8th Standard	Syllabus	Books	Study Materials	1st Mid Term	2nd Mid Term	3rd Mid Term
	Term 1	Term 2	Term 3	Public Model Q&A	NMMS	Periodical Test

7th Standard	Syllabus	Books	Study Materials	1st Mid Term	2nd Mid Term	3rd Mid Term
	Term 1	Term 2	Term 3	Periodical Test	SLAS	

6th Standard	Syllabus	Books	Study Materials	1st Mid Term	2nd Mid Term	3rd Mid Term
	Term 1	Term 2	Term 3	Periodical Test	SLAS	

1st to 5th Standard	Syllabus	Books	Study Materials	Periodical Test	SLAS	
	Term 1	Term 2	Term 3	Public Model Q&A		

Exams	TET	TNPSC	PGTRB	Polytechnic	Police	Computer Instructor
	DEO	BEO	LAB Asst	NMMS	RTE	NTSE

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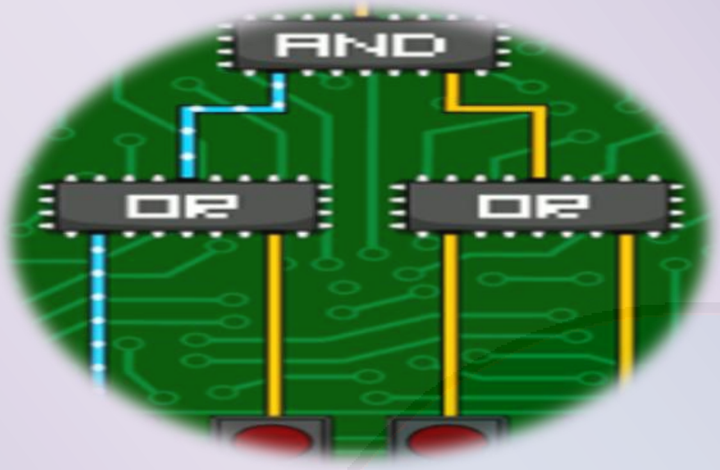


PHYSICS PRACTICALS

Class 12

Prepared by

R.Muthu Ganesh,M.E,B.Ed

LIST OF EXPERIMENTS

1. Determination of the specific resistance of the material of the given coil using metre bridge.
2. Determination of the value of the horizontal component of the Earth's magnetic field using tangent galvanometer.
3. Determination of the magnetic field at a point on the axis of a circular coil.
4. Determination of the refractive index of the material of the prism by finding angle of prism and angle of minimum deviation using spectrometer.
5. Determination of the wavelength of a composite light by normal incidence method using diffraction grating and spectrometer (The number of lines per metre length of the grating is given).
6. Investigation of the voltage-current (V-I) characteristics of PN junction diode.
7. Investigation of the voltage-current (V-I) characteristics of Zener diode.
8. Investigation of the static characteristics of a NPN Junction transistor in common emitter configuration.
9. Verification of the truth table of the basic logic gates using integrated circuits.
10. Verification of De Morgan's theorems using integrated circuits.

EXP NO 1: SPECIFIC RESISTANCE OF THE MATERIAL OF THE COIL USING METRE BRIDGE

Aim:

To determine the specific resistance of the material of the given coil using metre bridge

Apparatus required:

Metre bridge, galvanometer, key, resistance box, connecting wires, Lechlanche cell, jockey and high resistance.

Formula:

Specific resistance of the wire is given by

$$\rho = \frac{X\pi r^2}{L}\ (\Omega m)$$

Where

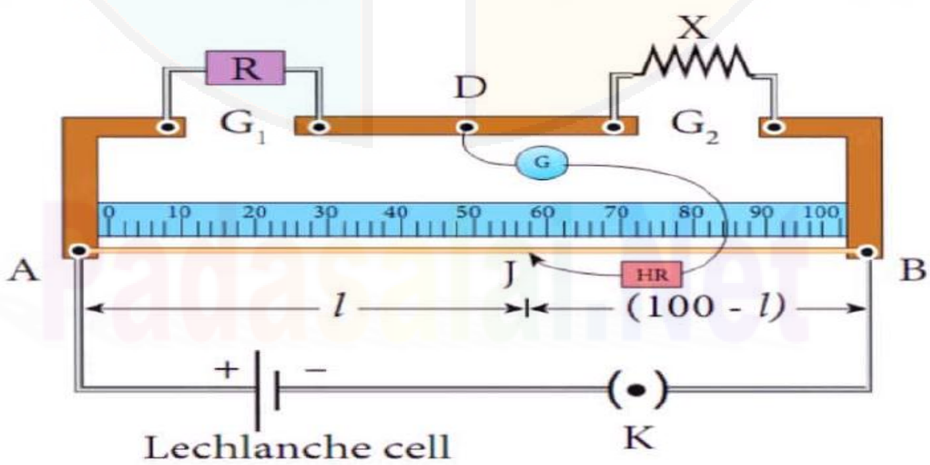
X = Resistance of the given coil(Ω)

R =known resistance (Ω)

L = length of the wire(m)

r= radius of the wire(m)

Circuit diagram:



Observation:

Length of the coil, L = 100cm = 1 m

Table 1: To find the resistance of the given coil:

S.No	Resistance R (Ω)	Before interchanging		After interchanging		Mean
		Balancing length l(cm)	$X_1 = \frac{R(100-l)}{l}$ (Ω)	Balancing length l(cm)	$X_2 = \frac{Rl}{(100-l)}$ (Ω)	$X = \frac{X_1+X_2}{2}$ (Ω)
1	1	14.4	5.9444	85.3	5.8027	5.8736
2	2	25.2	5.9365	74.6	5.8740	5.9052
3	3	33.5	5.9552	66.1	5.8496	5.9024
4	4	41.5	5.6385	58.4	5.6153	5.6269
5	5	46	5.8695	54	5.8695	5.8695
						Mean resistance, X= 5.8355 Ω

Table 2: To find the radius of the wire:

Zero Error = -(100 - 95) = -5 Zero Correction = +5 LC = 0.01 mm

S.No	PSR(mm)	HSC (div)	Total Reading, TR = PSR+(HSC* LC) (mm)	Corrected Reading = TR ± ZC (mm)
1	0	56	0.56	0.61
2	0	57	0.57	0.62
3	0	58	0.58	0.63
4	0	59	0.59	0.64
5	0	60	0.60	0.65
				Mean, 2r = $0.63*10^{-3}$ m
				r = $0.315*10^{-3}$ m

Calculation:

	1.To find X		**2.To find r**
1	$X = \frac{X_1+X_2}{2} = \frac{5.9444+5.8027}{2}$ $= \frac{11.7471}{2} = 5.8735\ \Omega$	1	Diameter = TR ± ZC = 0.56+0.05 =0.61 mm
2	$X = \frac{X_1+X_2}{2} = \frac{5.9365+5.8740}{2}$ $= \frac{11.8105}{2} = 5.9052\ \Omega$	2	Diameter = TR ± ZC = 0.57+0.05 =0.62 mm
3	$X = \frac{X_1+X_2}{2} = \frac{5.9552+5.8496}{2}$ $= \frac{11.8048}{2} = 5.9024\ \Omega$	3	Diameter = TR ± ZC = 0.58+0.05 =0.63 mm
4	$X = \frac{X_1+X_2}{2} = \frac{5.6385+5.6153}{2}$ $= \frac{11.2538}{2} = 5.6269\ \Omega$	4	Diameter = TR ± ZC = 0.59+0.05 =0.64 mm

5	X $= \frac{X_1+X_2}{2} = \frac{5.8695+5.8695}{2}$ $= \frac{11.7390}{2} = 5.8695\ \Omega$	5	Diameter = TR ± ZC = 0.60+0.05 =0.65 mm
Mean , $X = \frac{5.8735+5.9052+5.9024+5.6269+5.8695}{5}$ $= \frac{29.1775}{5} = 5.8355\ \Omega$		Mean , $2r = \frac{0.61+0.62+0.63+0.64+0.65}{5}$ $= \frac{3.15}{5} = 0.63$ mm $r = \frac{0.63}{2} = 0.315$ mm	

3.To find specific resistance:

$$\rho = \frac{X\pi r^2}{L}\ (\Omega m)$$

$$\rho = \frac{5.8355 * 3.14 * (0.315 * 10^{-3})^2}{1}\ (\Omega m)$$

$$\rho = 5.8355*3.14*9.9225*10^{-8}$$

$$= 1.8181*10^{-6}\ \Omega m$$

Procedure:

- A Resistance box R is connected in the left gap and the unknown resistance X in the right gap
- A Lechlanche cell is connected across the wire of length 1 m through a key
- A sensitive galvanometer G is connected between the central strip and the jockey through a High Resistance (HR).
- With a suitable resistance included in the resistance box, the circuit is switched on.
- To check the circuit connections, the jockey is pressed near both the ends of the metre bridge. The deflection of galvanometer on opposite sides shows that the circuit connections are correct.
- By moving the jockey over the wire, the point on the wire at which the galvanometer shows null deflection i.e balancing point J is found.
- The balancing length AJ = l is noted and the unknown resistance X is noted.
- The same procedure is repeated after interchanging R and X.
- The length of the coil L is noted and the radius r is found using screw gauge.
- From the values of X ,r and L, the specific resistance of the material of the wire is calculated

Result:

The specific resistance of the material of the given coil , **ρ= 1.8181*10⁻⁶ Ωm**

EXP NO 2: HORIZONTAL COMPONENT OF THE EARTH'S MAGNETIC FIELD USING TANGENT GALVANOMETER

Aim:

To determine the horizontal component of the Earth's magnetic field using tangent galvanometer

Apparatus Required:

Tangent Galvanometer(TG), commutator, battery, rheostat, ammeter, key and connecting wires.

Formula:

Horizontal component of the Earth's magnetic field is given by

$$B_H = \frac{\mu_0 nk}{2r} \text{ (Tesla)}$$

$$k = \frac{I}{\tan\theta} \text{ (Ampere)}$$

where

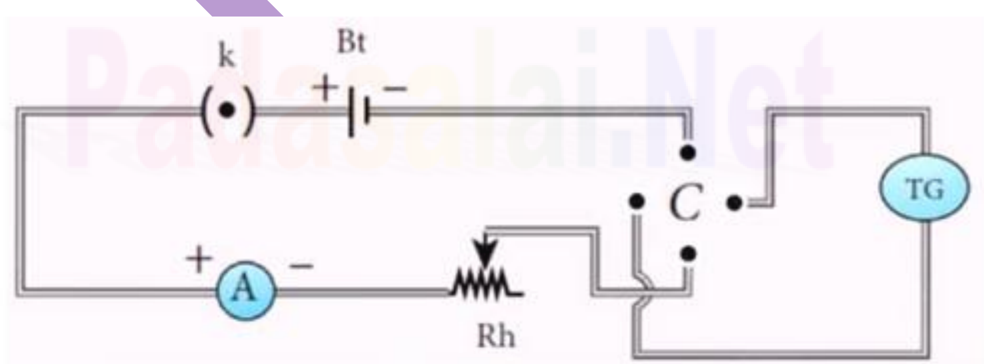
μ_0 = Permeability of free space ($4\pi * 10^{-7}$ Hm^{-1})

n = Number of turns of TG in the circuit (no unit)

k = Reduction factor of TG(Ampere)

r = Radius of the coil(m)

Circuit Diagram



Observation

Number of turns in the coil, n= 2

Circumference of the coil ($2\pi r$) = 50 cm = $50*10^{-2}$ m

Radius of the coil, r = $\frac{50*10^{-2}}{2*3.14} = \frac{50*10^{-2}}{6.28}$ = $7.961*10^{-2}$ m

To find the horizontal component of the Earth's magnetic field:

S.No	Current , I (Ampere)	Deflection in TG(degree)				Mean θ (degree)	k = $\frac{I}{\tan\theta}$ (Ampere)
		θ_1	θ_2	θ_3	θ_4		
1	1.6	35	35	35	35	35	2.285
2	2.1	40	40	40	40	40	2.503
3	2.4	45	45	45	45	45	2.400
4	2.9	50	50	50	50	50	2.433
5	3.2	55	55	55	55	55	2.240
							Mean k = 2.372 Ampere

Calculation:

1.To find k = $\frac{I}{\tan\theta}$

1. k = $\frac{I}{\tan\theta} = \frac{1.6}{\tan 35°} = \frac{1.6}{0.7002}$ = 2.285	2. k = $\frac{I}{\tan\theta} = \frac{2.1}{\tan 40°} = \frac{2.1}{0.8390}$ = 2.503
3. k = $\frac{I}{\tan\theta} = \frac{2.4}{\tan 45°} = \frac{2.4}{1}$ = 2.400	4. k = $\frac{I}{\tan\theta} = \frac{2.9}{\tan 50°} = \frac{2.9}{1.1917}$ = 2.433
5. k = $\frac{I}{\tan\theta} = \frac{3.2}{\tan 55°} = \frac{3.2}{1.4281}$ = 2.240	
Mean , k = $\frac{I}{\tan\theta} = \frac{2.285+2.503+2.400+2.433+2.240}{5} = \frac{11.861}{5}$ = 2.372 Ampere	

2.To find B_H

$B_H = \frac{\mu_0 nk}{2r}$ (Tesla)

$$B_H = \frac{4\pi*10^{-7}*2*2.372}{2*7.961*10^{-2}}$$

$$= \frac{59.5849*10^{-5}}{15.922} = 3.7422*10^{-5} \text{ Tesla}$$

Procedure:

- The preliminary adjustments were made.
- The number of turns n is selected and the circuit is switched on.
- The range of current through TG is chosen in such a way that the deflection of the aluminium pointer lies between 30°- 60°.
- A suitable current is allowed to pass through the circuit, the deflection θ_1 and θ_2 are noted from the two ends of the aluminium pointer.
- Now the direction of the current is reversed using the commutator C, the deflections θ_3 and θ_4 in the opposition direction are noted.
- The mean value θ is calculated and tabulated.
- Reduction factor k is calculated for each case and found that k is a constant.
- Repeat the same procedure for different values of current and the readings are tabulated.
- The radius of the circular coil is found by measuring its circumference using a thread around the coil.
- From the values of r,n and k, the horizontal component of the Earth's magnetic field is calculated by using the formula, $B_H = \frac{\mu_0 nk}{2r}$

Result:

The horizontal component of the Earth's magnetic field using tangent galvanometer is,

B_H = 3.7422*10^{-5} Tesla.

EXP NO 3: MAGNETIC FIELD ALONG THE AXIS OF A CIRCULAR COIL –DETERMINATION OF B_H

Aim:

To determine the horizontal component of the Earth's magnetic field using current carrying circular coil and deflection magnetometer.

Apparatus Required:

Circular coil apparatus, compass box, commutator, battery, rheostat, ammeter, key and connecting wires.

Formula:

Horizontal component of the Earth's magnetic field is given by

$$B_H = \frac{\mu_0 n r^2}{2(r^2+x^2)^{\frac{3}{2}}} \quad \frac{I}{\tan\theta} \quad \text{(Tesla)}$$

where

μ_0 = Permeability of free space ($4\pi \times 10^{-7}$ Hm^{-1})

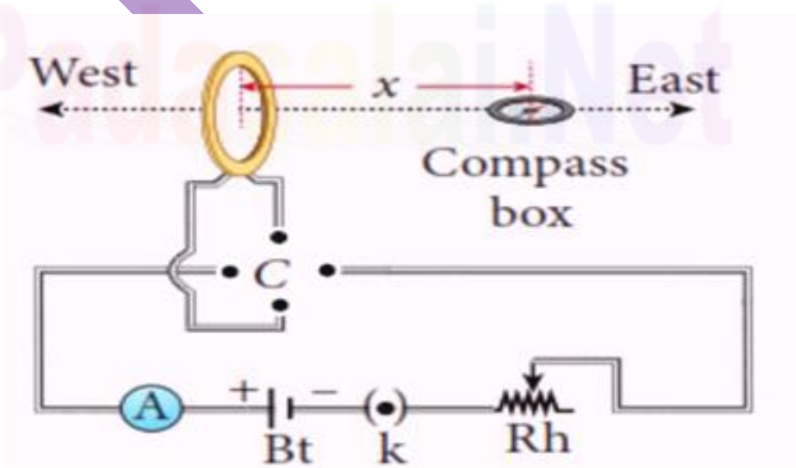
n = Number of turns of TG in the circuit (no unit)

I = Current flowing through the coil (Ampere)

r = Radius of the circular coil (m)

x = Distance between centre of compass box and centre of the coil (m)

Circuit Diagram



Observation

Number of turns in the coil, n= 5

Circumference of the coil ($2\pi r$) = 50 cm = $50*10^{-2}$ m

Radius of the coil, r = $\frac{50*10^{-2}}{2*3.14} = \frac{50*10^{-2}}{6.28}$ = $7.961*10^{-2}$ m

To find the horizontal component of the Earth's magnetic field:

S.No	Distance x (cm)	Current, I (Ampere)	Deflection for Eastern side				Deflection for Western side				Mean θ (degree)	$\frac{I}{\tan\theta}$ (Ampere)
			θ_1	θ_2	θ_3	θ_4	θ_5	θ_6	θ_7	θ_8		
1	6	1.2	32	32	33	33	33	33	32	32	32.5	1.8838
2	6	1.4	35	35	36	36	36	36	35	35	35.5	1.9629
3	6	1.6	38	38	39	39	39	39	38	38	38.5	2.0115
4	6	1.8	41	41	42	42	42	42	41	41	41.5	2.0345
5	6	2.0	44	44	45	45	45	45	44	44	44.5	2.0352
												Mean =1.9855 Ampere

Calculation:

1.To find $\frac{I}{\tan\theta}$

1. $\frac{I}{\tan\theta} = \frac{1.2}{\tan 32.5°} = \frac{1.2}{0.6370}$ = 1.8838

2. $\frac{I}{\tan\theta} = \frac{1.4}{\tan 35.5°} = \frac{1.4}{0.7132}$ = 1.9629

3. $\frac{I}{\tan\theta} = \frac{1.6}{\tan 38.5°} = \frac{1.6}{0.7954}$ = 2.0115

4. $\frac{I}{\tan\theta} = \frac{1.8}{\tan 41.5°} = \frac{1.8}{0.8847}$ = 2.0345

5. $\frac{I}{\tan\theta} = \frac{2.0}{\tan 44.5°} = \frac{2.0}{0.9826}$ = 2.0352

Mean, $\frac{I}{\tan\theta} = \frac{1.8838+1.9629+2.0115+2.0115+2.0345}{5} = \frac{9.9279}{5}$ = 1.9855 Ampere

2.To find B_H

$$B_H = \frac{\mu_0 n r^2}{2(r^2+x^2)^{\frac{3}{2}}} \quad \frac{I}{\tan\theta} \text{ (Tesla)}$$

$$B_H = \frac{4*3.14*10^{-7}*5*(7.961*10^{-2})^2*1.9855}{2((7.961*10^{-2})^2+(6*10^{-2})^2)^{\frac{3}{2}}}$$

$$= \frac{7896.5349*10^{-11}}{2(0.0063377+0.0036)^{\frac{3}{2}}} = \frac{7896.5349*10^{-11}}{2(0.0099377)^{\frac{3}{2}}}$$

$$= \frac{7896.5349*10^{-11}}{0.00198133} = 3984523.26*10^{-11}$$

$= 3.9845*10^{-5}$ Tesla

Procedure:

- The preliminary adjustments were made.
- The number of turns n is selected and the circuit is switched on.
- The compass box is placed along its axis, with its centre at a distance x from the centre of the coil on one side.
- The range of current through circular coil is chosen in such a way that the deflection of the aluminium pointer lies between 30°- 60°.
- A suitable current is allowed to pass through the circuit, the deflection θ_1 and θ_2 are noted from the two ends of the aluminium pointer.
- Now the direction of the current is reversed using the commutator C, the deflections θ_3 and θ_4 in the opposition direction are noted.
- The compass box is taken to the other side ad fixed at the same distance x and four more readings θ_5, θ_6, θ_7 and θ_8 are noted.
- The mean value θ is calculated and tabulated.
- Repeat the same procedure for different values of current and the readings are tabulated.
- The radius of the circular coil is found by measuring its circumference using a thread around the coil.
- From the values of r, n, x and $\frac{I}{\tan\theta}$, the horizontal component of the Earth's magnetic field is calculated by using the formula, $B_H = \frac{\mu_0 n r^2}{2(r^2+x^2)^{\frac{3}{2}}} \frac{I}{\tan\theta}$

Result:

The horizontal component of the Earth's magnetic field using current carrying circular coil is,

$B_H = 3.9845*10^{-5}$ Tesla.

EXP NO 4: REFRACTIVE INDEX OF THE MATERIAL OF THE PRISM

Aim:

To determine the refractive index of the material of the prism

Apparatus required:

Spectrometer, prism, prism clamp, Sodium vapour lamp, spirit level

Formula:

Refractive index of the material of the prism,

$$\mu = \frac{Sin\left(\frac{A+D}{2}\right)}{Sin\left(\frac{A}{2}\right)} \text{ (no unit)}$$

where

A = Angle of the prism (degree)

D = Angle of minimum deviation (degree)

Diagram:

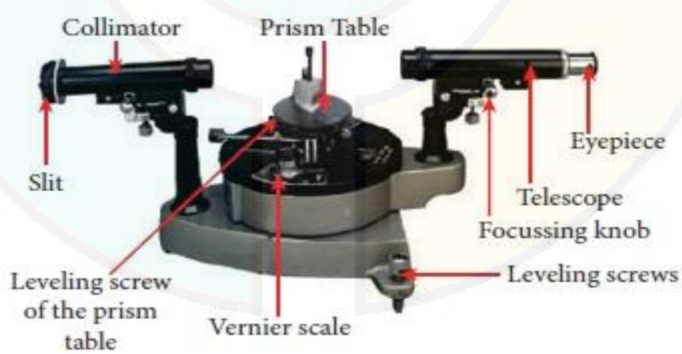


Figure (a) Angle of the prism

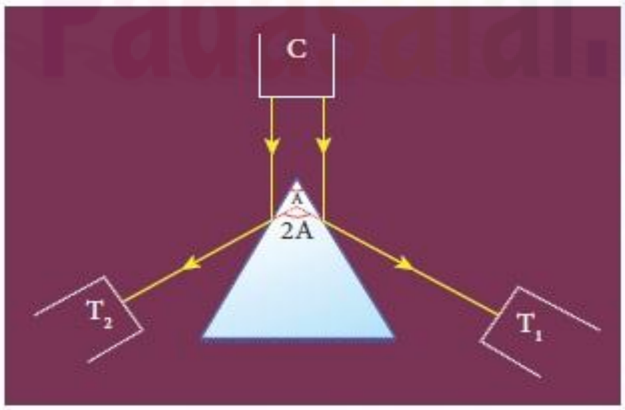


Figure (b) Angle of the prism

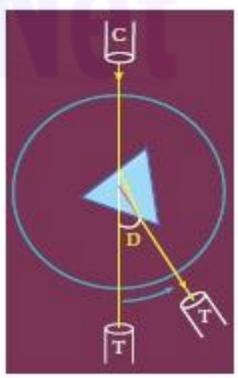


Figure (c) Angle of minimum deviation

Observation:

Table 1: To find the angle of the prism (A)

Image	Vernier (A) Degree			Vernier(B) Degree		
	MSR	VSC	TR	MSR	VSC	TR
Reflected image from face 1, R_1	60°	7'	60° 7'	240°	7'	240° 7'
Reflected image from face 2, R_2	299°	3'	299° 3'	119°	3'	119° 3'
Difference ,2A	$2A = R_1 \sim R_2$		121°4'	$2A = R_1 \sim R_2$		121°4'
					Mean 2A	121°4'
					Mean A	60°32'

Table 2: To find the angle of minimum (D)

Image	Vernier (A) Degree			Vernier(B) Degree		
	MSR	VSC	TR	MSR	VSC	TR
Reflected image from face 1	60°	7'	60° 7'	240°	7'	240° 7'
Reflected image from face 2	299°	3'	299° 3'	119°	3'	119° 3'
Difference ,2A	$2A = R_1 - R_2$		121°4'	$2A = R_1 - R_2$		121°4'
					Mean 2A	121°4'
					Mean A	60°32'

Calculation:

1.To find the angle of the prism (A)

Vernier A	Vernier B
$2A = R_1 \sim R_2$ = 299° 3' – 60° 7' = 298° 63'– 60° 7' = 238° 56' 2A = 360° - 238° 56' = 121° 4'	$2A = R_1 \sim R_2$ = 240° 7' - 119° 3' 2A = 121° 4'
Mean ,2A = $\frac{121°4'+121°4'}{2}$ = $\frac{242°8'}{2}$ = **121° 4'**	Mean ,A = $\frac{121°4'}{2}$ **= 60°32'**

2.To find the angle of minimum (D)

Vernier A	Vernier B
$D = R_3 \sim R_4$ = 319° 46' - 0° D= 360° - 319° 46' =40° 14'	$D = R_3 \sim R_4$ = 180° - 139° 46' D = 40° 14'
Mean ,D = $\frac{40°14'+40°14'}{2}$ = $\frac{80°28'}{2}$ = **40° 14'**	

3.To find the Refractive index (μ)

$$\mu = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)} \text{ (no unit)}$$

$$= \frac{\sin\left(\frac{60°\,32' + 40°14'}{2}\right)}{\sin\left(\frac{60°\,32'}{2}\right)}$$

$$= \frac{\sin\left(\frac{100°\,46'}{2}\right)}{\sin\left(\frac{60°\,32'}{2}\right)} = \frac{\sin(50°\,23')}{\sin(30°\,16')}$$

$$= \frac{0.7705}{0.5040} = \mathbf{1.529} \text{ (no unit)}$$

Procedure:

1.Initial adjustments of the spectrometer were made.

2.Determination of angle of the prism (A).

- The slit is illuminated by yellow light from sodium vapour lamp.
- The prism is placed on the prism table so that its refracting edges face the collimator.
- The light from the collimator incident on both the reflecting faces of the prism and is reflected. The telescope is rotated towards left to obtain the reflected image of the slit from face 1 and its main scale reading and vernier coincidence are noted from both vernier scales.
- Then the telescope is rotated towards right to obtain the reflected image of the slit from face 1 and its reading are noted.
- The difference between the two readings gives 2A, from which angle of the prism A is calculated.

3.Determination of angle of minimum deviation (D).

- The prism table is rotated such that light emerging from collimator incident on one of the refracting faces, gets refracted and emerges out from other refracting face.
- The direct ray as well as the refracted ray is viewed through the telescope.
- The readings are tabulated and the difference between the two readings gives the angle of minimum deviation, D.
- From the values of A and D, the refractive index of the material of the glass prism is determined.

Result:

1. Angle of the Prism (A) = **60°32'(degree)**
2. Angle of minimum deviation of the prism (D) = **40°14'(degree)**
3. Refractive index of the material of the prism (μ) = **1.529 (no unit)**

EXP NO 5: WAVELENGTH OF THE CONSTITUENT COLOURS OF A COMPOSITE LIGHT USING DIFFRACTION GRATING AND SPECTROMETER

Aim:

To find the wavelength of the constituent colours of a composite light using diffraction grating and spectrometer.

Apparatus required:

Spectrometer, mercury vapour lamp, diffraction grating, grating table, spirit level.

Formula:

Wavelength of the constituent colours of a composite light,

$$\lambda = \frac{\sin\theta}{nN} \ (A^\circ)$$

Where

N = Number of lines per metre of the given grating(no unit)

n = Order of the diffraction(no unit)

θ = Angle of diffraction(degree)

Diagram:

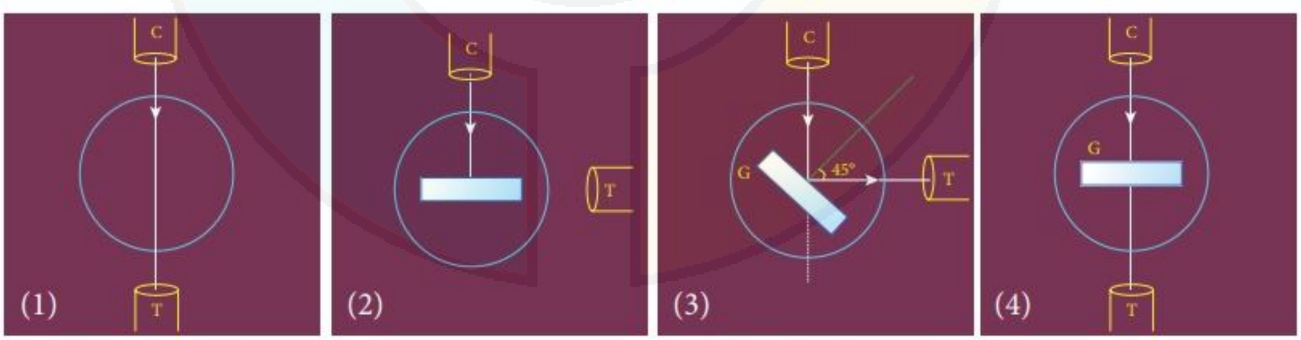


Figure (a) Normal incidence

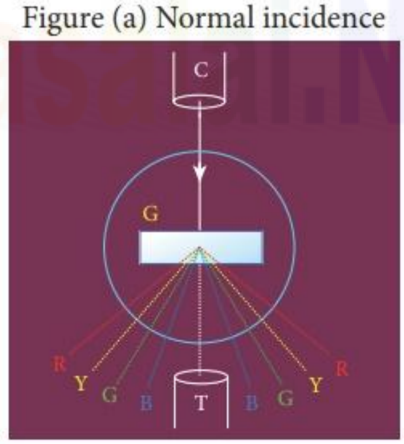


Figure (b) Angle of diffraction

Observation:

To find the wavelength of prominent colours of the mercury spectrum:

Number of lines, N = $5*10^5$ lines per metre

Colours of light	Diffracted Ray Reading(Degree)												Diffference 2θ (Degree)			θ (Degrees)
	Left						Right									
	Vernier A			Vernier B			Vernier A			Vernier B						
	MSR	VSC	TR	MSR	VSC	TR	MSR	VSC	TR	MSR	VSC	TR	Ver A	Ver B	Mean	
Blue	302° 0’	0	302° 0’	122° 0’	0	122° 0’	327° 0’	0	327° 0’	147° 0’	0	147° 0’	25° 0’	25° 0’	25° 0’	12° 30’
Green	299° 0’	0	299° 0’	119° 0’	0	119° 0’	330° 30’	0	330° 30’	150° 30’	0	150° 30’	31° 30’	31° 30’	31° 30’	15° 45
Yellow	298° 0’	0	298° 0’	118° 0’	0	118° 0’	331° 30’	0	331° 30’	151° 30’	0	151° 30’	33° 30’	33° 30’	33° 30’	16° 45
Red	296° 0’	0	296° 0’	116° 0’	0	116° 0’	333° 30’	0	333° 30’	153° 30’	0	153° 30’	37° 30	37° 30	37° 30	18° 45

Calculation:

Wavelength of prominent colours of the mercury spectrum:

BLUE	GREEN	YELLOW	RED
$\lambda = \frac{\sin\theta}{nN} = \frac{\sin 12°30'}{1*5*10^5}$ $= \frac{0.2164}{5*10^5}$ $= 4.328*10^{-7}$ $= 4328*10^{-10}$ m = 4328 A°	$\lambda = \frac{\sin\theta}{nN} = \frac{\sin 15°45'}{1*5*10^5}$ $= \frac{0.2714}{5*10^5}$ $= 5.428*10^{-7}$ $= 5428*10^{-10}$ m =5428 A°	$\lambda = \frac{\sin\theta}{nN} = \frac{\sin 16°45'}{1*5*10^5}$ $= \frac{0.2881}{5*10^5}$ $= 5.762*10^{-7}$ $= 5762*10^{-10}$ m = 5762 A°	$\lambda = \frac{\sin\theta}{nN} = \frac{\sin 18°45'}{1*5*10^5}$ $= \frac{0.3214}{5*10^5}$ $= 6.428*10^{-7}$ $= 6428*10^{-10}$ m = 6428 A°

Procedure:

1.Initial adjustments of the spectrometer were made.

2.Adjustments of the grating for normal incidence

- The slit is illuminated with a composite light (white light) from mercury vapour lamp.
- The telescope is brought in line with the collimator. The vertical cross wire is made to coincide with the image in the slit (Figure a 1)
- The vernier disc alone is rotated till the vernier scale reads 0° - 180° and is fixed. This is the direct ray reading.
- The telescope is then rotated (anti - clockwise) through an angle of 90° and fixed(Figure a 2)
- Diffraction grating is mounted and rotated so that the light reflected from it coincides with the vertical cross wire. The reflected image is white in colour(Figure a 3)
- Vernier disc along with the grating table is rotated through an angle of 45° such that the light from the collimator is incident normally on the grating (Figure a 4)

3.Determination of wavelength of the constituent colours of the mercury spectrum

- The telescope is brought in line with the collimator to receive direct image, white in colour.
- Then the telescope is turned to any one side (say left) of direct image to observe first order diffracted image.
- The vertical cross wire is made to coincide with the prominent spectral lines (violet, blue, yellow, red) and the readings of both the vernier scales of each colours are noted.
- Then the telescope is turned to the other side and the readings of the prominent spectral lines are again noted.
- The readings are tabulated.
- From the values of N. n and θ, the wavelength of the prominent colours of the mercury light is determined using the formula, $\lambda = \frac{\sin\theta}{nN}$ (A°)

Result:

1. The wavelength of blue line = $\mathbf{4328 * 10^{-10}}$ **m**
2. The wavelength of green line = $\mathbf{5428 * 10^{-10}}$ **m**
3. The wavelength of yellow line = $\mathbf{5763 * 10^{-10}}$ **m**
4. The wavelength of red line = $\mathbf{6428 * 10^{-10}}$ **m**

EXP NO 6: VOLTAGE – CURRENT CHARACTERISTICS OF A JUNCTION DIODE

Aim:

To draw the voltage – current (V -I)characteristics of PN junction diode and to determine its knee voltage and forward resistance.

Apparatus Required:

PN Junction diode (IN 4007), variable DC power supply, milli – ammeter, micro – ammeter, voltmeter, resistance and connecting wires.

Formula:

Forward Resistance of the diode,

$$R_F = \frac{\Delta V_F}{\Delta I_F} \ (\Omega)$$

Where

ΔV_F = change in forward resistance (volt)

ΔI_F = change in forward current (mA)

Circuit diagram

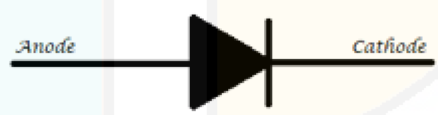


Figure (a) Symbol of PN junction diode

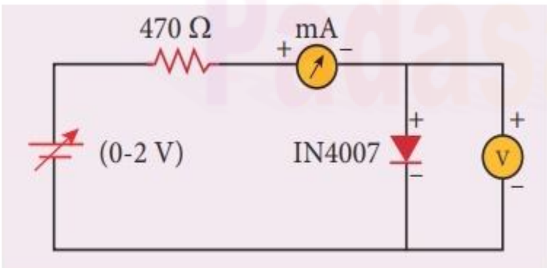


Figure (b) PN junction diode in forward bias

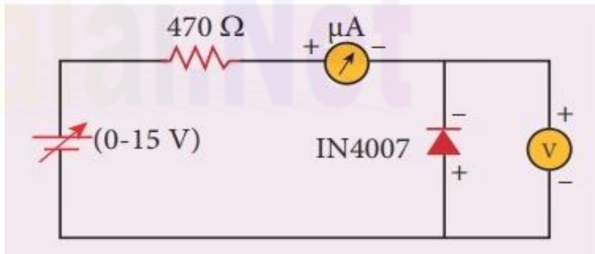


Figure (c) PN junction diode in reverse bias

Observation

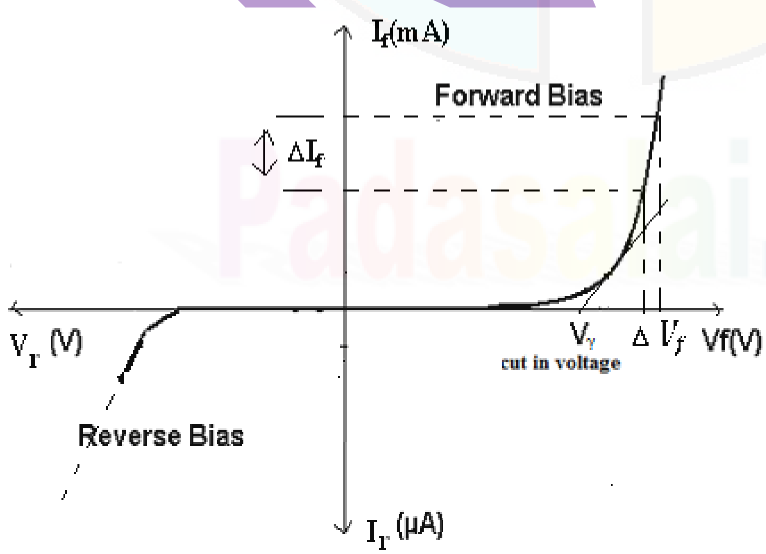
Table 1: Forward bias characteristics

S.No	Forward bias voltage,V_F (volt)	Forward bias current, I_F (mA)
1	0.1	0
2	0.2	0
3	0.3	0
4	0.4	0
5	0.5	0
6	0.6	3.5
7	0.7	17.5

Table 2: Reverse bias characteristics

S.No	Reverse bias voltage,R_F (volt)	Reverse bias current, R_F (µA)
1	1	50
2	2	70
3	3	90
4	4	100
5	5	110
6	6	120
7	7	130

Model Graph:



$$\text{Slope} = \frac{\Delta I_F}{\Delta V_F}$$

$$\text{Forward resistance, } R_F = \frac{1}{\text{Slope}}$$

Calculation:

1. Forward resistance, $R_F = \frac{1}{\text{Slope}}$

$$= \frac{\Delta V_F}{\Delta I_F}$$

$$= \frac{0.1}{14 * 10^{-3}}$$

$$= 0.007142 * 10^3\ \Omega$$

$$= 7.142\ \Omega$$

2. Knee voltage or Cut in Voltage = 0.55 V (from graph)

Procedure:

1.Forward bias characteristics:

- The connections are given as per the circuit diagram.
- The forward voltage (V_F) across the diode is increased from 0.1 V to 1.0 V and the forward current (I_F), through the diode is noted.
- The readings are tabulated and the graph is drawn by taking V_F along the positive X - axis and I_F along the positive Y- axis.
- The voltage corresponding to the dotted line in the forward bias gives the knee or cut in voltage.
- The slope is calculated and the reciprocal of it gives the forward resistance of the diode.

2.Reverse bias characteristics:

- The connections are given as per the circuit diagram.
- The reverse voltage (V_R) across the diode is increased from 1 V to 10 V and the reverse current (I_R), through the diode is noted.
- The readings are tabulated and the graph is drawn by taking V_R along the negative X - axis and I_R along the negative Y- axis.

Result:

The V-I characteristics of the PN junction diode are studied

1. Knee voltage or Cut in Voltage of the PN junction diode = **0.55 V** (from graph)
2. Forward resistance of the PN junction diode, R_F = **7.142 Ω**

Forward Bias Characteristic curve:

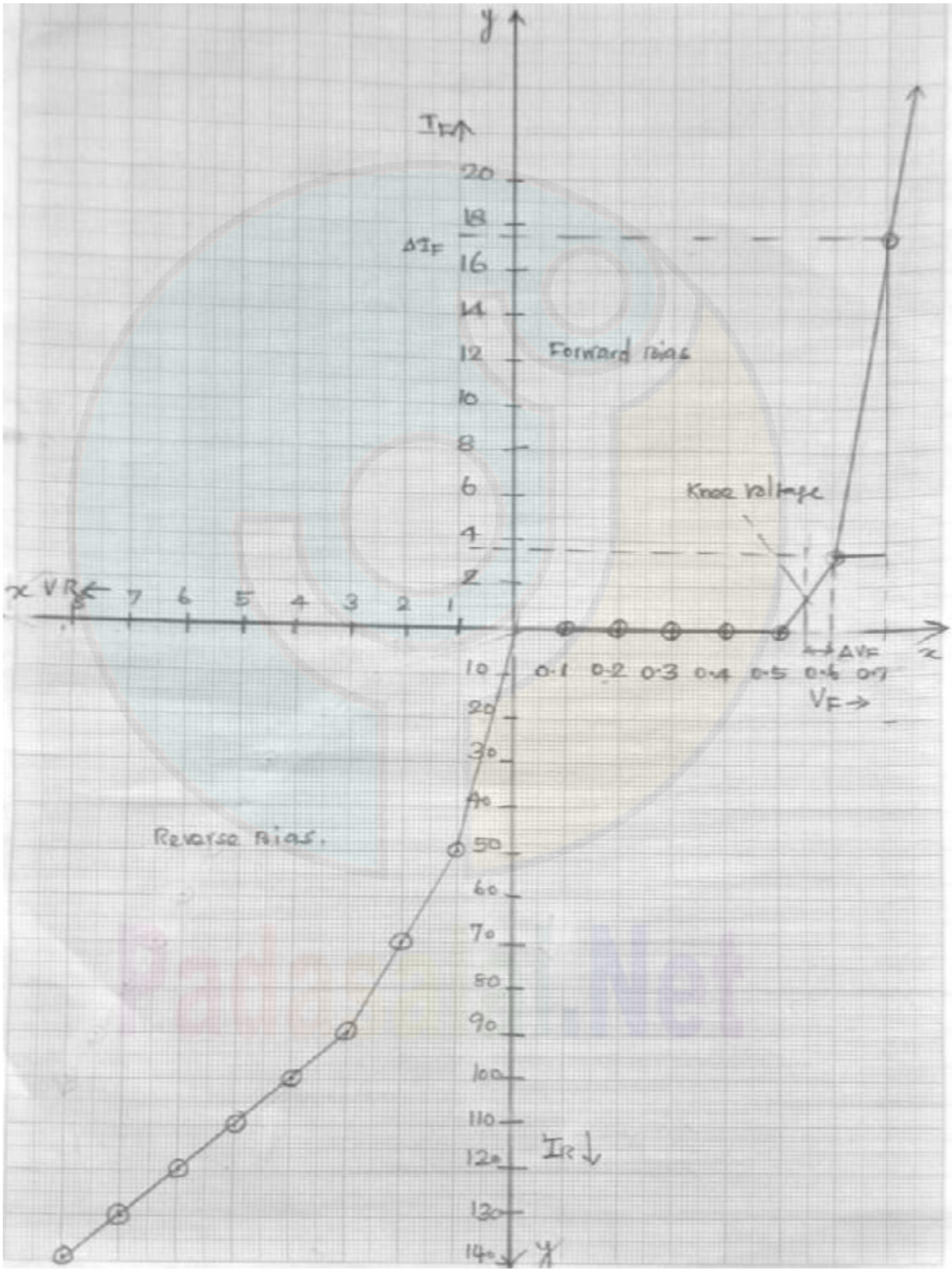
Scale: X axis 1 cm = 0.1 V

Y axis 1 cm = 2 mA

Reverse Bias Characteristic curve:

Scale: X axis 1 cm = 1 V

Y axis 1 cm = 10 μA



EXP NO 7: VOLTAGE – CURRENT CHARACTERISTICS OF A ZENER DIODE

Aim:

To draw the voltage – current (V -I) characteristics a Zener diode and to determine its knee voltage, forward resistance and reverse breakdown voltage.

Apparatus Required:

Zener diode (IZ5 6V), variable DC power supply(0-15 V), milli – ammeter, voltmeter, resistance and connecting wires.

Formula:

Forward Resistance of the diode,

$$R_F = \frac{\Delta V_F}{\Delta I_F} \ (\Omega)$$

Where

ΔV_F = change in forward resistance (volt)

ΔI_F = change in forward current (mA)

Circuit diagram:

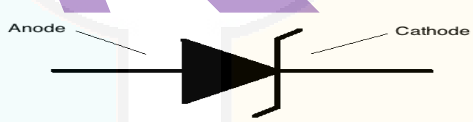


Figure (a) Symbol of Zener diode

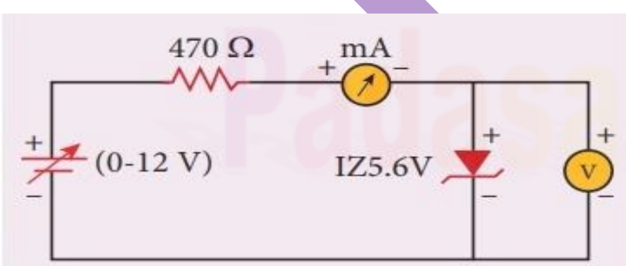


Figure (b) Zener diode in forward bias

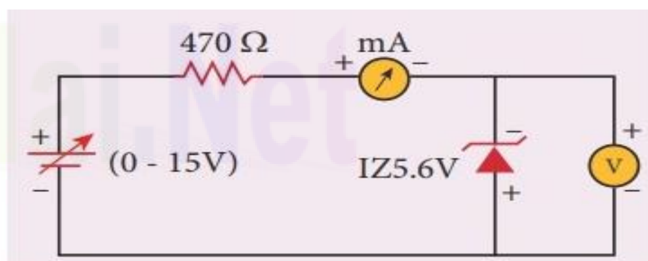


Figure (c) Zener diode in reverse bias

Observation

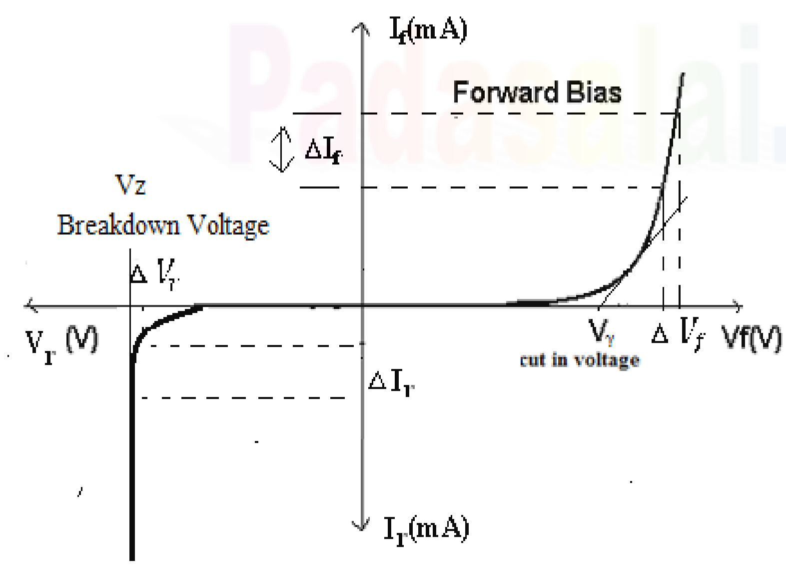
Table 1: Forward bias characteristics

S.No	Forward bias voltage, V_F (volt)	Forward bias current, I_F (mA)
1	0.1	0
2	0.2	0
3	0.3	0
4	0.4	0
5	0.5	0
6	0.6	0
7	0.7	0
8	0.8	4
9	0.9	14

Table 2: Reverse bias characteristics

S.No	Reverse bias voltage, R_F (volt)	Reverse bias current, R_F (μA)
1	1	0
2	2	0
3	3	0
4	4	0
5	5	0
6	6	0
7	6.2	0.2
8	6.4	10
9	6.5	11

Model Graph:



$$\text{Slope} = \frac{\Delta I_F}{\Delta V_F}$$

$$\text{Forward resistance, } R_F = \frac{1}{\text{Slope}}$$

Calculation:

1. Forward resistance, $R_F = \frac{1}{\text{Slope}} = \frac{\Delta V_F}{\Delta I_F}$

$$= \frac{0.1}{10*10^{-3}}$$

$= 0.01*10^3\ \Omega$

$= 10\ \Omega$

2. Knee voltage or Cut in Voltage = 0.75 V (from graph)
3. Break down voltage of the Zener diode, V_Z = 6.4 V (from graph)

Procedure:

1.Forward bias characteristics:

- The connections are given as per the circuit diagram.
- The forward voltage (V_F) across the diode is increased from 0.1 V to 1.0 V and the forward current (I_F), through the diode is noted.
- The readings are tabulated and the graph is drawn by taking V_F along the positive X - axis and I_F along the positive Y- axis.
- The voltage corresponding to the dotted line in the forward bias gives the knee or cut in voltage.
- The slope is calculated and the reciprocal of it gives the forward resistance of the diode.

2.Reverse bias characteristics:

- The connections are given as per the circuit diagram.
- The reverse voltage (V_R) across the diode is increased from 1 V to 10 V and the reverse current (I_R), through the diode is noted.
- The readings are tabulated and the graph is drawn by taking V_R along the negative X - axis and I_R along the negative Y- axis.
- In the reverse bias, Zener breakdown occurs at a particular voltage called Zener Voltage, V_Z.
- The breakdown voltage of the Zener diode is determined from the graph.

Result:

The V-I characteristics of the Zener junction diode are studied

1. Forward resistance of the PN junction diode, R_F = **10 Ω**
2. Knee voltage or Cut in Voltage of the PN junction diode = **0.75 V** (from graph)
3. Breakdown voltage of the Zener diode, V_Z = **6.4 V** (from graph)

Forward Bias Characteristic curve:

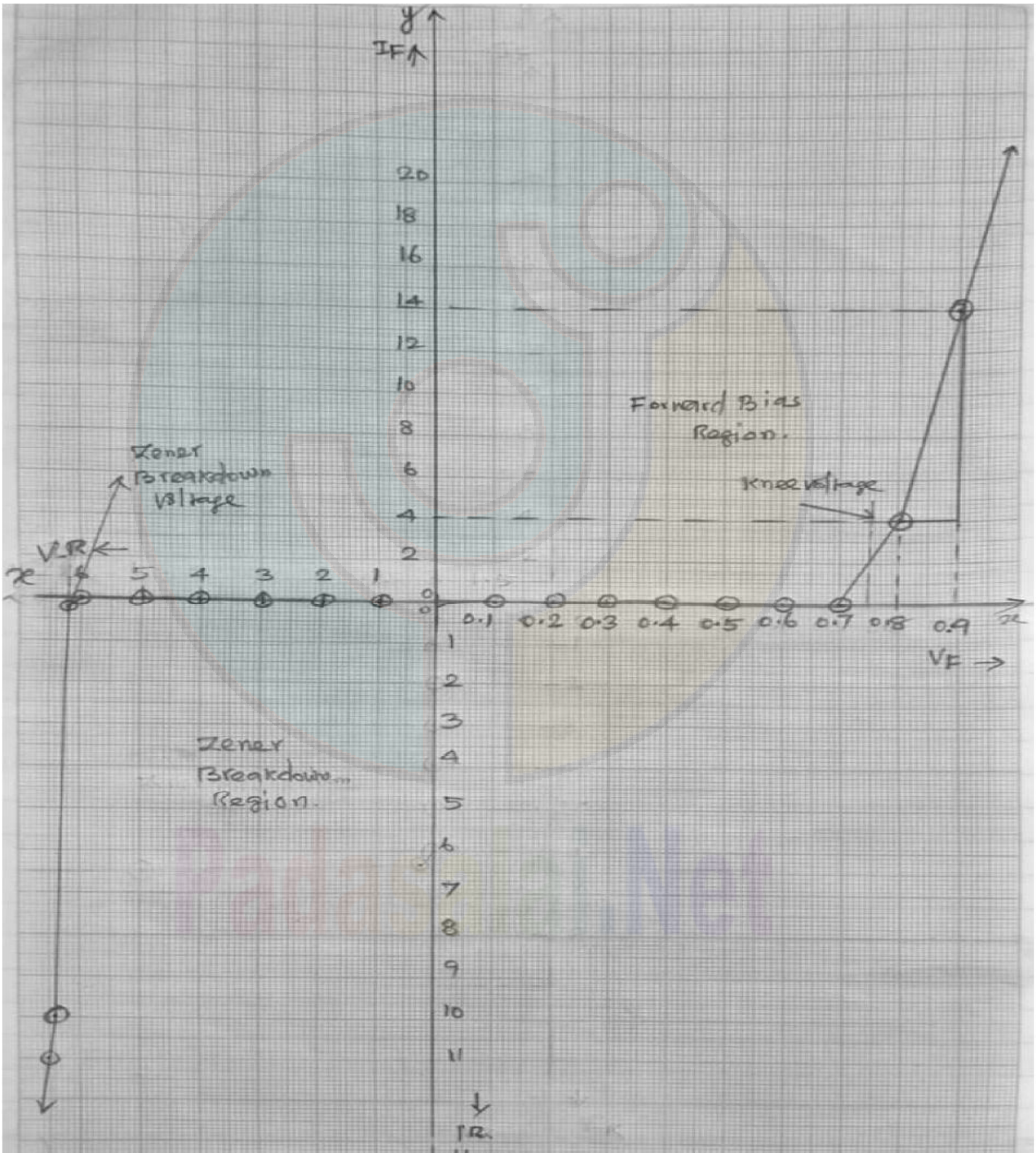
Scale: X axis 1 cm = 0.1 V

Y axis 1 cm = 2 mA

Reverse Bias Characteristic curve:

Scale: X axis 1 cm = 1 V

Y axis 1 cm = 1 µA



EXP NO 8: CHARACTERISTICS OF A NPN JUNCTION TRANSISTOR IN COMMON EMITTER CONFIGURATION

Aim:

To study the characteristics and to determine the current gain of a NPN junction transistor in Common Emitter configuration.

Apparatus required:

Transistor – BC 548/ BC 107, Bread board, micro- ammeter, milli – ammeter, voltmeters, Variable DC power supply, connecting wires.

Formula:

S.No	Formula	Parameters
1	$r_i = [\frac{\Delta V_{BE}}{\Delta I_B}]_{V_{CE}}$	r_i = Input impedance (Ω) ΔV_{BE} = change in Base- Emitter voltage(volt) ΔI_B = change in Base current(μA)
2	$r_o = [\frac{\Delta V_{CE}}{\Delta I_c}]_{I_B}$	r_o = Output impedance (Ω) ΔV_{CE} = change in Base- Emitter voltage(volt) ΔI_C = change in Collector current(mA)
3	$\beta = [\frac{\Delta I_C}{\Delta I_B}]_{V_{CE}}$	β = Current gain (no unit) ΔI_B = change in Base current(μA) ΔI_C = change in Collector current(mA)

Circuit diagram:

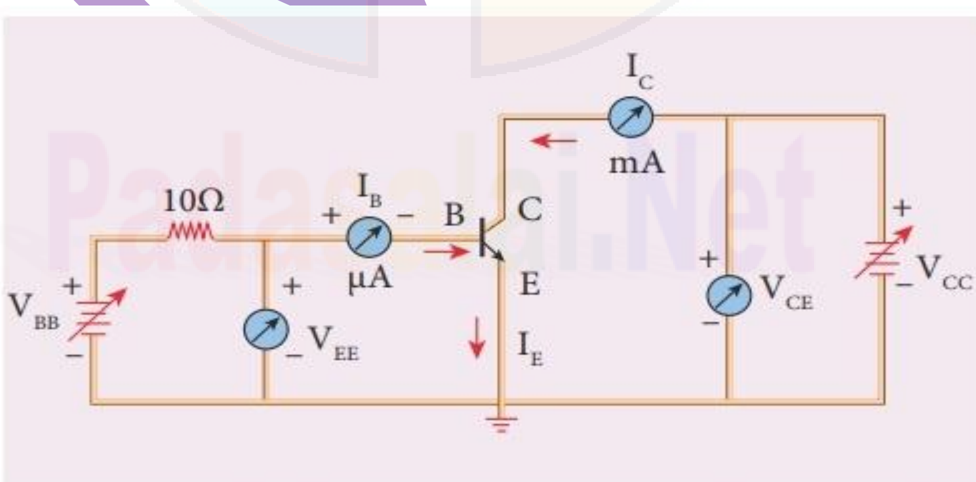


Figure NPN junction transistor in CE configuration

Observation:

Table 1: Input characteristics V_{BE} vs I_B (V_{CE} constant)

S.No	V_{CE} = 2V		V_{CE} = 5V	
	V_{BE}(V)	I_B(μA)	V_{BE}(V)	I_B(μA)
1	0	0	0.1	0
2	0.1	0	0.2	0
3	0.2	0	0.3	0
4	0.3	0	0.4	0
5	0.4	0	0.5	0
6	0.5	25	0.6	12
7	0.55	80	0.7	48
8	0.6	140	0.8	86
9	0.9	-	0.9	148
10	1.0	-	1.0	200

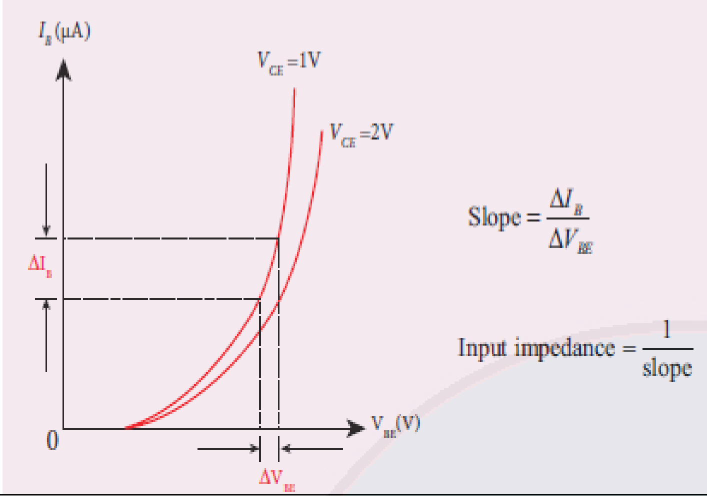
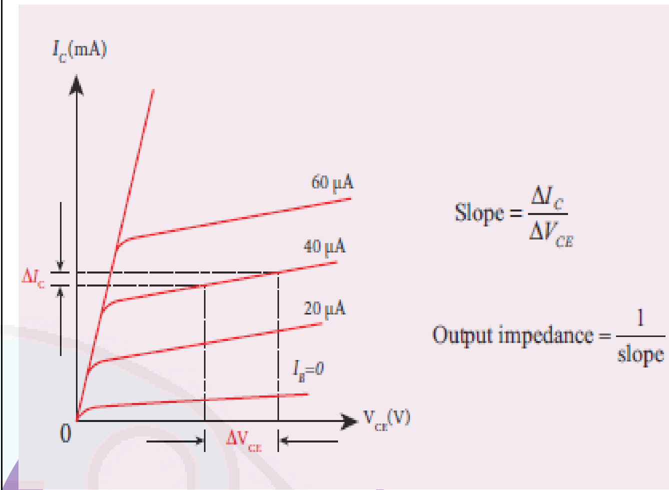
Table 2: Output characteristics V_{CE} vs I_C (I_B constant)

S.No	I_B = 20μA		I_B = 40μA	
	V_{CE}(V)	I_C(mA)	V_{CE}(V)	I_C(mA)
1	0	0	0	0
2	0.2	5.5	0.2	8
3	0.4	7	0.4	9.5
4	0.6	8	0.6	10.5
5	0.8	8.5	0.8	11
6	1.0	9	1.0	11
7	2.0	9	2.0	11
8	3.0	9	3.0	11

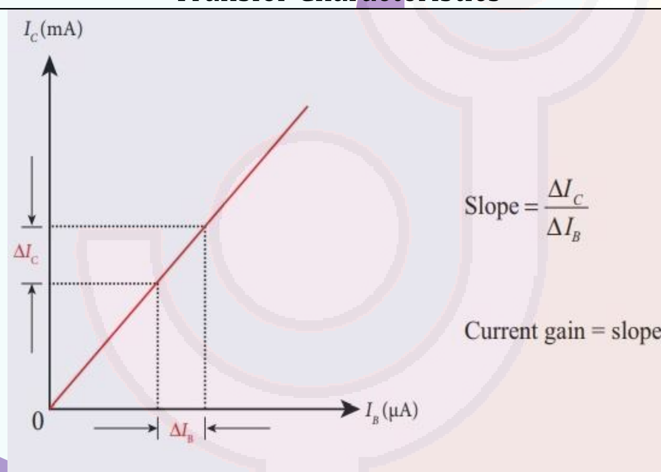
Table 3: Transfer characteristics I_B vs I_C (V_{CE} constant)

S.No	V_{CE} = 5V	
	I_B(μA)	I_C(mA)
1	0	0
2	10	1.25
3	20	2.5
4	30	3.75
5	40	5
6	50	6.25
7	60	7.5
8	70	8.75

Model Graph:

Input characteristics	Output characteristics
	

Transfer Characteristics



Procedure:

The connections are given as per the circuit diagram

The current and the voltage at the input and output can be varied by DC power supply.

1. Input characteristics V_{BE} vs I_B (V_{CE} constant)

- ❖ At constant V_{CE} , the Base–Emitter voltage, V_{BE} is varied in steps of 0.1 V and the corresponding Base current, I_B is noted.
- ❖ The same procedure is repeated for different values of V_{CE} and the readings are tabulated.
- ❖ A graph is drawn by taking V_{BE} along X- axis and I_B along Y- axis for both the values of V_{CE}.
- ❖ The curve thus obtained is the input characteristics of the transistor and the slope is calculated.
- ❖ The reciprocal of the slope gives the input impedance of the transistor.

2. Output characteristics V_{CE} vs I_C (I_B constant)

- At constant I_B , the Collector–Emitter voltage, V_{CE} is varied in steps of 1 V and the corresponding Collector current, I_C is noted.
- The same procedure is repeated for different values of I_B and the readings are tabulated.
- A graph is drawn by taking V_{CE} along X- axis and I_C along Y- axis for both the values of I_B.
- The curve thus obtained is the output characteristics of the transistor and the slope is calculated.
- The reciprocal of the slope gives the output impedance of the transistor.

3. Transfer characteristics I_B vs I_C (V_{CE} constant)

- At constant V_{CE} , the Base Current I_B is varied in steps of μA and the corresponding Collector current I_C is noted.
- The same procedure is repeated for different values of V_{CE} and the readings are tabulated.
- A graph is drawn by taking I_B along X- axis and I_C along Y- axis for both the values of V_{CE}.
- The curve thus obtained is the transfer characteristics of the transistor and the slope is calculated.
- The slope gives the current gain,β of the transistor.

Calculation:

1)Input impedance,$r_i = [\frac{\Delta V_{BE}}{\Delta I_B}]_{V_{CE}}$

ΔV_{BE} = 0.6 – 0.5 = 0.1 V, ΔI_B = 140 – 25 = 115 μA

$r_i = \frac{0.1}{115*10^{-6}}$

$= 8.695*10^{-4}*10^{6}$

$= 8.695*10^{2}$

= 869.5 Ω

2)Output impedance,$r_o = [\frac{\Delta V_{CE}}{\Delta I_c}]_{I_B}$

ΔV_{CE} = 1.0 – 0.6 = 0.4 V, ΔI_C = 9 – 8 = 1 mA

$r_o = \frac{0.4}{1*10^{-3}}$

$= 0.4*10^{3}$

= 400 Ω

3)Current gain,$\beta = [\frac{\Delta I_C}{\Delta I_B}]_{V_{CE}}$

ΔI_B = 40 – 30 = 10μA, ΔI_C= 5 – 3.75 = 1.25 mA

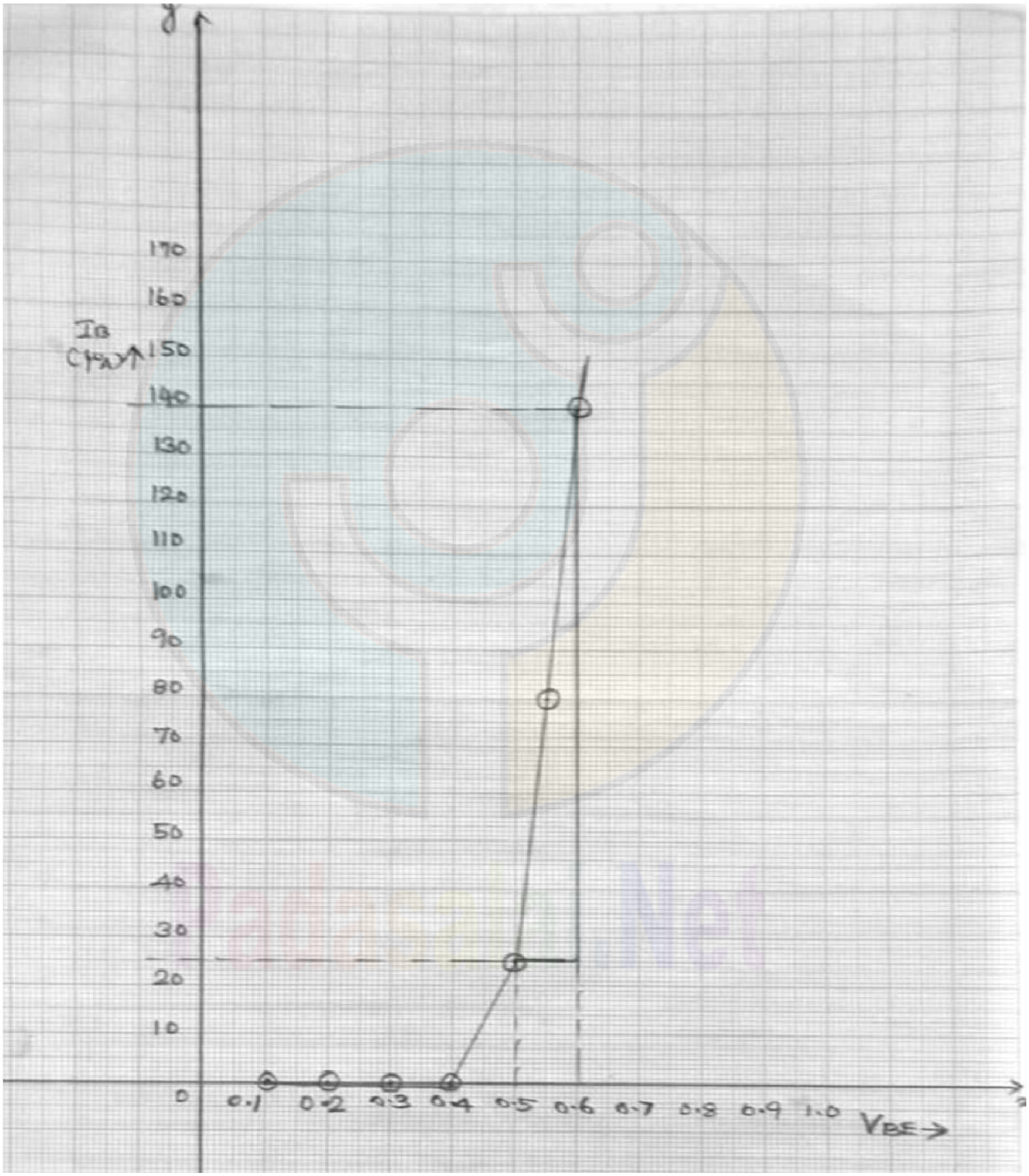
$\beta = \frac{1.25*10^{-3}}{10*10^{6}}$

$= 0.125*10^{-3}*10^{6} = 0.125*10^{3}$

= 125(no unit)

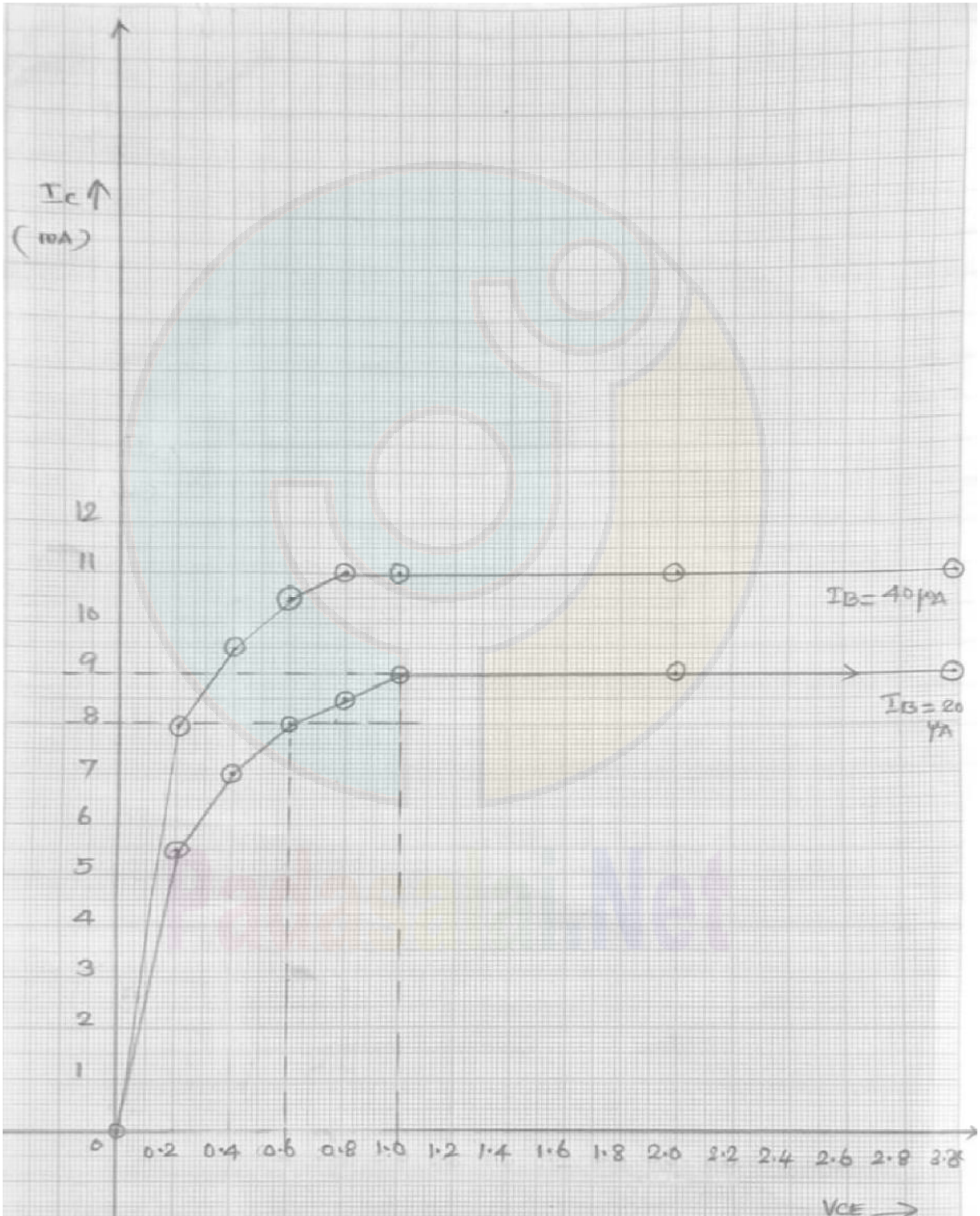
Input Characteristic curve:

Scale: X axis 1 cm = 0.1 V
Y axis 1 cm = 10 μA



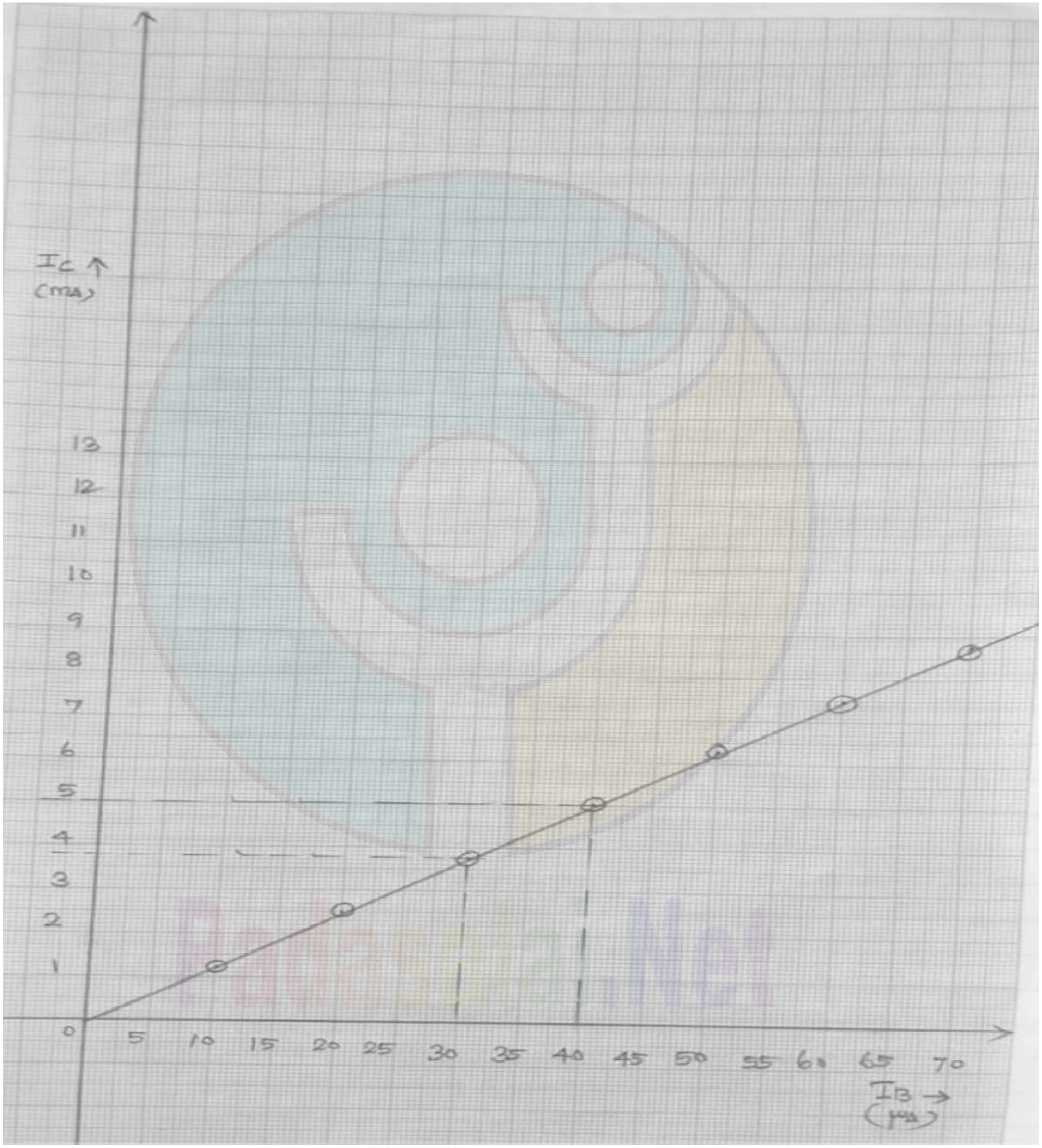
Output Characteristic curve:

Scale: X axis 1 cm = 0.2 V
Y axis 1 cm = 1 mA



Transfer Characteristic curve:

Scale: X axis 1 cm = 5 μA
Y axis 1 cm = 1 mA



Result:

1.The input, output and transfer characteristics of the NPN junction transistor in Common Emitter configuration are drawn.

2.(a)Input impedence, $\mathbf{r_i = 869.5\ \Omega}$

(b)Output impedance, $\mathbf{r_0 = 400\ \Omega}$

(c)Current gain, **β = 125(no unit)**

EXP NO 9: VERIFICATION OF TRUTH TABLE OF LOGICGATES USING INTEGRATED CIRCUITS

Aim:

To verify the truth table of AND,OR,NOT,EX – OR, NAND and NOR gates using Integrated circuits

Apparatus required:

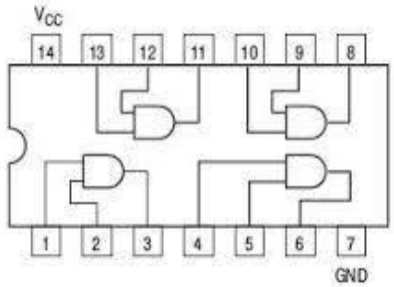
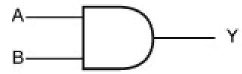
AND gate(IC 7408),NOT gate(IC 7404),OR gate(IC 7432),NAND gate(IC 7400),NOR gate(IC 7402), X- OR gate(IC 7486),Power supply, Digital IC Trainer kit, connecting wires.

Boolean Expressions:

S.No	Logic Gates	Boolean Expressions
1	AND	Y = A.B
2	OR	Y = A+B
3	NOT	$Y = \bar{A}$
4	Ex-OR	$Y = \bar{A}\,B + A\bar{B}$
5	NAND	$Y = \overline{A.B}$
6	NOR	$Y = \overline{A+B}$

Where

A,B are inputs and Y is output

<table>
<tr><th>Logic Gate</th><th>Pin diagram</th><th>Logic symbol</th><th>Truth table</th></tr>
<tr><td>AND
IC 7408</td><td></td><td></td><td><table><tr><th>A</th><th>B</th><th>Y = A.B</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td></tr>
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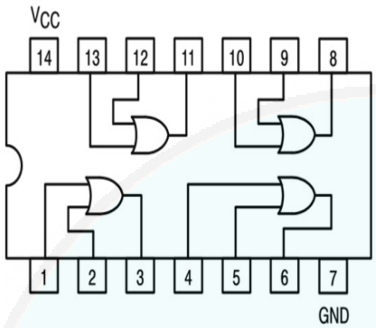
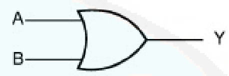
IC 7432</td><td></td><td></td><td><table><tr><th>A</th><th>B</th><th>Y = A+B</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr></table></td></tr>
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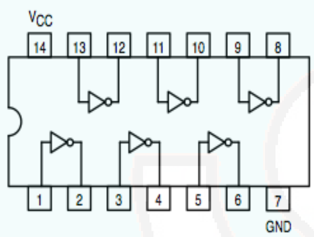
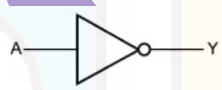
IC 7404</td><td></td><td></td><td><table><tr><th>A</th><th>$Y = \bar{A}$</th></tr><tr><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td></tr></table></td></tr>
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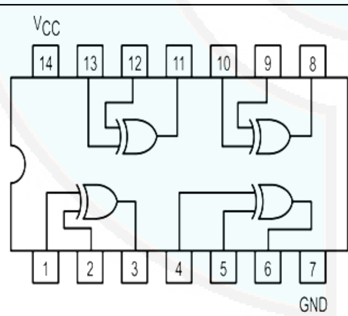
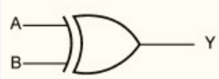
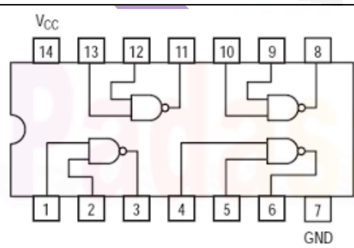
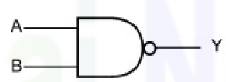
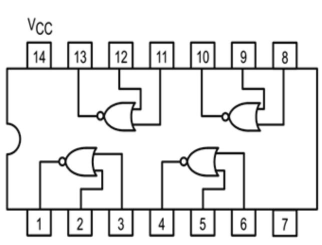
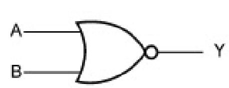
IC 7486</td><td></td><td></td><td><table><tr><th>A</th><th>B</th><th>$Y = \bar{A}B + A\bar{B}$</th></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td></tr>
<tr><td>NAND
IC 7400</td><td></td><td></td><td><table><tr><th>A</th><th>B</th><th>$Y = \overline{A.B}$</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td></tr>
<tr><td>NOR
IC 7402</td><td></td><td></td><td><table><tr><th>A</th><th>B</th><th>$Y = \overline{A+B}$</th></tr><tr><td>0</td><td>0</td><td>1</td></tr><tr><td>0</td><td>1</td><td>0</td></tr><tr><td>1</td><td>0</td><td>0</td></tr><tr><td>1</td><td>1</td><td>0</td></tr></table></td></tr>
</table>

Calculation:

INPUTS		AND Gate	OR Gate	NOT Gate	X-OR Gate	NAND Gate	NOR Gate
A	B	Y = A.B	Y = A+B	$Y = \bar{A}$	$Y = \bar{A}B + A\bar{B}$	$Y = \overline{A.B}$	$Y = \overline{A+B}$
0	0	0	0	1	0	1	1
0	1	0	1	1	1	1	0
1	0	0	1	0	1	1	0
1	1	1	1	0	0	0	0

AND Gate : $Y = A.B$ 1) $0.0=0$ 2) $0.1=0$ 3) $1.0=0$ 4) $1.1=1$

OR Gate : $Y = A+B$ 1) $0+0=0$ 2) $0+1=1$ 3) $1+0=1$ 4) $1+1=1$

NOT Gate : $Y = \bar{A}$ 1) $\bar{0}=0$ 2) $\bar{1}=0$

X-OR Gate : $Y = \bar{A}B + A\bar{B}$

1) $\bar{0}.0 + 0.\bar{0} = 1.0 + 0.1 = 0 + 0 = 0$

2) $\bar{0}.1 + 0.\bar{1} = 1.1 + 0.0 = 1 + 0 = 1$

3) $\bar{1}.0 + 1.\bar{0} = 0.0 + 1.1 = 0 + 1 = 1$

4) $\bar{1}.1 + 1.\bar{1} = 0.1 + 1.0 = 0 + 0 = 0$

NAND Gate : $Y = \overline{A.B}$

1) $\overline{0.0} = 1+1 = 1$ 2) $\overline{0.1} = 1+0 = 1$ 3) $\overline{1.0} = 0+1 = 1$ 4) $\overline{1.1} = 0+0 = 0$

NOR Gate : $Y = \overline{A+B}$

1) $\overline{0+0} = 1.1 = 1$ 2) $\overline{0+1} = 1.0 = 0$ 3) $\overline{1+0} = 0.1 = 0$ 4) $\overline{1+1} = 0.0 = 0$

Procedure:

- To verify the truth table of a logic gate, the suitable IC is taken and the connections are given as per the circuit diagram.
- For all the ICs, 5 V is applied to the pin 14 while the pin 7 is connected to the ground.
- The logic inputs of the truth table are applied and the corresponding output is noted.
- Using the same procedure, the other ICs are checked for their outputs and their truth tables are verified.

Result:

The truth table of logic gates AND, OR, NOT, Ex-OR, NAND and NOR using integrated circuits is verified.

EXP NO10: VERIFICATION OF DE-MORGAN'S THEOREMS

Aim:

To verify De Morgan's first and Second Theorems

Apparatus required:

Power Supply (0 – 5 V), IC 7400,7408,7432,7404 and 7402, Digital IC Trainer kit, connecting wires

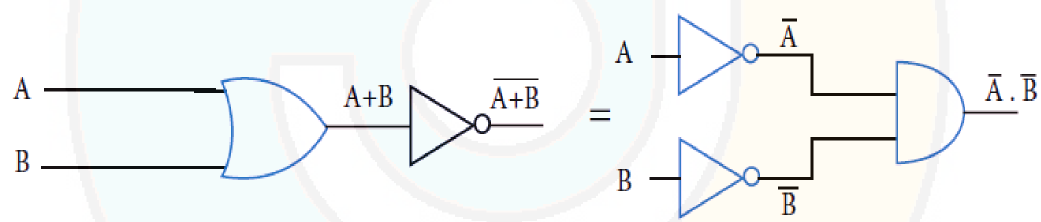
Formula:

De Morgan's First Theorem: $\overline{A+B} = \bar{A}.\bar{B}$

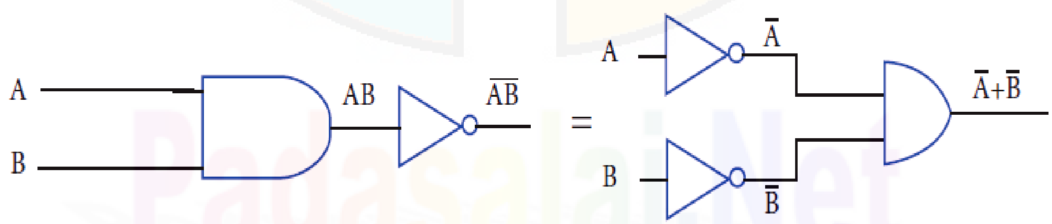
De Morgan's Second Theorem: $\overline{A.B} = \bar{A} + \bar{B}$

Logic Diagram:

De Morgan's first theorem



De Morgan's second theorem



Truth Table:

De Morgan's First Theorem:

A	B	$\bar{A}$	$\bar{B}$	$\bar{A}.\bar{B}$	A+B	$\overline{A+B}$
0	0	1	1	**1**	0	**1**
0	1	1	0	**0**	1	**0**
1	0	0	1	**0**	1	**0**
1	1	0	0	**0**	1	**0**

De Morgan's Second Theorem:

A	B	$\overline{A}$	$\overline{B}$	$\overline{A}+\overline{B}$	A.B	$\overline{A.B}$
0	0	1	1	**1**	0	**1**
0	1	1	0	**1**	0	**1**
1	0	0	1	**1**	0	**1**
1	1	0	0	**0**	1	**0**

Calculation:

De-Morgan's first theorem

$\overline{A+B}$ 1) $\overline{0+0}=1.1=1$ 2) $\overline{0+1}=1.0=0$ 3) $\overline{1+0}=0.1=0$

4) $\overline{1+1}=0.0=0$

$\bar{A}.\bar{B}$ 1) $\bar{0}.\bar{0}=1.1=1$ 2) $\bar{0}.\bar{1}=1.0=0$ 3) $\bar{1}.\bar{0}=0.1=0$

4) $\bar{1}.\bar{1}=0.0=0$

De-Morgan's second theorem

$\overline{A.B}$ 1) $\overline{0.0}=1+1=1$ 2) $\overline{0.1}=1+0=1$ 3) $\overline{1.0}=0+1=1$

4) $\overline{1.1}=0+0=0$

$\bar{A}+\bar{B}$ 1) $\bar{0}+\bar{0}=1+1=1$ 2) $\bar{0}+\bar{1}=1+0=1$ 3) $\bar{1}+\bar{0}=0+1=1$

4) $\bar{1}+\bar{1}=0+0=0$

Procedure:

De Morgan's First Theorem:

- Connections are given for LHS ($\overline{A+B}$) of the theorem as per the circuit giagram
- The output is noted and tabulated as per the truth table.
- Repeat the same procedure for RHS ($\overline{A}.\overline{B}$) of the theorem.
- From the truth table, it is shown that $\overline{A+B}=\overline{A}.\overline{B}$

De Morgan's Second Theorem:

- Connections are given for LHS ($\overline{A.B}$) of the theorem as per the circuit giagram
- The output is noted and tabulated as per the truth table.
- Repeat the same procedure for RHS ($\overline{A}+\overline{B}$) of the theorem.
- From the truth table, it is shown that $\overline{A.B}=\overline{A}+\overline{B}$

Result:

De Morgan's First and Second Theorems are verified.