II BSC SEMESTER-IV

ELECTRICITY, MAGNETISM & ELECTRONICS

PRACTICAL MANUAL
(PAPER IV)

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Department of Physics
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II BSc PHYSICS PRACTICALS

Paper – IV

01. Determine Figure of merit of a moving coil galvanometer.

02. LCR circuit Series/Parallel resonance, Q factor.

03. Determination of ac-frequency – Sonometer.

04. Magnetic field along the axis of a circular coil carrying current – Stewart & Gee's apparatus.

05. Logic Gates – OR, AND, NOT and NAND gates, verification of Truth tables.

06. construction of Half adder and full adders – verification of truth tables.

Magnetic field a long axis of circular coil stewart - Gee's method.

Aim:

To study the verification of the intensity of magnetic field along the axis of a circular coil carrying current using stewart and Gee's type of tangent galvanometer

Apparatus:

stewart and Gee's type of tangent galvanometer, battery, commutator, ammeter (0 to 30 amp), rheostat (70 ohm, 2 amp), plug key and connecting wires.

Formula:

$$B = \frac{2\pi n i a^2}{10(x^2+a^2)^{3/2}}$$ weber-meter^2 (or) Tesla.

Where,

B = Intensity of the magnetic field at a point the axis of the circular coil carrying current.

n = no. of turns of the coil = 50.

a = radius of the coil = $\frac{21.5+18}{4}$ = 9.875

i = current flowing through the coil = 0.2

x = distance of magnetic needle from the centre of the coil towards east and west

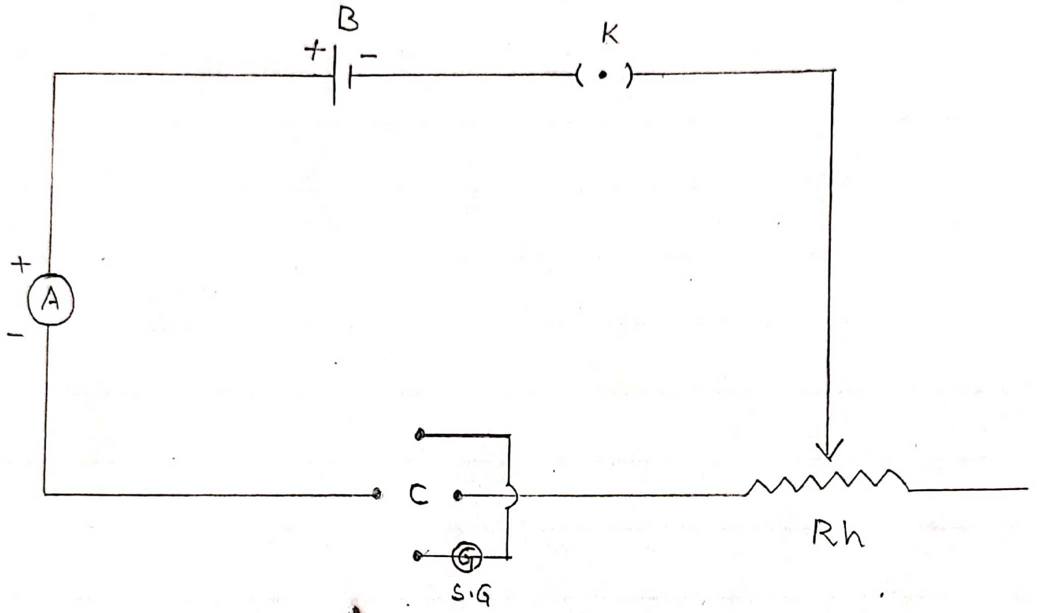
B = H Tan θ.

H = Horizontal component of the earth's magnetic field = 0.38.

DESCRIPTION:- Stewart and Gee galvanometer is shown in figure. It consists of a circular coil in a vertical plane fixed to a horizontal bench at it's middle point. The ends of the coil are connected to binding screws. A magnetic compass box is arranged such that it can be slided along a horizontal scale passing through the centre of the coil. The length of the scale is perpendicular to the plane of the coil. The compass box consists of a short magnetic needle and along aluminium pointer attached to its mid point perpendicular to it and they are pivoted at the centre of a horizontal circular scale graduated in diagrams. The circular scale consists of four co-ordinates each of which measures angle from 0 to 90°. A plane mirror is provided below the points so that the deflections can be observed without parallax error.

PROCEDURE:- The circuit is connected as shown. The primary adjustments are made. The coil of the set along the magnetic medium. The Al pointer is made to read 0-0°. The ends of the coil are connected to the commutator flows through the magnetic needle, in the compass is

Circuit Diagram:-



A - Ammeter

B - Battery

Rh - Rheostat

C - Commutator

S.G - Stewart and Gee's type galvanometer.

Formula:- $F = \frac{2\pi n i a^2}{10(x^2+a^2)^{3/2}}$ Tesla. ; $F = H \tan\theta$

No. of turns = n = 50

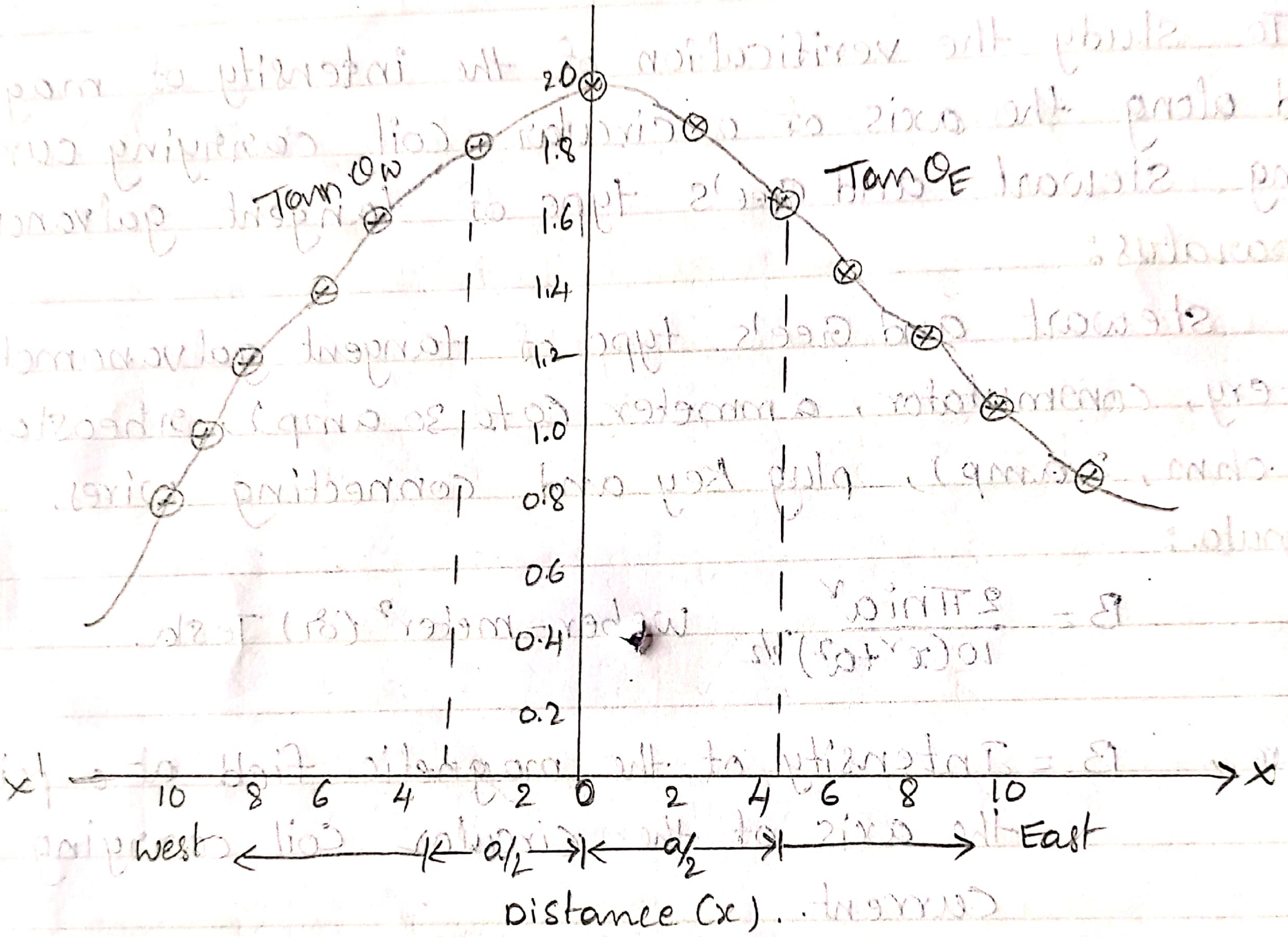
Current passing through the coil = i = 0.2 amp

The mean radius of the coil = a = 10.37 cm

Horizontal component of earth magnetic field (H) = 0.38 Hz

Position of the magnet	Distance 'x' cm	Deflection				Average θ	Tan θ	$B = H \tan\theta$ tesla	$B = \frac{2\pi n i a^2}{10(x^2+a^2)^{3/2}}$ tesla.
		θ_1	θ_2	θ_3	θ_4				
West	0	52	52	63	63	57.5	1.5448	0.5866	0.6068
	2	52	52	61	61	56.5	1.4872	0.5652	0.5750
	4	53	53	56	56	54.5	1.3805	0.5244	0.4930
	6	44	44	48	48	46	1.0355	0.3934	0.3981
	8	36	36	38	38	37	0.7536	0.2863	0.3014
	10	27	27	29	29	28	0.5317	0.2020	0.2273
	12	25	25	21	21	23	0.4245	0.1613	0.1695
East	0	55	55	62	62	58.5	1.6055	0.6100	0.6068
	2	55	55	60	60	57.5	1.5448	0.5870	0.5750
	4	51	51	56	56	53.5	1.3311	0.5058	0.4930
	6	44	44	52	52	48	1.1106	0.4220	0.3981
	8	43	43	41	41	42	0.9004	0.3421	0.3011
	10	33	33	31	31	32	0.6249	0.2374	0.227
	12	25	25	26	26	27.5	0.4680	0.1778	0.169

Graph:



2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
Tan θW
Tan θE
10
8
6
4
2
0
2
4
6
8
10
X'
X
West
East
a/2
a/2
Distance (x).

subjected to the horizontal component and magnetic field(H) and magnetic induction field (F) due to circular coil carrying current. These two magnetic fields are acting at right angles to each other. The magnetic needle along the direction of resultant magnetic field. The magnetic needle is deflected through an angle θ from the direction of H. Then we get equ $F = H \tan\theta$.

The circuit in the circuit is adjusted such that the deflection lies between 30° and 60° using rheostat. The compass box is displaced by 5cm or 10cm along the horizontal scale and the deflection of the needle is measured at every distance by reading both ends. Let the readings be θ_1 & θ_2. The readings θ_3 and θ_4 are observed. The experiment is repeated for points on the other side of the coil. If θ is the observe for the four deflections, readings $H \tan\theta$. A graph shows the variation of magnetic field on the axis of a circular coil with distance. It is symmetrical about Y-axis and the magnetic field is maximum at the centre of the coil.

PRECAUTIONS:-

1. Galvanometer should not be disturbed after making primary adjustments.
2. The deflection should be observed without parallax error.
3. From objects should be kept awy from the coil.
4. The current measured in amperes converted into and used in the formula.

17/05 Result:- The value of $H \tan\theta$ and $\frac{2\pi n i a^2}{10(x^2+a^2)^{3/2}}$ are calculated and compound. They are found to be Equal.

Date 28.10.2021

Expt. No. 01

Page No. 01

L.C.R Circuit - Series Resonance.

Aim:

To study frequency response characterstics of LCR Series resonance circuit and to determine the resonance frequency and quality factor.

Apparatus:

A signal generator (osicllator for function generator), VTVM (Vacumtube voltmeter). a millimeter, condenser, an inductance coil, a resistance box and connecting wires.

Formula:

Theoretical formula:

Resonance frequency of the series resonant circuit is

$$f_0 = \frac{1}{2\pi\sqrt{LC}} \text{ HZ}$$

Quality factor of the circuit is $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$.

Band width $(\beta) = f_2 - f_1$

where

R = Resistance of resistor (ohm).

L = Inductance of the coil (Henry).

C = capacitance of the condenser (Farad).

Experimental formula:

Resonance frequency of the circuit of

f_0 = 2000 HZ (from the graph).

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Circuit Diagram :-

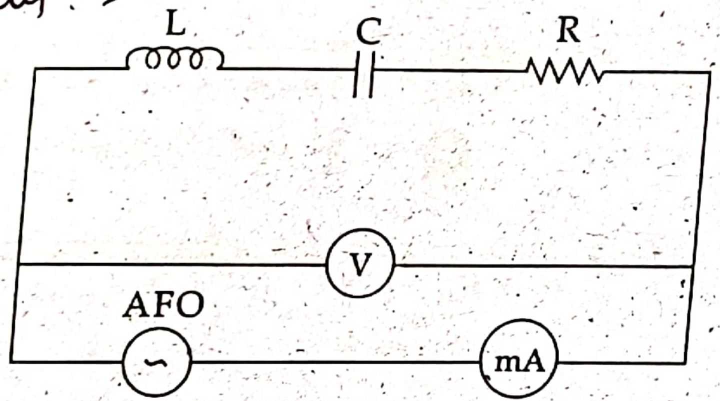


Fig - 1 An a.c. series L - C - R circuit

The curve obtained by plotting the current. I against the frequency *f* of the supply is known as a resonance curve. resonance curve will be as shown in Fig - 2.

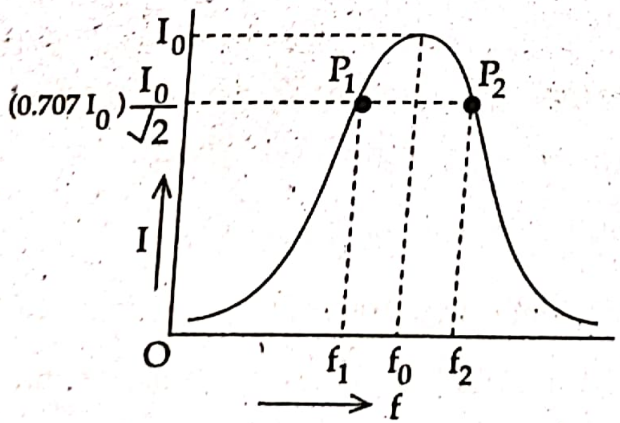


Fig - 2 Resonance curve

From graph $= \frac{I_{max}}{\sqrt{2}}$

Bandwidth $= f_2 - f_1$

Frequency (Hz)	Current (amp)	Log F
20	0.03	1.3010
40	0.14	1.6021
60	0.24	1.7782
80	0.33	1.9031
100	0.42	2.0000
200	0.84	2.3010
300	1.25	2.4771
400	1.73	2.6021
500	2.17	2.6990
600	2.60	2.7782
700	3.15	2.8451
800	3.68	2.9031
900	4.27	2.9542
1000	4.92	3.0000
2K	13.14	3.3010
2.1K	13.64	3.3222
2.2K	13.83	3.3424
2.3K	13.74	3.3617
2.4K	13.43	3.3802
2.5K	13.05	3.3979
2.6K	12.52	3.4150
2.7K	11.87	3.4314
2.8K	11.62	3.4472
2.9K	10.78	3.4624
3K	10.31	3.4771
4K	6.33	3.6021
5K	4.51	3.6990
6K	3.54	3.7782
7K	2.81	3.8451
8K	2.30	3.9031
9K	1.90	3.9542
10K	1.46	4.0000
15K	0.37	4.1761
20K	0.05	4.3010

Bond width of the resonant circuit.

$$\Delta f = f_2 - f_1 \text{ Hz (from the graph)}$$

Where

f_1 = Lower half power frequency.

f_2 = upper half power frequency.

Quality factor of the circuit $Q = \frac{f_0}{\Delta f}$

Theory.

A coil of the self inductance 'L' ~~re~~ resistance 'R' and a condenser of capacitence 'c' are connected in wires with a source of AC supply as shows in figure. This circuit is known as series LCR circuit where an alternating voltage of a pure sine wall force which is represented by

$$E = E_0 \sin \omega t.$$

Procedure:

A coil of self inductance L (15 μH) a condenser of capacity c (0.01 μF) a resistance R (10 Ω) and milliammeter A are to be connected in series with the signal generator as shown in the figure. switch on the signal generator. Adjust the frequency m b of the signal generator so that the frequency f of the AC signal is 2 KH. Adjust the amplitude of the input signal to a conveseint value by mean of VTVM i.e the input voltage V. then out the current 'I' is the circuit shown by the milliammeter A.

Signature :

Increase the frequency of f of input signal in convenient steps. Keeping the input voltage V constant theought the experiment. Then the current increase slowly at the beginning afterwards increase sharply and then reaches a peak value called the sharpness of the resonance. This will happen when the frequency of the app-lied voltage is equal to the natural frequency of the circuit i.e, resonance occurs, This frequency of which the current reaches a peak value is called the resonace. resonance frequency f₀. At the resonance frequency. The current is maximum and the inductance is mini-mum. Again increase the frequency of the input sign-al beyond the resonance frequency then the current Through the circuit gradually decreases. Note the obser-vation in table.

Repeat the expermiment by introducing different values of R in the circuit, for the same values of R [in the circuit. for the same] L and C, Keeping the input voltage V_i constant through out the experiment, the theoritical values of the resonance frequency 'f_0' and the quality factor Q, can be calculated using the formulas.

Graph:

Draw a graph with frequency 'f' on the x-axis The current 'I' on the y-axis. A sharp resonance curves as shown in figure will be obtained from the

Signature :

graph. Note the maximum current 'I_0' and the correspon ding frequency at which the current is maximum. This frequency is called as resonance frequency 'f_0'.

To determine the band width (Δf) and quality factor Q.

From the graph find the value of $I_0/\sqrt{2}$ mark the value of $I_0/\sqrt{2}$ on the y-axis from the value draw a line parallel to axis on x-axis This line cuts the curves at two points A, B called the half power point from the points A and B draw lines parallel to y-axis, which meets the x-axis at two points corresponding to frequency f_1 and f_2 called the half power frequences on either side of the resonance frequency f_0.

Board width of the circuit $\Delta f = (f_2 - f_1)$ Hz.

Quality factor of the circuit $Q = \frac{f_0}{\Delta f}$.

The Theoritical and experimental values of the resonance frequency 'f_0' and the quality factor 'Q' are to be compared.

Scanned with Oken Scanner

for different values of ...

PRECAUTIONS:-

1. The output voltage of the signal generator should be kept constant for every frequency.
2. The readings should be taken on either side of f_0.
3. To measure o/p voltage, multimeter is used and zero, adjustment is made before taking the readings.

RESULT:-

From graph, $f_2 = 3.29$ KHz

$f_1 = 1.4$ KHz

Band Width $= f_2 - f_1 = 3.29 - 1.4 = 1.89$ KHz

Q- factor $= 1.16$

Resonant frequency $f_0 = 2.252$ KHz.

EXPERIMENT 9

HALF- ADDER AND FULL- ADDER

Expt. No.

Date : ....

9.1 AIM

To construct half- adder and full- adder using logic gates and to verify their truth tables.

9.2 EQUIPMENT & COMPONENTS

1. Bread board - 1
2. Power supply - 1 (5V)
3. AND gate IC 7408 - 2
4. OR gate IC 7432 - 1

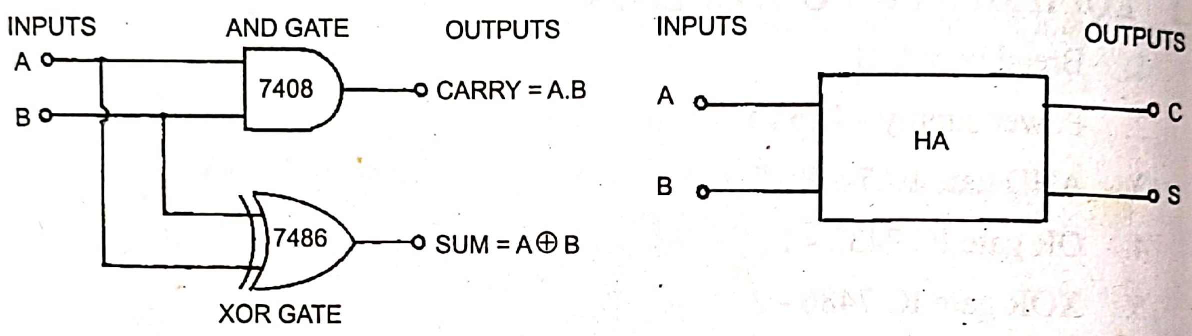
2. Half- Adder

A logic circuit that performs the addition of two binary digits (or two bits) and produces a 2-digit data i.e., a **sum** and a **carry** is called a half- adder.

Whenever, we add two binary numbers, we start with the least significant column. This means that we have to add two bits with the possibility of a carry. The logic circuit and block diagram of a half-adder are shown in fig.9(a) and 9(b).

A half-adder can be realized by using one XOR gate and one AND gate as shown in fig 9(a). When two binary inputs (A and B) are given to the half-adder circuit, then it produces two output in the form of SUM (S) and CARRY(C). i.e., the output of the XOR gate is called the SUM while the output of the AND gate is called the CARRY.

We know that, the AND gate produces a high output only when both inputs are high. The XOR gate produces a high output if either input (not both) is high. Hence, the truth table of a half half-adder is developed by writing the truth-table output of AND gate in CARRY column and the output truth table of XOR gate in SUM column. The truth table for a half-adder is given in table 9.1.



(a) Logic circuit *(b) Block diagram*

9. Half-Adder

The Boolean expressions (functions) for CARRY and SUM can be written as,

$$\text{CARRY, C} = A.B$$

and

$$\text{SUM, S} = A\overline{B} + \overline{A}B = A \oplus B$$

Table 9.1. Truth table for half-adder

INPUTS		**OUTPUTS**	
A	**B**	**C**	**S**
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

$$\text{CARRY, C} = A.B$$

$$\text{SUM, S} = A \oplus B$$

$$= A\overline{B} + \overline{A}B$$

3. **Full- Adder**

In the half- adder, there are only two inputs and there is no provision to add CARRY coming from the lower bit order when more than two-bit addition is performed i.e., for higher order columns the half-adder circuit cannot be used for binary addition. So, to accomplish the multi-bit addition, another logic circuit called Full-Adder is used.

A full- adder is a logic circuit that ...

9.4 PROCEDURE

1. Half- Adder

1. Take two IC's, 7486 and 7408 and identify their pin numbers.
2. Construct the logic circuit by inserting the IC's on the bread board as shown in fig.9.8.
3. Connect the 1 and 2 pins of IC 7486 to the 1 and 2 pins of the IC 7408 respectively.

4. Connect the positive terminal of one LED to S and of the other to C.Also, connect the negative terminal of both the LED's to the negative terminal of the power supply, which acts as ground in the circuit.
5. Switch ON the the power supply and apply different combinations of the logical inputs (high and low values i.e., either 0 or 1) at A and B and observe the logical outputs S and C at the pin 3 of IC 7486 and IC 7408 by observing the LED's.
6. Note down the observations in the table 9.3.
7. Compare the observed logical outputs with the theoretical values given in the truth table 9.1.

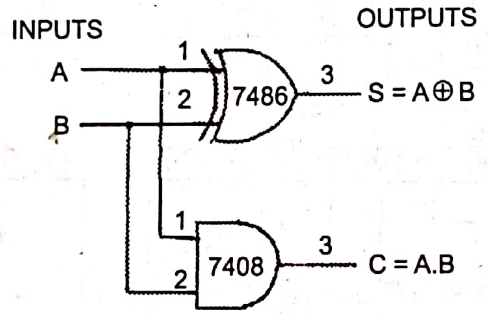


Fig. 9.8 Circuit diagram of half-adder

2. Full- Adder

1. Take two IC's 7408, two IC's 7486, one IC 7432 and identify their pin numbers.
2. Construct the logic circuit by fixing the IC's on the bread board as shown in fig.9.9.
3. Connect the pins 1 and 2 of IC 7486 to the pins 1 and 2 of IC 7408. Also, connect the pins 4 and 5 of IC 7408 to the pins 4 and 5 of IC 7486. The pins 3 and 6 of IC 7408 are to be connected to the pins 1 and 2 of IC 7432 respectively.
4. Connect the output of XOR gate to LED to observe the sum (output)
5. Connect the output of OR gate to LED to observe the CARRY (output)
6. Switch ON the power supply and apply different combinations of the logical inputs at A, B and C. Observe the sum and carry at the pins 6 and 3 of IC's 7486 and 7432 respectively.
7. Note down the observations in the table 9.4.
8. Compare the observed logical outputs with that of the theoretical values given in the truth table 9.2.

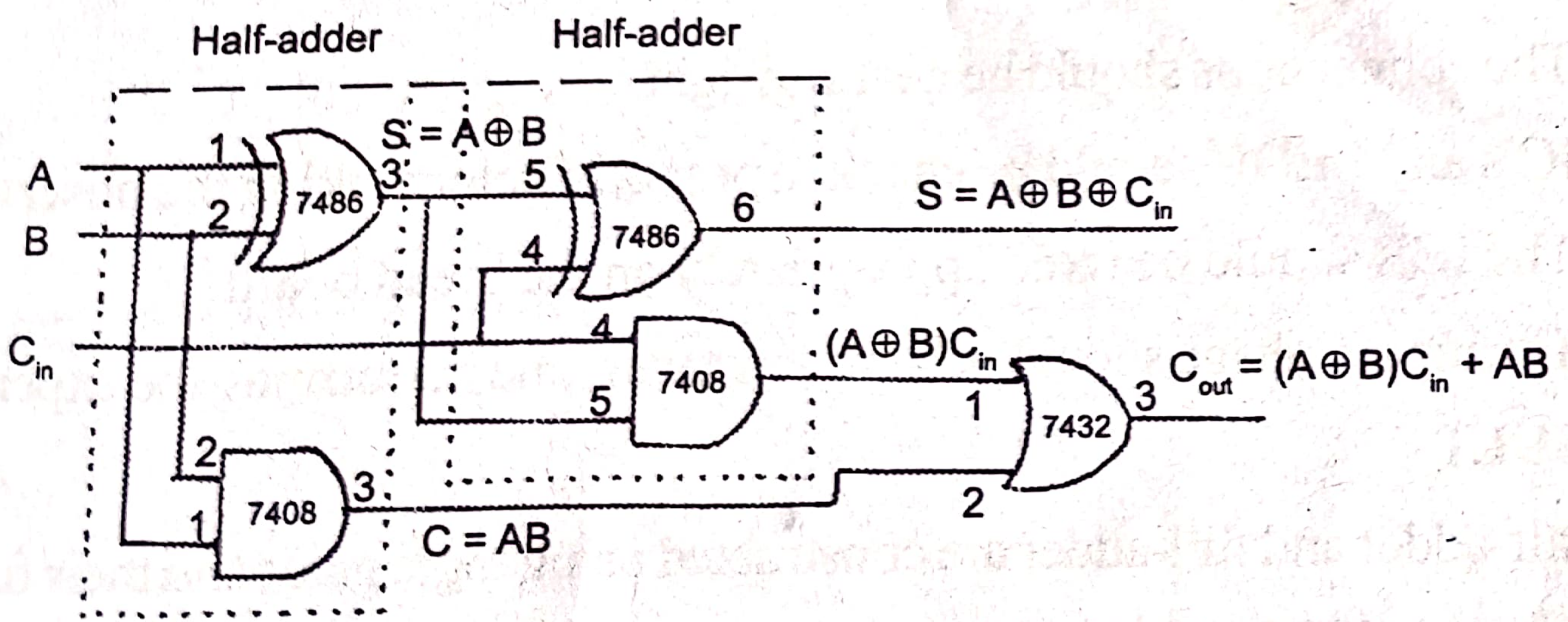


Fig 9.9 Circuit diagram of a full-adder using two half-adders

Table 9.4 Truth table of full-adder

INPUTS			OUTPUTS	
A	B	C_{in}	$S = A \oplus B \oplus C_{in}$	$C_{out} = AB + AC_{in} + BC_{in}$
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

9.6 PRECAUTIONS

1. The connections should be neat and tight.
2. IC's and LED's should be checked properly before taking the observations.
3. The IC's should be fixed appropriately on the bread board.
4. The input voltage should be kept constant while performing the experiment.

9.7 RESULT

The half-adder and full-adder are constructed using logic gates and their functions are verified in terms of truth tables.

Figure of merit of a moving coil Galvanometer.

Aim:

To determine the figure of a moving coil galvanometer.

Apparatus:

Moving coil galvanometer (Ballistic galvanometer or, spot galvanometer), two high resistances boxes, low resistance box (1 to 10 Ω), battery, plug key commutator and connecting wires.

Formula:

$$\eta = i/\theta \text{ micro amp/m.m.}$$

Where,

η = figure of merit of the galvanometer.

i = current passing through the galvanometer

$$i = \frac{EP \times 10^6}{(P+Q)(R+G)} \text{ Micro-amp}$$

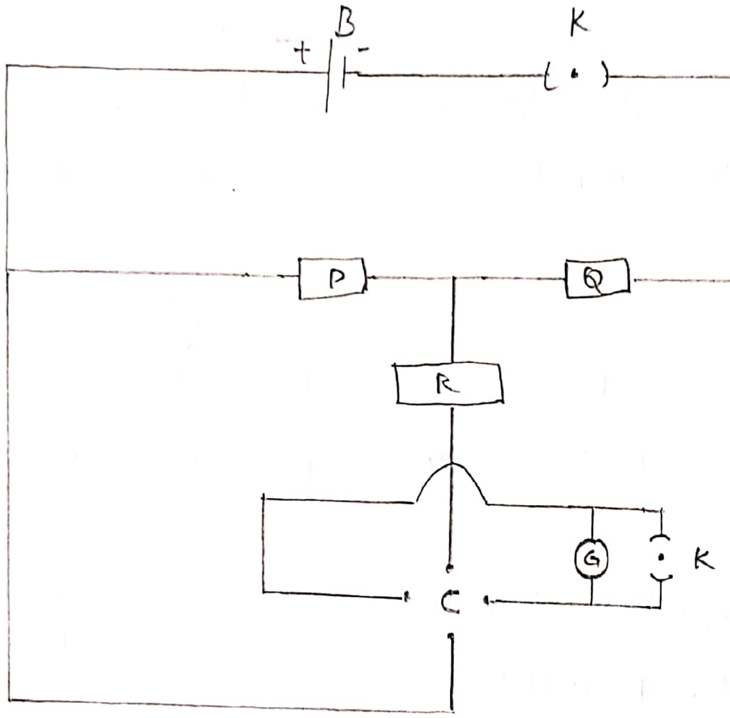
E = E.M.F of the battery (1.5 volt)

P, Q, R = resistance.

G = resistance of the galvanometer

(To be determined by half-deflection method)

θ = deflection of the galvanometer.



S.NO	P Ω	Q Ω	R Ω	Deflection Left θ_1	Deflection Right θ_2	Mean θ	Current through galvanometer $i = \frac{EP \times 10^6}{(P+Q)(R+G)}$ μ/amp	$K = \frac{i}{\theta}$ μ/amp
1.	5	9995	1000	22	20.8	21.4	0.90	0.042
2.	4	9996	1000	18.4	16.8	17.6	0.72	0.040
3.	3	9997	1000	13.1	12.6	12.8	0.54	0.042
4.	2	9998	1000	9	8.6	8.8	0.36	0.040
5.	1	9999	1000	4.6	4.5	4.5	0.18	0.039

Average $\frac{i}{\theta}$ = 0.0406

PROCEDURE:-

The figure of merit of a galvanometer is the amount of current required to produce 1 deflection on a scale. Two resistance boxes P and Q are connected in series to the battery. This forming Raleigh's form of potentiometer. The end of the resistance box P is connected to ballestic galvanometer in series with a resistance box R through a commutator. The resistance of galvanometer is kept at 100 and the value P+Q is at 10,000Ω and the steady deflection in the galvanometer observe P and Q at some constant resistance is removed from R. So that galvanometer deflection fall half its original value G give the resistance of the galvanometer. This is called as the half deflection method finding the resistance of the galvanometer.

1. To determine the resistance G of the galvanometer by half-deflection method:

In order to determine the resistance G of the galvanometer, Keep $P = 1\Omega$ and $Q = 9999\Omega$ with $R = 0$. Set the commutator in one direction close the main circuit and note the full deflection of the spot of light on the left side of the scale. Then, reverse the direction of the current by means of the commutator and note the full deflection of the spot light on the right side of the scale.

Now plug out a suitable resistance, from the resistance box, R (say R_1) until the deflection is reduced to half of its value note the value of R_1 in the table reverse the direction of the current and note the value of resistance R_2 for half-deflection. Find the average value of the resistance R i.e., $\left(\frac{R_1 + R_2}{2}\right)$. This value is equal to the resistance G of the galvanometer. Repeat the experimenter with $P_1 = 2, 3$ and 4, $Q = 9998, 9997, 9996$ keeping $P + Q = 10,000$. Find the average value of G. Note the observations in the table.

Note:

If the deflection of the spot light does not lie with in the scale limit, when $R = 0$, then introduce suitable resistance in R (say R_1) So that the spot of light moves equal distanc

Signature :

To determine resistance G of the galvanometer.

S.No.	Resistance		Resistance in P		Internal resistance $G = R_2 - 2R_1$
	P	Q	For full R_1 deflection	for half R_2 deflection	
1	5	9995	1000	2200	200

(in R to) on either side of the centre of the transparent scale, within the scale value (say R_2) till the deflection is reduced to half of its value. Then the resistance of the galvanometer $G = R_2 - 2R_1$.

2. To determine the figure of merit of the galvanometer:

In order to determine the figure of merit of the galvanometer, Keep a convenient value P+G (say 500 Ω or 1000 Ω) with P = 1 Ω and Q = 9999 Ω, note the deflection of the spot of light on the scale (left side) when the current is passed through the galvanometer by means of the commutator and note the corresponding deflections on the scale (right side) find the mean deflection Q.

Repeat the experiment for fixed values of P - 2, 3, 4 and 5 Ω and Q = 9999, 9998, 9997, 9996 Ω. Note the observations in the table the figure of merit of the galvanometer can be calculated using the formula.

Precautions:

1. The lamp and scale arrangment should be made properly.
2. The transparent scale should be kept a standard distance of 1 meter from the mirror of the galvanometer.
3. The deflections of the spot of light should be noted without parallex error.

4. very low currents of the order of a fraction of micro-amp should be sent through the galvanometer.

Result:

The figure of merit of the galvanometer

η micro amp/mm.

η = 0.0524 micro amp/m.m.

3 DETERMINATION OF AC FREQUENCY - SONOMETER

Experiment No.

Date

Aim To determine the frequency of (domestic) a.c. supply by means of a sonometer using magnetic wire.

Apparatus Sonometer with magnetic wire (iron wire), electromagnet, hanger with slotted weights each of 0.5 *kg*, and a meter scale, a sensitive balance with weights.

Diagram :-

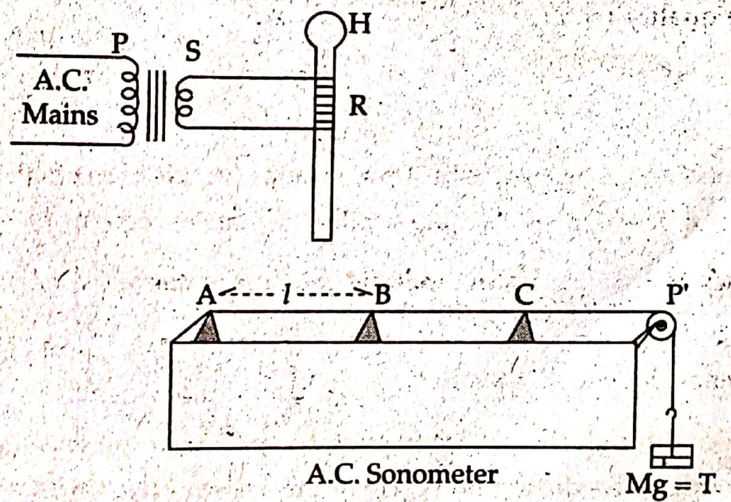


Fig - 1 : Sonometer

With reference to Fig - 1.

Formula:-

The frequency of the vibrating sonometer wire is given by $n = \frac{1}{2l}\sqrt{\frac{T}{m}}$ (Hz) (or) $n = \frac{1}{2\sqrt{m}} \frac{\sqrt{T}}{l}$ Hz --- (1)

Where l = the length (*in cm*) of the vibrating segment under tension T.

T = tension (*in dynes*) under which the wire is kept

= Mg (*dynes*) with

M = mass hung from the hanger (*grams*)

and g = acceleration due to gravity [cm/s^2] = 980 cm/s^2

and m = linear density or mass per unit length of the wire (in gm/cm)

We are here considering all the values in c.g.s. system and get n in hertz.

The frequency of the a.c. mains is now given by

$$N = \frac{n}{2} \text{ Hz}$$

Description :-

Fig - 2

Sonometer is a hollow wooden box having holes on one side face. Usually it will be of rectangular cross section. It is actually a **sound box.** On the box, a uniform meter wire is rigidly fixed at one end D and the wire on the other end passes through over a fixed pulley P and hangs down. At the second end of the wire a wieght hanger is suspended. Weights can be added to the weight hanger. If the mass hanging is M, then the tension applied over the string will be $T = Mg$. Three wooden prisms A, B, C with knife edges can be arranged along the length of the box (and wire also) and can be slided along the box. The heights of the wooden prism are such that, the **wire passes over the knife edges of these prisms** tightly. Paper riders (already cut in "^" size and kept ready for use) of small sizes are placed over the wire between A and B. When the wire between A and B (of length AB) vibrates in unison (resonance) with the given tuning fork, the amplitude of vibration of the string increases enormously and as a consequence, the paper rider jumps out and falls down. The resonating length AB of the wire can be measured with a metre scale. The sonometer is shown in Fig - 2.

(B) Electromagnet : The primary of the step down transformer P is connected to the 220 V a.c. mains. The insulated wires coming out from the secondary S are wound over a soft iron rod R. The iron rod R is provided at the top with an insulated handle H. This is shown in Fig - 1. This arrangement makes a convenient electromagnet.

The electromagnet - iron rod R is held vertically over the magnetic wire of the sonometer as shown in Fig - 1. The magnetic (iron) wire is kept under tension by hanging the weight hanger at the free end of the wire (passing over the pulley P) and adding weights. Changing these weights changes the tension T.

We can repeat the experiment with different values of tension T and measuring the

Procedure

As shown in Fig.-1, and explained already, the electromagnet is formed with the help of a.c. mains, step down transformer and the soft iron rod *'R'*. Initially a weight 1000 *gm* (including the weight hanger) is suspended to the wire. The distance between the fixed bridge *'A'* and movable bridge *'B'* is first kept at a minimum value. The paper rider in the 'Λ' shape is placed on the wire in between *A* and *B*. The electromagnet is firmly held with the handle *H* and the lower end is placed above the midpoint of *AB* and close to the wire. The distance between *A* and *B* is adjusted by **slowly and steadily** moving *B* away from *A*. At each position of *B*, the paper rider is kept at the middle of *AB*. The process is continued until the paper rider vibrates rapidly and falls down. At this position the distance '1' between the two bridges *A* and *B* is accurately measured with a metre scale.

Next, the tension *T* is increased gradually in steps of 500 *gm*. each time and the corresponding resonating length *'l'* is measured. Each time the value $\frac{\sqrt{T}}{l}$ is calculated. The readings are tabulated is Table - 1 and average value of $\frac{\sqrt{T}}{l}$ is calculated.

Observations

$g = 980\ cm/s^2$

Table - 1

Sl. No.	Mass attached $M\,gm$	Tension $T = Mg$ dynes	Distance between A and $B = 1\ cm$			$\frac{\sqrt{T}}{l}$
			1st time	2nd time	Average	

Average value of $\frac{\sqrt{T}}{l}$ = ____________

Length of iron wire taken = 100 cm

To determine the radius of the wire using screwguage

Error = -5 correction = +5

SC. NO.	P.S.R a	Head scale Reading		Diameter D = a+(n×L.C)
		observed	corrected	
1	0	35	40	0.40
2	0	36	41	0.41
3	0	35	40	0.40.

D = 0.4034 m.m.

D = 0.04 cm.

r = 0.02 cm.

Precautions

During this experiment, the following precautions are to be taken.

(1) No overtones should be formed. Entire length $A - B$ of wire should vibrate as one segment.

(2) There should be no kinks in the wires.

(3) Air should not blow the paper riders out.

(4) At every step of adjustment, the rider is to be placed at the middle of the length AB.

(5) Iron rod should be held by its handle and vertically.

Exp. No. 12
23/12/05

LOGIC GATES

AIM: Construction of logic gate using diodes, transistors and resistors.
And also to study the operation of each logic gate.

Apparatus:

Power supply (0-5 V), Diodes, transistors (BC-107), resistors of 10k Ω, voltmeter of (0-10 V) range and Multimeter.

THEORY:

i) OR-Gate:

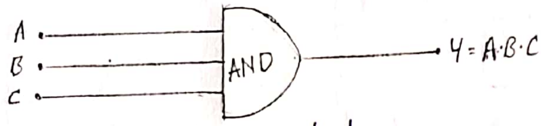
The OR-gate operates on the basic functions of Boolean Algebra. If A & B are boolean variables, we can operate the OR function on both these variables giving another variable Y = A+B = A (or) B. From this function, we can say that if either of the variables is true, then the o/p is true.

The OR function can be extended for more than two variables i.e.; Y = A+B+C+ - - -. The logic symbol for OR gate is as shown in the figure. Construction of OR-gate through diodes represents one way of building of OR-gate. In this circuit, the i/p can be either low or high.

Let us consider 0V for low level and +5V for high level. If both the inputs are low, then the output is

Circuit Arrangements, Logic symbols & Truth tables:

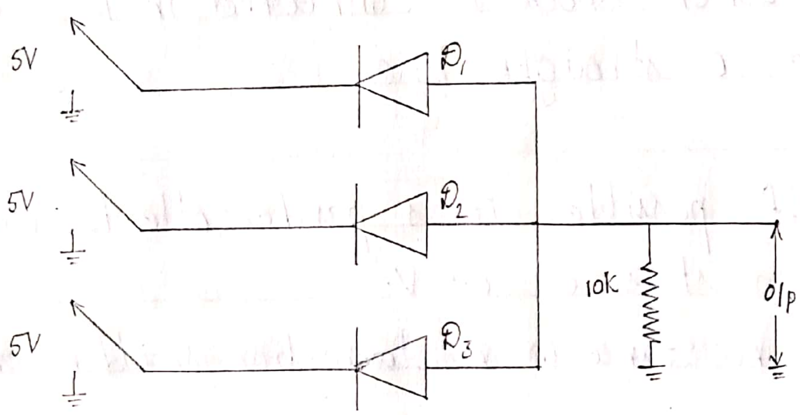
i) AND gate:



Logic symbol

Truth table

Input			Output
A	B	C	Y = A·B·C
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1



Circuit Arrangement.

low. This is because, since there is no supply voltage to any one of the diodes to conduct, the o/p goes low. Since the gate has three inputs, we can call the circuit as three i/p OR-gate.

ii) AND-gate:

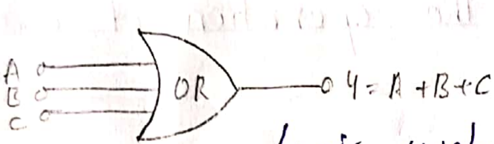
The AND gate operates on the basic functions of Boolean algebra. If A & B are two Boolean variables, we can operate the AND function on both these variables giving another variable Y = A·B = A and B. From this function we can say that if both A & B are true, then only the input is true. This can be extended for more than two variables – Y = A·B·C .... The logic symbol for AND function is as shown in the figure. Construction of AND gate using diodes represents one way of building of AND gate through discrete components.

In this circuit, the input can be either +5V for high level or 0V for low level. If both the inputs are low, the o/p is low. And if both the inputs are high, then only the o/p is high. Since the gate has three inputs, we can called the circuit as three i/p AND gate.

iii) NOT-gate:

The NOT-gate is also called as an inverter, because it inverts the input. This gate has only

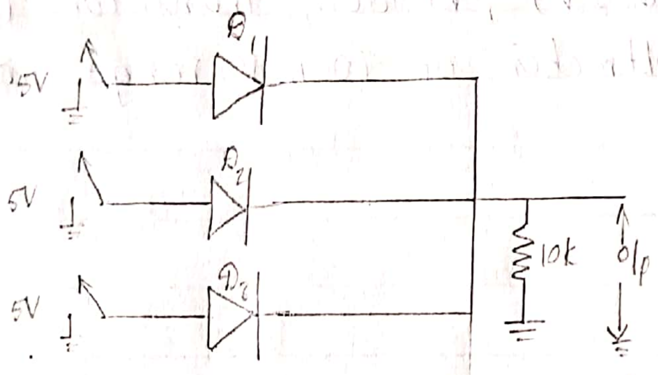
ii) OR Gate :



Logic symbol

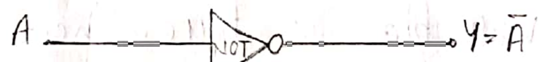
Truth table

A	B	C	Y.
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1



Circuit Arrangement.

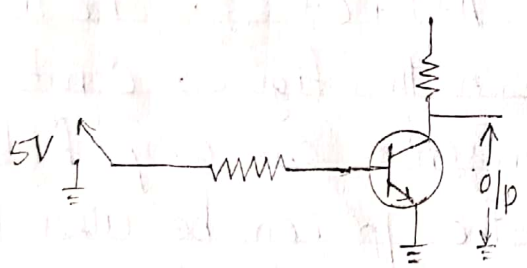
iii) NOT Gate:



Logic symbol

Truth table

A	Y = Ā
0	1
1	0



Circuit Arrangement.

one input and one output. The logic symbol for NOT-gate is shown in the adjacent figure. If we give the i/p $A=0$, then the compliment of A, $\bar{A}=1$, appears at the o/p. If we give the i/p $A=1$, then the compliment of A, $\bar{A}=0$, appears at the o/p.

iv) NAND - gate:

This is a combination of an AND gate and followed by an Inverter. The final inverted o/p is high when all the i/ps are low and the final inverted o/p is low when all the i/ps are high. The Boolean expression for NAND gate is — $Y=\overline{A \cdot B}$.

v) NOR - gate:

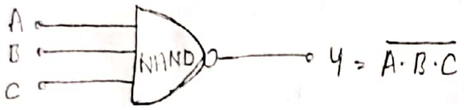
This is a combination of an OR gate followed by an Inverter. If one or more i/ps are high, then the final inverted o/p goes low. If all the i/ps are low, then the final inverted o/p goes high. The Boolean expression for NOR gate is — $Y=\overline{A+B}$.

PROCEDURE:

i) Connect the OR-gate circuit diagram and check the connections once again before switching on.

ii) Apply the i/p voltage and simultaneously observe the o/p voltage.

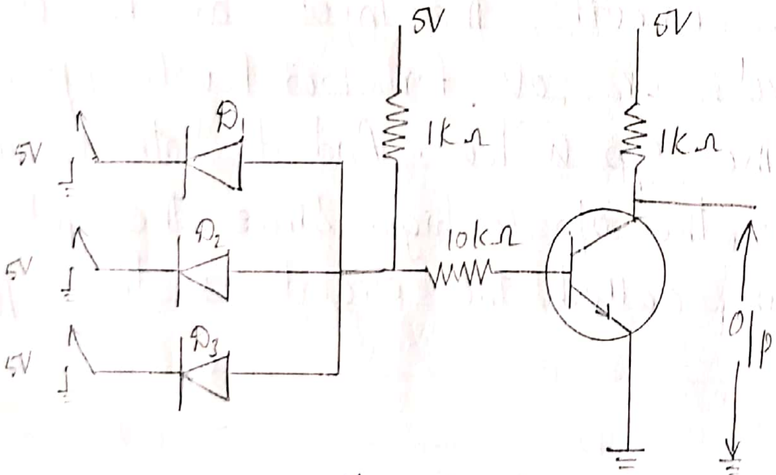
iv) NAND Gate:



Logic Symbol.

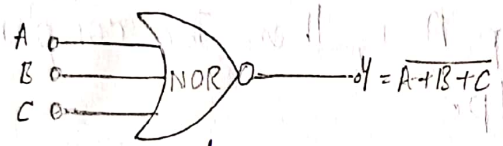
Truth table

A	B	C	Y
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0



Circuit Arrangement

(v) NOR Gate:

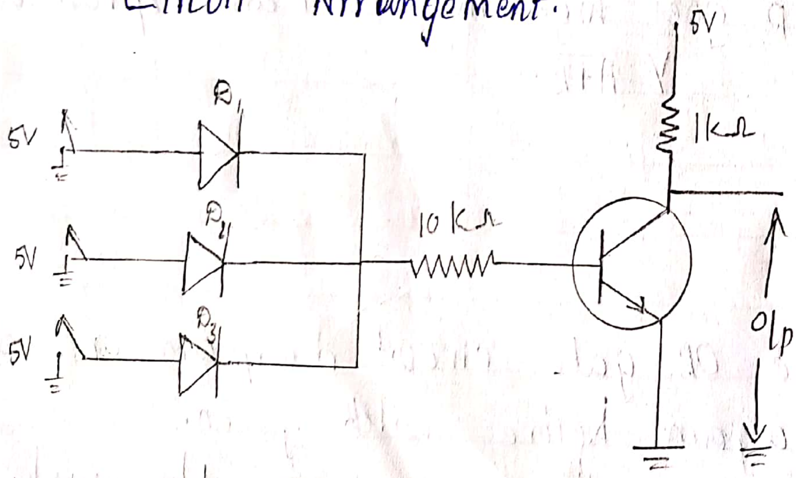


Logic Symbol

Truth table

A	B	C	Y
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

Circuit Arrangement.



iii) Change the positive combinations of the inputs and observe the outputs and tabulate.

iv) Connect the circuit for AND gate and repeat the steps 2 & 3.

v) Connect the circuit for NOT gate and repeat the steps 2 & 3.

vi) Connect the circuit for NAND gate and repeat the steps 2 & 3.

vii) Connect the circuit for NOR gate and repeat the steps 2 & 3.

RESULT:

7.8 PRECAUTIONS

1. The connections should be neat and tight.
2. Identify the **p** and **n** sections of the two diodes and verify them whether they are in working condition or damaged.

7.9 RESULT

1. The logic gates are constructed and the functions of the gates are verified in terms of truth tables.