B.Sc. I ST YEAR

2 ND Semester

PHYSICS

BSc Physics **INDEX** I st Yr - 2nd Semester

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7.	To study the ripple and regulation factors of a half wave rectifiers.				

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Experiment No. 1

Object :-

To draw the V-I Characteristic of PN junction diode.

Apparatus :-

Junction diode or a transistor, milliammeter, microammeter, Voltmeter, rheostat, battery and connection wires.

Observation :-

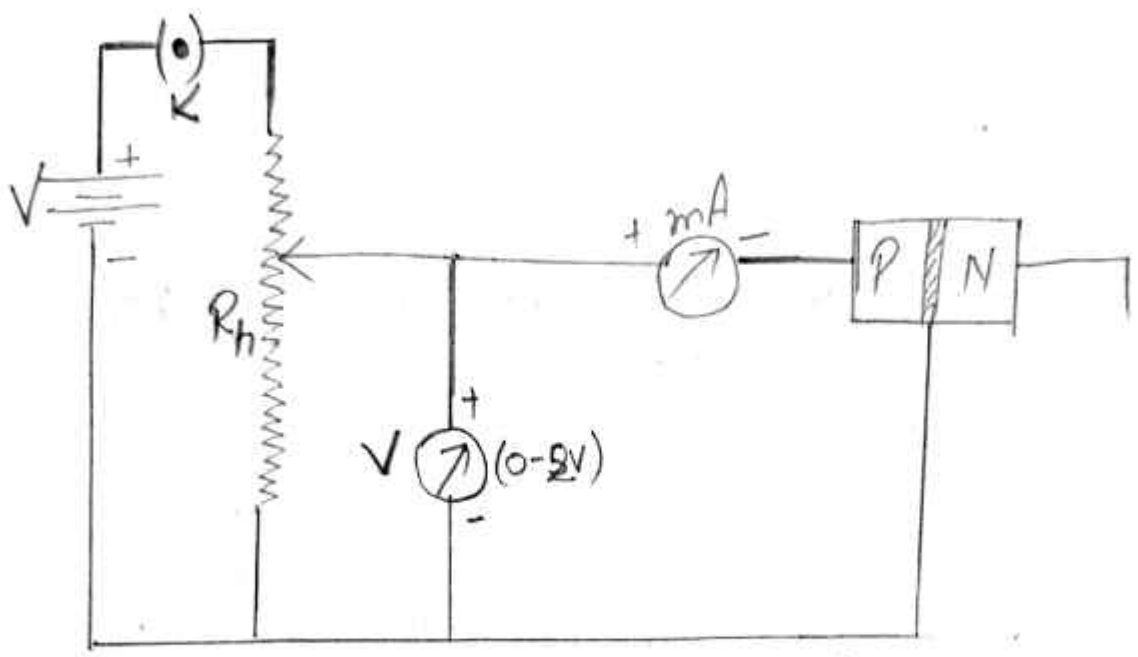
Table for Voltage Vs Current in forward bias:

Sr.no.	V_F (Volt)	I_F (mA)
1	0	0
2	0.1	0
3	0.2	0
4	0.3	0
5	0.4	0
6	0.5	0
7	0.6	0.2
8	0.64	0.4
9	0.66	0.6
10	0.68	0.8
11	0.70	1.2
12	0.72	2.0
13	0.74	3.4
14	0.78	5.0
15	0.80	9.4

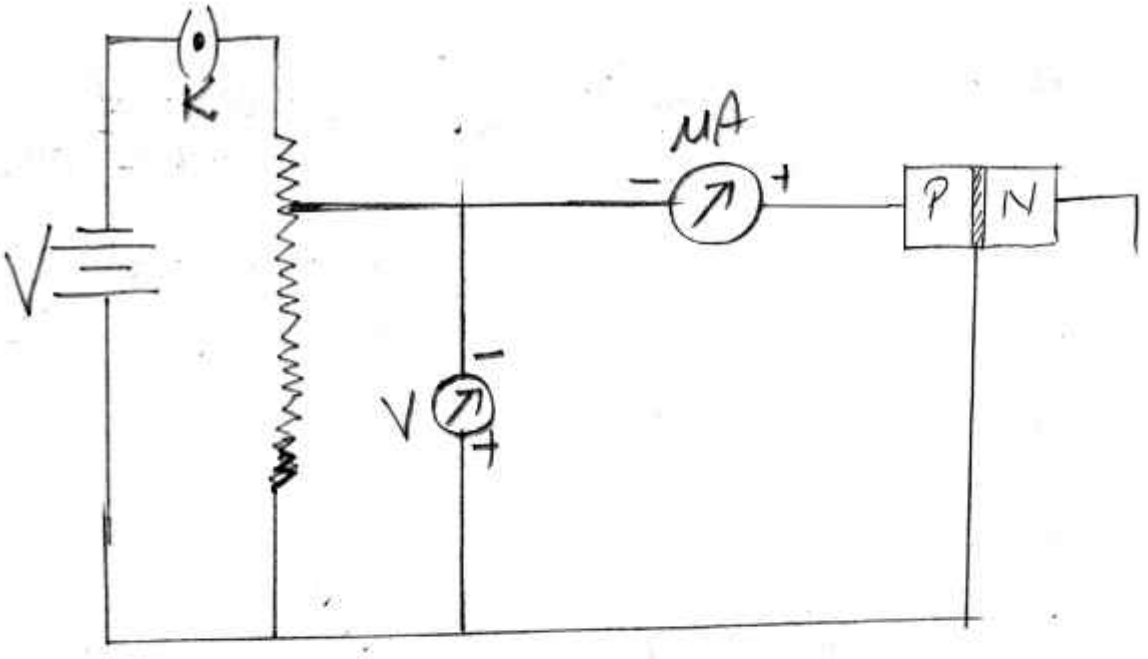
Least count of voltmeter = ± 0.02 Volt

Least count of milliammeter = 0.2 mA

Teacher's Signature : .....



Forward biasing



Reverse biasing

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Table for Voltage Vs current in reverse bias :-

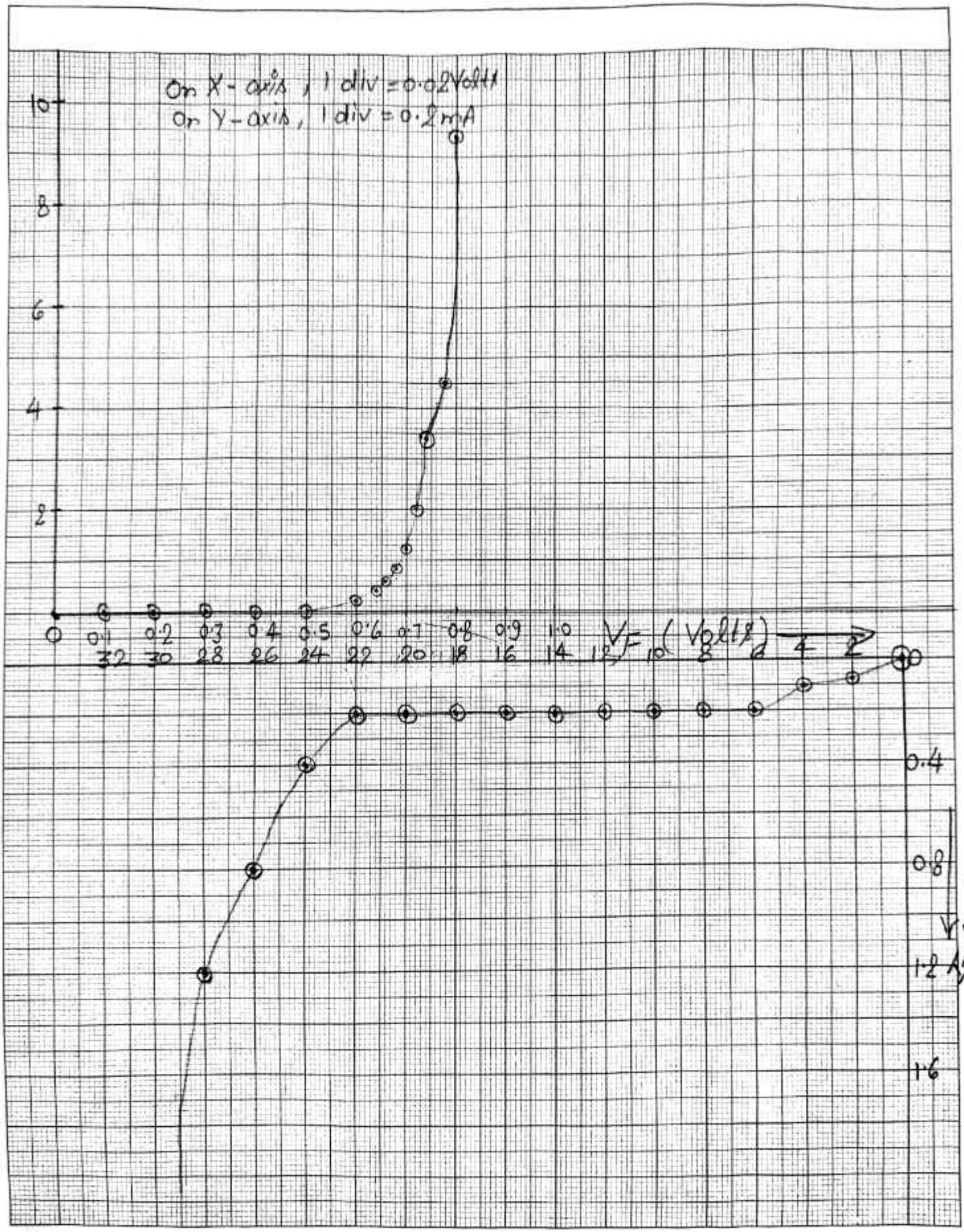
Least count of Voltmeter = 0.5 volt
Least count of microammeter = 5 μA

Sr.no.	V_R (Volt)	I_R (μA)
1	0	0
2	2	0.04
3	4	0.1
4	6	0.2
5	8	0.2
6	10	0.2
7	12	0.2
8	14	0.2
9	16	0.2
10	18	0.2
11	20	0.2
12	22	0.2
13	24	0.4
14	26	0.8
15	28	1.2

Result :-

The characteristic of PN junction diode for forward current as well as for reverse biased are shown in graph.

Teacher's Signature : .....


On X - axis, 1 div = 0.02 Volt
On Y - axis, 1 div = 0.2 mA
10
8
6
4
2
0
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2
V_f (Volt)
0.4
0.8
1.2
1.6
I_f (mA)

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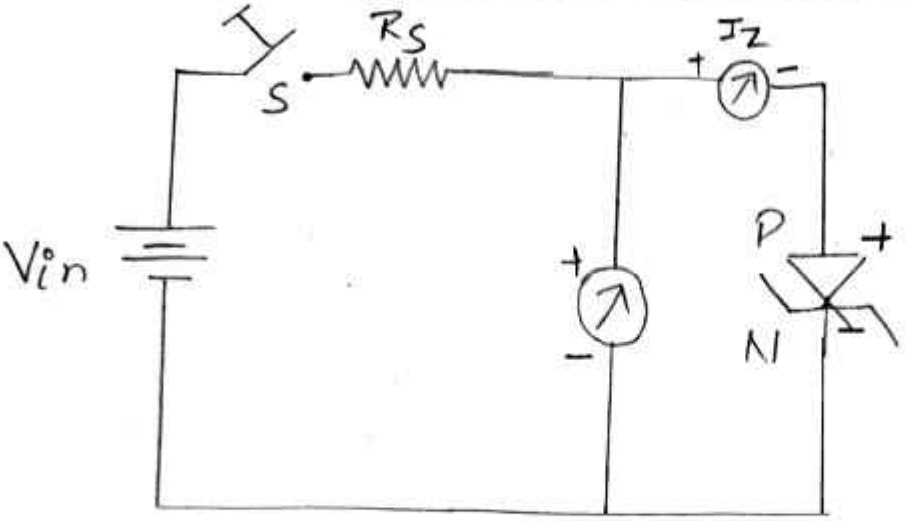
Precautions and Sources of error :-

[i] The voltage applied should not be large of the transistor.

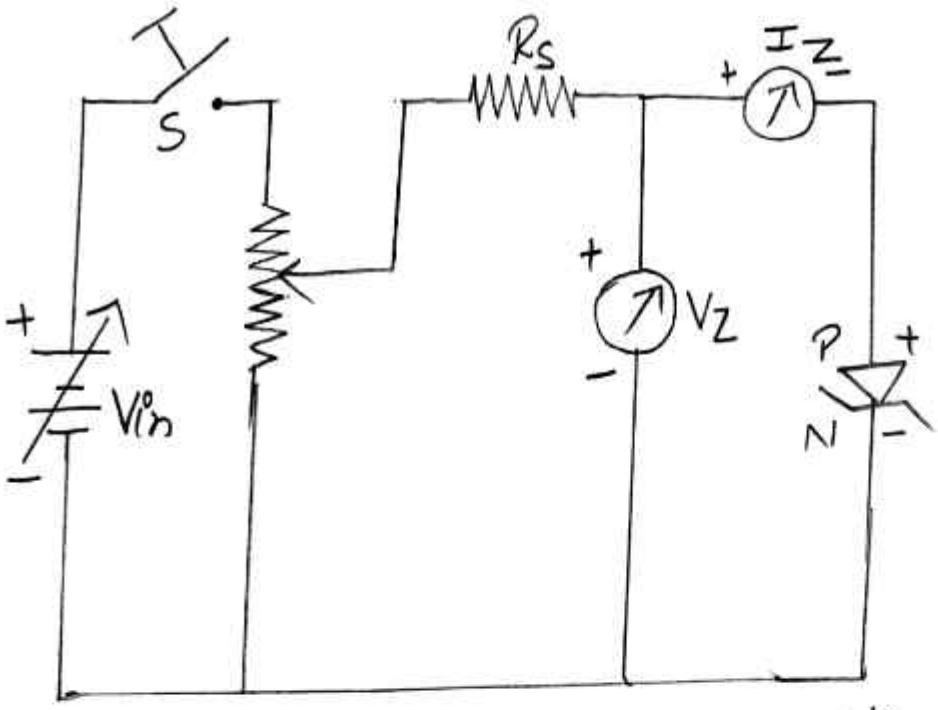
[ii] Current through the transistor should not be passed for a long time to avoid overheating.

[iii] The biasing connections should be correctly done.

Teacher's Signature : .....



(a) For reverse characteristic



(b) For forward characteristic

Expt. No..... Page No..... Date...../...../.....

Experiment No. 2

Object :-

To draw the characteristics of a zener diode.

Apparatus :-

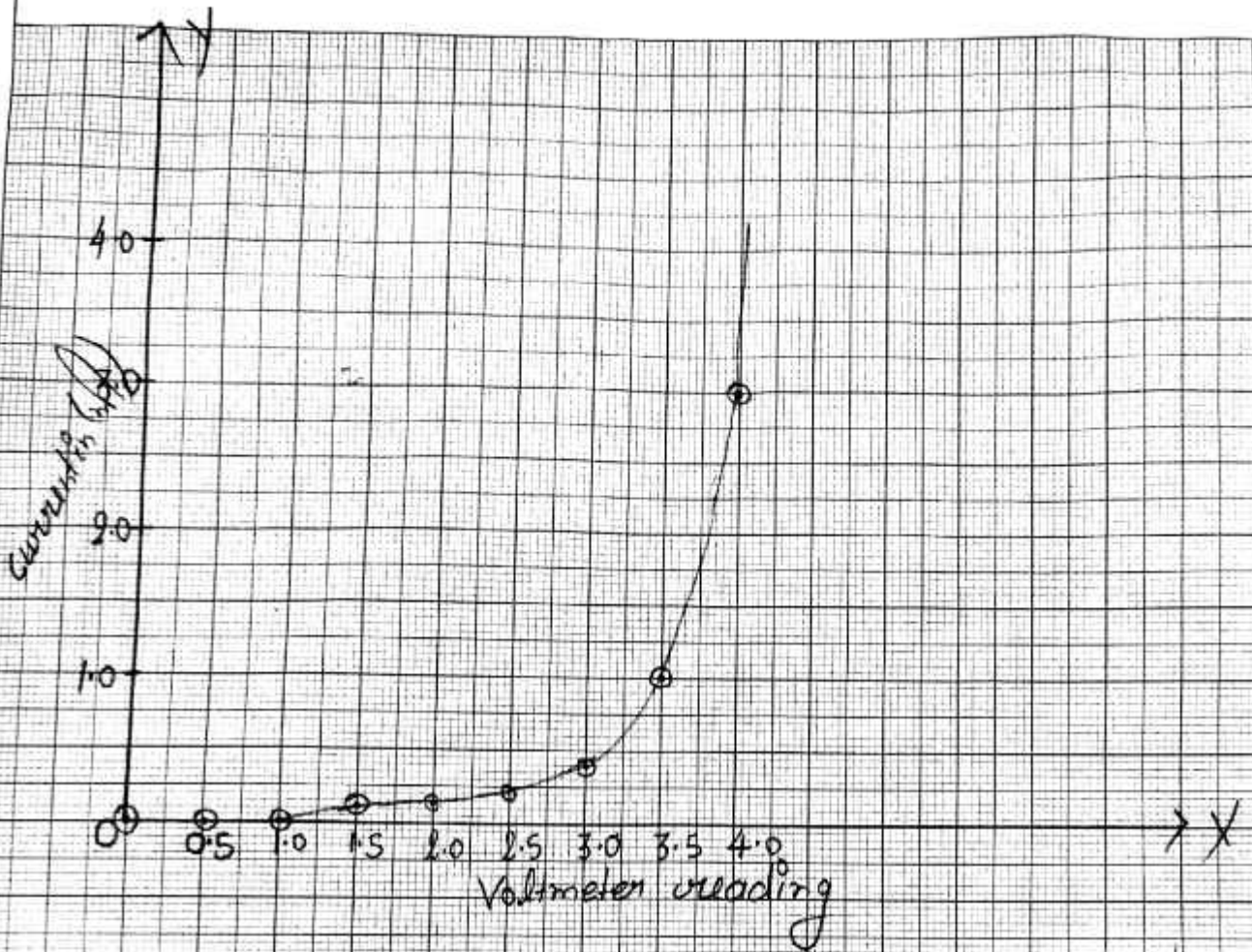
Zener diodes of different ratings, voltmeter, milliammeter, rheostats, a step down transformer and connection wires.

Observation Table :-

For forward characteristic —

Voltmeter in Volt	Current in (mA)
0	0
0.5	0
1.0	0
1.5	0.1
2.0	0.1
2.5	0.2
3.0	0.4
3.5	1.0
4.0	3.0

Teacher's Signature : .....



V-I Characteristic Curve for Zener diode in FB

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For Reverse Characteristic :-

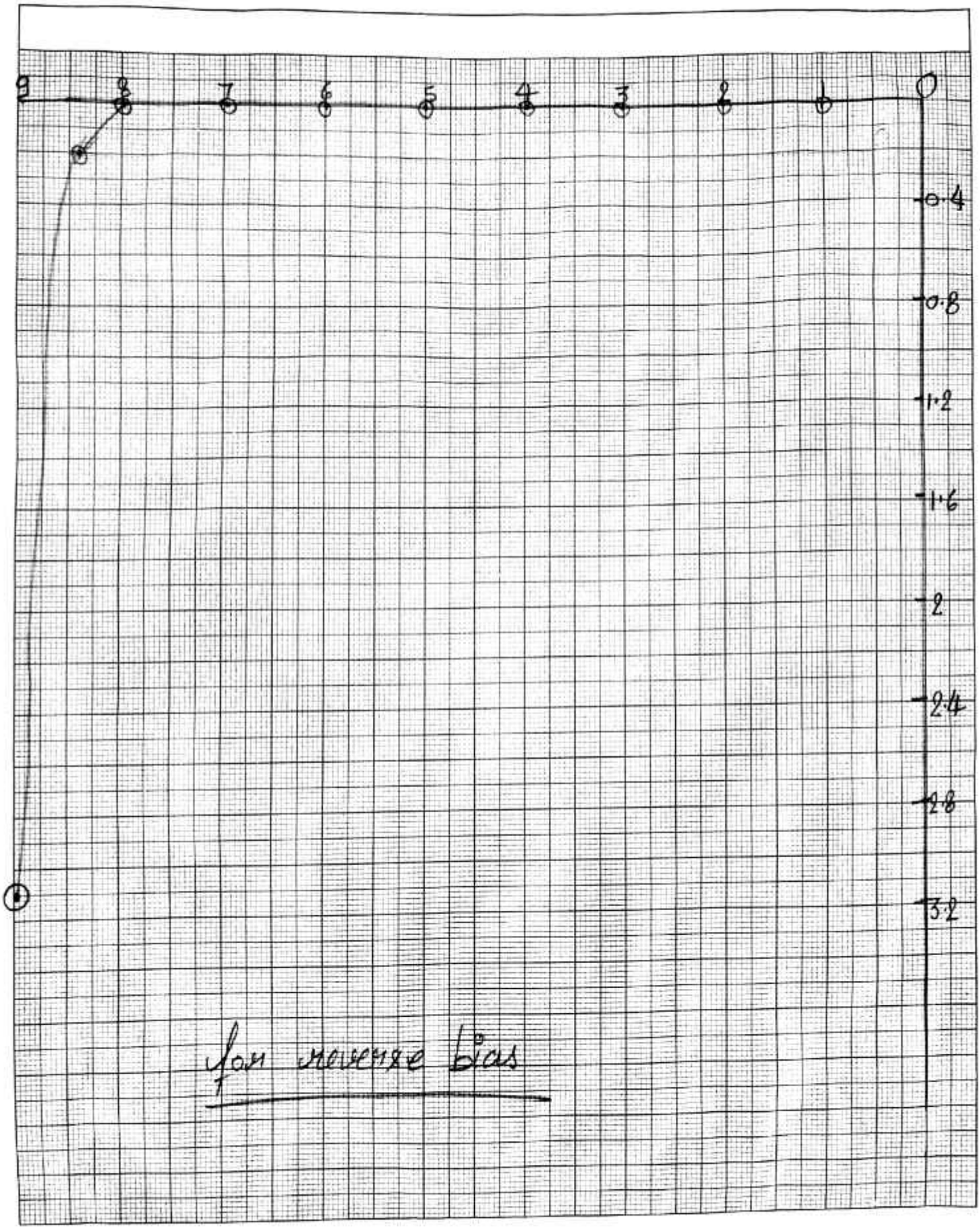
V_R & I_R for PN junction diode in reverse bias —

Sr. No	V_R (Volt)	I_R (mA)
1.	0	0
2.	1	0
3	2	0
4	3	0
5	4	0
6	5	0
7	6	0
8	7	0
9	8	0
10	8.8	0.2
11	9	3.0
[illegible]	[illegible]	[illegible]

Result :-

The characteristic curves of zener diode is shown in attached graph. The V-I characteristic of zener diode indicates the characteristic of zener diode in forward bias its same as PN-Junction diode. In reverse bias a negligible constant current flow through the zener diode but the current becomes abruptly large at certain voltage.

Teacher's Signature : .....


9
8
7
6
5
4
3
2
1
0
-0.4
-0.8
-1.2
-1.6
-2
-2.4
-2.8
-3.2
for reverse bias

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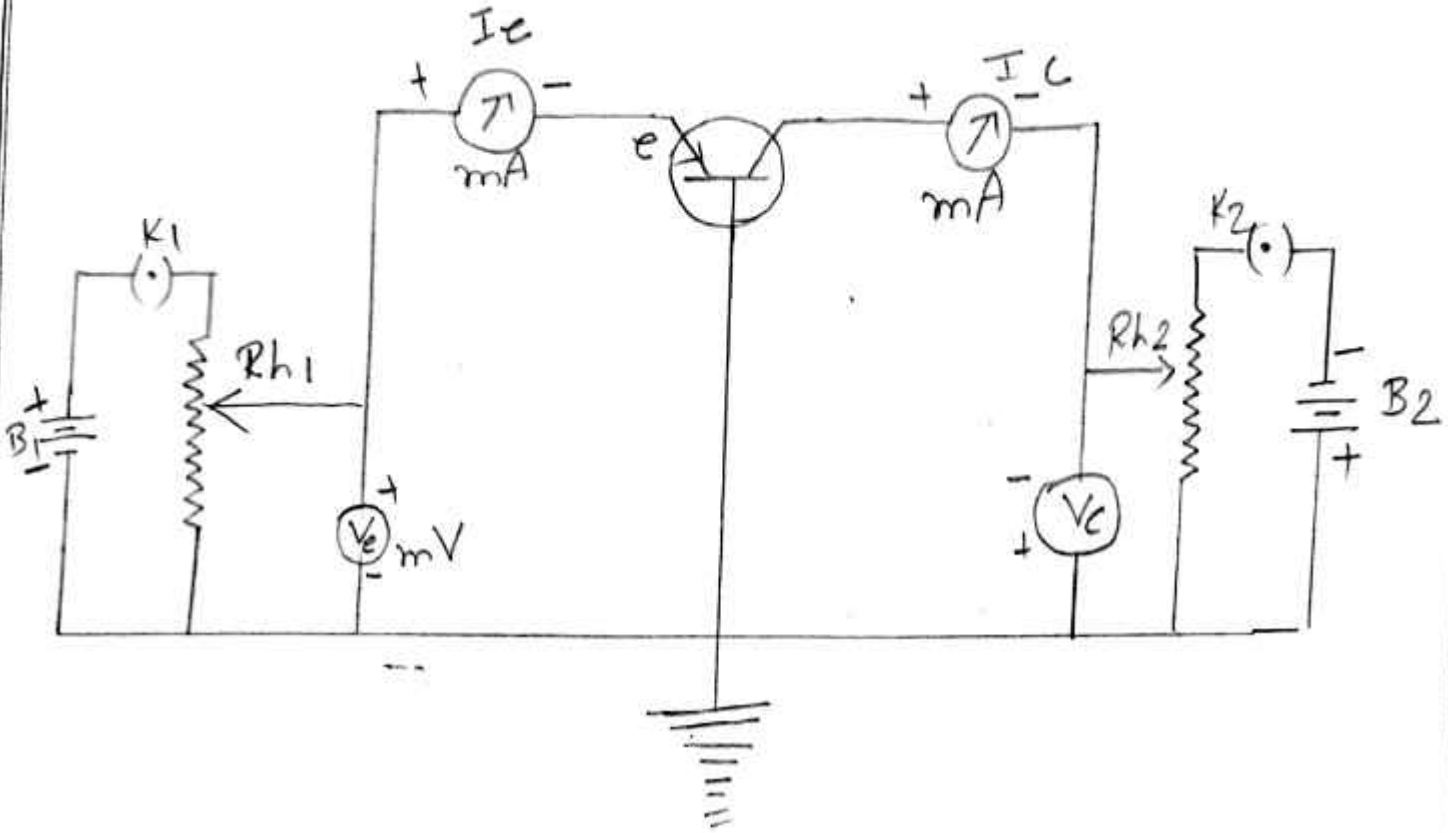
Precautions :-

[1] Zener diode should be connected in reverse bias condition.

[2] The input D.C must be regulated

[3] The input voltage should be between 0-20 volts.

Teacher's Signature : .....


Ie
+
−
mA
e
+
I C
−
mA
K1
Rh1
B1
+
−
Ve
+
−
mV
Vc
+
−
Rh2
K2
B2
+
−

Expt. No..... Page No..... Date...../...../.....

Experiment No. 3

Object :-

To draw the characteristic of a PNP junction transistor in common emitter arrangement.

Apparatus Used :-

PNP transistor, batteries, voltmeter millivoltmeter, milli and micro arrangement. two rheostats, two one way keys and connection wires

Observation :-

~~Table for Input characteristic~~

~~V_{CE} = 6V~~

~~V_{BE} I_B(μA)~~

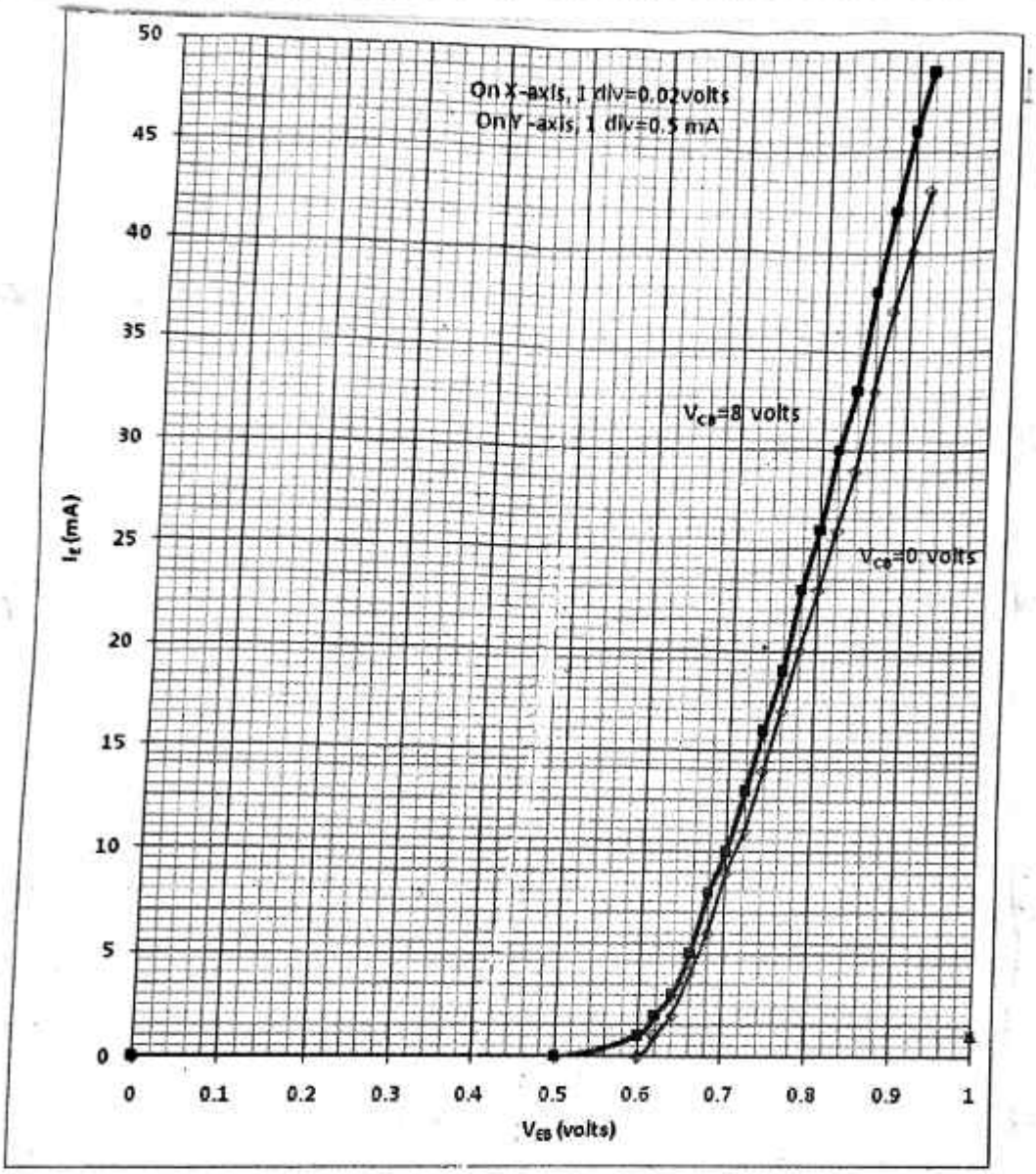
Observation:

A. Table for input characteristic

1. Least count of voltmeter= 0.02 V
2. Least count of ammeter= 1 mA

Sr. No.	V_{CB}=0volt		V_{CB}=8volt	
	V_{EB} (Volt)	I_E (mA)	V_{EB} (Volt)	I_E (mA)
1.	0	0	0	0
2.	0.6	0	0.6	1
3.	0.62	1	0.62	2
4.	0.64	2	0.64	3
5.	0.66	4	0.66	5
6.	0.68	6	0.68	8
7.	0.7	9	0.7	10
8.	0.72	11	0.72	13
9.	0.74	14	0.74	16
10.	0.76	17	0.76	19
11	0.78	20	0.78	23
12.	0.8	23	0.8	26
13.	0.82	26	0.82	30
14.	0.84	29	0.84	33
15.	0.86	33	0.86	38
16.	0.88	37	0.88	42
17.	0.9	40	0.9	46
18.	0.92	43	0.92	49

Teacher's Signature : .....



Input characteristic Curve

Graph 01

Expt. No..... ..... Page No..... Date...../...../.....

→ Table for Output characteristic

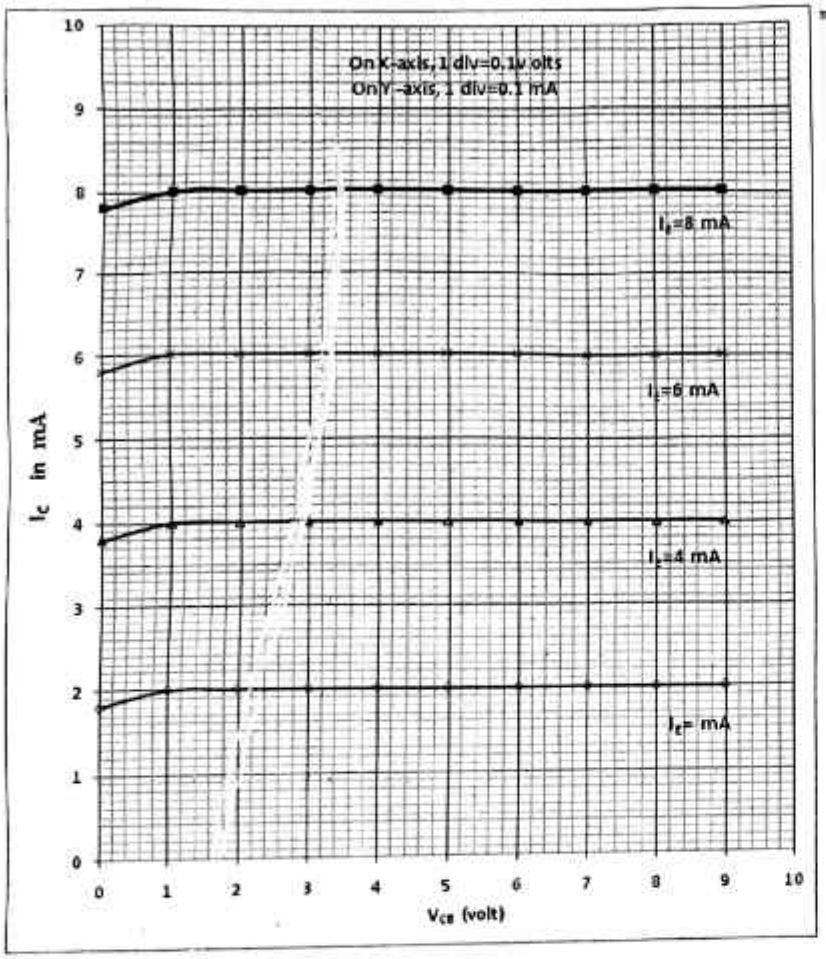
1- Least count of Voltmeter = 0.2V
2. Least count of ammeter = 1mA

Sr.no.	V_{CB} (Volts)	I_C (mA) I_E = 2mA	I_E = 4mA	I_E = 6mA	I_E = 8mA
1	0	1.8	3.8	5.8	7.8
2	1	2.0	4.0	6.0	8.0
3	2	2.0	4.0	6.0	8.0
4	3	2.0	4.0	6.0	8.0
5	4	2.0	4.0	6.0	8.0
6	5	2.0	4.0	6.0	8.0
7	6	2.0	4.0	6.0	8.0
8	7	2.0	4.0	6.0	8.0
9	8	2.0	4.0	6.0	8.0
10	9	2.0	4.0	6.0	8.0

→ Table for forward current transfer characteristic
V_{CB} = 2 Volts = Constant

Sr.no.	I_E (mA)	I_C (mA)
1	0	0
2	5	5
3	10	10
4	15	15
5	20	19
6	25	24
7	30	29
8	35	33
9	40	38

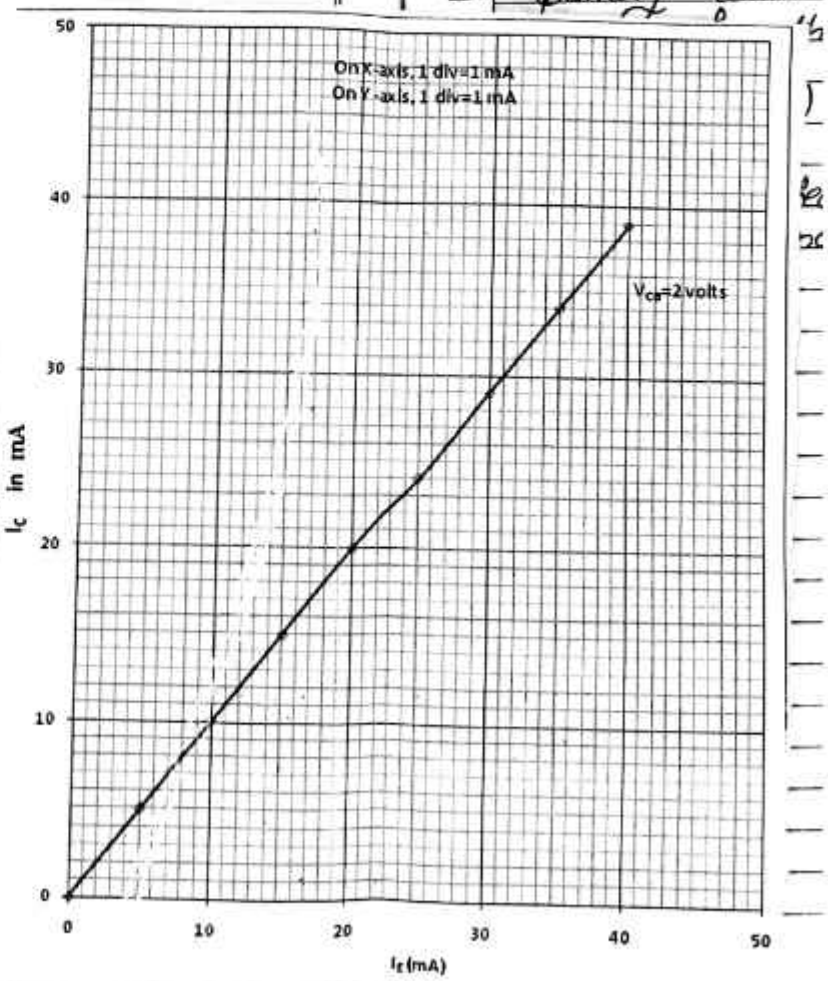
Teacher's Signature : .....



Output characteristic Curve

Graph (2)

Graph (3)



Current Transfer characteristic Curve

Expt. No.....

Result :-

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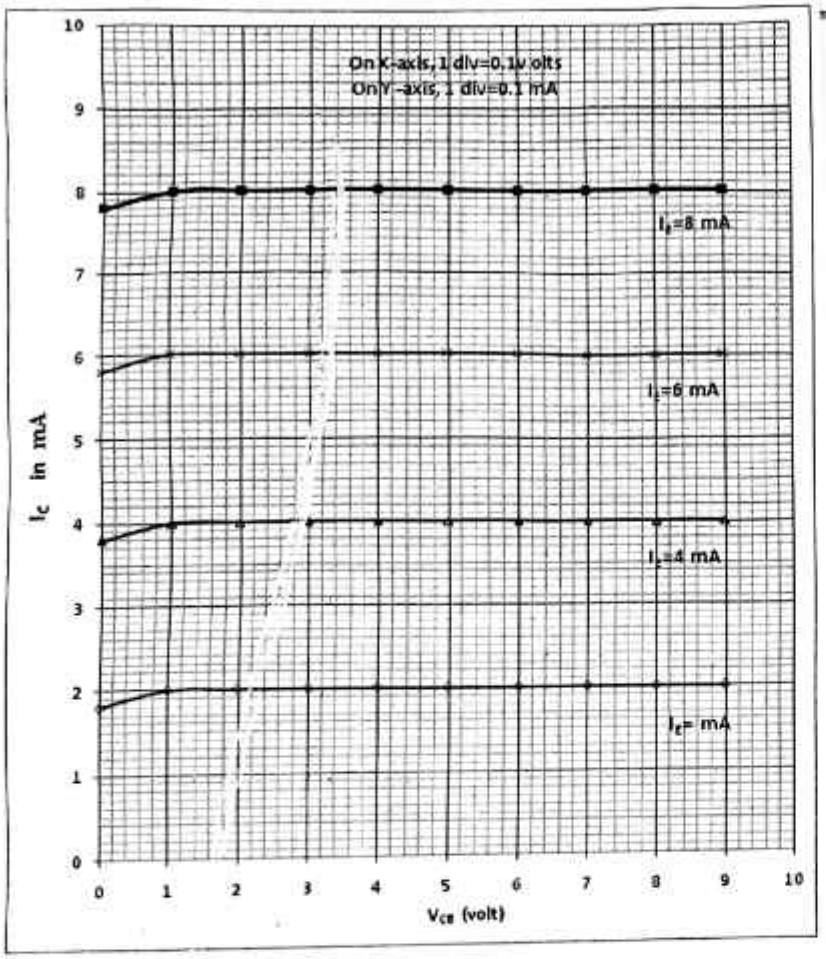
(---) in comm

the abo

Precautions abc

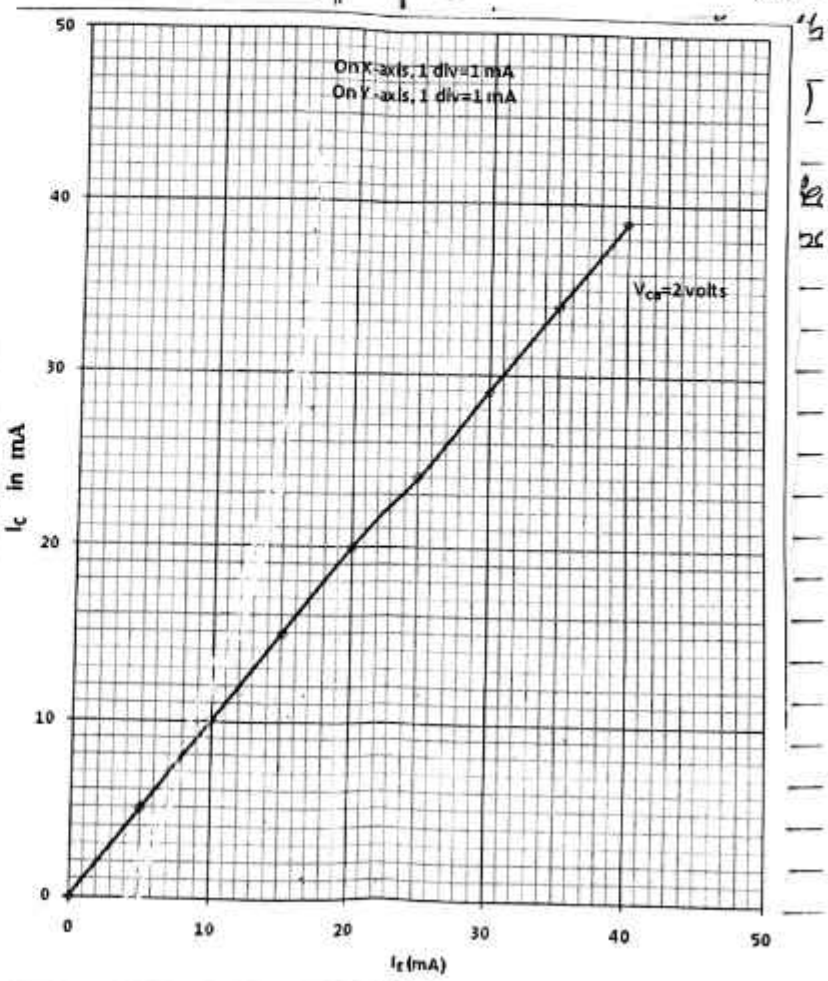
Battery with



Output characteristic Curve

Graph (2)

Graph (3)



Current Transfer characteristic Curve

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Result :-

The characteristic of PNP Junction transistor (---) in common base arrangement shown in the attached graphs.

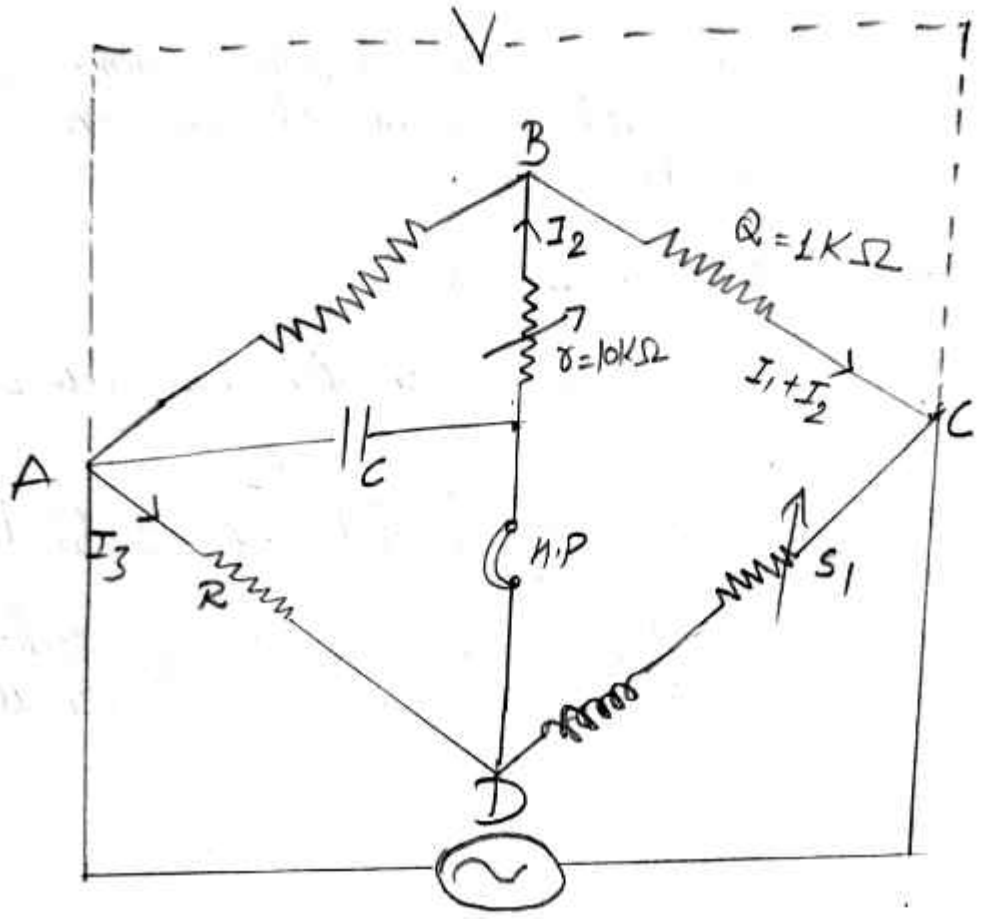
Precautions and Sources of error :-

[1] Battery with correct polarity should be used in the circuit.

[2] Overheating of the transistor should be avoided.

[3] Voltages applied in various parts of the circuit should not exceed the recommended value.

Teacher's Signature : .....



Anderson's bridge circuit

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Experiment No. 4

Object :-

To determine the self inductance of a coil by Anderson's Bridge.

Apparatus :-

Post office box, Resistance box, Audio frequency oscillator, step down transformer, Headphone, Battery, Galvanometer, Fractional resistance box, capacitors etc.

Formula Used :-

The self inductance of a given coil is given by

$$L = CR(2r + Q)$$

where, C = Capacity of resistance of Post office box
Q, R = Non-inductive resistance of P.O. box.
r = The variable non-inductive resistance of resistance box.

Observation table :-

* For the inductive resistance of the coil (s) ——— :-

Teacher's Signature : .....

Calculation :-

$$L_1 = CR(2\delta + Q)$$
$$= 0.1 \times 156 \ (2 \times 2870 + 1000)$$
$$= 105.144 \text{ mH}$$

$$L_2 = 0.1 \times 122 \ (2 \times 3780 + 1000)$$
$$= 12.2 \times 8560$$
$$= 104.432 \text{ mH}$$

$$L_3 = 0.2 \times 110 \ (2 \times 2200 + 1000)$$
$$= 118.800 \text{ mH}$$

$$L = \frac{L_1 + L_2 + L_3}{3} = 109.458 \text{ mH}$$

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S.No	Ratio arms		Variable resistance	Deflection from Initial Position to	Resistance $S = R\frac{Q}{P}$
	P(Ω)	Q(Ω)	R(Ω)		
1	10	10	16	Left	Between
2	10	10	17	Right	16 & 17
3	100	10	162	Left	Between
4	100	10	163	Right	16.2 & 16.3
5	1000	10	1625	left	16.26
6	1000	10	1626	Null	
7	1000	10	1627	Right	

* Table for Inductance :-

Sr.No	P(Ω)	Q(Ω)	R(Ω)	$\sqrt{1}$(Ω)	L	Mean Value of L (mH)
1	1000	1000	156	2870	1051.44	
2	1000	1000	122	3780	104.432	109.458
3	1000	1000	110	2200	118.800	

Result :-

The value of self inductance for given coily

$L_1 = 1051.44$ mH

$L_2 = 104.432$ mH

$L_3 = 118.800$ mH

& mean value is 109.458

Teacher's Signature : .....

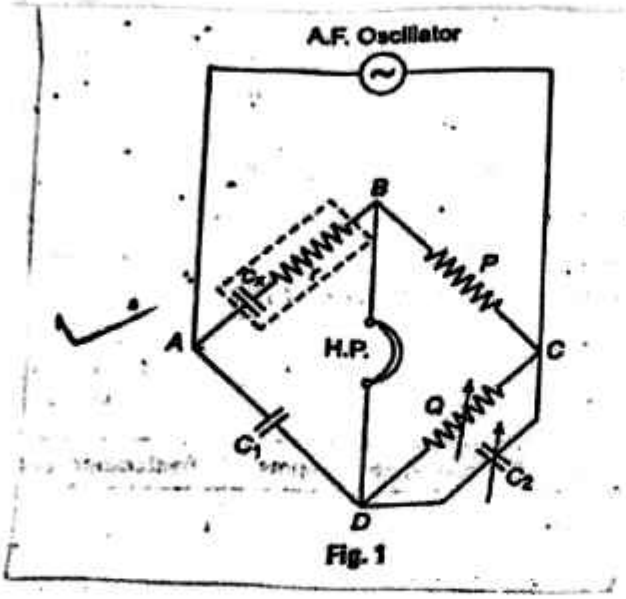

Fig. 1

Schering Bridge circuit

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Experiment No. 5

Object :-
To determine the capacitance and the corresponding power factor of capacitor by Schering bridge.

Apparatus :-
Audio frequency oscillator, Experimental capacitor, Standard capacitor, Variable air capacitor, Resistance boxes, Headphone and connecting wires etc.

Formula Used -

[1] The capacitance of the given capacitor is given by -

$$C_x = \frac{C_1 Q}{P} \qquad \boxed{L = CR(2R + Q)}$$

where, C_1 = Capacitance of the standard capacitor used in the circuit.

P & Q are resistance introduced in the arms of Wheatstone's bridge circuit.

[2] The power factor of the capacitor

$$C_x = 2\pi f C_x \gamma$$

where, γ = internal resistance of the capacitor C_x

Teacher's Signature : .....

Calculation —

$$L_1 = CR(2\gamma + Q)$$

$$= 0.1 \times 156\ (2 \times 2870 + 1000)$$

$$= 105.144\ mH$$

$$L_2 = 0.1 \times 122\ (2 \times 3780 + 1000)$$

$$= 12.2 \times 8560$$

$$= 104.432\ mH$$

$$L_3 = 0.2 \times 110\ (2 \times 2200 + 1000)$$

$$= 22 \times 5400$$

$$= 118.800\ mH$$

$$L = \frac{L_1 + L_2 + L_3}{3}$$

$$\boxed{L = 109.458\ mH}$$

Expt. No..... Page No..... Date...../...../.....

Observation —:

1. Table for d.c resistance S of the inductive coil

Sr.No.	P(Ohm)	Q(Ohm)	R(Ohm)	$S = \frac{RQ}{P}$ (Ohm)
1	10	10	16	16
2	100	10	162	16.2
3	1000	10	1626	16.26

2. Table for Inductance —:

Sr.No	P(Ohm)	Q(Ohm)	R(Ohm)	r(Ohm)	L (Henery)	Mean Value of L
1	1000	1000	156	2870	105.144	
2	1000	1000	122	3780	104.432	109.58
3	1000	1000	110	2200	118.800	

Taking, C = 0.1 MF & 0.2 MF

Result —

The value of self Inductance for given coils —

* $L_1 = 105.144$ mH
* $L_2 = 104.432$ mH
* $L_3 = 118.800$ mH

& mean value of L is = 109.458 mH

Teacher's Signature : .....

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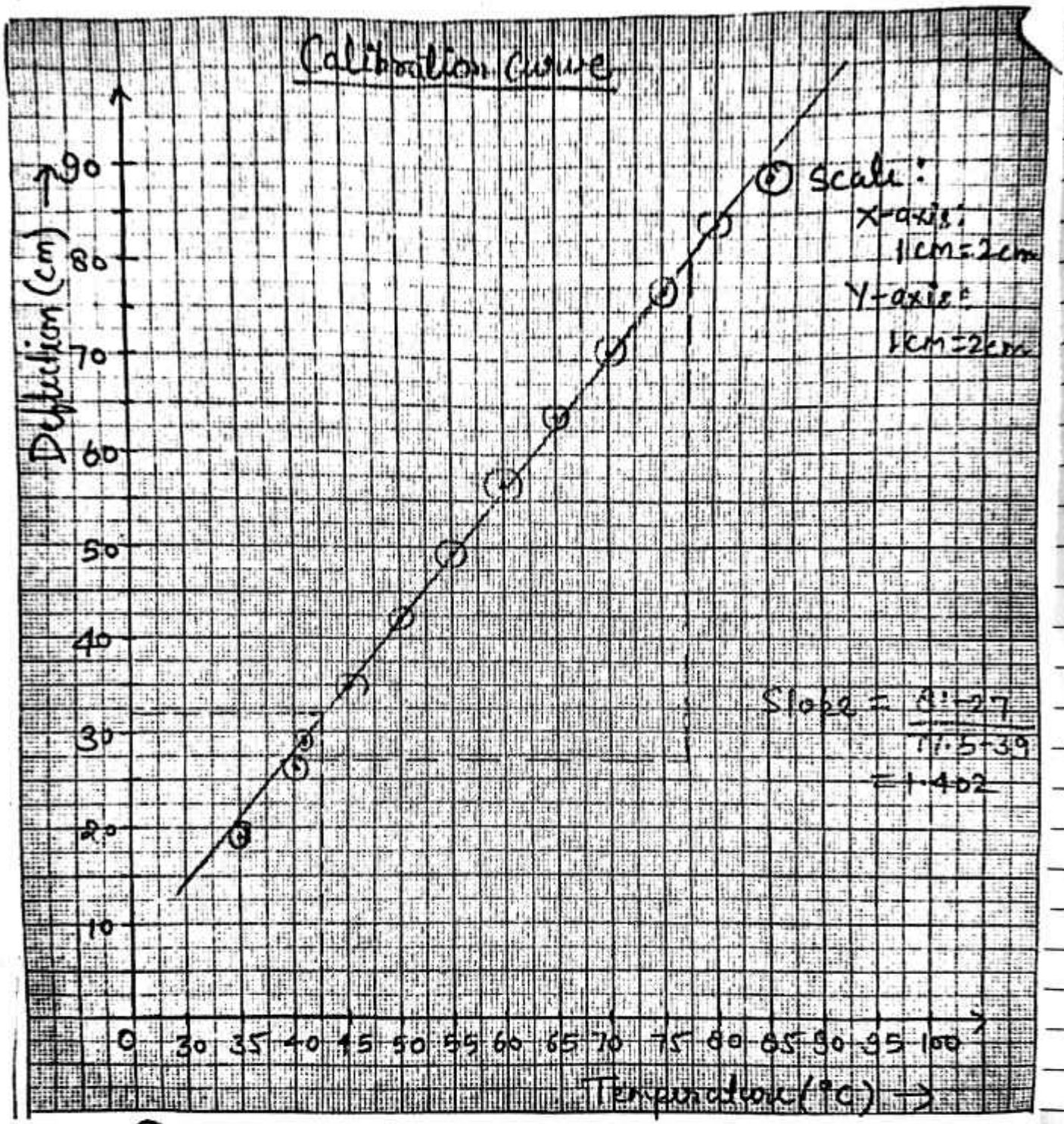
Precautions & Sources of error :-

[1] The variable air capacitor should be of negligible power factor.

[2] The variable resistance Q should include a decade and subdivided ohm for fine adjustment.

[3] The variation of capacitance C_2 should be smooth.

Teacher's Signature : .....


Calibration Curve
Deflection (cm)
90
80
70
60
50
40
30
20
10
0
30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Temperature (°C) →
Scale:
X-axis:
1cm = 2cm
Y-axis:
1cm = 2cm
Slope = 81-27 / 71.5-39
= 1.402

Graph (1)

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Experiment No. 6

Object :- To determine the value of Steafan's constant.

Apparatus :- Steafan's apparatus, a sensitive galvanometer, three thermometers, stop watch, copper flask and heater.

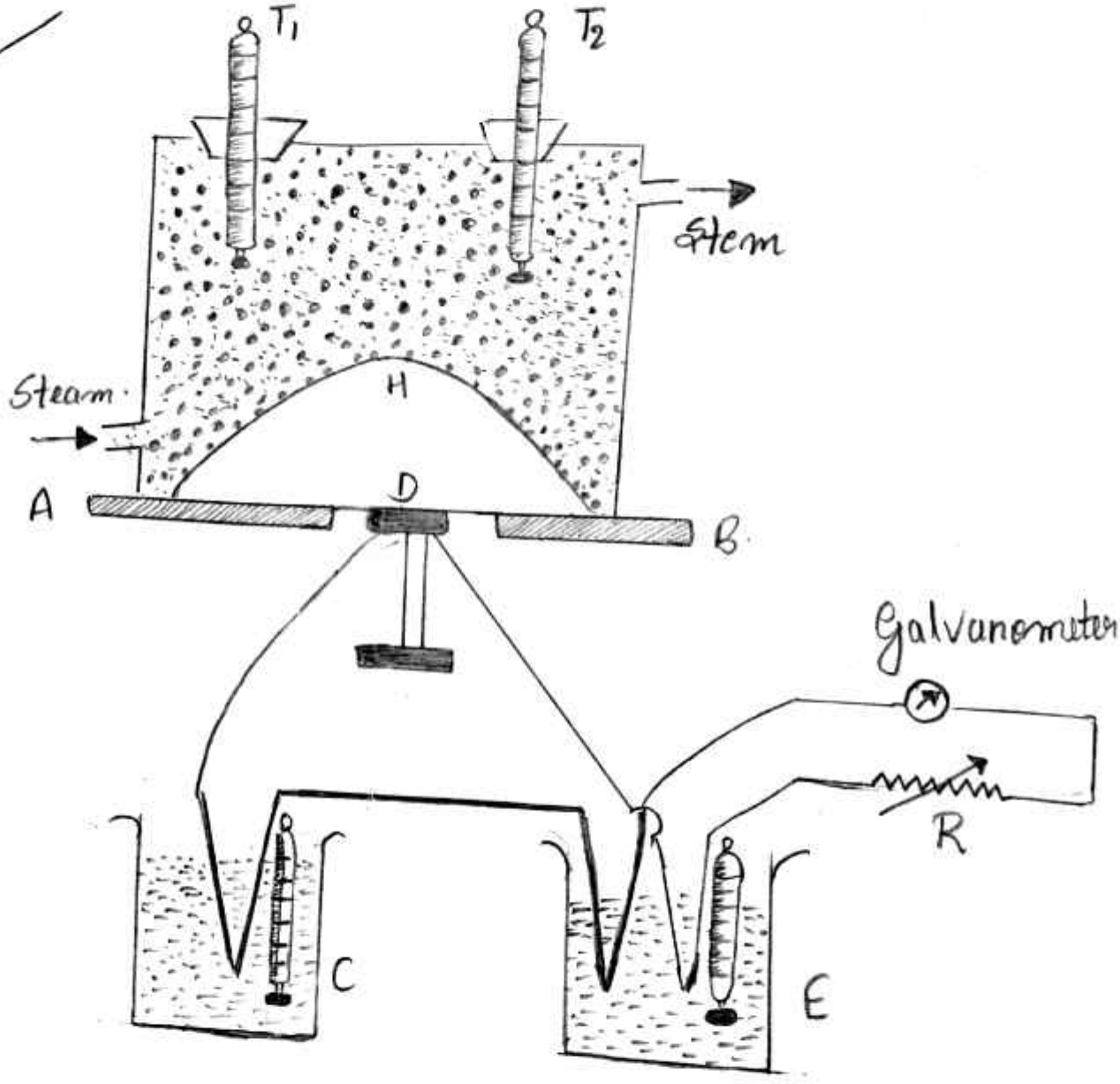
Formula Used :-

$$\sigma = \frac{JmS}{A(T_1^4 - T_2^4)} \cdot \frac{dT}{dt}$$

where, J = Mechanical equivalent of heat
m = mass of the disc
s = specific heat of the material of the disc.
A = Area of the disc
T_1 = absolute steady temperature of the hemisphere.
T_2 = absolute temperature of the disc.
$\frac{dT}{dt}$ = rate of change of temperature.

Teacher's Signature : .....

Fig



Determination of Stefan's Constant

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Observation :-

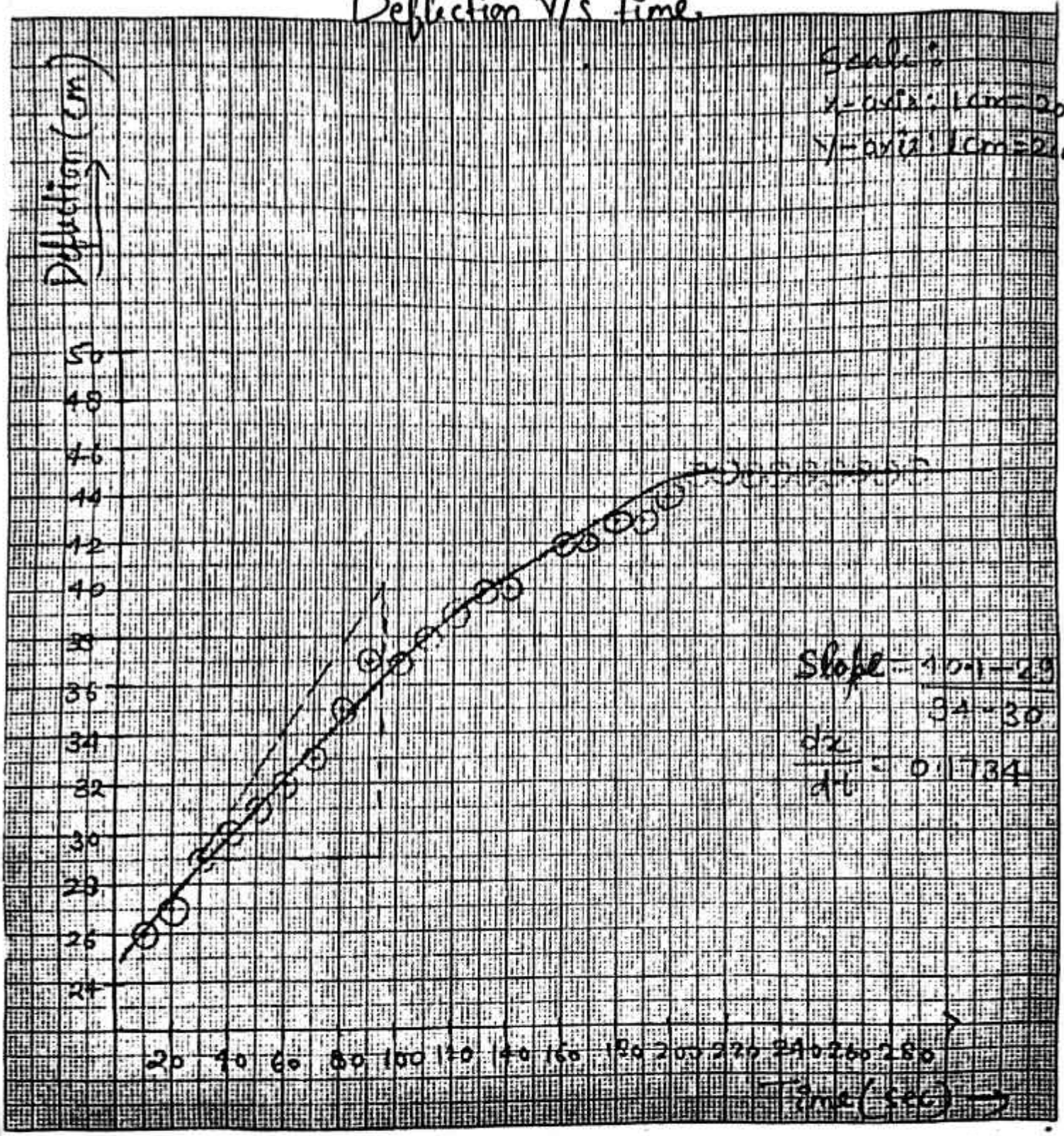
Table for calibration of the thermocouple-

Sr. No.	Temp (°C)	Deflection (cm)
1	85	89
2	80	84
3	75	77
4	70	71
5	65	64
6	60	57
7	55	49
8	50	42
9	45	35
10	40	26
11	35	19

Table for galvanometer deflection with time :-

Sr. no.	Time (sec.)	Deflection (cm)	Time (sec.)	Deflection (cm)
1	0	26	130	40
2	10	26	140	40
3	20	27	150	41
4	30	29	160	42
5	40	30	170	42
6	50	31	180	43
7	60	32	190	43
8	70	33	200	44
9	80	35	210	45
10	90	37	220	45
11	100	37	230	45
12	110	38	240	45

Teacher's Signature : .....


Deflection V/s time.
Scale:
x-axis: 1cm = 2sec
y-axis: 1cm = 2cm
Deflection (cm)
50
48
46
44
42
40
38
36
34
32
30
28
26
24
20 40 60 80 100 120 140 160 180 200 220 240 260 280
Time (sec)
Slope = 10-1-29 / 34-30
dz/dt = 0.1734

graph (2)

Calculation :-

From calibration curve

$$\frac{1}{\text{Slope}} = \frac{dT}{dx} = 0.7132$$

from curve between t & x

$$\text{Slope} = \frac{dT}{dx} = 0.7134$$

$$\frac{dT}{dt} = \frac{dT}{dx} \times \frac{dx}{dt} = 0.7132 \times 0.1734$$

$$= 0.123\ ^{\circ}C\ \text{Sec}^{-1}$$

For σ :-

$$T = 41^{\circ}C = 314K$$

$$\sigma = \frac{Jms}{A(T_1^4 - T_2^4)} \left(\frac{dT}{dt}\right)_T$$

$$= \frac{4.18 \times 3 \times 0.056 \times 0.123}{10^{-4} \times 1.7625 \times [(371)^4 - (314)^4]}$$

$$\sigma = 5.318 \times 10^{-8}\ Js^{-1} m^{-2} K^{-4}$$

Actual value $= 5.672 \times 10^{-8}\ Js^{-1} m^{-2} K^{-4}$

$$\% \text{ error} = \left(\frac{5.672 - 5.318}{5.672}\right) \times 100$$

$$= 6.2\ \%$$

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Result :-

Value of Steafan's Constant = 5.318×10^{-8} $Js^{-1}m^{-2}K^{-4}$

Standard or actual value of $\sigma = 5.67 \times 10^{-8}$ $Js^{-1}m^{-2}K^{-4}$

% error = 6.2 %

Standard Result :- $\sigma = 5.67 \times 10^{-8}$ $W/(m^2 - K^4)$

Precautions & Sources of error :-

[1] A sensitive galvanometer should be used.

[2] A heating device for producing steam, should be kept at greater distance from the radiator.

[3] The steady temperature of hemisphere is to be ensured with the help of the thermometer.

Teacher's Signature : .....

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Experiment No. 07

Object ⇒ To study the ripple and regulation factors of a half wave rectifier.

Apparatus ⇒

Two junction diodes, two condensers, two resistances, one inductance, one transformer, voltmeter and ammeter, four switches and connecting leads.

Formula Used ⇒ The ripple factor and voltage regulation are given by

Voltage regulation

$$\text{Voltage at no load } (V_{NL}) = \frac{\text{Voltage at full load } (V_L)}{\text{Voltage at full load } (V_L)} \times 100$$

$$= \frac{V_{NL} - V_L}{V_L} \times 100$$

percent ripple

$$= \frac{\text{a.c. voltage across output}}{\text{d.c voltage across output}} \times 100$$

$$= \frac{V_{a.c}}{V_{d.c}} \times 100$$

If current is measured, then

$$r = \sqrt{\left(\frac{i^2_{rms}}{i^2_{dc}} - 1\right)}$$

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Where i_{rms} = rms value of current
i_{dc} = d.c. value of current

Observation :-

S.N	Operational Circuit of power supply	Position of switches J_1	J_2	J_3	J_4	D.C voltage in Output (V_{dc})	V_{rms}	$\gamma = \frac{V_{rms}}{I_{dc}} \times 100$
1.	Half wave rectifier	off	off	ON	off	4.5	4.9	108%
2.	Half wave rectifier with shunt capacitor filter	off	off	off	On	7.5	3	40%
3.	Half wave rectifier with L-type filter	off	off	off	On	3.25	1.0	31%
4.	Half wave rectifier with π-type filter	off	On	off	On	6.25	0.8	12%
5.	Full wave rectifier	On	off	On	off	7.25	3.6	49.2%
6.	Full wave rectifier with shunt capacitor filter	On	off	On	On	9.25	1.6	17.2%
7.	Full wave rectifier L-Type filter	On	off	off	On	7.00	0.2	1.0%

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Result :- The values of ripple factors in the power supply in different configuration are as follows :-

1- In Half wave rectifier :- % = 10.6 %

With shunt capacitor filter :- % = 40 %

With L-Type filter :- % = 31 %

With π-Type filter :- % = 12 %

2- In full wave rectifier :- % = 49 %

With shunt capacitor filter :- % = 17.2 %

With L-type filter :- % = 1.0 %

With π-type filter :- % = 0.01 %

3- It is observed that the value of ripple factor in all full wave rectifier is smaller than the corresponding half wave rectifiers.

4. The value of ripple factor for full wave rectifier with π-type filter is least.

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Precautions :-

[1] Range of the multimeter should be set properly before any measurement is made. Also adjust zero for the range selected.

[2] The components of the circuit should not be touched by hand.

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