PRACTICAL WORK BOOK

HIGHER SECONDARY
SECOND YEAR

PHYSICS

PREPARED BY
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INSTRUCTIONS TO STUDENTS

01. Before coming to the laboratory, a student should plan the experiment in advance by consulting with his / her friends and reading this book.

02. As separate observation Note Book must be used and everything regarding the experiment must be written before coming to the laboratory.

03. Write the date, experiment number, aim, apparatus required, formula, procedure and result in the right-hand page and diagram (Ray diagrams, and Circuit diagrams), tabulations, observations and calculations, in the left-hand page of the observation note book / record note book.

04. After the completion of experiment with all observations in the laboratory, the student should get the signature of the teacher. Within three days of the experiment the student should complete the calculations and get the signature of the teacher.

05. Enter the observed reading with the relevant units (gram, cm, mm…) but the final calculation must be done with SI units only. The result must be given with proper SI Unit.

PHYSICS PRACTICAL – SCHEME OF EVALUATION

Internal Assessment	**:** 20 Marks
External Examination	**:** 30 Marks
Total Marks	**: 50 Marks**

Internal Assessment (20)

(Teacher should maintain the Assessment Register and the Head of the Institution should monitor it)

Attendance (Above 90%)	**:** 05 Marks
Performance (while doing the experiment In the laboratory	**:** 05 Marks
Record Note Book	**:** 10 Marks

External Examination (30)

01. Formula **:** 04 Marks
(mere expression –2, explanation of notations –2)

02. Brief Procedure **:** 06 Marks
(For electricity and electronics diagrams – 3 Marks
Writing procedure –3 Marks)

03. Observations **:** 10 Marks

04. Calculations (Including graphs) **:** 08 Marks

05. Result **:** 02 Marks
(Correct Value –1 Mark, Mentioning SI Unit – 1Mark)

CONTENT

1. SPECTROMETER - μ OF A SOLID PRISM

AIM :

To determined the angle of a given prism and its angle of minimum deviation and hence calculate its refractive index.

APPARATUS:

Spectrometer, Solid Prism, Sodium Vapour lamp, Reading Lens etc.,

FORMULA:

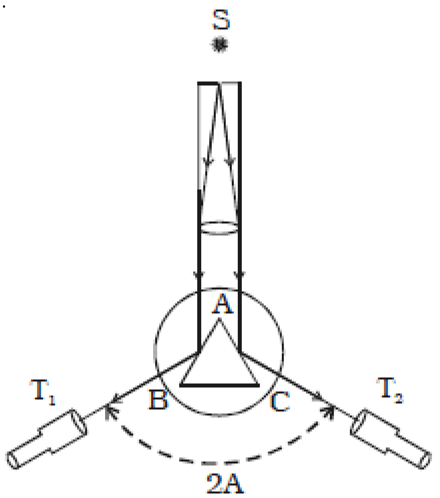
Refractive index of the material of the given prism

$$\mu = \frac{\sin\frac{A+D}{2}}{\sin\frac{A}{2}}$$

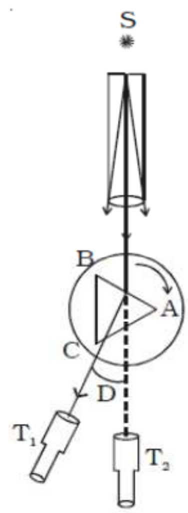
Where A is the angle of the prism (Degree)
D is the angle of minimum deviation (Degree)

DIAGRAM: (NOT FOR EXAMINATION)

To find the Angle of Prism:



To find the Angle of Minimum Deviation:



PROCEDURE

ANGLE OF THE PRISM:

After making preliminary adjustments, the prism is placed on the prism table. The slit is illuminated by a monochromatic source of light say, sodium vapour lamp.

Both the faces AB and AC receive parallel rays from the collimator. The telescope is rotated until the image of the slit formed by reflection at the face AB is made to coincide with the vertical cross wire of the telescope in the position T_1 The reading of the verniers are noted. The telescope is then rotated to the position T_2 where the image of the slit formed by reflection at the face AC coincides with the vertical cross wire. The readings corresponding to the verniers are again noted.

The difference between these two reading give twice the angle of the prism. Half of this gives the angle of the prism.

ANGLE OF MINIMUM DEVIATION:

The prism is placed on the prism table so that light from the collimator falls on one refracting face. The refracted image is observed through the telescope. The prism table is now rotated so that the refracted image moves towards the direct ray. If necessary the telescope is rotated so as to follow the image. It will be found that, as the prism table is rotated in the same direction, the image moves towards the direct ray up to a point and then turns back. The position of the image where it turns back is the minimum deviation position and the prism table is fixed in this position. The telescope is now adjusted so that its vertical cross wire coincides with the image and readings of the verniers are noted. Now the prism is removed and the telescope is turned to receive the direct ray and vertical cross wire is adjusted to coincide with the image. The readings of the verniers are noted.

The differences between the two readings give the angle of minimum deviation (D). The refractive index of the material of the prism is calculated using the formula

$$\mu = \frac{\sin\frac{A+D}{2}}{\sin\frac{A}{2}}$$

OBSERVATION:

i) To find the angle of Prism:

RAY	VERNIER I			VERNIER II		
	MSR	VC	TR = MSR+ (VC×LC)	MSR	VC	TR = MSR+ (VC×LC)
Reading of the image reflected from the one face (R_1)						
Reading of the image reflected from other face (R_2)						
	2A= R_1 ~R_2			2A= R_1 ~R_2		

Mean 2A =

A =

ii) **To find the angle of minimum deviation:**

RAY	VERNIER I			VERNIER II		
	MSR	VC	TR = MSR+ (VC×LC)	MSR	VC	TR = MSR+ (VC×LC)
Reading of the image in minimum deviation position (R_3)						
Reading of the direct image (R_4)						
	D = R_3 ~R_4			D = R_3 ~R_4		

Mean D =

CALCULATION:

To find "A"

2A = $R_1 \sim R_2$ = 　　　　　 2A = $R_1 \sim R_2$ =

2A = 　　　　　 2A =

AVERAGE 2A = $\dfrac{\quad + \quad}{2}$ = $\dfrac{\quad}{2}$ =

A = $\dfrac{\quad}{2}$ =

To find "D"

D = $R_3 \sim R_4$ = 　　　　　 D = $R_3 \sim R_4$ =

D = 　　　　　 D =

Average D = = $\dfrac{\quad + \quad}{2}$ = $\dfrac{\quad}{2}$ =

D =

To find " μ"

$$\boldsymbol{\mu = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{\quad + \quad}{2}\right)}{\sin\left(\frac{\quad}{2}\right)}}$$

$$\mu = \frac{\sin\left(\frac{\quad}{2}\right)}{\sin\left(\frac{\quad}{2}\right)} = \frac{\sin(\qquad)}{\sin(\qquad)}$$

μ = ---------------------

μ = -------------- (No Unit)

RESULT:

i) The Angle of the Prism **A** **=** **(Degree)**

ii) The Angle of Minimum Deviation **D** **=** **(Degree)**

iii) Refractive Index of the material of the given Prism μ = **(No unit)**

2. SPECTROMETER – GRATING – WAVELENGTH OF COMPOSITE LIGHT

AIM:

To determine the wavelength of the composite light using a diffraction grating and a spectrometer

APPARATUS:

Spectrometer, Plane diffraction grating, Mercury Vapour lamp, Reading Lens etc.,

FORMULA:

The wavelength (λ) of a spectral line using normal incidence arrangement of the grating is given by

$$\lambda = \frac{\sin\theta}{m\,N}$$

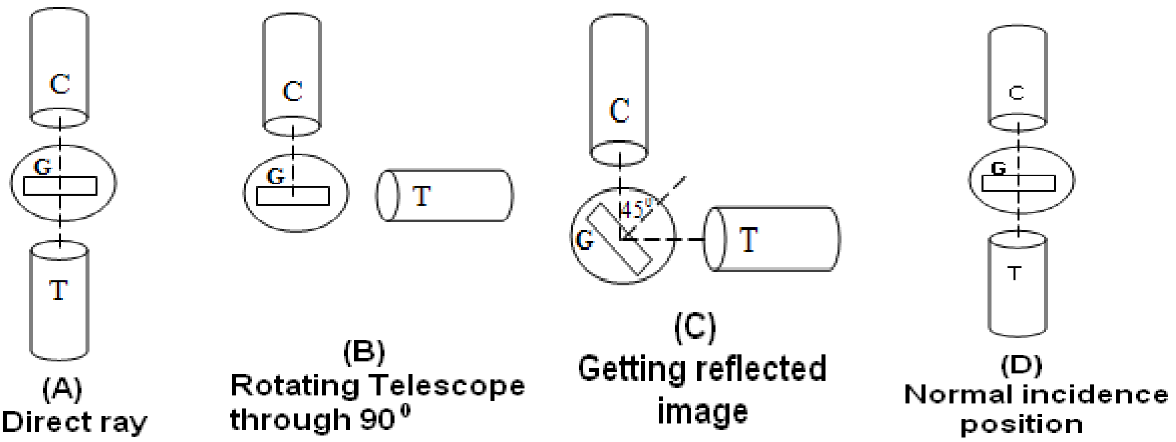
Where

θ is the angle of diffraction (Degree)

m is the order

N is the number of lines per unit length drawn on the grating (m)

ADJUSTING THE GRATING FOR NORMAL INCIDENCE: (NOT FOR EXAMINATION)



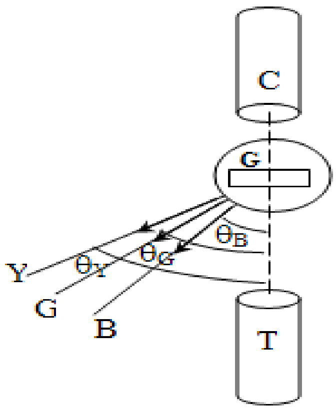
(A) Direct ray

(B) Rotating Telescope through 90°

(C) Getting reflected image

(D) Normal incidence position

DETERMINATION OF ANGLE OF DIFFRACTION: (NOT FOR EXAMINATION)



PROCEDURE:

The preliminary adjustments of the spectrometer are made. The slit is illuminated by white light from mercury vapour lamp. The grating is mounted on the prism table. The direct image (white) of the slit is adjusted to be 0^0 — 180^0. Telescope is then rotated through 90° and fixed. Prism table is rotated to get the reflected image which is made to coincide with the vertical cross wire. Keeping the platform fixed, vernier table is rotated through 45° so that the light rays from the collimator fall on the grating. Now the grating is in normal incidence position. The direct reading R_l is measured.

Now the telescope is released to get the first order (n= 1) diffracted image of the slit in the left side. It is adjusted so that the vertical cross wire coincides with violet spectral line. Readings corresponding to both the verniers are taken as R_2. The angle of diffraction θ is found as $R_1 \sim R_2$. The experiment is repeated for green and yellow spectral lines also. Number of lines per unit length of the grating is N. Wavelength of the spectral line is calculated from the formula

$$\lambda = \frac{\sin \theta}{m\,N}$$

OBSERVATION:

<table>
<tr><th colspan="2" rowspan="2">RAY</th><th colspan="3">VERNIER I</th><th colspan="3">VERNIER II</th></tr>
<tr><th>MSR</th><th>VC</th><th>TR = MSR+ (VC×LC)</th><th>MSR</th><th>VC</th><th>TR = MSR+ (VC×LC)</th></tr>
<tr><td colspan="2">Direct Reading</td><td></td><td></td><td>R_{D1}</td><td></td><td></td><td>R_{D2}</td></tr>
<tr><td rowspan="3">Diffracted Ray</td><td>BLUE</td><td></td><td></td><td>R_{B1}</td><td></td><td></td><td>R_{B2}</td></tr>
<tr><td>GREEN</td><td></td><td></td><td>R_{G1}</td><td></td><td></td><td>R_{G2}</td></tr>
<tr><td>YELLOW</td><td></td><td></td><td>R_{Y1}</td><td></td><td></td><td>R_{Y2}</td></tr>
</table>

TO FIND THE "θ"

	$R_{D1} - R_1$	$R_{D2} - R_2$	θ
BLUE			θ_B
GREEN			θ_G
YELLOW			θ_Y

$m = 1$

$N = 6 \times 10^5$

CALCULATION:

$R_{D1} - R_{B1} =$ 　　　　　　　　$R_{D2} - R_{B2} =$

$\theta_B =$ 　　　　　　　　$\theta_B =$

Average θ_B $= \dfrac{\quad + \quad}{2} =$

$R_{D1} - R_{G1} =$ 　　　　　　　　$R_{D2} - R_{G2} =$

$\theta_G =$ 　　　　　　　　$\theta_G =$

Average θ_B $= \dfrac{\quad + \quad}{2} =$

$R_{D1} - R_{Y1} =$ 　　　　　　　　$R_{D2} - R_{Y1} =$

$\theta_Y =$ 　　　　　　　　$\theta_Y =$

Average θ_Y $= \dfrac{\quad + \quad}{2} =$

$$\lambda_B = \frac{\sin\theta_B}{m\,N} = \frac{\sin(\qquad)}{1\times 6\times 10^5} = \frac{\qquad}{6\times 10^5} = \qquad \times 10^{-7}\,m$$

$$\lambda_G = \frac{\sin\theta_G}{m\,N} = \frac{\sin(\qquad)}{1\times 6\times 10^5} = \frac{\qquad}{6\times 10^5} = \qquad \times 10^{-7}\,m$$

$$\lambda_Y = \frac{\sin\theta_Y}{m\,N} = \frac{\sin(\qquad)}{1\times 6\times 10^5} = \frac{\qquad}{6\times 10^5} = \qquad \times 10^{-7}\,m$$

RESULT:

i) Wavelength of Blue colour λ_B = --------------- $\times 10^{-7}$m

ii) Wavelength of Green colour λ_G = --------------- $\times 10^{-7}$m

iii) Wavelength of Yellow colour λ_Y = --------------- $\times 10^{-7}$m

3. METRE BRIDGE – DETERMINATION OF RESISTANCE AND SPECIFICE RESISTANCE

AIM:

To determine the resistance of the given coil of wire using a meter bridge and to calculate the specific resistance of the material of the wire

APPARATUS:

Meter bridge, Lechlanche cell, Resistance box, Galvanometer, Plug key, High Resistance, Connecting wires, Screw Gauge etc.,

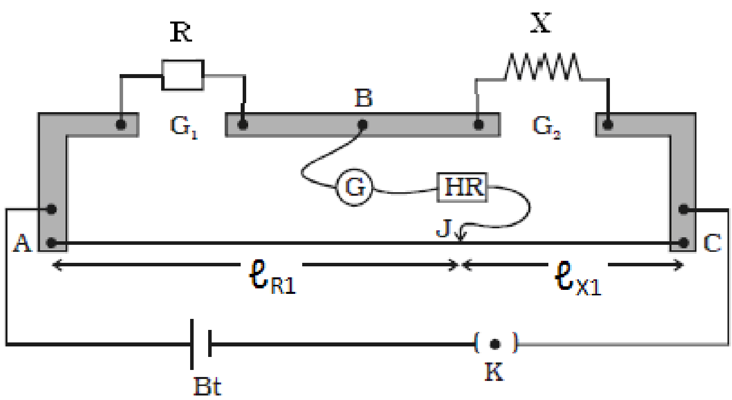
FORMULA:

Resistance of the wire $X = R\frac{l_X}{l_R}$ (Ω)

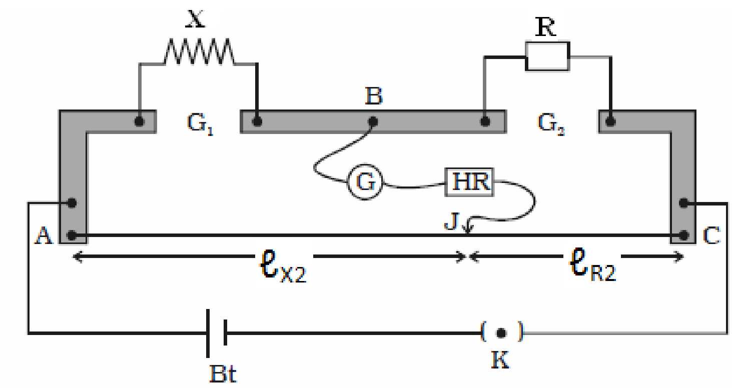
Specific resistance of the material of the wire $\rho = \frac{\pi r^2 X}{l}$ (Ωm)

Where
- R is known resistance (Ω)
- l_R is the balancing length of R (m)
- l_X is the balancing length of X (m)
- r is the radius of the wire (m)
- l is the length of the wire (m)

CIRCUIT DIAGRAM – BEFORE INTERCHANGING:



CIRCUIT DIAGRAM – AFTER INTERCHANGING:



PROCEDURE

The connections are made as in the circuit diagram. The jockey J is pressed near the ends A and C and if the deflections in the galvanometer are in the opposite directions, then the circuit is correct. Now the jockey is moved over the wire and its position J is found when there is no deflection in the galvanometer. The balancing length AJ = ℓ_{R1} is measured. JC = ℓ_{X1} is found out as (100 - ℓ_{R1}).

The experiment is repeated four more times by increasing the value of R in steps of 1 ohm.

Then the resistance box R and coil X are interchanged in the gaps G_1 and G_2. For the same values of R as in the previous part of the experiment the balancing length AJ = ℓ_{X2} are measured. The balancing length JC = ℓ_{R2} are found out as (100- ℓ_{X2}). The values of ℓ_X and ℓ_R are calculated from

$$\ell_X = \frac{\ell_{X1} + \ell_{X2}}{2} \quad \ell_R = \frac{\ell_{R1} + \ell_{R2}}{2}$$

The resistance of the coil is found by substituting in the formula $X = R\frac{\ell_X}{\ell_R}$

The length (ℓ) of the coil is measured using scale and radius(r) of the coil is measured using screw gauge. The specific resistance of the coil is calculated using the formula

$$\rho = \frac{\pi r^2 X}{l}$$

OBSERVATION:

(i) **To determine the resistance of the given coil:**

S. No.	R (ohm)	Balancing length before interchanging		Balancing length after interchanging		Mean		$X=R\frac{l_X}{l_R}$ (ohm)
		ℓ_{x1} (cm)	ℓ_{R1} (cm)	ℓ_{X2} (cm)	ℓ_{R2} (cm)	$\ell_X=\frac{\ell_{X1}+\ell_{X2}}{2}$ (cm)	$\ell_R=\frac{\ell_{R1}+\ell_{R2}}{2}$ (cm)	
1	1							
2	2							
3	3							
4	4							
5	5							

Mean X = Ω

(ii) **To determine the radius of the coil:**

LC = 0.01 $\times 10^{-3}$m

ZERO ERROR = **ZERO CORRECTION =**

S. No	PSR	HSC	HSR	CR = PSR+HSR×L.C
1				
2				
3				
4				
5				
			Diameter 2r	
			r	

CALCULATION:

$l_x = \frac{l_{x1}+l_{x2}}{2} = \frac{\qquad + \qquad}{2} =$ $\qquad$ $l_R = \frac{l_{R1}+l_{R2}}{2} = \frac{\qquad + \qquad}{2} =$

$l_x = \frac{l_{x1}+l_{x2}}{2} = \frac{\qquad + \qquad}{2} =$ $\qquad$ $l_R = \frac{l_{R1}+l_{R2}}{2} = \frac{\qquad + \qquad}{2} =$

$l_x = \frac{l_{x1}+l_{x2}}{2} = \frac{\qquad + \qquad}{2} =$ $\qquad$ $l_R = \frac{l_{R1}+l_{R2}}{2} = \frac{\qquad + \qquad}{2} =$

$l_x = \frac{l_{x1}+l_{x2}}{2} = \frac{\qquad + \qquad}{2} =$ $\qquad$ $l_R = \frac{l_{R1}+l_{R2}}{2} = \frac{\qquad + \qquad}{2} =$

Calculation for X

$X = R\frac{l_x}{l_R} =$

$X = R\frac{l_x}{l_R} =$

$X = R\frac{l_x}{l_R} =$

$X = R\frac{l_x}{l_R} =$

$X = R\frac{l_x}{l_R} =$

Mean X = $\frac{\qquad\qquad}{\mathbf{5}} =$

CALCULATION FOR ρ:

$$\rho = \frac{\pi r^2 X}{l} = \frac{3.14 \times \qquad \times 10^{-3} \times \qquad \times 10^{-3} \times \frac{\qquad}{1}}{\frac{\qquad}{1}}$$

ρ =

RESULT:

Resistance of the wire **X =** Ω

Specific resistance of the material of the wire **ρ** = Ωm

4. POTENTIOMETER – COMPARISION OF EMF'S OF TWO CELLS

AIM:

To compare the emf's of two primary cells using a potentiometer.

APPARATUS:

Potentiometer, Rheostat, 2V Battery, Plug key, DPDT Switch, Galvanometer, High Resistance, Connecting wires etc.

FORMULA:

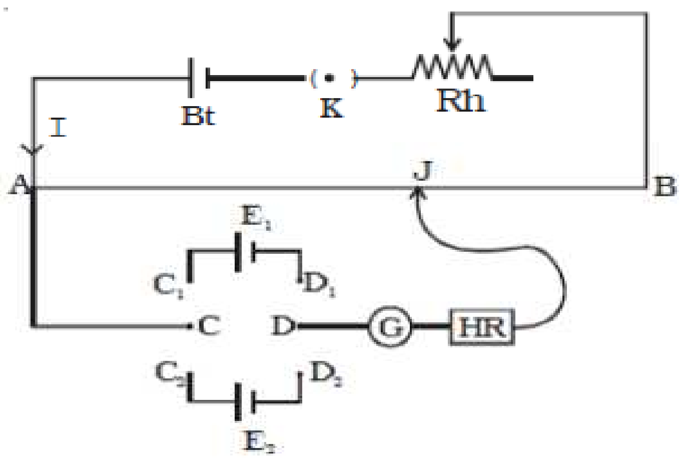
$$\frac{E_1}{E_2} = \frac{l_1}{l_2} \text{ (No Unit)}$$

E_1 emf of primary cell 1 (Lechlanche cell)

E_2 emf of primary cell 2 (Daniel cell)

l_1 is the balancing length for cell 1

l_2 is the balancing length for cell 2



PROCEDURE:

The connections are made according to the circuit diagram. The jockey J is pressed in the first and the last wire and the opposite side deflections in the galvanometer shows that the connections are correct. Lechlanche cell is included in the circuit using the DPDT switch. The jockey is moved over the potentiometer wire to get zero deflection in the galvanometer. The balancing length AJ is measured as ℓ_1. Daniel cell is included in the circuit using the DPDT switch, and the balancing length is measured as ℓ_2. The experiment is repeated for six times by moving rheostat in one direction for changing the current in the circuit.

The ratio of the emf of the two cells is found from the formula $\frac{E_1}{E_2} = \frac{l_1}{l_2}$

OBSERVATION:

S. No.	balancing length for Lechlanche cell	balancing length for Daniel cell	$\frac{E_1}{E_2} = \frac{l_1}{l_2}$
	l_1 cm	l_2 cm	
1			
2			
3			
4			
5			
6			
		Mean $\frac{E_1}{E_2}$	

CALCULATION:

$\frac{E_1}{E_2} =$	$\frac{E_1}{E_2} =$
$\frac{E_1}{E_2} =$	$\frac{E_1}{E_2} =$

$\frac{E_1}{E_2} =$	$\frac{E_1}{E_2} =$
Mean $\frac{E_1}{E_2} =$	

RESULT:

The mean ratio of emf's of the two cells **=** **(No Unit)**

5. TANGENT GALVANOMETER – DETERMINATION OF B_H

AIM:

To determine the value of the horizontal component of earth's magnetic field (B_H)

APPARATUS:

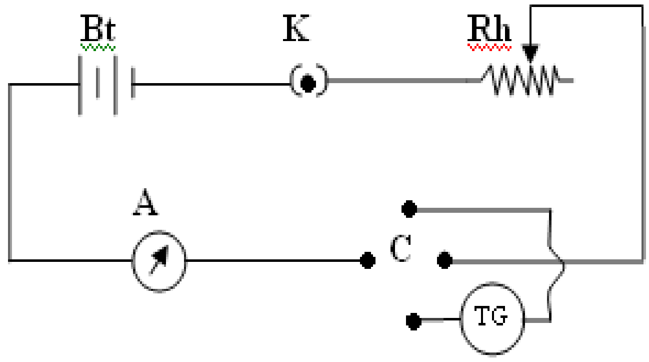
Tangent Galvanometer, Ammeter, Commudator, Battery, Plug key, Rheostat, Connecting wires etc

FORMULA:

$$B_H = \frac{\mu_0 n}{2a}\left(\frac{I}{tan\theta}\right) \text{ (Tesla)}$$

B_H - Horizontal component of earth's magnetic field
μ_0 –Permeability of free space
n – Number of turns
I – Current (A)
a – Radius of coil (m)
θ - Mean deflection produced in TG (Degree)

CIRCUIT DIAGRAM:



PROCEDURE:

The battery, rheostat, ammeter and tangent galvanometer are connected as in the circuit diagram. The coil in the tangent galvanometer is adjusted to be along the magnetic meridian. Then the compass box alone is rotated so that the aluminum pointer read $0^0 – 0^0$.

The current I is passed through the circuit and the deflection of the needle are measured as θ_1 and θ_2 . By reversing the current, the deflections are measured as θ_3 and θ_4. The average deflection θ is found out. The experiment is repeated by varying current. The average value of $\frac{I}{tan\theta}$ is found out. The radius R of the coil is found out by measuring its circumference. The number of turns "n" of the coil is noted.

The Horizontal component of earth's magnetic induction is calculated by substituting in the formula

$$B_H = \frac{\mu_0 n}{2a}\left(\frac{I}{tan\theta}\right)$$

OBSERVATION:

S. No.	Current I (A)	Deflection of T.G. (Degree)				Mean θ	Tan θ	$\frac{I}{\tan\theta}$
		θ_1	θ_2	θ_3	θ_4			
1								
2								
3								
4								
							Mean $\frac{I}{\tan\ \theta}$	

CALCULATION:

Circumference of the coil (**2πr**) = $\times 10^{-2}$ m

Radius (r) = $\frac{\quad}{2\pi}$ $\times 10^{-2}$ m =

$\frac{I}{\tan\theta} =$	$\frac{I}{\tan\theta} =$
$\frac{I}{\tan\theta} =$	$\frac{I}{\tan\theta} =$

Mean $\boldsymbol{\frac{I}{\tan\theta}} =$

$$B_H = \frac{\mu_0 n}{2a}\left(\frac{I}{\tan\theta}\right) = \frac{4\pi \times 10^{-7} \times 5 \times}{2 \times}$$

$$= \underline{\qquad\qquad\qquad}$$

RESULT:

The horizontal component of earth's magnetic field (B_H) **=** **Tesla**

6. SONOMETER – FREQUENCY OF AC

AIM:

To determine the frequency of the ac main using a Sonometer

APPARATUS:

Sonometer, 6V AC Power supply, Weights, Bar Magnet, Knife Edges, Connecting wires etc.

FORMULA:

The frequency of the ac main

$$n = \frac{1}{2} \times \frac{\sqrt{T}}{l} \times \frac{1}{\sqrt{m}} \text{ (Hertz)}$$

Where T is the tension of the sonometer wire
ℓ is the resonating length (m)
m is the linear density of the wire (kg)

PROCEDURE:

The ac mains voltage is brought down to 6 V by means of step down transformer. The secondary of the transformer is connected to the ends of the sonometer wire. A bar magnet is held below the sonometer wire at the centre. The magnetic field is horizontal and at right angles to the length of the wire.

With 200 gm (M) added to the weight hanger, the A.C. current is passed through the wire. Now the wire is set into forced vibrations. The length between the two knife edges is adjusted so that it vibrates in one segment. The length between the knife edges is measured as ℓ_1. The same procedure is repeated and ℓ_2 is measured. The average ℓ_1 and ℓ_2 is ℓ. The experiment is repeated for the loads 400gm, 600 gm and 800 gm.

The radius of the wire r is measured using screw gauge. The linear density of the wire is $m = \pi r^2 \rho$, where ρ is its density. The frequency of the A.C. mains is calculated from the formula

$$n = \frac{1}{2} \times \frac{\sqrt{T}}{l} \times \frac{1}{\sqrt{m}}$$

OBSERVATION:

S. No.	Load	Length of the vibrating segment		Mean	T = Mg	$\sqrt{T}$	$\frac{\sqrt{T}}{l}$
	M (kg)	ℓ_1(cm)	ℓ_2(cm)	ℓ (cm)	(Newton)		
1.	0.200						
2.	0.400						
3.	0.600						
4.	0.800						

(ii) **To determine the radius of the Sonometer wire:**

LC = 0.01×10^{-3}m

ZERO ERROR = ZERO CORRECTION =

S. No.	**PSR**	**HSC**	**HSR**	**CR = PSR+(HSR×L.C)**
1				
2				
3				
4				
			Mean d	

Radius r = $\times 10^{-3}$m

CALCULATION:

Diameter of the wire **d** =

Radius of the wire r = $\frac{d}{2}$ =

Density of the steel wire (ρ) = 7800kgm^{-3}

Linear density m = $\pi r^2 \rho$ =

$\sqrt{m}$ =

T = 0.2×9.8 = 1.96	$\sqrt{T}$ =	ℓ=	$\frac{\sqrt{T}}{l}$ =
T = 0.4×9.8 =3.92	$\sqrt{T}$ =	ℓ=	$\frac{\sqrt{T}}{l}$ =
T = 0.6×9.8 =5.88	$\sqrt{T}$ =	ℓ=	$\frac{\sqrt{T}}{l}$ =
T = 0.8×9.8 =7.84	$\sqrt{T}$ =	ℓ=	$\frac{\sqrt{T}}{l}$ =

Mean $\frac{\sqrt{T}}{l} = \frac{\qquad\qquad}{4}$ =

$$n = \frac{1}{2} \times \frac{\sqrt{T}}{l} \times \frac{1}{\sqrt{m}}$$

RESULT:

The frequency of the ac main n = Hz

7. JUNCTION DIADE AND ZENER DIADE

AIM:

a) To study the forward bias characteristics of a PN junction diode and to determine the forward resistance of the diode.

b) To study the reverse breakdown characteristics of the zener diode

APPARATUS:

Variable power supply, Junction Diode , Zener Diode, Milliammeter, Voltmeter etc.

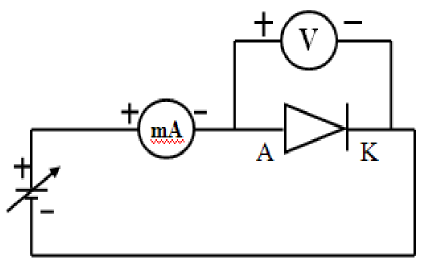
FORMULA:

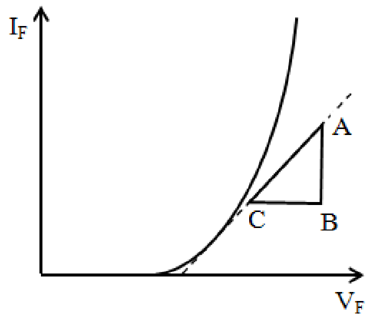
Forward resistance of the PN junction diode $R_f = \frac{\Delta V_f}{\Delta I_f}\ (\Omega)$

ΔV_f is the forward voltage (V)

ΔI_f is the forward current (mA)

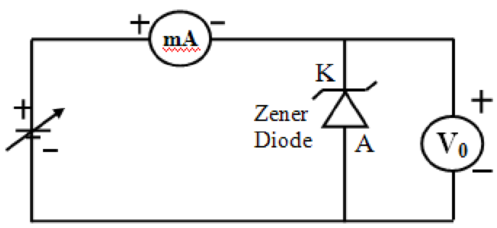
JUNCTION DIODE – FORWARD BIAS

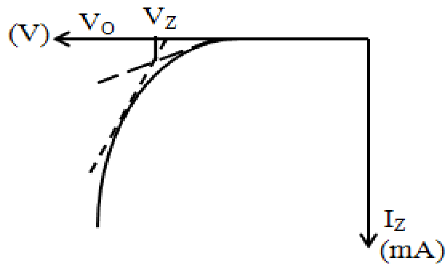




$$R_f = \frac{\Delta V_f}{\Delta I_f} = \frac{BC}{AB}$$

ZENER DIODE – REVERSE BIAS





PROCEDURE:

1) FORWARD CHARACTERISTIC CURVE:

The circuit is wired as in the diagram. The forward voltage V_f is increased from zero in steps of 0.1 V up to 1V. The corresponding values of I_f are noted. A graph is drawn with V_f along X-axis and I_f along Y-axis. This is called forward characteristic curve. The reciprocal of the slope of this curve above the knee point is found as forward resistance of the Diode. Forward resistance $r_i = \left(\frac{\Delta V_f}{\Delta I_f}\right)$

2) REVERSE BREAKDOWN CHARACTERISTICS OF THE ZENER DIODE:

The circuit is wired as in the diagram. The voltage V_O is increased from zero in steps of 1V up to 10V. The corresponding values of I_Z are noted. A graph is drawn with V_O along X-axis and I_Z along Y-axis. This is called reverse characteristic curve. At particular voltage, the current increases enormously, this voltage is called zener voltage (V_Z)

OBSERVATION:

Junction diode - Forward Bias:

S. No.	V_F (V)	I_F (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Zener diode - Reverse Bias:

S. No.	Vo (V)	I_Z (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

CALCULATION:

$$R_f = \frac{\Delta V_f}{\Delta I_f} = \frac{BC}{AB} = \frac{\qquad\qquad}{} =$$

RESULT:

i) The Forward Resistance of the Junction Diode =

ii) The zener Breakdown Voltage =

8. COMMON EMITTER NPN TRANSISTOR CHARACTERISTICS

AIM:

To study the characteristics of a common Emitter NPN transistor and to determine its input impedance, output impedance.

APPARATUS:

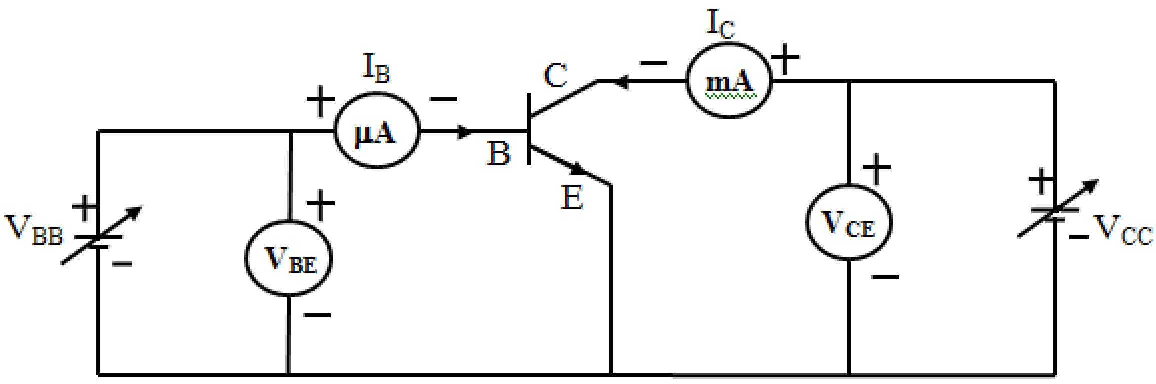
NPN Transistor, Power supply, Microammeter, Milliammeter, Voltmeter etc

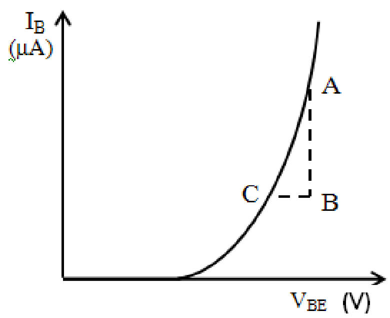
FORMULA:

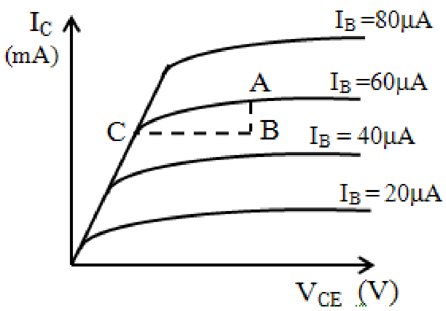
(i) input impedance $r_i = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right) (\Omega)$

(ii) output impedance $r_o = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right) (\Omega)$

ΔV_{BE} is the change in base emitter voltage (V)
ΔI_B is the change in base current (μA)
ΔV_{CE} is the change in collector emitter voltage (V)
ΔI_C is the change in collector current (mA)







$r_i = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right) = \frac{BC}{AB}$

$r_o = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right) = \frac{BC}{AB}$

PROCEDURE:

1. **INPUT CHARACTERISTIC CURVE:-**

The collector emitter voltage V_{CE} is kept at a constant value. The base emitter voltage V_{BE} is increased from zero in steps of 0.1 V up to 1V. The corresponding values of I_B are noted. A graph is drawn with V_{BE} along X-axis and I_B along Y-axis. This is called input characteristic curve. The reciprocal of the slope of this curve above the knee point is found as input impedance of the transistor.

$$\text{Input impedance } \boldsymbol{r_i} = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right)$$

2. OUTPUT CHARACTERISTIC CURVE:-

The base current I_B is kept at a constant value. V_{CE} is increased in steps of 0.5 V from Zero. The corresponding values of I_C are noted. A graph is drawn with V_{CE} along X-axis and I_C along Y-axis. This is called output characteristic curve. The reciprocal of the slope of the output characteristic curve near horizontal part gives the output impedance (r_0).

$$\text{Output impedance } \boldsymbol{r_o} = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right)$$

INPUT CHARACTERISTICS

V_{CE} = 5V

S. No.	V_{BE} (V)	I_B (mA)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

OUTPUT CHARACTERISTICS

I_B = 20μA, 40μA, 60μA, 80μA

S. No.	Vo (V)	I_C (mA)	I_C (mA)	I_C (mA)	I_C (mA)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

CALCULATION:

$$r_i = \left(\frac{\Delta V_{BE}}{\Delta I_B}\right) = \frac{BC}{AB} =$$

$$r_o = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right) = \frac{BC}{AB} =$$

RESULT:

i) The static characteristic curves of the transistor in CE configuration are drawn.

ii) The Input Impedance r_i = (Ω)

iii) The Output Impedance r_0 = (Ω)

9. COMMON EMITTER NPN TRANSISTOR CHARACTERISTICS II

AIM:

To study the characteristics of a common Emitter NPN transistor and to determine its output impedance and current gain

APPARATUS:

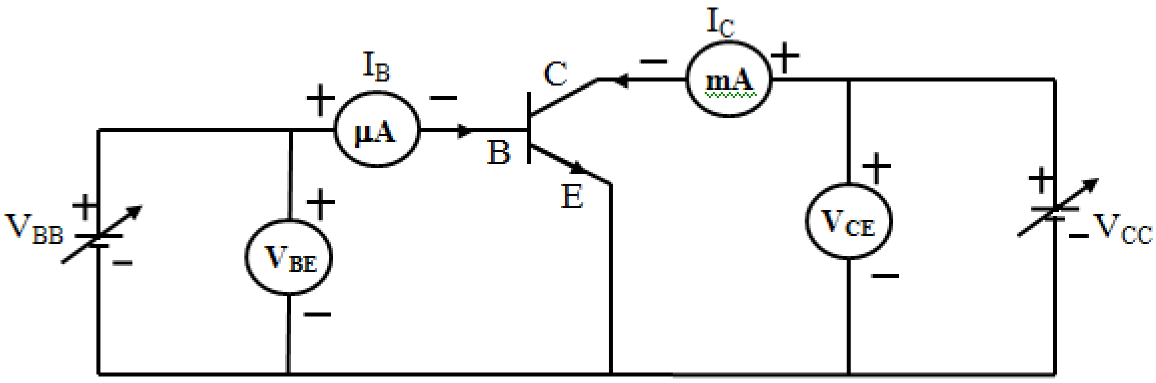
NPN Transistor, Power supply, Microammeter, Milliammeter, Voltmeter etc

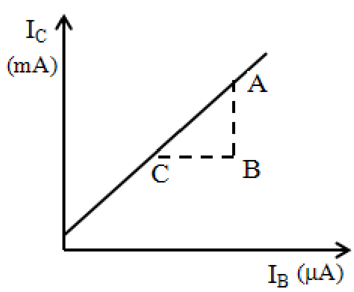
FORMULA:

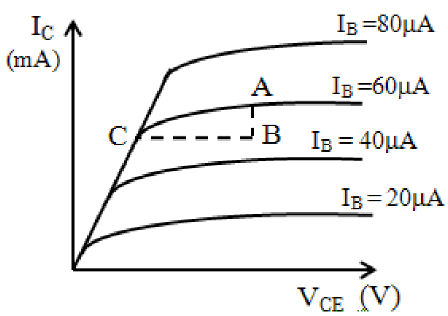
(i) Output impedance $r_o = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right) (\Omega)$

(ii) current gain $\beta = \left(\frac{\Delta I_C}{\Delta I_B}\right)$

ΔI_B is the change in base current (μA)
ΔV_{CE} is the change in collector emitter voltage (V)
ΔI_C is the change in collector current (mA)







$$r_o = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right) = \frac{BC}{AB} \qquad \beta = \left(\frac{\Delta I_C}{\Delta I_B}\right) = \frac{AB}{BC}$$

PROCEDURE:

1. OUTPUT CHARACTERISTIC CURVE:-

The base current I_B is kept at a constant value. V_{CE} is increased in steps of 0.5 V from Zero. The corresponding values of I_C are noted. A graph is drawn with V_{CE} along X-axis and I_C along Y-axis. This is called output characteristic curve. The reciprocal of the slope of the output characteristic curve near horizontal part gives the output impedance (r_0).

$$\text{Output impedance } \boldsymbol{r_o} = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right)$$

2. TRANSFER CHARACTERISTIC CURVE :-

The collector emitter voltage V_{CE} is kept at a constant value (5V). I_B is increased in steps of 25 µA from 25 µA to 100µA. The corresponding values of I_C are noted. A graph is drawn with I_B along X-axis and Ic along Y-axis. This is called transfer characteristic curve. The slope of this curve gives the current gain of the transistor.

$$\text{Current gain} \quad \boldsymbol{\beta} = \left(\frac{\Delta I_C}{\Delta I_B}\right)$$

TRANSFER CHARACTERISTIC

($V_{CE} = 5V$)

S. No.	I_B (µA)	I_C (mA)
1	20	
2	40	
3	60	
4	80	
5	100	
6	120	

OUTPUT CHARACTERISTICS

I_B = 20µA, 40µA, 60µA,

S. No.	Vo (V)	I_C (mA)	I_C (mA)	I_C (mA)	I_C (mA)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

CALCULATION:

$$r_o = \left(\frac{\Delta V_{CE}}{\Delta I_C}\right) = \frac{BC}{AB} =$$

$$\beta = \left(\frac{\Delta I_C}{\Delta I_B}\right) = \frac{AB}{BC} =$$

RESULT:

i) The static characteristic curves of the transistor in CE configuration are drawn.

ii) The output impedance r_0 = (Ω)

iii) The current gain β = (No Unit)

10. OPERATIONAL AMPLIFIER

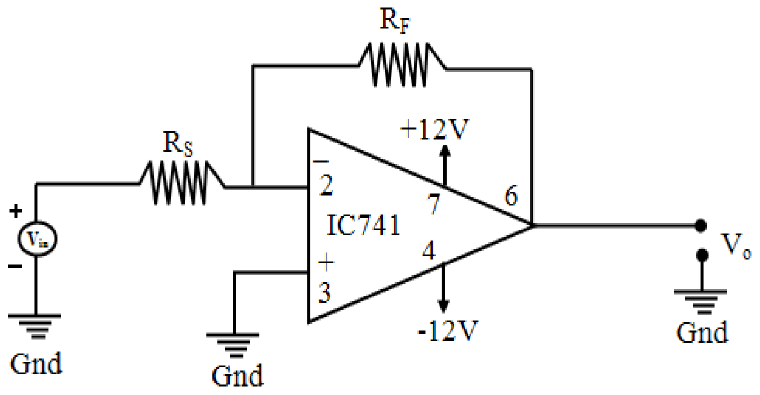
AIM:
To construct the following basic amplifiers using OP-AMP IC741
i) Inverting amplifier ii) Summing amplifier

APPARATUS:
IC 741 , Dual Power Supply 12 V, Resistor 10 K, 22 K, 33 KΩ,47 KΩ, Voltmeter, etc

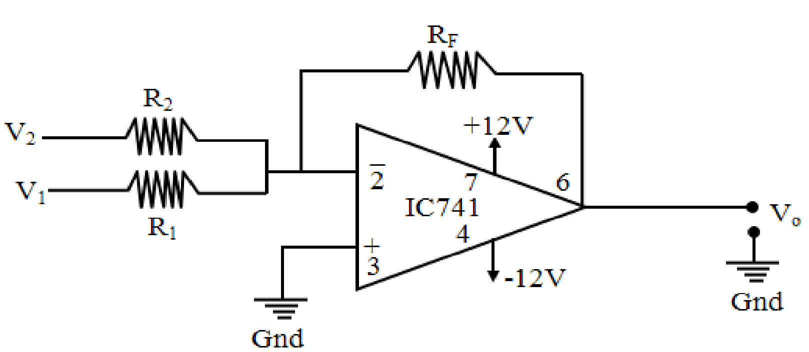
FORMULA:
i) Voltage gain of the inverting amplifier, $A_V = \left(\frac{V_O}{V_{in}}\right) = -\left(\frac{R_f}{R_s}\right)$ (No Unit)
ii) The output voltage of the inverting summing amplifier, $V_0 = -(V_1 + V_2)$ (V)

Where V_0 output voltage (V)
V_{in}, V_1 and V_2 are the input voltages (V)
R_f and R_s are the external resistances (Ω

INVERTING AMPLIFIER:



SUMMING AMPLIFIER:



BASIC AMPLIFIERS USING OP- AMP

INVERTING AMPLIFIER:

The circuit is wired as shown in the diagram using OP-AMP IC 741. R_S is kept as 10 KΩ and R_F as 22 KΩ. The input voltage V_{in} is kept as 1V and output voltage Vo is measured from the digital voltmeter. Then the experiment is repeated for input values V_{in} = 1.5 V, 2V and 2.5 V. Second Set of readings is taken by keeping V_{in} = 1 V and R_s = 10 KΩ and changing R_F as 10 KΩ,22KΩ,33 KΩ & 47 KΩ. Experimental gain is found as $A_V = \left(\frac{V_O}{V_{in}}\right)$

Theoretical gain is found from $A_V = -\left(\frac{R_f}{R_s}\right)$

Both the A_V values are compared and found to be equal.

SUMMING AMPLIFIER:

The circuit is wired as shown in the diagram using OP AMP IC 741, The values of R_1, R_2 and R_F are kept as 10 K Ω. The input voltages are kept as V_I = 1V and V_2 = 0.5V and the output voltage Vo is measured using the digital voltmeter Then the experiment is repeated for different sets of values for V_1 and V_2. Theoretical output voltage is found from $V_0 = -(V_1 + V_2)$. Since this is equal to experimental output voltage the summing action of the amplifier is verified.

OBSERVATION:

INVERTING AMPLIFIER:

SET	S.NO	R_s (Ω)	R_f (Ω)	V_{in}(V)	V_{out}(V)	Experimental Gain $A_V = \left(\frac{V_O}{V_{in}}\right)$	Theoretical Gain $A_V = -\left(\frac{R_f}{R_s}\right)$
I	1	10K	22K	1			-2.2
	2	10K	22K	1.5			-2.2
	3	10K	22K	2			-2.2
	4	10K	22K	2.5			-2.2
II	1	10K	10K	1			-1.0
	2	10K	22K	1			-2.2
	3	10K	33K	1			-3.3
	4	10K	47K	1			-4.7

OBSERVATION:

SUMMING AMPLIFIER:

$R_1 = R_2 = R_f = 10K\Omega$

S.NO	V_1 (Volt)	V_2 (Volt)	Experimental Output voltage V_0 (Volt)	Theoretical output voltage $V_0 = -(V_1 + V_2)$ (Volt)
1	1.0	0.5		-1.5
2	1.0	1.0		-2.0
3	1.0	1.5		-2.5
4	1.0	2.0		-3.0

CALCULATION:

INVERTING AMPLIFIER:

$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right)$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$

$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = -\left(\frac{R_f}{R_s}\right) =$

SUMMING AMPLIFIER:

1) $V_o = -(V_1 + V_2) =$

2) $V_o = -(V_1 + V_2) =$

3) $V_o = -(V_1 + V_2) =$

4) $V_o = -(V_1 + V_2) =$

RESULT:

i) The inverting amplifier is constructed using OP-AMP and gain is determined.

ii) The summing amplifier is constructed and the output voltage is found to be the sum of the applied input voltages.

11. OPERATIONAL AMPLIFIER II

AIM:

To construct the following basic amplifiers using OP- AMP IC741

I) Non- inverting amplifier ii) Summing amplifier

APPARATUS:

IC 741 , Dual Power Supply 12 V, Resistor 10 K, 22 K, 33 KΩ,47 KΩ, Voltmeter, etc

FORMULA:

I) Voltage gain of the Non- inverting Amplifier, $A_V = \left(\frac{V_O}{V_{in}}\right) = 1 + \left(\frac{R_f}{R_s}\right)$ (No unit)

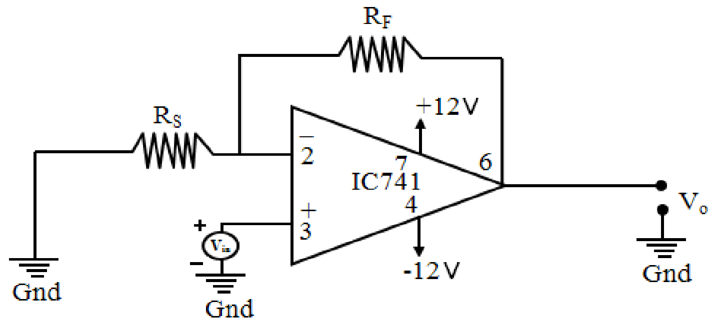
II) The output voltage of the inverting Summing Amplifier, $V_0 = -(V_1 + V_2)$ (V)

Where V_0 output voltage (V)

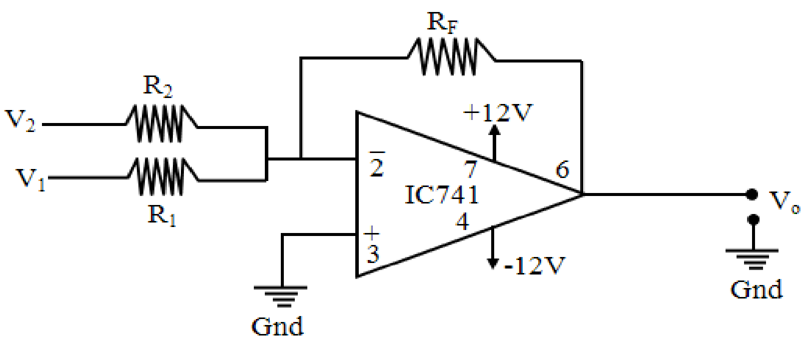
V_{in}, V_1 and V_2 are the input voltages (V)

R_f and R_s are the external resistances (Ω

NON-INVERTING AMPLIFIER:



SUMMING AMPLIFIER:



BASIC AMPLIFIERS USING OP- AMP

NON- INVERTING AMPLIFIER:

The circuit is wired as shown in the diagram using OP-AMP IC 741. R_S is kept as 10 KΩ and R_F as 22 KΩ. The input voltage V_{in} is kept as 1V and output voltage Vo is measured from the digital voltmeter. Then the experiment is repeated for input values V_{in} = 1.5 V, 2V and 2.5V. Second Set of readings is taken by keeping V_{in} = 1 V and R_s = 10 KΩ and changing R_F as 10 KΩ,22KΩ,33 KΩ & 47 KΩ. Experimental gain is found as $A_V = \left(\frac{V_O}{V_{in}}\right)$

Theoretical gain is found from $A_V = 1 + \left(\frac{R_f}{R_s}\right)$

Both the A_V values are compared and found to be equal.

SUMMING AMPLIFIER:

The circuit is wired as shown in the diagram using OP AMP IC 741, The values of R_1, R_2 and R_F are kept as 10 K Ω. The input voltages are kept as V_I = 1V and V_2 = 0.5V and the output voltage Vo is measured using the digital voltmeter Then the experiment is repeated for different sets of values for V_1 and V_2. Theoretical output voltage is found from $V_0 = -(V_1 + V_2)$. Since this is equal to experimental output voltage the summing action of the amplifier is verified.

OBSERVATION:

NON-INVERTING AMPLIFIER:

SET	S.NO	R_s (Ω)	R_f (Ω)	V_{in}(V)	V_{out}(V)	Experimental Gain $A_V = \left(\frac{V_O}{V_{in}}\right)$	Theoretical Gain $A_V = 1 + \left(\frac{R_f}{R_s}\right)$
I	1	10K	10K	1.0			2.0
	2	10K	10K	1.5			2.0
	3	10K	10K	2.0			2.0
	4	10K	10K	2.5			2.0
II	1	10K	10K	1.0			2.0
	2	10K	22K	1.0			3.2
	3	10K	33K	1.0			4.3
	4	10K	47K	1.0			5.7

OBSERVATION: SUMMING AMPLIFIER:

$R_1 = R_2 = R_f = 10K\Omega$

S.NO	V_1 (Volt)	V_2 (Volt)	Experimental Output voltage V_0 (Volt)	Theoretical output voltage $V_0 = -(V_1 + V_2)$ (Volt)
1	1.0	0.5		-1.5
2	1.0	1.0		-2.0
3	1.0	1.5		-2.5
4	1.0	2.0		-3.0

CALCULATION:

NON – INVERTING AMPLIFIER:

$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right)$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$
$A_V = \left(\frac{V_O}{V_{in}}\right) =$	$A_V = 1 + \left(\frac{R_f}{R_s}\right) =$

SUMMING AMPLIFIER:

I) $V_o = -(V_1 + V_2) =$

II) $V_o = -(V_1 + V_2) =$

III) $V_o = -(V_1 + V_2) =$

IV) $V_o = -(V_1 + V_2) =$

Result:

I) The Non-Inverting amplifier is constructed using OP- AMP and Gain is determined.

II) The Summing Amplifier is constructed and the Output Voltage is found to be the sum of the applied Input Voltages.

12. INTEGRATED LOGIC GATE CIRCUITS

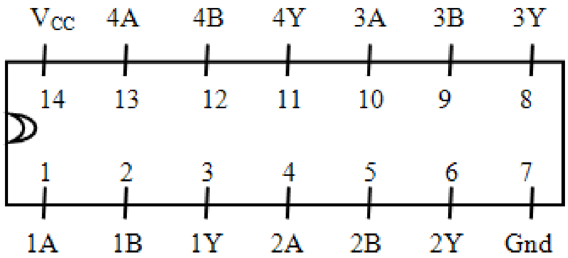
AIM:

To study the Truth Table of integrated Logic Gates IC 7400(NAND), 7408(AND), 7402 (NOR), 7432 (OR), 7404 (NOT) and 7486 (EXOR)

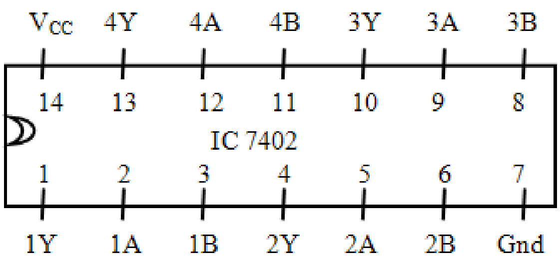
APPARATUS:

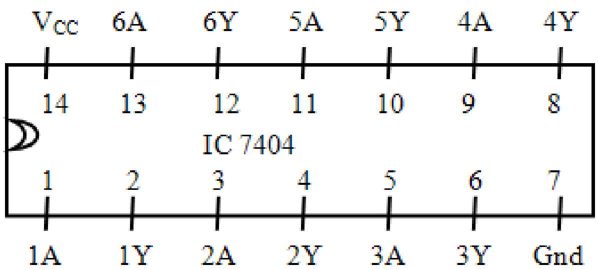
IC TRAINER KIT, ICs 7400 (NAND), 7402 (NOR), 7404 (NOT), 7408 (AND), 7432(OR), and 7486 (EXOR)

1) FOR IC's 7400 (NAND), 7408(AND), 7432(OR) & 7486(EX-OR)



2) FOR IC 7402(NOR)–QUAD 2 INPUT **HEX INVERTER NOT (7404)**





POSITIVE LOGIC SYSTEM:-

Logic 1 represents TRUE or high voltage 5V or LED ON

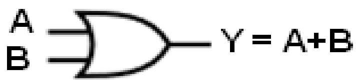
Logic 0 represents FALSE or low voltage 0V or LED OFF

OR Function	When any one input or all inputs are true, output is true $Y = A + B$
AND Function	only when all inputs are true, output is true $Y = AB$
NOT Function	Output is the complement of input $Y = \bar{A}$
NOR Function	only when all inputs are false, output is true $Y = \overline{A + B}$
NAND Function	When any one of the inputs is false, output is true $Y = \overline{A \cdot B}$
EXOR Function	Only when the inputs are different, output is true

$$Y = A \oplus B = A\bar{B} + \bar{A}B$$

NAND Gate:-
Power supply +5V is connected to pin 14 and ground to pin 7 of the IC. Inputs A & B are connected to pins 1 & 2 of the IC. Output pin 3 of the IC is connected to logic level indicator. Both inputs A & B are kept at logic 0 and output LED is observed, Then the inputs are changed as logic 0 & logic 1, logic 1 & logic 0 and logic 1 & logic 1 and the outputs are observed each time. The inputs and outputs are tabulated in the truth table.
AND, OR and EXOR Gates:-
ICs 7408 (AND), 7432 (OR) and 7486 (EXOR) are placed on the board arid the same procedure is followed as for NAND gate and outputs are tabulated in the truth table.
NOR Gate:-
IC 7402 is placed on the board. Power supply and ground are connected as before. The inputs are connected to pins 2 & 3 and the output to pin 1 of IC. Then the same procedure is repeated and tabulation is done in the truth table.
NOT Gate:-
IC 7404 is placed on the board. One input A is connected to pin 1 and the output to pin 2 of IC. Input is kept at logic 1 and then at logic 0 and the outputs are found and tabulated in the truth table.

IC 7432(OR)



TRUTH TABLE (OR)

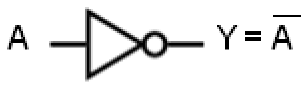
A	B	Y = A+B
0	0	
0	1	
1	0	
1	1	

IC 7408 (AND)

TRUTH TABLE (AND)

A	B	Y = A•B
0	0	
0	1	
1	0	
1	1	

IC 7404 (NOT)



TRUTH TABLE (NOT)

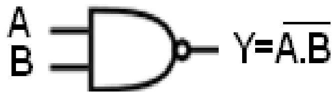
A	$Y = \overline{A}$
0	
1	

IC 7402(NOR)

TRUTH TABLE (NOR)

A	**B**	**Y =** $\overline{A+B}$
0	0	
0	1	
1	0	
1	1	

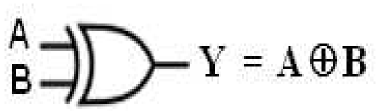
IC 7400 (NAND)



TRUTH TABLE (NAND)

A	B	Y = $\overline{A \cdot B}$
0	0	
0	1	
1	0	
1	1	

IC 7486 (EX-OR)



TRUTH TABLE (EX-OR)

A	B	Y = A⊕B
0	0	
0	1	
1	0	
1	1	

CALCULATION:

OR GATE

INPUT A	INPUT B	OUTPUT Y = A+B
0	0	
0	1	
1	0	
1	1	

AND GATE

INPUT A	INPUT B	OUTPUT Y = A•B
0	0	
0	1	
1	0	
1	1	

NOT GATE

INPUT A	OUTPUT $Y = \overline{A}$
0	
1	

NOR GATE

INPUT A	INPUT B	OUTPUT Y = $\overline{A + B}$
0	0	
0	1	
1	0	
1	1	

NAND GATE

INPUT A	INPUT B	OUTPUT Y = $\overline{A \cdot B}$
0	0	
0	1	
1	0	
1	1	

EX- OR GATE

INPUT A	INPUT B	OUTPUT Y = A⊕B
0	0	
0	1	
1	0	
1	1	

RESULT:

The performance of Digital Gates OR, AND, NOT, NAND, NOR and EX-OR are verified using IC Chips

“உங்கள் குறிக்கோளில் வெற்றியடைய வேண்டுமானால் உங்கள் இலக்கில் இம்மியும் பிசகாமல் குறிவைத்து, அதே சிந்தனையுடன் செயல்படவேண்டும்.”

&&&&&&&

“வாழ்நாள் முழுவதும் ஒவ்வொரு மணித்துளியும் நேர்மையாய், உண்மையாய் உழைக்கின்றவர்களின் கரங்களே தூய்மையான கரங்கள்.”

@@@@@@@@

“உபயோகமற்ற எண்ணங்களை அகற்றி நான் நினைத்தது நடக்கும் என்று உறுதியான எண்ணங்களை உங்கள் உள்ளம் முழுவதும் நிரப்புங்கள்.”

######

“சிறிதளவு தைரியம் இல்லாத காரணத்தால், பெரிய அளவு திறமைகள் வீணாகின்றன. கோழைத்தனம் என்பது ஒருவனுடைய எல்லா முயற்சிகளையும் முறியடித்து, அவனுடைய அனைத்துத் திறமைகளையும் குழி தோண்டி புதைத்து விடும்.”

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