as the frequency is increased.

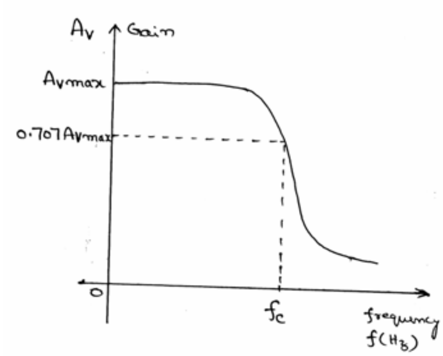
Cutoff frequency $f_c = 1/2\pi RC$ Hz

Gain $A_v = V_o / V_i$ V_o = Output Voltage

V_i = Input Voltage

Circuit Diagram : Low Pass Filter





Procedure :

1. Connections are made as per the circuit diagram.
2. Apply a sinusoidal signal of constant amplitude (say IV or 2V or 3V etc.) to the input of this filter.
3. Measure the input voltage Vi (rms) with a.c. voltmeter or digital multimeter.
4. For various frequencies of (OHz to f > fc) the input signal the output voltages across the capacitor are noted.
5. The readings are tabulated.
6. The gain Av = Vo / Vi is calculated in each step.
7. Graph is drawn between the frequency 'f' taken along x – axis and gain Av – Vo / Vi taken along y – axis.
8. To calculate the cut off frequency fc draw a horizontal line parallel to x-axis at 0.707 times maximum gain (0.707 x A_V max).
9. This line cuts the frequency response curve at some point. From this point draw a vertical line parallel to y – axis. The intersection point of this line with x – axis gives the cut off frequency fc.

Table :

S. No.	Frequency F (Hz)	Output Voltage Vo (Volts)	Gain Av = Vo / Vi
1.	50	1	1
2	60	0.99	0.99
3	70	0.99	0.99
4	80	0.98	0.98
5	100	0.98	0.98
6	200	0.97	0.97
7	400	0.96	0.96
8	500	0.95	0.95
9	600	0.94	0.94
10	700	0.92	0.92
11	800	0.84	0.84
12	1000	0.83	0.83
13	1500	0.72	0.72
14	2000	0.62	0.62
15	3000	0.53	0.53
16	4000	0.44	0.44
17	5000	0.36	0.36
18	6000	0.33	0.33
19	7000	0.3	0.3
20	8000	0.28	0.28
21	9K	0.27	0.27
22	10K	0.25	0.25

Precautions :

1. All the connections should be tight.
2. To obtain good frequency response curve vary the input signal frequency from O Hz to greater than fc.
3. This input sinusoidal signal amplitude is kept constant at some voltage.

Result : The frequency response curve is drawn on the graph and cut off frequency is found to be 1600 Hz.

Expt. No. 10 **Date : ………………**

Aim : To obtain the frequency response of a high pass Rc Filter and determine the cut off frequency.

Apparatus :

1. Signal generator
2. Decade resistance box (or 1 KΩ resistor)
3. Decade capacitance box (0.1 μF capacitor)
4. A.C Voltmeter (or DMM) (0-10V)
5. Connecting wires.

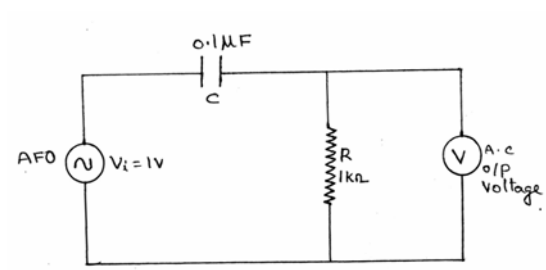
Theory : A filter is said to be a high pass filter if it attenuates all frequencies from OHz to cut off frequency fc and passes all the frequencies beyond fc. It is abbreviated as HPF. A RC high pass filter is shown in the circuit. The capacitive reactance is high at low frequencies and is very low at very high frequencies. Therefore the circuit passes high frequencies. Therefore the circuit passes high frequencies (gain is unity) and rejects low frequencies (gain is small).

Cut off frequency $f_c = 1 / 2\pi RC$ Hz.

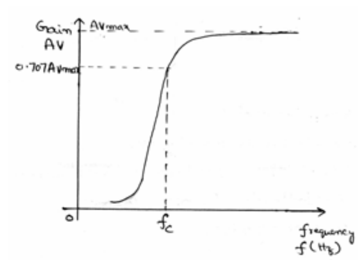
Gain $A_v = V_o / V_i$ V_o = Cutoff Voltage

V_i = Input Voltage

Circuit Diagram : High pass R.C. Circuit



Model Graph : High pass R.C. Circuit



Procedure :

1. Connections are made as per the circuit diagram.
2. Apply a sinusoidal signal of constant amplitude (say 1V, or 2V or 3V) to the input of this filter.
3. The input voltage Vi (rms) is measured with a.c. voltmeter or digital multi-meter.
4. The input signal frequency is varied in steps (from OHz to frequencies greater than fc) and the output voltage across the resistor are noted.
5. The readings are tabulated and gain Av = Vo / Vi is calculated in each step.
6. Graph is drawn between the frequency 'f' taken along. x – axis and gain Av = Vo / Vi taken along y – axis.
7. To calculate the cut off frequency fc a horizontal line is drawn parallel to x-axis at 0.707 times maximum gain (0.707x Av max)
8. This line cuts the frequency response curve at some point. From this point draw a vertical line parallel to y – axis. The intersection point of this line with x – axis gives the cut off frequency fc.

Table :

S. No.	Frequency F (Hz)	Output Voltage Vo (Volts)	Gain Av = Vo / Vi
1	50	0.03	0.03
2	60	0.037	0.037
3	70	0.045	0.045
4	80	0.052	0.052
5	90	0.065	0.065
6	100	0.13	0.13
7	200	0.18	0.18
8	300	0.24	0.24
9	400	0.3	0.3
10	500	0.32	0.32
11	800	0.45	0.45
12	1000	0.54	0.54
13	1500	0.7	0.7
14	2000	0.84	0.84
15	3K	0.93	0.93
16	4K	0.95	0.95
17	6K	0.97	0.97
18	8K	0.98	0.98
19	10K	0.99	0.99
20	20K	0.99	0.99
21	30K	1	1

Precautions :

1. All the connections should be tight.
2. To obtain good frequency response curve vary the input signal frequency from OHz to greater than fc.
3. This input sinusoidal signal amplitude is kept constant at some voltage.

Result : The frequency response curve is drawn on the graph and cut off frequency of High pass filter found to be 1600 Hz.

Expt. No. 11 **Date : ………………**

Aim:- To obtain the forward bias and reverse bias characteristics of a semiconductor diode.

Apparatus:

1.	P-N Junction diode (IN 4001)	-1
2.	Volt meters (0-10V, 0-50V)	-2
3.	Ammeters (0-50 mA, 0-1mA)	-2
4.	Regulated power supply (0-50V)	-1
5.	Resistor (1 kΩ, 0.5W)	-1
6.	Connecting wires or patch cords	

Theory:- A Semiconductor Diode is a P-N junction Diode. It conducts only in one direction. It is a unidirectional device.

Forward bias: When Anode (P-side) of the Diode is connected to battery positive terminal and cathode (N-side) is connected to negative terminal the Diode is said to be forward biased. The forward resistance of the Diode is small.

Reverse bias: When anode of the Diode is connected to battery negative terminal and cathode is connected to positive terminal of the Diode is said to be reverse biased. The reverse resistance of a Diode is very high.

Circuit Diagram :

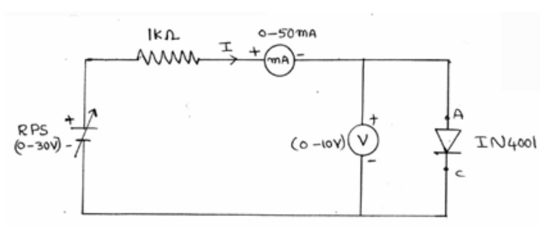


Fig.1 Diode connected in Forward Bias

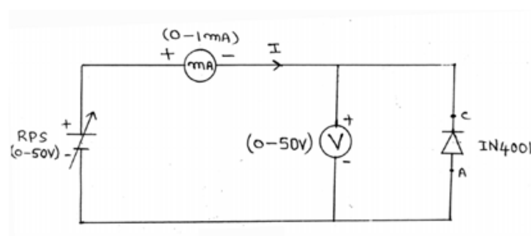
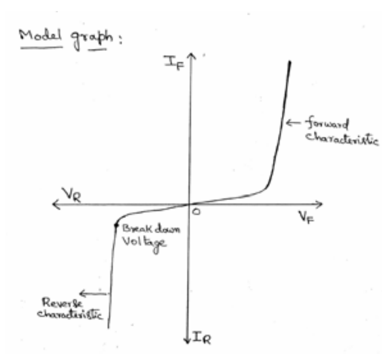


Fig.2 Diode connected in Reverse Bias

Graph: Fig.3 V-I Characteristics of Diode



Procedure:

a) Forward bias:

1. The connections are made as per the circuit diagram (fig1)
2. R.P.S is switched ON.
3. The forward voltage across the Diode is varied in small steps, the readings of the Voltmeter and Ammeter are tabulated.
4. The graph is drawn between V_F taken along X-axis and I_F taken along Y-axis.

b) **Reverse bias**:

1. The connections are made as per the circuit diagram (fig 2)
2. The power supply is switched ON.
3. The reverse voltage across the Diode is varied in small steps, the readings of Voltmeter and Ammeter are tabulated.
4. The graph is drawn between V_R taken along X-axis and I_R taken along Y-axis.

Table: 1 Forward Bias characteristics

S.No	V_F (Volts)	I_F (mA)
1	0	0
2	0.2	0
3	0.3	0
4	0.4	0.05
5	0.5	0.1
6	0.52	0.2
7	0.54	0.4
8	0.6	0.6
9	0.62	1.0
10	0.67	3.0
11	0.68	4.4
12	0.7	10

Table: **2 Reverse Bias characteristics**

S. No	V_R(Volts)	I_R (mA)
1.	0	0
2.	1	0.1
3.	5	0.1
4.	10	0.2
5.	15	0.3
6.	20	0.4
7.	25	0.5
8.	30	0.6
9.	35	0.7
10.	40	0.8
11.	45	0.9
12.	50	1.0

Precautions:

1. Connections are made with correct polarity
2. No loose connections are allowed.
3. Readings should be noted without parallax error
4. All the controls are kept in minimum position before switch ON the power supply.

Result: The forward bias and reverse bias characteristics of a Semiconductor Diode are obtained and drawn on the graph.

Expt. No. 12 **Date : ………………**

Aim: To obtain the forward and reverse bias characteristics of a Zener Diode and to find its break down voltage.

Apparatus:

1. Zener Diode (6Z) -1
2. Voltmeters (0-10V) -2
3. Ammeters (0-50 mA, 0-1mA) -2
4. Regulated power supply (0-30V) -1
5. Resistor (1 kΩ, 1W) -1
6. Connecting wires or patch cords

Theory: A heavily doped P-N junction Diode which has sharp break down voltage is called Zener Diode. It is normally operated in reverse bias.

Forward Bias: When Anode of the Diode is connected to battery positive terminal and cathode is connected to negative terminal the Diode is said to be forward biased.

Reverse Bias: When Anode of the Diode is connected to battery negative terminal and cathode of the Diode is connected to the Battery positive terminal the Diode is said to be reverse biased.

Break down Voltage: At some reverse voltage the voltage across the Zener Diode remains constant and current through it increases sharply. This voltage is known as Zener break down voltage(V_Z).

Circuit Diagram :

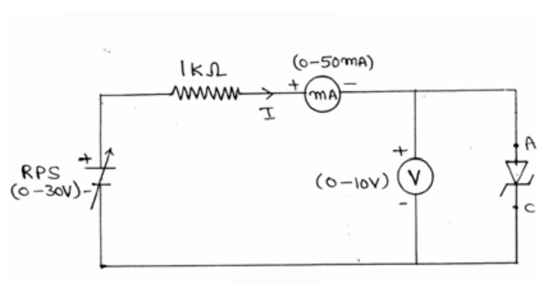


Fig.1
Zener Diode connected in Forward Bias

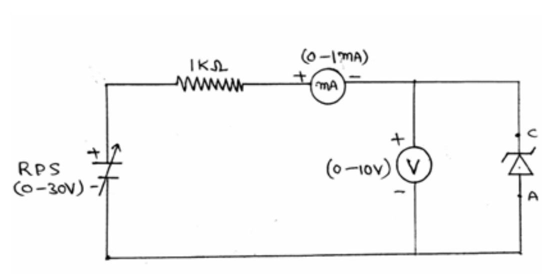
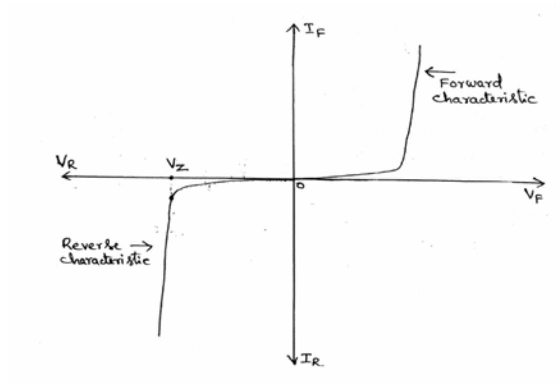


Fig.2
Zener Diode connected in Reverse Bias

Graph : V-I Characteristics of Zener Diode



PROCEDURE:

Forward bias:

1. Connections are made as per the circuit diagram (fig1)
2. The regulated power supply (R.P.S) is switched ON
3. The forward voltage across the Diode is varied in small steps, the readings of the Volt meter and Ammeter are tabulated.
4. The forward characteristic is drawn on the graph taking V_F along X-axis and I_F along Y-axis.

Reverse bias:

1. Connections are made as per the circuit diagram (fig.2)
2. R.P.S is switched ON
3. The reverse Voltage across the Diode is varied in small steps, the readings of the Voltmeter and Ammeter are tabulated.
4. At some reverse voltage, the voltage across the Zener Diode remains constant and current through it increases sharply. This voltage is known as Zener breakdown voltage (V_Z).
5. The graph is drawn between V_R taken along X-axis and I_R taken along Y-axis.

Table :1

Zener Diode Forward Bias Characteristics

S.No.	V_F (Volts)	I_F (mA)
1.	0	0
2.	0.2	0
3.	0.6	0
4.	0.7	1
5.	0.75	4
6.	0.8	15
7.	0.82	33
8.	0.83	42
9.	0.84	45

Table:2

Zener Diode Forward Bias Characteristics

S.No.	V_R (Volts)	I_R (mA)
1.	0.5	0.02
2.	1.0	0.04
3.	1.5	0.06
4.	2.0	0.1
5.	2.5	0.12
6.	3.0	0.14
7.	3.5	0.18
8.	4.0	0.2
9.	4.5	0.22
10.	5.0	0.24
11.	5.5	0.28
12.	6.0	0.34
13.	6.0	0.4
14.	6.0	0.5
15.	6.0	0.7
16.	6.0	0.8

Precautions:

1. Connections are made with correct polarity
2. No loose connections are allowed.
3. Readings are noted without parallax error.
4. All the controls are kept in minimum position before switch on the power supply.

Result:- The forward and reverse bias characteristics of a Zener Diode are obtained and the graph is drawn. The Zener break down voltage is found to be V_Z=6V

Expt. No. 13 **Date : ………………**

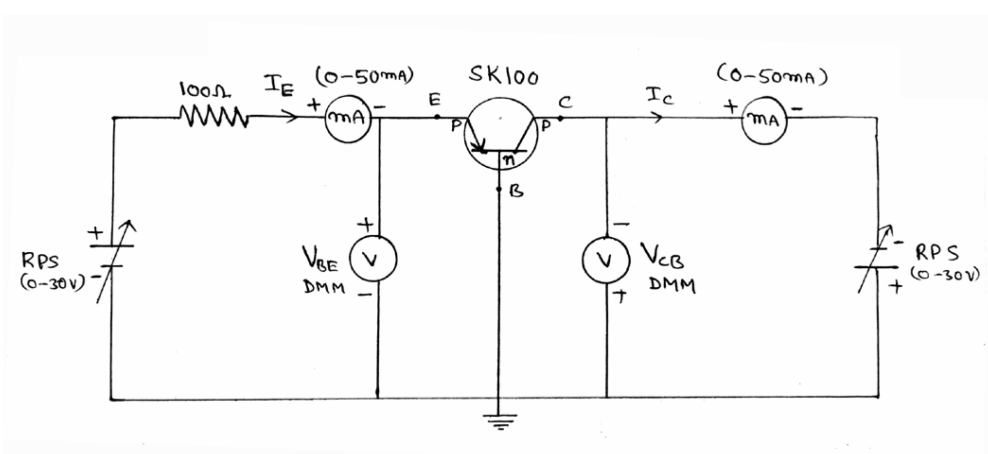
Aim:- To determine the input and output characteristics of a Transistor in C.B. configuration.

Apparatus:

1. Transistor (SK 100) -1
2. Ammeters (0-50 mA) -2
3. Digital multi meters OR 0-2v, 0-1V voltmeters -2
4. Resistor (100Ω) -1
5. Regulated power supply (0-30V dual channel) -1
6. Connecting wires or patch cards.

Theory:- A Transistor consists of two P-N junctions formed by sandwitching either p-type or N-type semiconductor between a pair of opposite types. It is a three terminal active device. The three terminals are Emitter (E), Base (B) and collector (C) The emitter –base junction is forward biased and collector-base junction is reverse biased. In C.B. configuration base is common to both input (emitter) and output (collector). The input resistance is very low (20-100Ω) and output resistance is very high (1MΩ). In CB configuration the graph drawn between $\mathbf{V_{EB}}$ and $\mathbf{I_E}$ keeping $\mathbf{V_{CB}}$ as constant is known as input characteristics.Similarly the graph drawn between $\mathbf{V_{CB}}$ and $\mathbf{I_C}$ keeping $\mathbf{I_E}$ as constant is known as output characteristics .

Circuit Diagram : Transistor connected in CB mode



Model Graph :

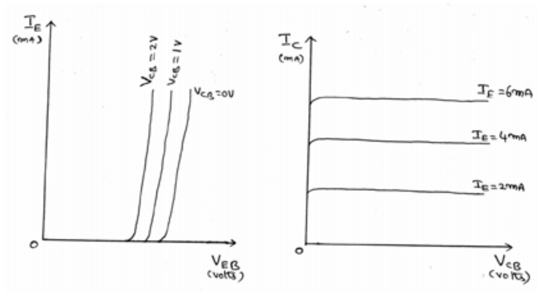


Fig .1 Input characteristics **Fig .2 Out put characteristics**

Procedure :- The procedure to obtain input and output characteristics is given below.

a) Input Characteristics:

1. Connections are made as per the circuit diagram
2. Switch on the power supply. Keep VcB at some Constant Value (say OV)
3. Then vary V_{EB} in small steps and note down V_{EB} and I_E .Readings are tabulated
4. The same procedure is repeated for different values of V_{CB} (say 1v, 2v).
5. Input characteristics are drawn on the graph between V_{EB} and I_E at constant V_{CB}

b) Output Characteristics:

1. The same circuit is used for the output characteristics
2. Keep I_E at some constant value (say I_E = 2 mA)
3. Then vary V_{CB} in small steps and note down V_{CB} and I_C The readings are tabulated.
4. Repeat the same procedure for different values of I_E (say 4 mA, 6 mA)
5. Output characteristics are drawn on the graph between V_{CB} and I_C at constant I_E.

Table 1 : Input Characteristics :

S. No	**V_{CB} = 0 V**		**V_{CB} = 1 V**		**V_{CB} = 2 V**	
	V_{BE} (V)	**I_E(mA)**	**V_{BE}(V)**	**I_E(mA)**	**V_{BE}(V)**	**IE(mA)**
1	0	0	0.02	0		
2	0.6	1	0.62	1		
3	0.62	2	0.64	2		
4	0.64	3	0.65	3		
5	0.65	4	0.66	4		
6	0.66	5	0.66	5		
7	0.66	6	0.67	6		
8	0.67	7	0.67	7		
9	0.67	8	0.68	8		
10	0.68	9	0.68	9		

Table 2 : Out put Characteristics:

S.No	I_E = 2 mA		I_E = 4 ma		I_E = 6 mA	
	V_{CB}(V)	I_C(mA)	V_{CB}(V)	I_C(mA)	V_{CB}(V)	I_C(mA)
1	0	2.0	0	4.0	0	6.0
2	0.5	2.2	0.5	4.2	0.5	6.2
3	1.0	2.2	1.0	4.2	1.0	6.2
4	1.5	2.2	1.5	4.2	1.5	6.2
5	2.0	2.2	2.0	4.2	2.0	6.2
6	2.5	2.2	2.5	4.2	2.5	6.2
7	3.0	2.2	3.0	4.2	3.0	6.2
8	3.5	2.2	3.5	4.2	3.5	6.2
9	4.0	2.2	4.0	4.2	4.0	6.2
10	4.5	2.2	4.5	4.2	4.5	6.2

Precautions:

1. Connections are made with correct polarity
2. No loose connections are allowed
3. Readings are noted without parallax error.
4. All the controls are kept in minimum position before switch on the power supply.

Result :- Input and output characteristics of a Transistor in C.B. configuration are obtained and drawn on the graph.

Expt. No. 14 **Date : ………………**

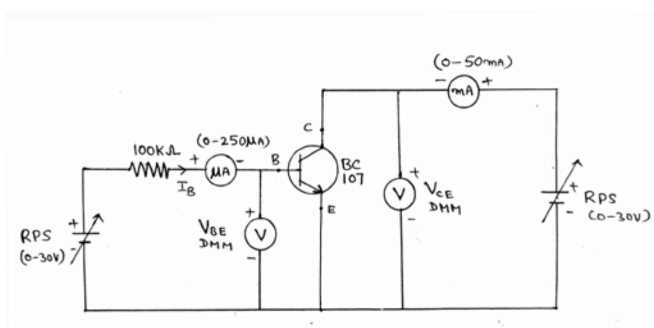
Aim:- To obtain the input and output characteristics of a Transistor in C.E. configuration.

Apparatus:

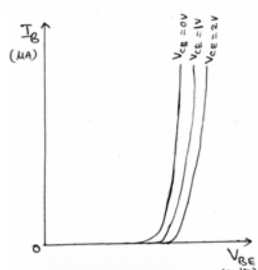
1. Transistor (BC 107) -1
2. Ammeters (o-250 **μ**A, 0-50 mA) -2
3. Digital multi meters or (0-2 V, 0-10 V volt meters) -1
4. Resister (100 k **Ω**,) -1
5. Regulated power supply (0-30 V Dual channel) -1
6. Connecting wires or patch cords

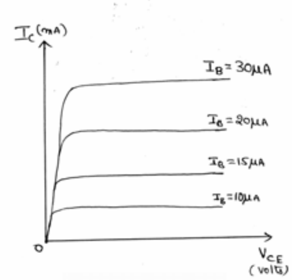
Theory :- A Transistor consists of two P-N junctions formed by sandwitching either P- type or N-type semiconductor between a pair of opposite types. It is a three terminal active device. The three terminals are Emitter (E), Base (B) and Collector (C). In CE mode of operation the Base Emitter junction is forward biased and Collector Emitter junctions is reverse biased. In C.E configuration emitter is common to both input (Base) and output (Collector). In CE configuration the graph drawn between $\mathbf{V_{BE}}$ and $\mathbf{I_B}$ keeping $\mathbf{V_{CE}}$ as constant is known as input characteristics .Similarly the graph drawn between $\mathbf{V_{CE}}$ and $\mathbf{I_C}$ keeping $\mathbf{I_B}$ as constant is known as output characteristics .

Circuit Diagram :



Model Graph :





Input Characteristics **Output Characteristics**

Procedure:

The procedure to determine input and output characteristics are given below.

a) Input characteristics:

1. Connections are made as shown in the circuit
2. Switch on the R.P.S keep V_{CE} at some Constant voltage (say 0 v)
3. Then vary V_{BE} in small steps and note down V_{BE} and I_B readings are tabulated.
4. Repeat the same procedure for different values of V_{BE} (say V_{BE} =1 V, $V_{BE =}$ 2 V)
5. Input characteristics are drawn on the graph between V_{BE} and I_B at constant V_{CE}

b) Output Characteristics

1. The same circuit is used for output characteristics
2. Keep I_B at some constant value (say 10 mA)
3. Then V_{CE} is varied in small steps, the readings of V_{CE} and corresponding I_C are noted and tabulated.
4. Repeat the same procedure for different values of I_B (say 20 mA, 30 mA etc)
5. Output characteristics are drawn on the graph between V_{CE} and I_C at constant I_B

Table : Input Characteristics

S.No	V_{CE} = 0 v		V_{CE} = 4 mA		V_{CE}= 2V	
	V_{BE}(V)	I_B(μA)	V_{BE} (V)	I_B(μA)	V_{BE} (V)	I_B (μA)
1	0.51	1	0.58	1	0.57	1
2	0.54	2	0.59	2	0.60	2
3	0.56	4	0.60	4	0.62	4
4	0.60	6	0.62	6	0.63	6
5	0.61	8	0.63	8	0.64	8
6	0.62	11	0.64	10	0.65	10
7	0.63	12	0.65	14	0.66	14
8	0.64	17	0.66	20	0.67	20

Table: Output Characteristics

S.No	I_B = 10 µA		I_B =15µA		I_B= 20 µA	
	V_{CE} (Volts)	I_C (mA)	V_{CE} (Volts)	I_C (mA)	V_{CE} (Volts)	I_C (mA)
1	0.00	0.0	0.00	0.0	0.00	0.0
2	0.03	0.2	0.04	0.4	0.05	1.0
3	0.05	0.4	0.05	0.8	0.07	1.6
4	0.06	0.6	0.07	1.2	0.08	2.4
5	0.08	1.0	0.09	1.8	0.10	3.2
6	0.10	1.4	0.11	2.4	0.12	3.8
7	0.12	1.8	0.13	3.0	0.14	4.4
8	0.13	2.0	0.14	3.4	0.15	4.8
9	0.14	2.2	0.20	3.9	0.20	5.4

Precautions:

1. Connections are made with correct polarity
2. No loose connections are allowed
3. Readings are noted without parallax error
4. All the controls are kept in minimum position before switch on the power supply.

Result :- Input and output characteristics of a Transistor in C.E. configuration are obtained and drawn on the graph.

Expt. No. 15 **Date : ………………**

Aim: To determine the characteristics of JFET

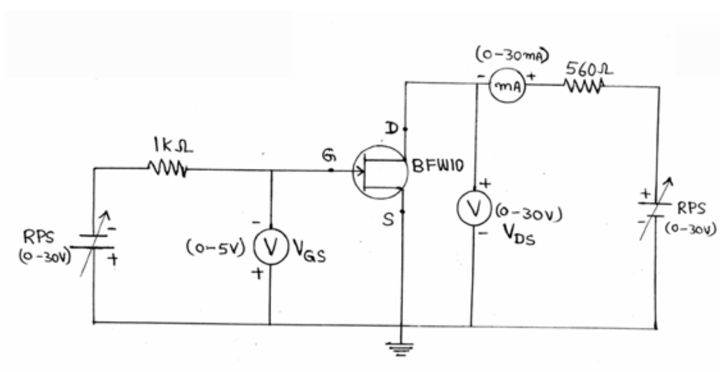
Apparatus:

1.	JFET (BFW 10)	-1
2.	Ammeter (o – 30 mA)	-1
3.	Voltmeters (0- 5 V, 0 – 30 V)	-2
4.	Resistors (1 KΩ, 560Ω)	-2
5.	Regulated power supply (0-30 V Dual channel)	-1
6.	Connecting wires or patch cords.	

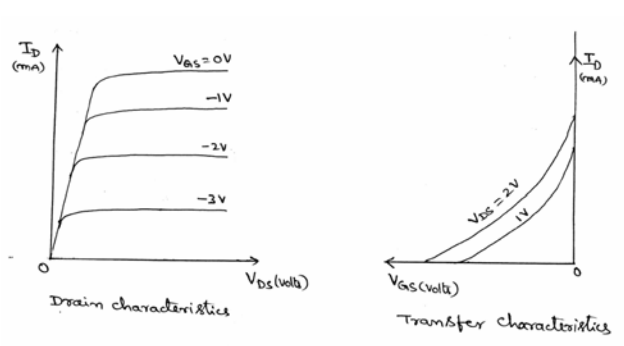
Theory :- A Field Effect Transistor is abbreviated as FET. FET is a Unipolar device in which conduction is due to majority carries only. It has three terminals source, Drain and Gate. The flow of current through the channel from source to drain is controlled by an electric field. Hence the name Field effect transistor (FET). FET is a Voltage controlled device. Junction field effect transistors are two types 1) N-Channel FET 2) P-Channel FET. In N-Channel FET Current flows due to free electrons. In P-Channel FET current flows due to holes only.

.

Circuit Diagram :



Model Graph :



Procedure :

a) Drain or Output Characteristics:

1. The connections are made as shown in the circuit diagram.
2. R.P.S. is switched ON keep the gate to source voltage V_{GS} at a constant Value (say V_{GS} = 0 V)
3. The drain to source voltage V_{DS} is varied in small steps, the values of V_{DS} and I_D are noted and the readings are tabulated.
4. The same procedure is repeated for different Values of V_{GS} (Say V_{GS} = 1 V, V_{GS} = 2 V).
5. Drain characteristics are drawn on the graph between V_{DS} and I_D at constant V_{GS}.

b) Transfer Characteristics

1. The same circuit is used for transfer characteristics
2. Keep the V_{DS} at some constant value (Say $V_{DS =}$ 1 V)
3. The Gate to source voltage V_{GS} is varied in small steps, the values of V_{GS} and I_D are noted and the readings are tabulated.
4. The same procedure is repeated for different Values of V_{DS} (Say V_{DS} = 2 V, 3V).
5. Transfer characteristics are drawn on the graph between V_{GS} and I_D at constant V_{DS}.

Table: Drain Characteristics

S.No	**V_{GS} = 0 v**		**V_{GS} = -1 V**		**V_{GS}= - 2 V**	
	V_{DS}(volts)	**I_D(mA)**	**V_{DS}(V)**	**I_D(mA)**	**V_{DS} (V)**	**I_D (mA)**
1	0	0	0	0	0	0
2	1	4	1	3	1	2
3	2	7	2	5	2	3
4	3	9	3	5	3	3
5	4	10	4	5	4	3
6	5	10	5	5	5	3
7	6	10	6	5	6	3
8	7	10	7	5	7	3
9	8	10	8	5	8	3

Table: Transfer Characteristic :

S. No	V_{DS} = 1 V		V_{DS} = 2 V	
	V_{GS}(V)	I_D(mA)	V_{GS} (V)	I_D(mA)
1	0	6.5	0	10
2	1.62	4	0.86	8
3	2.30	3	1.6	6
4	3.08	2	2.42	4
5	3.69	1	3.29	2
6	3.98	0	4.48	0

Precautions:

1. Connections are made with correct polarity
2. No loose connections are allowed
3. Readings are noted without parallax error
4. All the controls are kept in minimum position before switch on the power supply.

Result :- The drain and transfer characteristics of a FET are obtained and plotted on the graph.

Expt. No. 16 **Date : ………………**

Aim:- To obtain the forward characteristics of SCR and to identify the break over (V_{BO}) at different gate currents.

Apparatus:

1.	SCR S106 MI	-1
2.	Resistor 2 kΩ,	-2
3.	Variable resistor (pot) (0-65 kΩ,)	-1
4.	Regulated power supply (0-5V, 0-100V)	-2
5.	Ammeters (0-50 mA , 0-100 **μ**A) d.c.	-2
6.	Voltmeter (0-100 V) d.c.	-1
7.	Patch cords or connecting wires	
8.	Experimental board.	

Theory: Silicon controlled rectifier (SCR) is a power electronic PNPN switching device. It has three terminals Anode (A), Cathode (K) and Gate (G). It is a unilateral device and can be used as a rectifier. It can change alternating current into direct current. The amount of power fed to the load can be controlled by changing the firing angle, by varying the gate voltage and hence the name controlled rectifier.

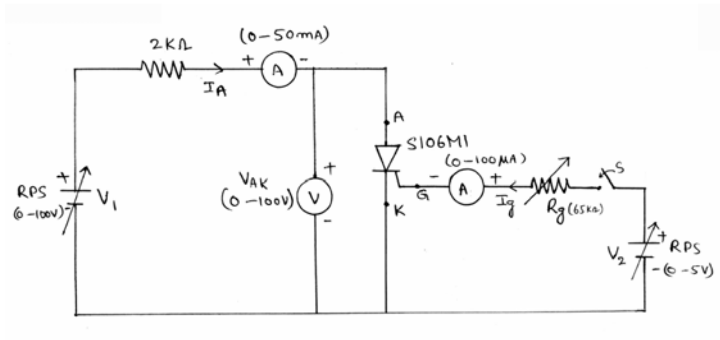
1. When gate is open ($I_G = 0$)

A large anode cathode voltage V_{AK} is to be applied to make SCR conducting. Minimum forward Voltage gate being open at which SCR starts conducting heavily (turned ON) is called break over voltage (V_{BO}). Under this condition the voltage across SCR drops suddenly.

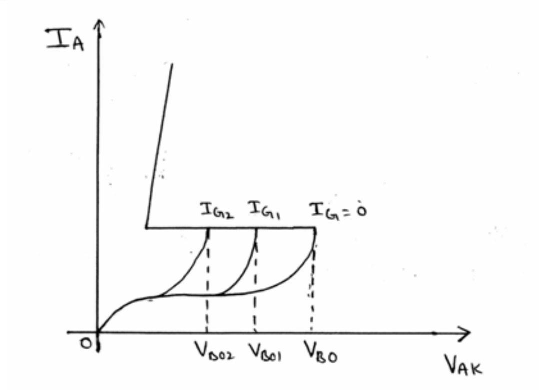
2. When gate is positive w.r.t. cathode:

SCR will be turned ON at lower supply voltage by applying small positive potential to the gate. As the gate current increases SCR is turned on at lower voltages. When SCR is conducting, it will not open (stop conducting) even if gate voltage is removed. The only way to stop conduction is to decrease the supply voltage. As a result the anode current drops to the holding current and SCR is turned off. The maximum anode current at which SCR is turned OFF from On State, when Gate is open is known as Holding current (I_h) .

Circuit Diagram :



Model Diagram :



Procedure:

1. Connections are made as per the circuit diagram
2. Initially the gate current is kept Zero I_G =- 0 (Gate open V_2 = 0 V)when the switch is opened.
3. Voltage 'V_1" is slowly varied and the anode current (I_A) and anode to cathode voltage (V_{AK}) are noted.
4. At some voltage SCR is triggered and heavy current flows. This voltage is noted as forward break over voltage V_{BO}
5. Switch 'S' is closed gate current (I_{G1}= 6 **μ**A) is applied by varying the voltage V_2 and adjusting the resistor R_g
6. Steps 3,4 and 5 are repeated for different gate currents (say I_{G2} = 9 mA) and the readings are tabulated.
7. Graph is drawn between V_{AK} taken along x-axis and I_A taken along Y-axis.

Table :

S. No	**I_G=**		I_G=		I_G=	
	V_{AK}(V)	**I_A(mA)**	**V_{AK} (V)**	**I_A(mA)**	**V_{AK} (V)**	**I_A (mA)**

Result : The characteristics of SCR are obtained. The break over voltage is found to be V_{BO} = 65 V when I_G = 6 **μ**A.

Expt. No. 17 **Date : ………………**

Aim: To obtain the regulation characteristics of a Zener voltage regulator.

Apparatus:

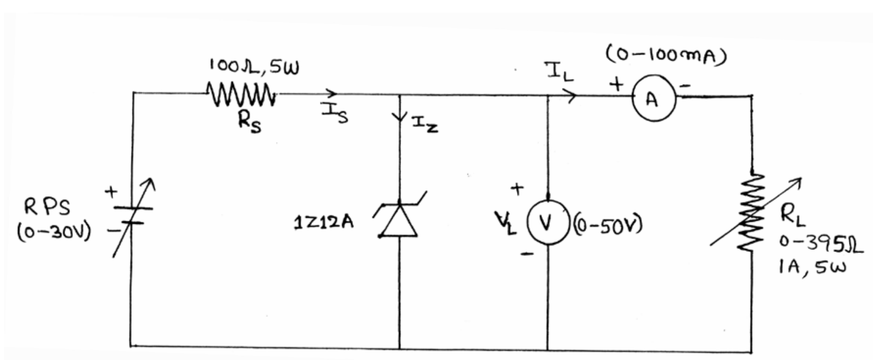
1.	Zener diode (1Z12A)	-1
2.	Regulated power supply (0-30V)	-2
3.	Ammeter (0-100 mA) dc	-1
4.	Voltmeter (0-30V) dc	-1
5.	Rheostat (350 Ω, 1 A)	-1
6.	Wire wound resistor (100Ω, 5 W)	-1
7.	Connecting wires or patch cords.	

Theory :- A Zener diode can be used as a voltage regulator to provide constant voltage from a source whose voltage may vary over sufficient range. The Zener Diode is reverse connected across the load R_L across which constant output is to be maintained. The series resistance R_S absorbs the output voltage fluctuations. The Zener Diode will maintain a constant voltage ($V_O = V_Z$) across the load so long as the input voltage does not fall below V_Z. It keeps output voltage constant irrespective of current passing through it.

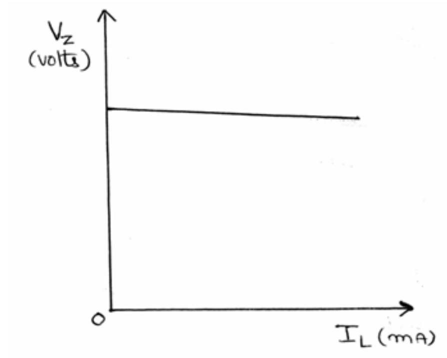
$$I_S = I_Z + I_L$$

If the load current I_L increases, then current through Zener Diode I_Z decreases by the same value to maintain I_S constant. Thus the voltage drop across RS remains constant. If the load current I_L decreases then current through the Zener Diode will increase by the same amount to maintain I_S constant. Thus the output voltage is stabilized.

Circuit Diagram :



Model Graph :



Procedure:

1. Connections are made as shown in the circuit.
2. Zener Diode must be connected in reverse bias.
3. Input voltage is kept constant at 20 V
4. Note down the on load voltage (V_{ZL}) before connecting load R_L
5. The load resistance R_L is varied and the Zener voltage V_Z, load current I_L are noted.
6. V_Z and I_L are tabulated for various values of load resistance R_L Note down the full load voltage V_{FL}
7. The voltage regulation graph is plotted with I_L taken along X-axis and V_L taken along Y-axis.
8. The percentage of regulation is calculated Using the formula:

   % regulation = $(V_{NL} – V_{FL}) / V_{FL}$ x 100

Calculations:

V_{NL} = 6.380, V_{FL} = 5.77 V

$$\% \text{ Regulation} = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$$

$$= \frac{6.38 - 5.77}{5.77} \times 100$$

$$= 10.57\%$$

Result:- The regulation characteristics of a Zener voltage regulator are obtained and the % regulation is found to be 10.57%

Expt. No. 18 **Date : ………………**

Aim : To draw the frequency response of the RC coupled amplifier and to calculate the gain and band width of RC coupled amplifier.

Apparatus :

1. Function generator (AFO)
2. RC Coupled amplifier experimental board
3. AC Milli volt meter (0-25 V)
4. Digital multi meter
5. Regulated power supply
6. Components list

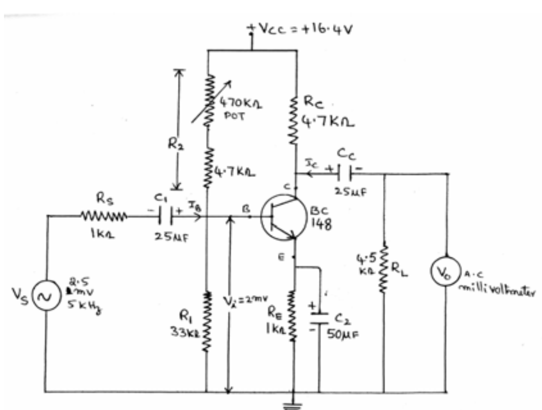
   Transistor : BC 148

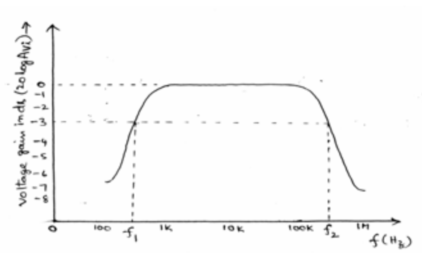
   Resistors : 14Ω, 4.7KΩ, 33KΩ, 4.5KΩ, 470KΩ, 1KΩ (POT)

   Capacitors : 25µf, 50µf

Theory : This is the most popular type of coupling because it is cheap and provides excellent audio fidelity over a wide range of frequency. It is generally used for voltage amplification. Coupling capacitor Cc is used to connect the output of first stage to the base of second stage. If Cc allows A.C and block D.C the resistors R_1 R_2 and R_E provides the biasing and stabilization network. By capacitor C_E offers low reactance path to the signal. When A.C. signal V in applied to the base of the transistor it appears in the amplified form across the collector load Rc. It can be given to the second stage for further amplification.

Circuit Diagram : R.C. Coupled Amplifier , Model Graph : Frequency Response





Procedure :

1. Connections are made as per the circuit diagram.
2. Apply a voltage Vcc = 16.4V and adjust R_2 (470KΩ POT) to set V_{CE} = 5V (i.e. to set operating point at V_{CE} = 5V, I_C = 2mA)
3. A sinusoidal voltage of Vi = 2mV (say Vs = 2.5 mV) at a frequency of 5 KHz is applied to the input of the amplifier.
4. Measure the open circuit output voltage Vo using A.C. milli voltmeter.
5. Connect the output load resistance R_L (4.5KΩ).
6. Keeping input voltage constant the input signal frequency (100Hz – 900 KHz) is varied in steps and the output voltage (Vo) is measured.
7. Readings are tabulated. Gain is calculated.
8. Frequency response is drawn on the graph between the frequency (f) taken along x – axis and 20 log Avi (dB) taken along y – axis.
9. A Horizontal line is drawn at 3db points. Wherever this line cuts the curve points are noted as f_1 and f_2. band width = $f_2 - f_1$

Table : Vi = 2mV, Av max. = 300 (From table)

S. No.	Frequency F(Hz)	Output Voltage Vo (volts)	Voltage Gain Av = Vo / Vi	Normalized gain Avi = Av / Av max	Gain in dB 20 log Avi in dB
1.	100	0.20	100	0.33	-9.54
2	200	0.35	175	0.583	-4.68
3	300	0.40	200	0.67	-3.52
4	400	0.45	225	0.75	-2.50
5	500	0.47	235	0.78	-2.12
6	600	0.50	250	0.83	-1.58
7	700	0.52	260	0.86	-1.24
8	1000	0.54	270	0.90	-0.92
9	2000	0.6	300	1.0	0
10	3000	0.6	300	1.0	0
11	5000	0.6	300	1.0	0
12	7000	0.6	300	1.0	0
13	9000	0.6	300	1.0	0
14	10000	0.6	300	1.0	0
15	20000	0.6	300	1.0	0
16	30000	0.6	300	1.0	0
17	50000	0.6	300	1.0	0
18	80000	0.6	300	1.0	0
19	100K	0.57	285	0.95	-0.45
20	150K	0.55	275	0.916	-0.75
21	200K	0.48	240	0.8	-1.9
22	300K	0.45	225	0.75	-2.5
23	400K	0.40	200	0.66	-3.5
24	500K	0.35	175	0.58	-4.7
25	700K	0.30	150	0.50	-6.0
26	900K	0.27	135	0.45	-6.9

From the table Av max. = 300

Calculations :

Vs = 2.5mv, Vi = 2mv, f = 5 KHz, Vo = 0.5 V

voltage Gain Av = Vo / Vi = 0.5 / 2 x 10-3 = 250

From the graph :

Lower half power frequency f_1 = 360 Hz

Upper half power frequency f_2 = 290 KHz

Band width B.W. $f_2 - f_1$ = 2,90,000 – 360 = 289.6 KHz

Result : The frequency reponse of RC coupled amplifier is drawn and gain, band width calculated.

Gain Av = Vo / Vi = 250

Band width B.W. = $f_2 - f_1$ = 289.6 KHz

Expt. No. 19 **Date : ………………**

Aim : To obtain the max power output of the given push – pull amplifier, find its efficiency and to draw load versus power output curve.

Apparatus :

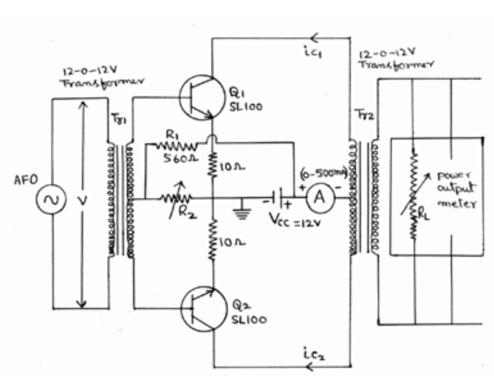
1. Audio frequency oscillator -1
2. Power output meter -1
3. Regulated power supply -1
4. Push pull amplifier experimental board.
5. Output Transformer -1
6. Driver Transformer -1
7. Decade resistance box -1
8. Ammeter (0-500 mA) d.c -1
9. Transistors SL 100 -2
10. Resistors : (560Ω, 1w), (10Ω, 1w), (10Ω, 1w)

Theory : Push pull amplifier is a power amplifier. It is generally used in the output stages of electronic circuits where high output power at high efficiency is required. The two transistors Q_1 and Q_2 are excited by the same input signal but with a phase difference of 180^0. The input signal is applied to the base of the two transistors through driver transformer Tr_1. When base of transistors Q_1 is positive the base of Q_2 is negative. Thus in a full cycle of the signal, half cycle of the signal is amplified by Q_1 and another half cycle is amplified by Q_2. The primary of the output transformer Tr_2 combines in the secondary. % Efficiency = Po (ac) / Pi (dc) x 100

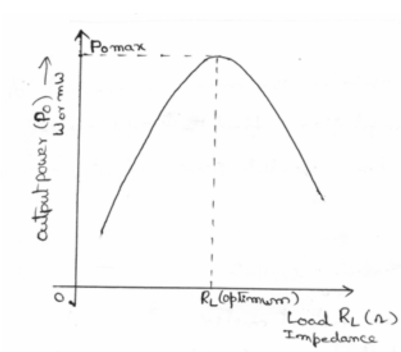
Po = Output power measured with output power meter

Pi = Vcc. Ic at optimum load.

Circuit Diagram : Push pull amplifier ,



Model Graph :



Procedure :

1. Connect the dc supply voltage (12V) to the circuit from RPS.
2. A sinusoidal signal of frequency 1KHz and some amplitude (5mv) is applied to the input of power amplifier from audio frequency oscillator (AFO).
3. Connect a loud speaker at the output across the secondary of output transformer Tr_2.
4. Adjust the resistance R_2 (DRB) to hear proper sound. If the sound is heard the circuit is said to be under working
5. Replace the loud speaker with a power output meter.
6. The value of the load impedance in the output power meter is varied in steps.
7. The readings of load impedance and output power are tabulated.
8. Draw a graph between load impedance R_L and output power (Po).
9. From this graph the impedance for which the output power is maximum is found. This gives the value of optimum loud.
10. Calculate the % efficiency.

Calculations :

Selected value of optimum load = 44.3 Ω

Frequency of input signal = 1 KHz

Maximum output power Po max = 32.5 mw

At optimum Load :

Vcc = 6V, Ic = 10 mA Input power Pi = $6 \times 10 \times 10^{-3}$

Pi (dc) = 60 mw

Output power Po = 32.5 mw (from table)

% efficiency = Output power Po (a.c) / Input power Pi (d.c) x 100

= 32.5 /60 x 100

= 54.6 %

Result : The load impedance versus out put power curve is drawn and optimum load impedance, maximum output power, % efficiency are found to be

Max. output power = 32.5 mw

Optimum load impedance = 44.3Ω

% efficiency = 54.6%

Expt. No. 20 **Date : ………………**

Aim:- To find the ripple factor and % regulation of a Half-wave rectifier with and without filter.

Apparatus:

1. Diode (BY 127) -1
2. Transformer (0-18 V) -1
3. Multi meter (For V_{AC} and V_{DC}) -2
4. Decade resistance box -1
5. Capacitor (32µF) -1

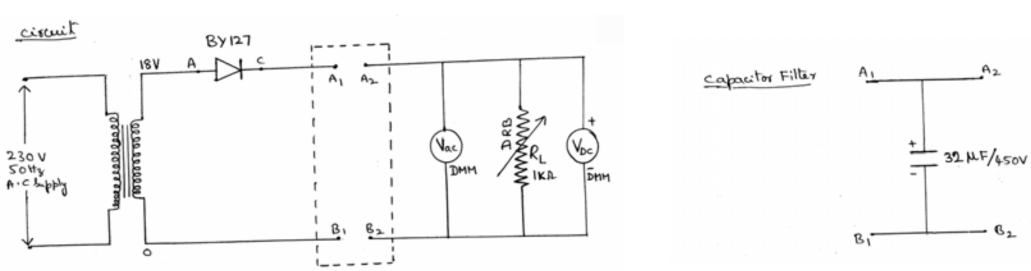
THEORY:

A rectifier is a circuit, which converts A.C supply into D.C supply. When the input A.C voltage is applied to the Half-wave rectifier circuit during positive half cycle the Diode becomes forward bias and conducts current. The current flows through the load resistor $R_{L.}$ During negative half cycle the Diode becomes reverse biased and offers very high resistance. No current flows through the load resistor and output voltage becomes zero. So, that at the output positive half cycles of the input wave form will appear and negative half cycles are clipped at the output, so we will get unidirectional current. Rectifier output contains A.C and D.C components. This type of output practically not useful in circuits. Filter removes the A.C components and the D.C to the load. .

$$\text{Ripple factor } \gamma = V_{ac} / V_{dc}$$

$$\% \text{ Regulation } = [V_{NL}-V_L / V_{NL}] \times 100$$

Circuit Diagram :



Procedure:

a) Without filter:

1. Connections are made as per the circuit diagram (i) without connecting filter.
2. V_{NL} is noted without connecting the load R_L
3. Next the load is connected between output terminals.
4. For different values of R_L the readings of voltmeters V_{ac} and V_{dc} are tabulated.
5. Using the formula ripple factor and % regulation are calculated.

b) With filter:

1. Connections are made as per the circuit diagram Filter is connected between terminals A_1, A_2 and B_1, B_2.
2. V_{NL} is noted without connecting the load R_L
3. Next the load R_L is connected between output terminals.
4. For different values of R_L the readings of voltmeters V_{ac} and V_{dc} are tabulated.
5. Using the formula Ripple factor and % regulation are calculated.

Table : Without Filter: V_{NL} = 10. 85 V

S.No	R_L (Ω)	Vac (Volts)	Vdc (Volts)	γ = Vac/Vdc	%R=(V_{NL}-V_L / V_{NL}) x100
1	10	3.87	3.30	1.17	69.58
2	20	5.01	4.12	1.2	62.02
3	30	5.55	4.52	1.22	58.34
4	40	5.8	4.75	1.24	56.22
5	50	5.9	4.90	1.204	54.83
6	60	6.1	5.0	1.22	53.91
7	70	6.2	5.06	1.22	53.36
8	80	6.3	5.13	1.22	52.71
9	90	6.4	5.19	1.23	52.16
10	100	6.43	5.21	1.23	51.98
11	500	6.9	5.64	1.22	48.01
12	1K	7.0	5.60	1.25	48.38
		Total		14.624	661.5

γ = 14.624/12 =1.218 % Regulation = 661.5/12 = 5.13

Table: With Filter V_{NL} = 18 V

S. No.	R_L (Ω)	Vac (Volts)	Vdc (Volts)	γ = Vac/Vdc	%R=(V_{NL}-V_L / V_{NL}) x100
1	10	3.84	3.32	1.15	81.55
2	20	4.90	4.25	1.15	76.38
3	40	5.53	5.18	1.06	71.2
4	50	5.62	5.50	1.02	69.4
5	100	5.44	6.91	0.78	61.61
6	200	4.67	9.09	0.5	49.5
7	400	3.42	11.61	0.2	35.5
8	500	3.03	12.38	0.2	31.2
9	600	2.70	12.97	0.2	27.94
10	800	2.21	13.88	0.1	22.88
11	1K	1.79	14.64	0.1	18.66
Total				6.46	545.82

γ =6.46/11 = 0.587 %Regulation = 545.82/11 = 49.62

Precautions:

1. Connections are made with correct polarity
2. No loose connections are allowed.
3. Readings are noted without parallax error.

Result :- The ripple factor and % regulation of Half-Wave rectifier are found to be

	Ripple factor (γ)	**% Regulation (R)**
Without Filter	1.218	55.13
With Filter	o.587	49.62

Expt. No. 21 **Date : ………………**

Aim:-To find the ripple factor and % Regulation of Full – wave rectifier with and without filter.

Apparatus:

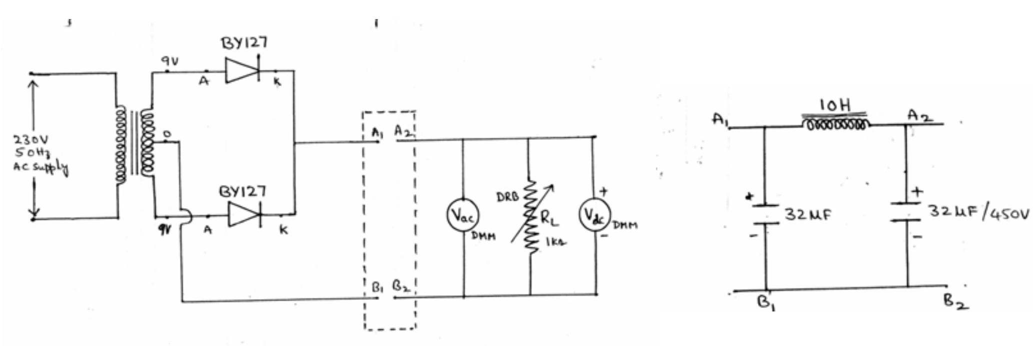
1.	Diode (BY 127)	-2
2.	Transformer (9-0-9V)	-1
3.	Multi meter (For Vac. and V_{dc})	-2
4.	Decade Resistance Box	-1
5.	Capacitors (32**μ**F)	-2
6.	Choke (10 H)	-1

Theory:- A rectifier is a circuit, which converts A.C supply into D.C supply, During positive half cycle of input a.c. voltage Diode "D_1" is forward biased and "D_2" is reverse biased. The current flows through the load resistor R_L due to "D_1" only. During negative half cycle of input A.C. voltage Diode "D_2" is forward biased and "D_1" is reverse biased. The current flows through the load resistor R_L due to "D_2" only. Therefore the current flows through the load during positive and negative half cycles in the same direction. In this way full wave rectifier converts A.C. into D.C supply. Rectified output contains A.C. and D.C. components. In this Filter removes the A.C components and the D.C to the load.

Ripple factor $\gamma = V_{\mathbf{ac}}/V_{dc}$

% Regulation % $R = V_{NL} - V_L / V_{NL} \times 100$

Circuit Diagram :



Procedure:

a) Without Filter:

1. Connections are made as per the circuit diagram without filter.
2. V_{NL} is noted without connecting the load R_L
3. Next the load R_L is connected between output terminals.
4. For different values of R_L the readings of voltmeters V_{ac} and V_{dc} are tabulated.
5. Using the formula Ripple factor and % regulation are calculated.

With Filter:

1. Connections are made as per the circuit diagram with filter connected between terminals A_1, A_2 and B_1, B_2
2. V_{NL} is noted without connecting the load R_L
3. Next the load R_L is connected between output terminals
4. For different values of R_L the readings of voltmeters V_{ac} and V_{dc} are tabulated.
5. Using the formula Ripple factor and % Regulation are calculated.

Table:

S. No.	R_L (Ω)	V_{ac} (Volts)	V_{dc} (Volts)	γ = Vac/Vdc	%R=(V_{NL}-V_L / V_{NL}) x100
1	10	3.2	6.51	0.491	25.7
2	50	3.8	7.80	0.487	10.95
3	100	3.9	8.03	0.486	8.33
4	200	4.0	8.24	0.485	5.93
5	300	4.01	8.27	0.484	5.59
6	400	4.01	8.29	0.483	5.36
7	500	4.02	8.32	0.483	5.02
8	600	4.02	8.32	0.483	5.02
9	700	4.03	8.40	0.479	4.10
10	800	4.04	8.46	0.477	3.42
11	900	4.05	8.49	0.477	3.08
12	1 K		8.50	0.476	2.96
Total				5.791	85.46

γ = 5.791/12 = 0.482, % Regulation= 85.46/12= 7.12%

Table: With Filter V_{NL} = 12.65 V

S. No.	R_L (Ω)	Vac (Volts)	V_{dc} (Volts)	γ = Vac/Vdc	%R=(V_{NL}-V_L /V_{NL}) x100
1	10	0.03	0.18	0.16	98.6
2	50	0.04	0.82	0.04	93.5
3	100	0.04	1.48	0.02	88.3
4	200	0.5	2.51	0.01	80.15
5	300	0.5	3.29	0.01	72.99
6	400	0.5	3.90	0.01	69.16
7	500	0.5	4.37	0.01	64.45
8	600	0.5	4.76	0.01	62.37
9	700	0.5	5.12	0.009	59.52
10	800	0.5	5.40	0.009	57.31
11	900	0.5	5.64	0.008	55.41
12	1 K	0.4	5.95	0.006	52.96
Total				0.302	856.72

γ = 0.302/12 = 0.025 % Regulation = 856.72/12 = 71.39

Precautions:

1. Connections are made with correct polarity.
2. No loose connections are allowed.
3. Readings are noted without parallax error.

Result :- The ripple factor and % regulation of Full – wave rectifier are found to be

	Ripple factor (γ)	**% Regulation**
Without filter	0.482	7.12
With filter	0.025	71.39

Expt. No. 22 **Date : ………………**

Aim : To measure the frequency generated by the colpitts oscillator.

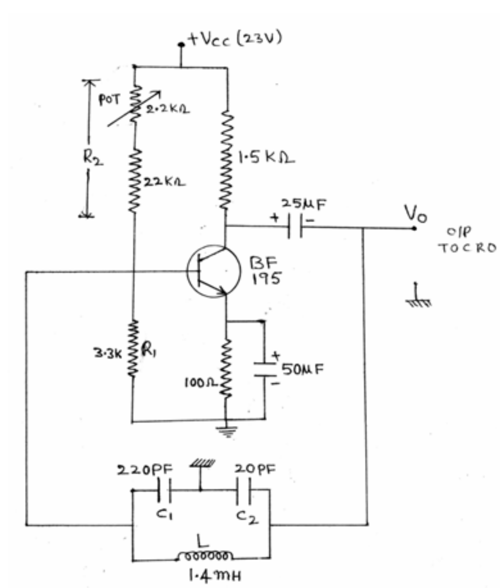
Apparatus :

1. Regulated power supply -1
2 Cathode Ray oscilloscope -1
3. Multi meter -1
4. Colpitts oscillator experimental board.
5. Transistor BF 195
6. Resistors : 3.3 KΩ, 22KΩ, 1.5KΩ, 100Ω, 2.2 KΩ POT
7. Capacitors : 220PF, 20PF, 25 μF, 50μF
8. Coil 1.4 mH

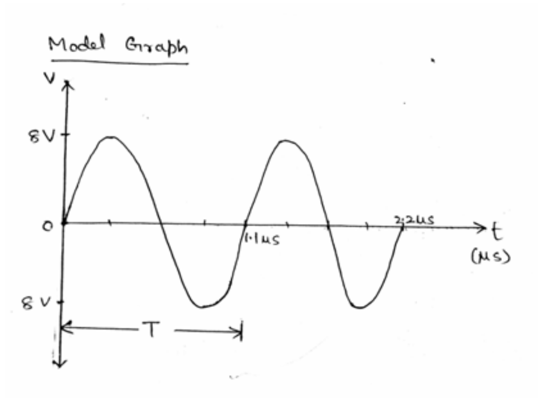
Theory : The colpitts oscillator is shown in figure. It consists of Transistor, a tank circuit formed by L, C_1 and C_2. It is wired with components as shown. Potentail divider arrangement provides base bias (3.3KΩ, 22KΩ and 2.2KΩ) when the power is switched on collector current starts increasing and charges the capacitors C_1 and C_2. When the Capacitors are fully charged the discharge through 'L' and oscillations are setup in the tank circuit. The oscillations across C_1 are applied to the base. This appear in the amplified form in its collector circuit. Thus the energy equal to the losses is supplied to the tank circuit in phase. The frequency of oscillations.

$$f_O = 1 / 2\pi\sqrt{LC} \quad \text{where} \quad C = C_1C_2 / C_1 + C_2$$

Circuit Diagram :



Model Graph :



Procedure :

1. The colpitts oscillator was connected as shown in the circuit.
2. operating point was set at V_{CE} = 7.5V and I_C = 2mA by supplying V_{CC} = 23V and by adjusting R_2. Measure V_{CE} = 7.5V with multi meter.
3. Connect the output of oscillator to C.R.O.
4. The pot resistance R_2 is adjusted to get undistorted sinwave on CRO.
5. The output voltage wave form observed on CRO is drawn on the graph.
6. The frequency and amplitude of oscillations were measured.
7. Theoretical and experimental frequencies are compared.

Theoretical Calculations :

$f_O = 1 / \pi\sqrt{2LC}$ where $C = C_1C_2 / C_1 + C_2$

C_O = 220PF, C2 = 20PF, L = 1.4 mH

$f_O = 9.93 \times 10^5$ Hz

From Graph (Practical Value) :

Amplitude of Sin wave		=	3.2 x 5 = 16 Vpp
Time period	T	=	1.1 µs
Frequency of oscillations	fo	=	1/T = 9.09×10^5 Hz

Result : The frequency of oscillations generated by colpitts oscillator is found to be . $f_O = 9.09 \times 10^5$ Hz.

Expt. No. 23 **Date : ………………**

Aim : To measure the frequency of oscillations generated by the tuned collector oscillator.

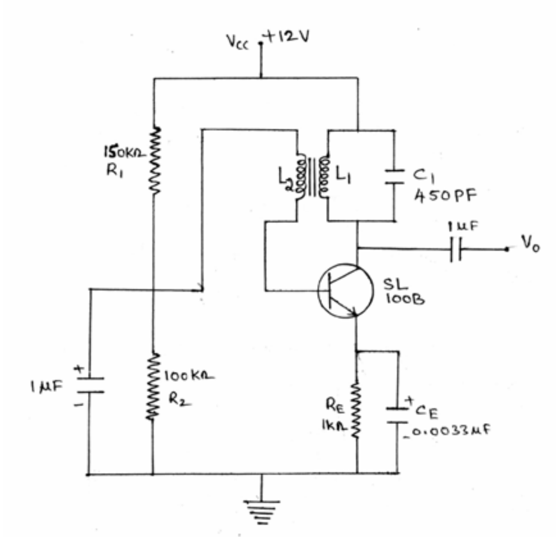
Apparatus :

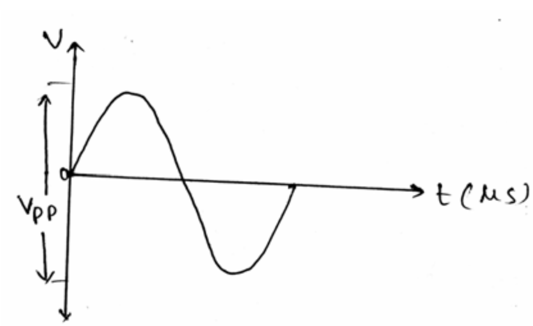
1. Regulated power supply -1
2. Cathode Ray oscilloscope (CRO) -1
3. Tuned collector oscillator experimental board
4. Transistor SL 100B -1
5. Resistors : 150KΩ, 100KΩ, 1KΩ (All ½ watt)
6. Capacitors : 1μF 25V - 2
   0.0033 μF 30V -1
   C_1 = 450 PF -1
7. RF Transformer : L_1 = 108 mH
   L_2 = 8 mH

Theory : Tuned collector oscillator is shown in the figure. It contains a tuned circuit $L_1 – C_1$ in the collector. The feed back coil L_2 in the base circuit is magnetically coupled to the tank circuit coil L_1. L_1 and L_2 forms the primary and secondary of the R.F. transformer. The biasing is provided by potential divider arrangement. The capacitor 'C' connected in the base circuit provides low reactance path to the oscillations.

When the circuit is switched ON the collector current increases and charges the capacitor C_1. When the capacitor is fully charged it discharges through coil L_1 setting up oscillations of frequency $fo = 1 / 2\pi\sqrt{L_1.C_1}$ This oscillators will induce some voltage in the coil L_2 . This voltage across L_2 is applied between the base emitter junction and it appears in the amplified form in the collector circuit. A phase shift of 180^0 is created between the voltage of L_1 and L_2 due to transformer action. Transistor produces 180^0 phase shift. As a result the total phase shift of 360^0 is produced. Thus energy fed back to the tank circuit is in phase with generated oscillations.

Circuit Diagram : **Model Graph :**





Calculations :

Theoretical : L_1 = 108mH, C_1 = 45O pf

$Fo = 1/2\pi\sqrt{L_1.C_1}$ = 22.8 Khz

Practical : Amplitude = -Vpp

Time period T = 45 μs

Frequency fo = 1/T = 22.2 KHz

Procedure :

1. Connections are made as shown in the circuit.
2. Power supply is switched ON
3. CRO is connected to the output.
4. Wave form is observed on the screen.
5. Amplitude and frequency of the sine wave is noted and drawn on the graph.
6. The theoretical and practical values are compared.

Results : The frequency of the oscillations is found to be fo = 22.2 KHz

Expt. No. 24 **Date : ………………**

AIM : To study about different I.C. packages and their pin identification.

APPARATUS : Different types of I.C's

STUDY : An integrated circuit (I.C) is a packaged electronic circuit. Integrated circuit consists of both active and passive components and their inter connections fabricated on a very small silicon chip. In the design of electronic circuits its size is an important factor. For many purposes the size and weight should be as low as possible.

ADVANTAGES:

1. These are small in size.
2. Low cost
3. Low weight
4. Low power consumption
5. More reliable

LIMITATIONS:

1. It is not possible to fabricate inductors on I.C.
2. Fabrication of Transformers on I.C. is difficult.
3. I. C. cannot be repaired in case of failure.
4. I.C's function at low voltages only.
5. It is not possible to produce high power in I.C's

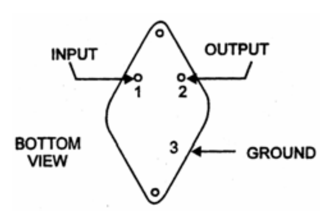
I.C.PACKAGES :

I. C. packages can be classified in to two groups.

1. Metallic package 2. Plastic package

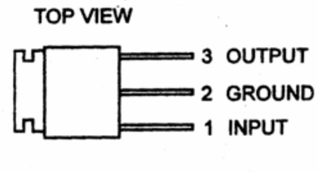
1. **Metallic package :** These are further classified in to three types

   a. To – 3, Package : This type of I.C's are used in voltage regulators. These are shown in fig. (a)



(a) TO – 3 PACKAGE

b. To – 220 package : This I.C's are used in voltage regulators. These are shown in fig. (b)



(b) TO – 220 PACKAGE

c. To-5 Package : It has a circular base and 8-10 connecting pins. These are shown in fig. (c)

(c) TO – 5 PACKAGE

2. Plastic Package :

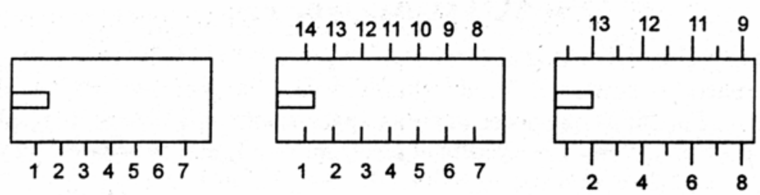
a) Single in line package (SIP) : In this type of I.C. connecting pins are only on one side of the I.C. as shown in fig. (a)

b) Dual in line package (DIP) : In this type of I.C. the connecting pins are provided on both sides as shown in fig(b). The pin numbers start from L.H.S. to R.H.S. from the identification mark. On the other side from R.H.S. to L.H.S. in continuation.

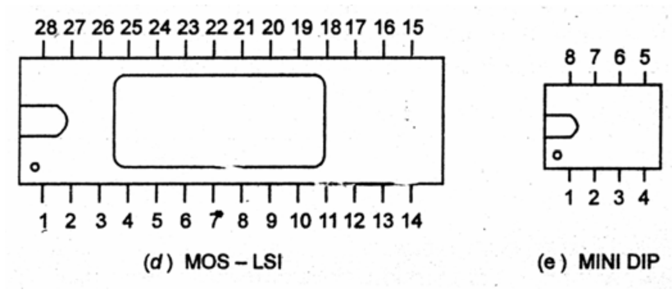
c) Quad in line package (QIP) : In this type of I.C. the connecting pins are more. Therefore there are arranged in two lines on each side as shown in fig. (c).

d) MOS – LSI Package : Its full name is metal oxide semiconductor large scale integration. It has up to 40 connecting pins as shown in fig. (d).

e) Mini dual in line package (MDIP) : In this type of I.C. there are only 8 pins. 4 pins on each side as shown in fig (e).



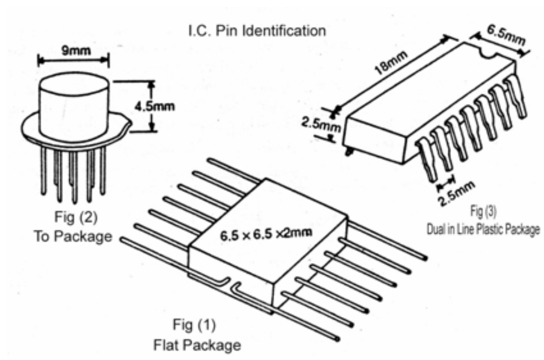
(a) SIP (b) DIP (c) QIP



Identification of I.C. Pins :-

Flat Package :

1. In Flat Package Count starts with pin where dot is located.
2. Count begins from L.H.S. to R.H.S. one side and R.H.S. to L.H.S. Continuously on other side.



To Package :

1. Count starts with the pin left of the tab.
2. Count proceeds in anti clock wise direction.

Dual in line plastic package :-

1. Count starts with pin which is left of notch.
2. Count begins from L.H.S. to R.H.S. on one side and R.H.S. to L.H.S. continuously on other side.

Result : With this study I came to know about different I.C. Package and identification of their pins.

Expt. No. 25 **Date : ………………**

Aim : To study about different types of Cells and Batteries.

Apparatus :

1. Lead acid Battery.
2. Dry cell
3. Multi-meter

Theory : Battery is the combinations of cell either it is connected in series or parallel. In turn cell is a electro chemical device which can convert chemical energy into electrical energy. Cells are classified as follows.

1. Primary cell 2. Secondary cell

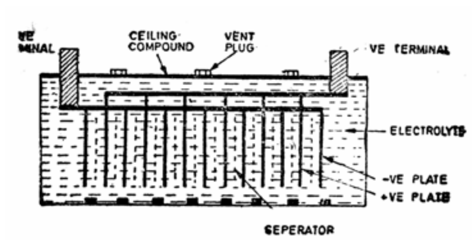
Primary cell : The cell which is used once cannot be reused is known as primary cell. They are also known as disposable cells or throw – away cells. Eg. Daniel cell, Voltaic and dry cell.

Secondary cell : The cell which is reused after discharging is known as secondary cell. They are also known as accumulators or rechargeable batteries or storage batteries. Eg. Lead acid cell, Nickel – iron cell and nickel cadmium cell.

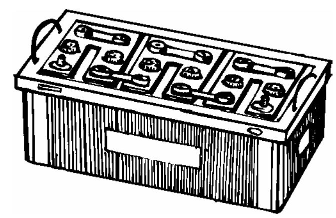
Observations : Construction and working of lead acid cell : A complete storage battery is a combination of cell consist of positive and negative plates. The negative plates are soldered to one terminal known as negative terminal and all the positive plates are soldered to the positive terminal. They are so assembled that each of the positive plates is inter linked to negative plate. As the negative and positive plate are kept close to each other, there always an increasing tendency for short circuit which is avoided by keeping wooden, ebonite, glass or rubber separators in between each positive and negative plate. Internal short circuit may also occur due to accumulation of active material at the bottom of the cell. To avoid this a considerable space is allowed. This whole assembly of a cell is usually put in a container made of hard rubber. In lead acid cell sponge lead (pbo) is used as negative plates and lead peroxide as positive plates and H_2So_4 as electrolyte.

WORKING : The charging and discharging action of a cell or Battery is known as working.

Internal View **External View**



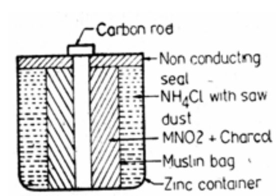
Battery parts.



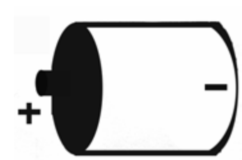
During discharging :When cell is fully charged its positive plate pbo_2 is dark chocolate brown and the negative plate is slate grey in colour .When the cell discharges it sends current through the external load and H_2SO_4 dissociates in to H_2^+ions and negative SO_4^- ions. As the current with in the cell is flowing from cathode to Anode H_2^+ions move to anode and SO_4^- ions move to Cathode.

During charging : When the cell is recharged H_2^+ ions move to cathode and SO_4^- ions SO_4^- ions go to anode and the following changes takes place.

Dry Cell : Dry cell is shown in the figure. In such a cell the electrolyte is in the form of a paste of NH_4Cl saturated with granulated carbon and powdered man ganese dioxide. The positive electrode is in the form of carbon rod placed in the centre. Around the carbon rod, mixture of charcoal, Mno_2 and a little gum is placed in a maslin bag. Surrounding this bag a pasty layer of NH_4Cl with saw dust is placed. The negative plate is Zinc container in which all the assembly is being placed. The top is covered with a non-conducting substance to prevent unnecessary leakage of electricity. The E.M.F of such a cell is nearly 1.5 volt and falls down gradually with the use. The mixture of charcoal and Mno_2 may get dried up, so this is moistened with a little NH_4Cl and $Zncl_3$.



Dry Cell.



Internal View **External View**

The cell is exhausted when zinc, NH_4cl or Mno_2 is used up. The discharged cell should be thrown away otherwise the salt may spoil the metal holder for the cell. The cell is considered to be exhausted when the voltage drops to 1volt or less.

Result : The voltage measured in Dry cell = 1.5V

The Voltage measured in lead acid cell = 6V

MODEL QUESTION PAPER

Time : 3 Hrs. **Max. Marks : 50**

Sub : Electronic Devices and Circuit Lab

Note : Answer any one of the following :

1. Determine Resistance of the Unknown Resister using V.I. Method and verify it by colour code ?
2. Measure the Co-efficient and coupling of the given Iron Core Transformer ?
3. Obtain the forward and Reverse bias characteristics of P.N. Diode ? and draw its graph ?
4. Measure the percentage of Regulation of Zener Voltage Regulator ?
5. Measure the frequency of Colpitts of Oscillator ?

Scheme of Valuation :

1. Theory	-	20 Marks
2. Practical	-	20 Marks
3. Viva	-	05 Marks
4. Record	-	05 Marks
TOTAL :	**-**	**50 Marks**