Manonmaniam Sundaranar University,

Directorate of Distance & Continuing Education,

Tirunelveli - 627 012 Tamilnadu, India

OPEN AND DISTANCE LEARNING (ODL) PROGRAMMES

(FOR THOSE WHO JOINED THE PROGRAMMES FROM THE ACADEMIC YEAR 2023–2024)

M.Sc. Physics

Course Material

PRACTICAL II

SPHP23

Prepared

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Tirunelveli - 12

PRACTICAL II

SPHP23

(Choose any SIX experiments from Part A and SIX from Part B)

PART A

PART B

Reference books

1. Practical Physics, Gupta and Kumar, Pragati Prakasan
2. Kit Developed for doing experiments in Physics-Instruction manual, R.Srinivasan K.R Premolar, Indian Academy of Sciences.
3. Op-Amp and linear integrated circuit, Ramakanth A Gaykwad, Eastern Economy Edition.
4. Electronic lab manual Vol I, K A Navas, Rajath Publishing
5. Electronic lab manual Vol II, K A Navas, PHI eastern Economy Edition

PART A

1. Determination of Young's modulus and Poisson's ratio by Elliptical fringes - Cornu's Method

Aim

To determine Young's modulus and Poisson's ratio of a glass plate using Cornu's method.

Apparatus required

Optically plane glass beam, Cornu's apparatus (Stage microscope fitted with XY movement micrometers and a vertical stand fitted with adjustable knife edges), Sodium lamp with Power supply, A square shaped glass plate, Slide caliper and screw gauge, Hangers, loads etc.

Formula

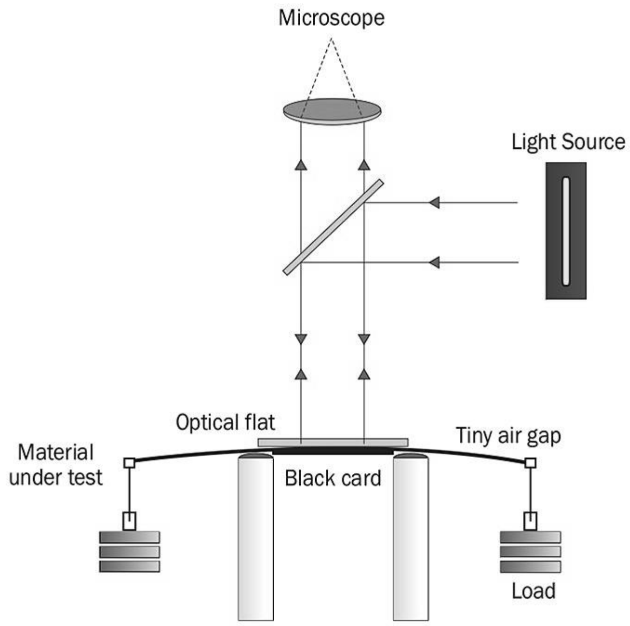
Poisson's ratio,

$$\sigma = \frac{R_x}{R_y}$$

Youngs modulus,

$$Y = \frac{(w_1 - w_2)d}{bt^3\left(\frac{1}{R_x} - \frac{1}{R_y}\right)} \quad pascal$$

Experimental setup



Observation

Least Count of the Micrometer = ____________

m_1 = 250 g

Table

Along X

Order of the fringe	Fringes on the left (x)			Fringes on the right (x)						Rx (cm)
	MSR (cm)	CSR (cm)	Total (cm)	MSR (cm)	CSR (cm)	Total (cm)	D (cm)	D^2 (cm^2)	$\rho_x = y_{N+S}^2 - y_N^2$ (cm^2)	

Along Y

Order of the fringe	Fringes on the left (y)			Fringes on the right (y)						Ry (cm)
	MSR (cm)	CSR (cm)	Total (cm)	MSR (cm)	CSR (cm)	Total (cm)	D (cm)	D^2 (cm^2)	$\rho_y = x_{N+S}^2 - x_N^2$ (cm^2)	

Procedure

1. Measure the width and the depth of the glass beam using vernier caliper and screw gauge. Take at least three readings for avoiding any error.
2. The experimental set up is shown. Place the glass beam on two knife edges. Measure the distance between the knife-edge and point of suspension on either side. Hang the load (say 250 gm) with hanger on both sides.
3. Place the plane glass plate on the beam near the middle. Adjust the beam and glass plate so that the fringes can be observed as shown.

4. Focus the microscope and adjust the beam and plate so that the fringes are symmetrical on both sides of horizontal cross-wire and tangential to the vertical cross-wire.
5. Turn the micrometer screw attached with microscope in longitudinal direction (along X) of every transverse fringe on both sides to measure longitudinal position (x). If necessary reduce the aperture size fitted with sodium lamp housing to improve contrast while taking reading.
6. Adjust the fringe position and micrometer in such a way that at least 8-10 fringes are visible on either side from center. Take readings for about 10 fringes on each side of the center. To avoid backlash error start from one extreme position (say10th fringe on the left or right side) from center.
7. Similarly measure transverse position (y) of longitudinal fringes by moving microscope in transverse direction.
8. Repeat the steps from 5-7 for another weight.
9. Plot an appropriate graph and determine values of Y and σ.

Calculation

y_N is the distance of the N-th dark fringe from the center along Y-axis

x_N is the distance of the N-th dark fringe from the center along X-axis

$$\sigma = \frac{R_x}{R_y}$$

$$Y = \frac{(w_1 - w_2)d}{bt^3\left(\frac{1}{R_x} - \frac{1}{R_y}\right)}$$

Result

Youngs modulus **Y** = **pascal**

Poisson's ratio $\boldsymbol{\sigma}$ =

2. Miscibility measurements using ultrasonic diffraction method

Aim

To Determine the velocity of ultrasonic waves in a non-electrolytic liquid by ultrasonic interferometer.

Apparatus required

Ultrasonic Measurement Lab Trainer, Liquid cell, Mains Cord, Co-axial cable

Formula

velocity of Ultrasonic wave in experimental liquid

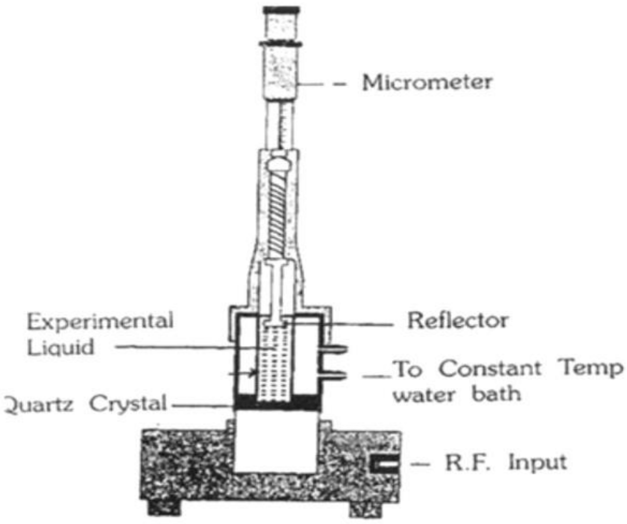
$$v = \lambda \times f$$

Where;

λ – wavelength of the ultrasonic wave

f – frequency of the ultrasonic wave

Experimental setup



Procedure

1. Connect the mains cord to the Trainer.
2. Insert the cell in the base and clamp it with the help of a screw provided on one of its side.
3. Unscrew the knurled cap of cell and lift it away from double walled construction of the cell. In the middle portion of it pour experimental liquid (water) and screw the knurled caps as shown in figure.
4. Two chutes in double wall construction are provided for water circulation to maintain desired temperature. Note: Make sure the power switch should be 'Off' at the time of connection.

5. Connect co-axial cable between liquid cell and receiver terminal of Nvis 6109 Ultrasonic Measurement Lab Trainer. Note: Set the gain knob at fully anticlockwise, before switch 'On' the trainer.
6. Switch 'On' the power of trainer.
7. Wait for 2-3 minutes until display shows a constant value of current (because for better interference, some time is needed).
8. Adjust the gain knob for maximum constant value of current.
9. Move the micrometer slowly (by increments of 0.01mm) in either clockwise or anticlockwise direction till the current shows minimum reading on meter.
10. Note the readings of micrometer corresponding to the value of current. Now again rotate the micrometer in same direction until the second minimum value of current occurred.
11. Note the readings of micrometer in the table below.
12. Repeat the same procedure for number of consecutive minima value of current and tabulate them.

Table

S. No	Current (μA) Min	Micrometer Reading N(mm)			Difference between Consecutive Max/Min $\lambda/2 = N_{n+1} - N_n$
		M.S. R	C.S.R.	T.R.=M.S.R.+ (C.S.R.*L.C.)	

Mean λ/2 =………………

Wavelength λ = ………. mm

= ……….. 10^{-3} m

Calculation

Frequency f = 2MHz = 2×10^6 Hz

Therefore, velocity of Ultrasonic wave in experimental liquid,

$v = \lambda \times f$ = ……………………….. m/s

Result

The velocity of Ultrasonic wave in experimental liquid **v = …………….. m/s**

3. Determination of Stefan's constant of radiation from a hot body

Aim

To determine the Stefan's constant of radiation from a hot body

Apparatus required

Stefan's Constant Apparatus, Thermometer, a Sensitive Galvanometer (Spot Galvanometer), Copper-Constantan Thermo-Couple, Metal Beaker with Sand, Steam Generator, Resistance Box, Test Tube, Mercury, Connecting Wires.

Formula

Stefan's law,

$$E = \sigma\left(T^4 - T_0^4\right)$$

Stefan's constant,

$$\frac{\sigma\left(T^4 - T_0^4\right)A}{J} = ms\frac{dT}{dt}$$

Where;

A-upper surface area of the disc

J- Mechanical equivalent of heat.

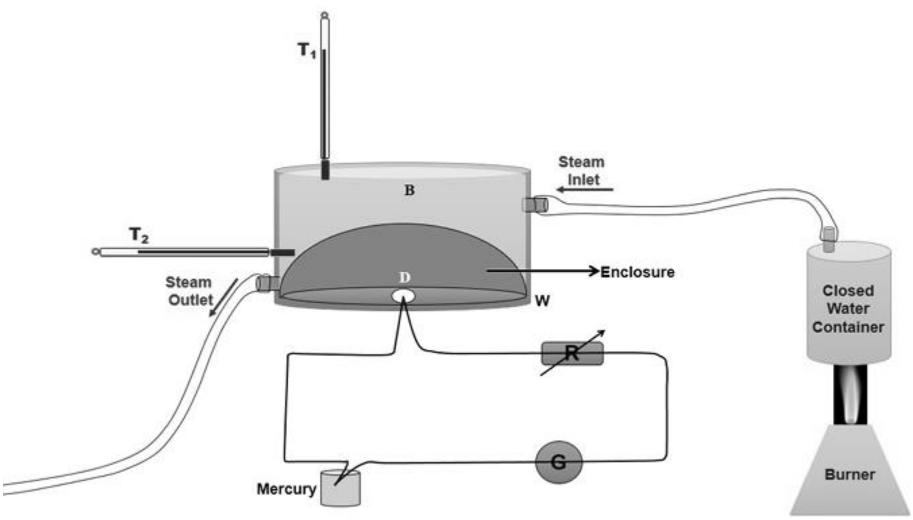
m-Mass of the disc

A-Area of the disc

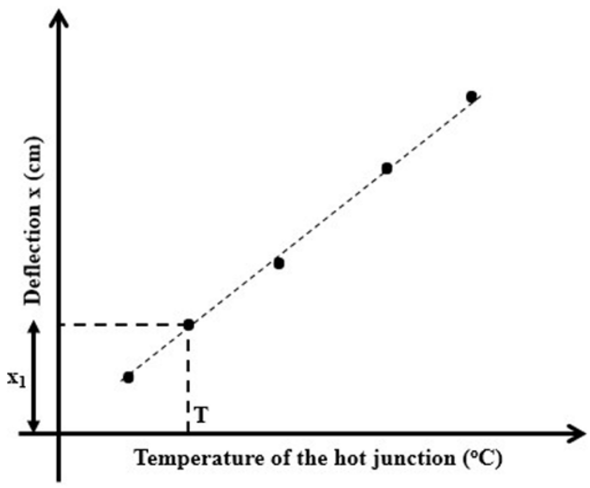
s-specific heat capacity of the disc

$\frac{dT}{dt}$- rate of change of temperature

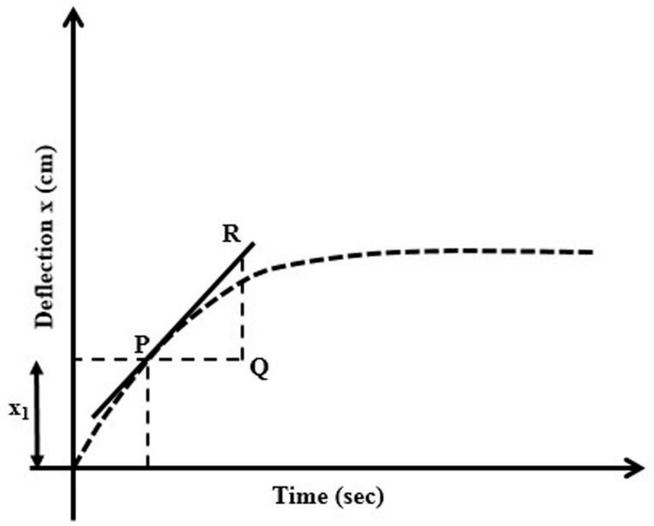
Experimental setup



Model graph 1



Model graph 2



Observation

Mean Temperature of the Enclosure (T_o) = …………………… K

Least Count of the Spot Galvanometer = ……………........... cm

Mass of the Disc (m)= ………………...........................………. g

Diameter of the Disc = ……………………….............………. m

Area of the Disc = ……………………….............…………....... m2

Specific Heat of the Disc (s)= ………………...............……….. Cal g-1 K-1

Table 1: For Calibration (Disc as Cold Junction)

S. No	Temperature of hot junction (^{0}C)	Temperature of Hot Junction (K = ^{0}C + 273)	Deflection x (cm)
1.			
2.			
3.			
4.			
5.			

Table 2: For T and (Disc as Hot Junction)

S. No	Time t (sec)	Deflection x (cm)
1.		
2.		
3.		
4.		
5.		

Procedure

1. Insulate the disc D using the cotton wool when one junction of the thermocouple is attached to this. The disc D acts as a cold junction. Consider the temperature of this disc to be equal to the Room Temperature (RT).
2. Place the other junction of the thermocouple in a test-tube containing mercury, which is placed in a sand-bath. Heat it to 100 – 120^{0}C and note down its temperature using a thermometer.
3. Make connections and adjust the deflection in spot galvanometer within its range by varying the resistance in series.
4. Now allow the hot junction to cool and note down the deflection in galvanometer with the decrease in temperature of the hot junction, till room temperature (Refer Table 1).
5. Plot a graph between the temperature of the hot junction along the x-axis and the deflection of the galvanometer along the y-axis (Refer model graph1).
6. Calculate its slope, which is and then reciprocate it
7. In this part, disc D behaves as a hot junction. First, take out the disc D and close the hole with some cotton wool.
8. Pass steam into the steam chamber. The temperature of the chamber will rise. When the temperature in two thermometers T1 and T2 becomes steady then record the temperature (in Kelvin) and take mean. This gives the average temperature of the enclosure T'.
9. Keep the other junction at room temperature.
10. Now remove the cotton from the hole and fit the disc in this. As the temperature of the disc increases the deflection in the galvanometer also increases. Note down the deflection of the galvanometer at a regular interval of 10 sec.
11. Calculate the Mass 'm' and Diameter 'd' of the given disc.
12. Plot the graph between time (t) along the x-axis and corresponding deflection (x) along the y-axis. Choose a point P on the graph close to the origin and draw a tangent to the

curve at this point to calculate. Note down the deflection (x1) corresponding to the point P (Refer model graph2). Thereafter, note down the temperature T corresponding to the deflection x1 (Refer model graph1).

13. Calculate Stefan's constant using $\frac{\sigma(T^4 - T_0^4)A}{J} = ms\frac{dT}{dt}$.

Calculation

$$\sigma = ms\frac{dT}{dt}\frac{J}{(T^4 - T_0^4)A}$$

.

Result

Stefan's constant ***σ*** **=** **$Js^{-1}m^{-2}K^{-4}$**

4. B-H curve using CRO

Aim

To trace the B-H loop (hysteresis loop) of a ferromagnetic specimen using a cathode ray oscilloscope (CRO) and to evaluate the energy loss in the specimen.

Apparatus required

CRO, capacitors, resistors, multi meter and core of the transformer.

Formula

$$E_L = \frac{N_1}{N_2} \times \frac{R_2}{R_1} \times \frac{C_2}{AL} \times S_V \times S_H \times Area\ of\ the\ loop\ in\ m^2 \quad joules/m^3/Cycle$$

Where;

No. of turns in the primary coil N1= 200

No. of turns in the secondary coil N2= 400

R1 and R2 are the resistances in the circuit given by R1= 5Ω, 22Ω and 47 Ω R2= 4.5 k Ω=4.5 x103Ω

Horizontal sensitivity S_H= ....volt / m

Vertical sensitivity S_v = ... volt / m

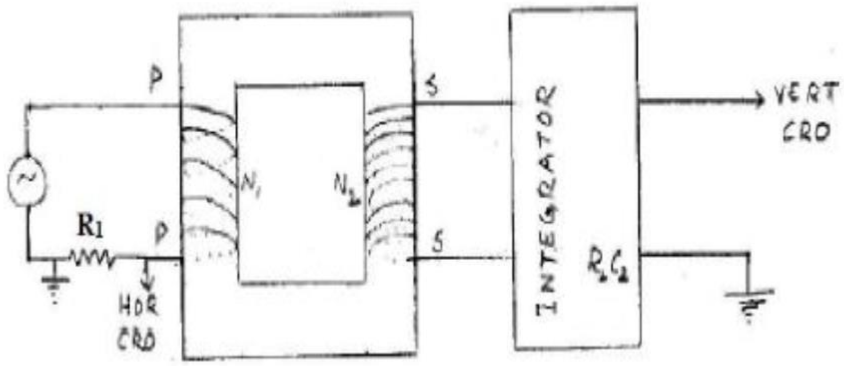
Length of the specimen L = 23 cm=0.23 m

Area of cross-section A = 2 x 1.4 sq. cm =2.8x 10^{-4} sq. m

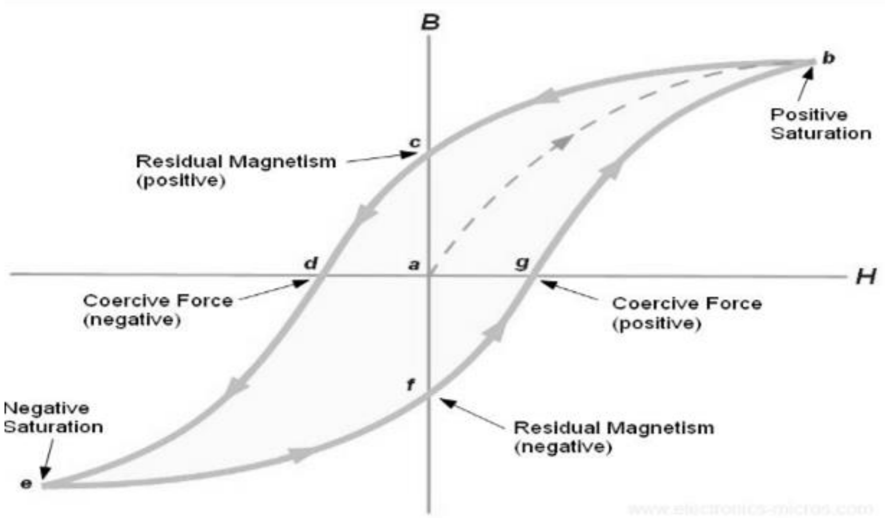
Capacitance C_2= 4.7 $micro$F = 4.7 x 10^{-6} F

Area of the loop = ... sq.cm = ... x 10^{-6} sq.m

Circuit diagram



Model graph



Procedure

1. Connect the primary terminals of the specimen to P.P. and secondary to S.S terminals.
2. Adjust the CRO to work on external mode (the time base is switched off). Adjust the horizontal and vertical position controls such that the spot is at the centre-of the CRO screen.
3. Connect terminal marked GND to the ground of the CRO. Connect terminal H to the horizontal input of the CRO. Connect terminal V to the vertical input of the CRO. Switch on the power supply of the unit. The Hysteresis loop is formed.
4. Adjust the horizontal and vertical gains such that the loop occupies maximum area on the screen of the CRO. Once this adjustment is made do not disturb the gain controls.
5. Trace the loop on a translucent graph paper. Estimate the area of the loop.
6. Remove the connection from CRO without disturbing the horizontal and vertical gain controls.
7. Determine the vertical sensitivity of the CRO by applying a known AC voltage say 1 volt (peak to peak). If the spot deflects by X cms for 1 volt, the vertical sensitivity is 10^2/ X (volt/m). Let it be Sv).

Table

Resistance R_1	Horizontal sensitivity S_H (V/m)	Vertical sensitivity Sv (V/m)	Area of the loop (m^2)	Energy loss (joules/m^3/cycle)
5				
22				
47				

Result

The energy loss per unit volume per cycle is ____________ **joule/m3/cycle**.

5. Measurement of Magnetic Susceptibility - Gouy's method

Aim

To determine the magnetic susceptibility of a paramagnetic sample by measuring the force exerted on the sample by a magnetic field gradient using the Gouy's method.

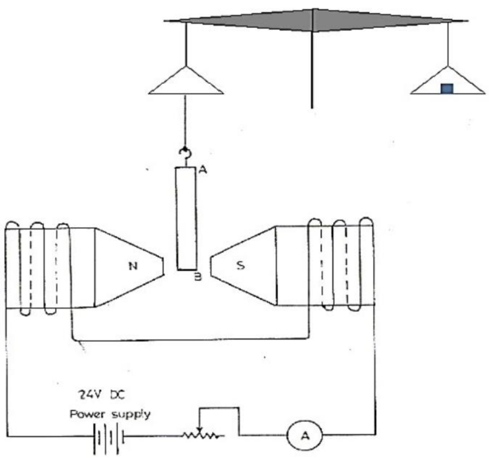
Apparatus required

The Guoy balance, the powder specimen ($FeC1_2$ or Fe_2SO_4) in a glass tube, dc power supply for the magnet.

Formula

$$mg = A\frac{\mu_0\chi_m}{2}(H_1^2 - H_2^2) \approx A\frac{\mu_0\chi_m}{2}H_1^2$$

Experimental setup



Table

S.No	Weight of empty glass tube (gm)	Current through the coils (A)	Magnetic field (Gauss)

S.No	Weight of Substance (gm)	Current through the coils (A)	Magnetic field (Gauss)

Procedure

1. The electromagnet is energized by a DC power supply.
2. The variable magnetic field is provided by the wedge-shaped pole-pieces.The entire electromagnet is housed inside a wooden casing.
3. The distance between the pole-pieces can be varied by means of a handleon top of the wooden casing.
4. A digital balance is placed which carries a hook at the bottom for suspending the glass tube containing the material (FeCl2, or Fe2SO4).
5. The magnetic field between the pole pieces can be varied by changing the current through the coils using a DC power supply.
6. The magnetic field corresponding to the current through the coils can be determined using a Gauss meter.
7. Zero-adjust the digital balance.
8. Determine the area of cross-section of the tube. Suspend the empty glass tube as shown in Figure 2 and find its weight in zero magnetic field.
9. Using the DC power supply, vary the current from 0 to 3.5 A in steps of 0.2A and in each case find the weight of the empty glass tube. Fill the tube with the given sample (say FeCl2) to about 3/4ths of the tube. Find the weight of the filled glass tube to an accuracy of 10 mg. in zero magnetic field.
10. As before, find the weight of the filled glass tube in different applied magnetic fields (both for the increasing and decreasing fields).
11. Repeat the experiment with one or two more substances.

Result

Magnetic susceptibility of various materials are tabulated

Material	Magnetic susceptibility	Density (10^3 Kg/m^3)
Aluminium	1.65×10^{-5}	2.70
Copper	-5.46×10^{-6}	8.96
Lead	-2.30×10^{-5}	11.36
Tin	-3.74×10^{-5}	7.28
Titanium	1.51×10^{-4}	4.50

6. Hall Effect in Semiconductor. Determine the Hall coefficient, carrier concentration and carrier mobility.

Aim

To study the hall effect in a given semiconductor and to determine the following parameters, viz., (i) hall voltage (V_H) (ii) hall co-efficient (R_H) (iii) concentration of charge carriers (n) (iv) mobility of charge carriers(μ) and (v) hall angle (θ_H).

Apparatus required

Semiconductor crystal (Ge), Hall probe, Hall effect setup, Electromagnet, Constant power supply (current), digital gauss mater etc.,

Formula

Hall co-efficient,

$$(R_H) = \frac{(V_H)\omega}{BI}$$

Concentration of charge carriers,

$$n = \frac{1}{R_H e}$$

Mobility of charge carriers,

$$\mu = R_H \sigma$$

Hall angle,

$$(\theta_H) = tan^{-1}[10^{-8} R_H B \sigma]$$

Where;

VH	-	hall voltage
Ω	-	Thickness of the specimen
B	-	Applied magnetic field
I	-	current applied to the Ge crystal
e	-	charge of the carrier (ρ=1.6x10^{-19}c)
σ	-	electrical conductivity of the Ge crystal

Procedure

1. Connect the width wise contacts of the Hall probe to the voltage terminals.
2. Connect the lengthwise contacts of the Hall probe to the current terminals.
3. Switch on the Hall Effect setup.
4. Set the current to a few milliamperes.
5. Check for any voltage reading with no magnetic field applied.
6. If there's a non-zero reading, adjust the setup to minimize this zero field potential.
7. Place the probe or specimen in the magnetic field.
8. Adjust the orientation until it becomes perpendicular to the magnetic field lines.
9. Set the display to the voltage side.
10. Measure the Hall voltage as a function of the magnetic field strength.

11. Keep the current fixed while varying the magnetic field strength.
12. Measure the strength of the magnetic field using a gauss meter.
13. Record the magnetic field strength corresponding to each Hall voltage measurement.
14. Change the direction of the current while keeping the magnetic field direction constant.
15. Measure the Hall voltage for both current directions.
16. Similarly, exchange the directions of the current and magnetic field and record Hall voltage measurements.
17. Record all observations systematically in a table.
18. Include measurements of Hall voltage for different current values, magnetic field strengths, and orientations.
19. Use the recorded data to calculate parameters such as Hall coefficient, concentration of charge carriers, and Hall angle.

Table1: Determination of Hall Voltage (V_H)

Ge crystal (No. 4517)
Distance between the two pole pieces = 1.5 cm
Residual magnetic field = 84 gauss
Current to the Ge crystal = 1mA
Zero field potential = 0.1mV

SI.No	Current to electromagnet (amp)	Magnetic field (gauss)	Corrected magnetic field(gauss)	Voltmeter reading(mV)				Mean V_H(mV)	Corrected hall voltage(mV)
				Position I		Position II			
				$+V_H$	$-V_H$	$+V_H$	$-V_H$		
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									

Calculation

Hall co-efficient,

$$(R_H) = \frac{(V_H)\omega}{BI}$$

Concentration of charge carriers,

$$n = \frac{1}{R_H e}$$

Mobility of charge carriers,

$$\mu = R_H \sigma$$

Hall angle,

$$(\theta_H) = tan^{-1}[10^{-8} R_H B \sigma]$$

Result

A study on Hall Effect for the given Ge crystal specimen has been performed. The type of carrier has been found to be p-type and also the following parameters have been determined from the result of the experiments.

i. Hall co-efficient, (R_H) =
ii. Concentration of charge carriers =
iii. Mobility of charge carriers, μ =
iv. Hall angle, θ_H =

7. Determination of Thickness of thin film. - Michelson Interferometer

Aim

To Determine thickness of thin film Using Michelson Interferometer

Apparatus required

Sodium vapour lamp, lens, telescope, thin film, mirrors etc.,

Formula

Thickness of the thin film,

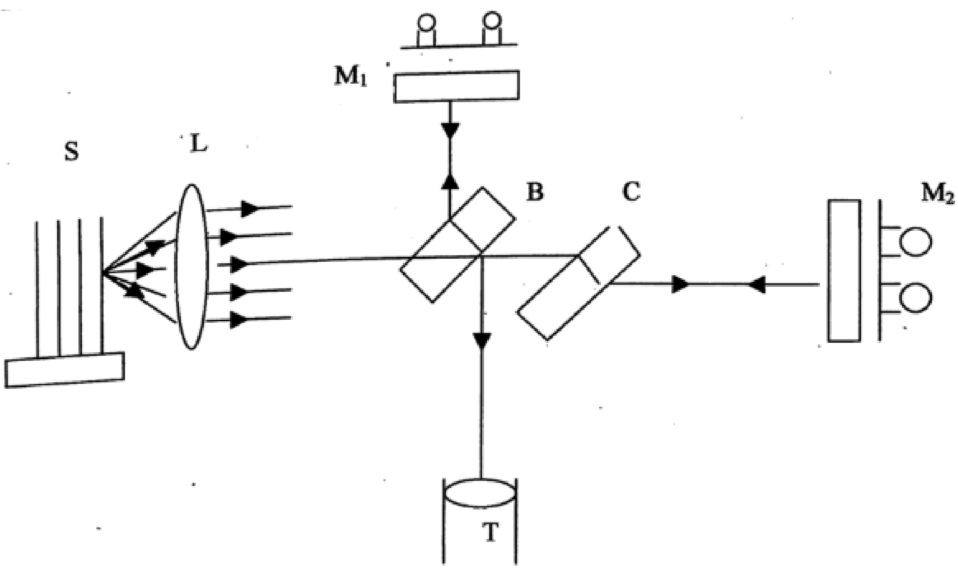
$$T = (1 - \mu)d \quad (mm)$$

Where;

μ = refractive index of mica

d = distance moved by the movable mirror

Experimental setup



M_1 = Movable mirror; S = Sodium vapour lamp; L = lens; B = Beam splitter; C = compensating plate; M_2= Fixed mirror; T = telescope

Procedure

1. Adjust the position of the movable mirror by using the coarse adjustment so that the adjustable mirror and the fixed mirrors are approximately equidistance from the beam splitter.
2. Place a sodium lamp at left hand side of the interferometer at a distance of approximately 50cm. Lamp should be approximately in line with the center of the beam splitter and fixed mirror. Place a ground glass plate. (size : 10*10 cm^2) between lamp and interferometer.

3. In front of ground glass plate, place an opaque screen (say thin aluminium sheet/card board sheet) with a 1 mm dia. hole pierced in the screen. The pinhole should be approximately in line with the centers of the beam splitter and the fixed mirror.
4. See that fine tilt screw of the fixed mirror are placed in the half way position of their full travel. Place the eye close to beam splitter. Two virtual image of the pinhole will be seen.
5. Adjust the coarse tilt adjustment screw of the fixed mirror so that the two virtual images nearly coincide. For this adjustment, it may be necessary to adjust the tilt also, of the movable mirror.
6. Use the fine tilt adjustment of the fixed mirror to make the two virtual images of the pinhole coincides exactly.
7. On removal of opaque screen interference fringes will be seen but fringes may not be circular. Again use the fine tilt adjustment of the fixed mirror till the circular fringes centered in the field of view
8. Place the telescope focused to infinity for about 30 cm away from beam splitter.
9. The telescope points toward the movable mirror. The fringes will be seen through telescope. The centre of the fringes seen through the telescope should not shift laterally if the movable mirror is displaced either by means of the fine or coarse adjustment drum. If this condition is not attained, repeat the steps 6,7&8 till this condition is achieved

Table

S.NO.	**No. of fringes shifted**		**Reading of drum in Division along with Number of rotation**		**Distance moved in div**
			Initial	**Final**	
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
				Total	

Result

Thickness of the thin film **T =** **mm**

PART B

1. Determination of I-V Characteristics and efficiency of solar cell.

Aim

To determine the I-V Characteristics and efficiency of solar cell.

Apparatus required

Solar cell, Light source, Basic circuit, connecting wires etc.

Formula

Efficiency of the solar cell,

$$\eta = \frac{P}{E \times A_c} \times 100\%$$

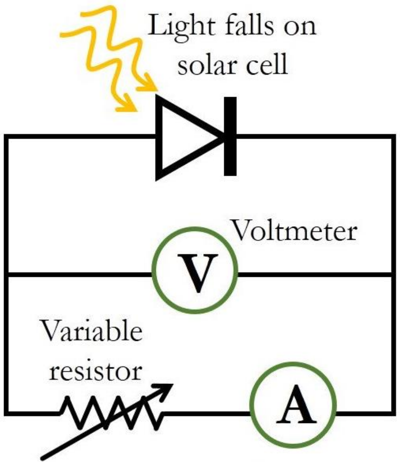
Where;

P - Maximum power output in W

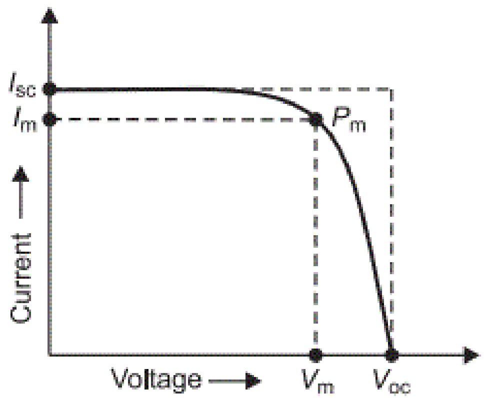
E - Incident radiation flux in W/m^2

A_c - Area of collector in m^2

Circuit diagram



Model graph



Table

R (Ohm)	Voltage (mV)	Current (mA)	Power (mW)
10			
22			
47			
56			
68			
.			
.			
.			
1K			

Procedure

1. Set up the circuit as shown in the figure. The solar cell power supply is connected to the bulb. The supply and cooling fan are switched on the solar cell is kept at a distance d from the source.
2. The rheostat is shorted and the short circuited current is noted (I_{sc} approx 50 mA).
3. Both thc terminals of the rheostat are disconnected from the ammeter voltmeter junction and the open circuit voltage is noted in the milli voltmeter (V_{oc} approx 500 mV).
4. By varying the resistance values as IO ohm, 22 ohm, 47 ohm, 56 ohm, 68 ohm, ..upto I kilo ohm correspondingly note down the values of voltage and current; power is calculated
5. Calculate and record the P value from the above table. Also calculate the efficiency and fill factor.
6. Draw a curve with voltage along axis and current along y axis to get the characteristics of the solar cell. Draw one more graph between power and voltage to show power variation.
7. Repeat the experiment for at least three more distances.

Calculation

$$\eta = \frac{P}{E \times A_c} \times 100\%$$

Result

The I-V Characteristics was observed by graph plot and efficiency of the solar cell was calculated $\boldsymbol{\eta}$ =

2. IC7490 as scalar and seven segment display using IC7447

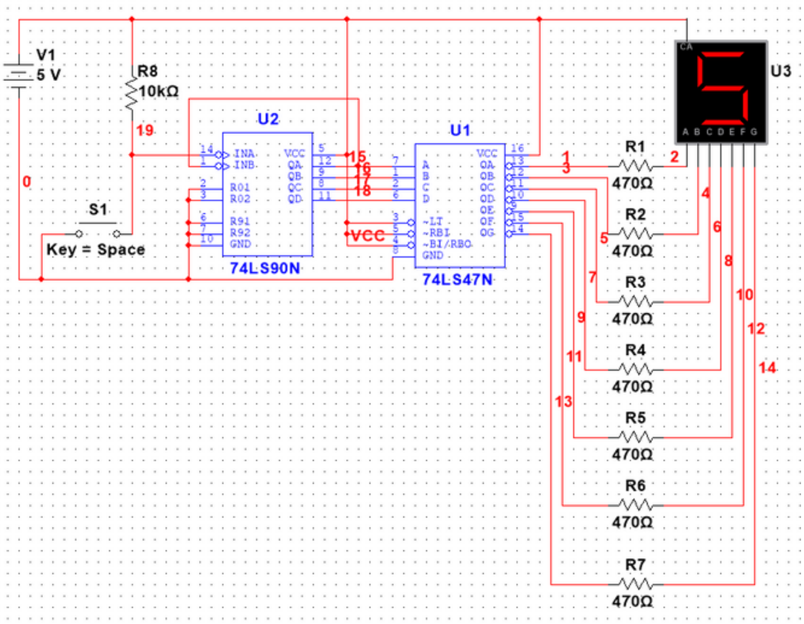
Aim

To construct a seven-segment display using IC7447 and IC7490 as scalar

Apparatus required

Breadboard, Power Supply (5V), Function Generator, 74LS47N BCD decoder, IC74LS90N Decade counter IC, LED (x7), Resistors (x7 - 470Ω), Push Button, Connecting wires.

Circuit diagram



Table

Push Button Presses	Octal Input (BCD)	7-Segment LED Display
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7

Procedure

1. Assemble the circuit on a breadboard according to the circuit diagram.
2. Apply a 5V power supply to the circuit.
3. Press the push button. The LED display should show a digit from 0 to 9.

4. Continue pressing the push button to see all the digits from 0 to 9 displayed on the LED display.

Result

A seven-segment display constructed using IC7447 and IC7490 as scalar verified using the table

3. Op-Amp – Active filters: Low pass, High pass and Band pass filters (Second Order) Butter worth filter

Aim

To design the Low pass, High pass and Band pass filters (Second Order) Butter worth filter using Op-Amp.

Apparatus required

Signal generator (0-10) mHz, Op amp IC741, Resistors (1kΩ,1.5kΩ,5kΩ,10kΩ), Capacitor 0.1µf, linear power supply ±15V, DSO

Formula

$$fc = \frac{1}{2\pi RC} \text{ or } \frac{1}{2\pi\tau}$$

$$GAIN = (1 + \frac{Rf}{Ri})$$

Where;

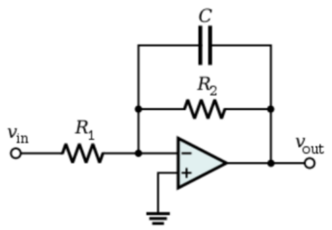
Rf- final resistance

Ri- initial resistance

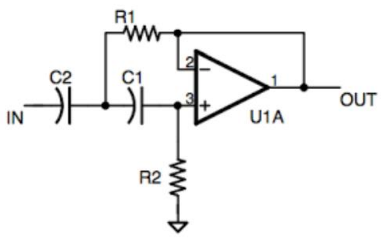
R-resistance

C-capacitance

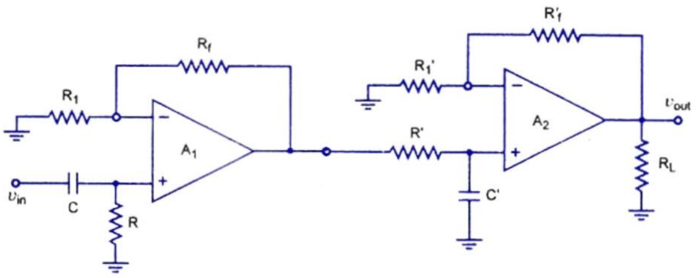
Circuit diagram



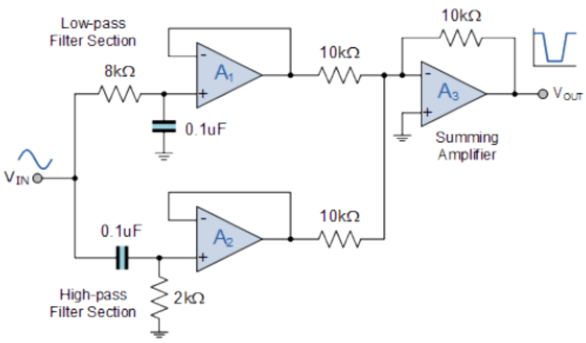
Low pass filter



High pass filter

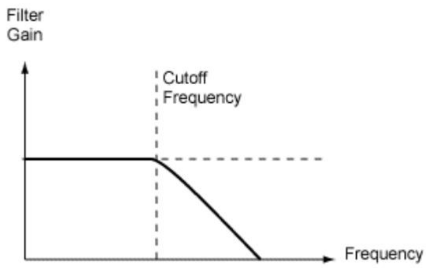


Band pass filter

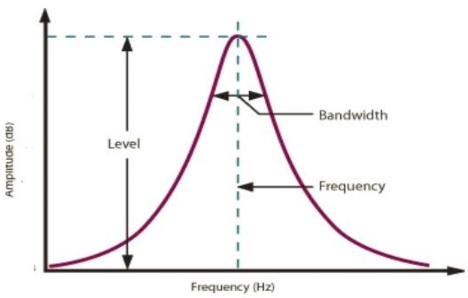


Butter worth filter

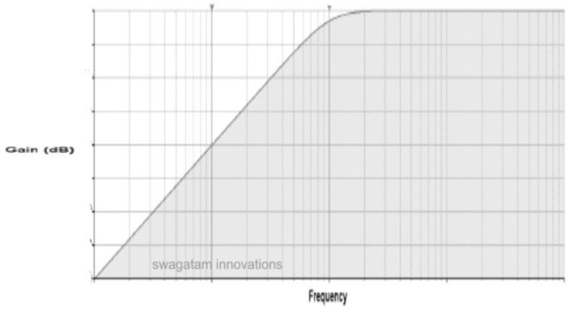
Model graph



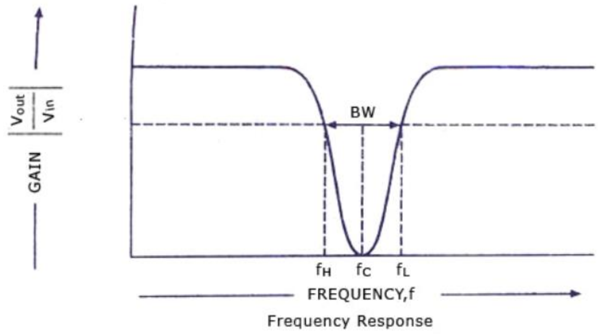
Low pass filter



Band pass filter



High pass filter



Butter worth filter

Table: Low pass filter

Input Frequency(hz)	Output Voltage(v)	Gain	Gain in db

High pass filter

Input Frequency(hz)	Output Voltage(v)	Gain	Gain in db

Band pass filter

Input Frequency(hz)	Output Voltage(v)	Gain	Gain in db

Butter worth filter

Input Frequency(hz)	Output Voltage(v)	Gain	Gain in db

Procedure

1. Connect the circuit as shown in diagram.
2. Connect the DSO to the probes and switch it on.
3. Check the graph for both positive and negative voltage and write down the output.

Result

Various active filter circuits, low pass, high pass, band pass, Butter worth filter was designed and the frequency response was analysed.

4. Construction of Schmidt trigger circuit using IC555 for given hysteresis

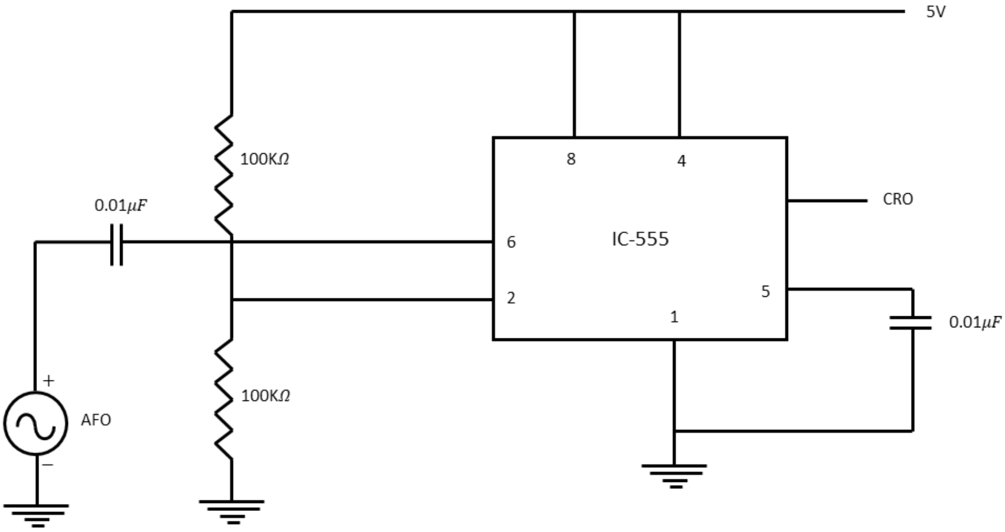
Aim

To obtain Schmidt trigger circuit using IC555 for given hysteresis and frequency response is traced out.

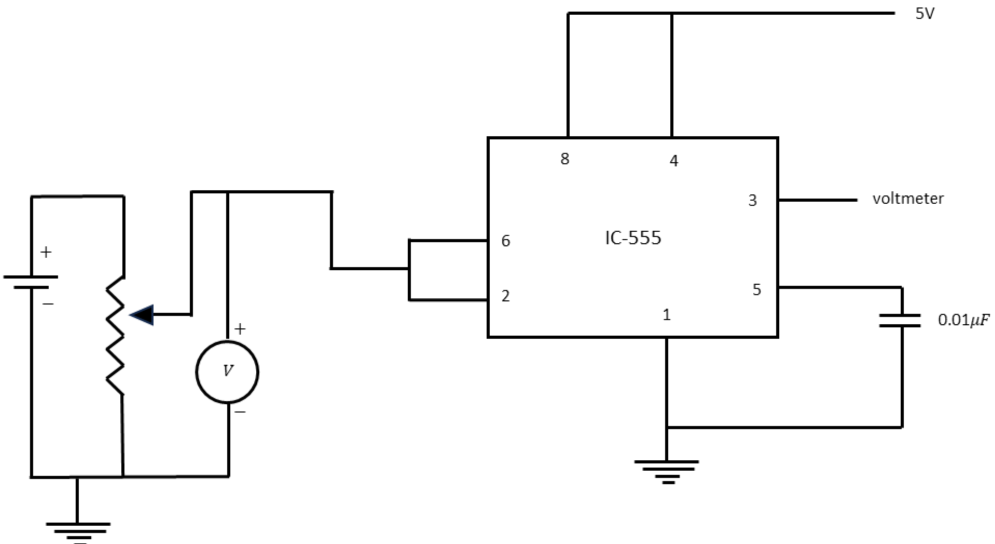
Apparatus required

IC-555, voltmeter, Rheostat, capacitor, CRO, AFO, 5V power supply, connecting wires etc.,

Circuit diagram

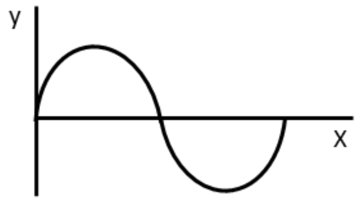


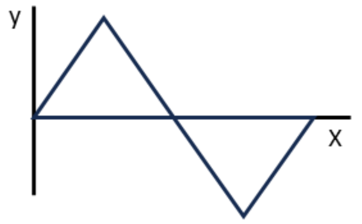
Schmitt trigger



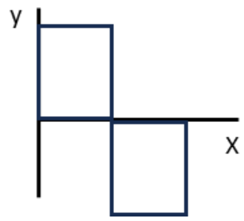
Model graph

Input

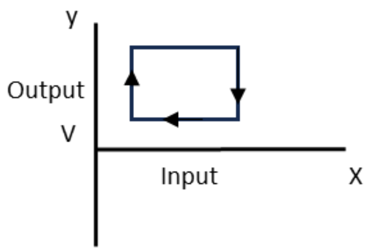




output



Schmitt's Trigger output



Table

Increasing		**Decreasing**	
Input (V)	**Output (V)**	**Input (V)**	**Output (V)**

Procedure

1. Assemble the circuit as shown in the circuit diagram
2. Vary the input voltage and tabulate the results
3. Trace out the waveform

Result

The square waveform is generated using Schmitt trigger circuit for various input signals and the waveforms and traced out.

The hysteresis voltage from graph = volts

5. BCD to Excess -3 and Excess 3 to BCD code conversion

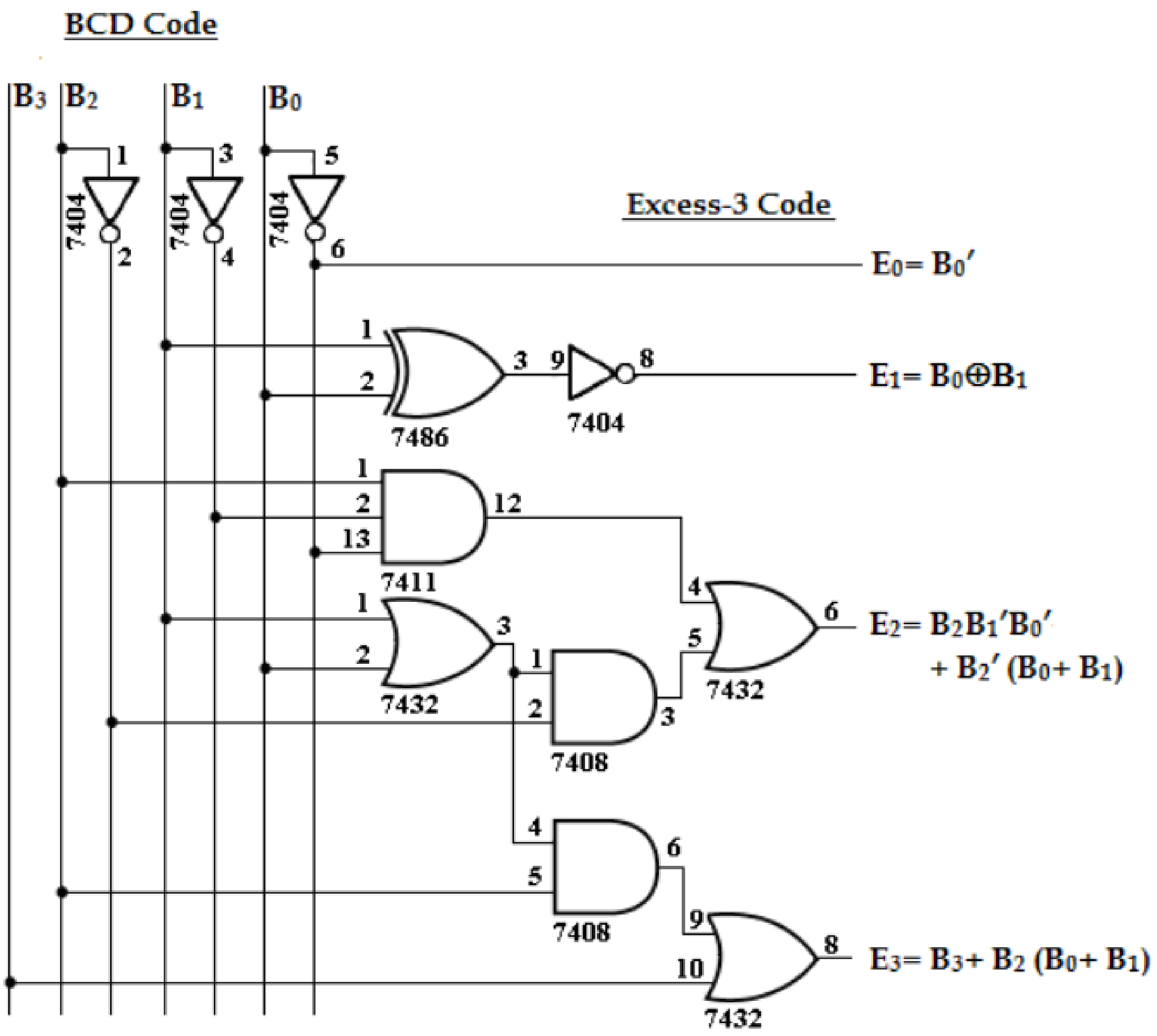
Aim

To construct a circuit for BCD to Excess -3 and Excess 3 to BCD code conversion and verify using truth table.

Apparatus required

IC trainer kit, IC-7432, IC-7408, IC-7404, IC-7486, IC-7411 and connecting wires etc

Circuit diagram



K-Map Simplification:

For E_3

B_3B_2 \ B_1B_0	00	01	11	10
00	0	0	0	0
01	0	1	1	1
11	x	x	x	x
10	1	1	x	x

$E_3 = B_3 + B_2(B_0 + B_1)$

For E_2

B_3B_2 \ B_1B_0	00	01	11	10
00	0	1	1	1
01	1	0	0	0
11	x	x	x	x
10	0	1	x	x

$E_2 = B_2B_1'B_0' + B_2'(B_0 + B_1)$

For E_1

B_3B_2 \ B_1B_0	00	01	11	10
00	1	0	1	0
01	1	0	1	0
11	x	x	x	x
10	1	0	x	x

$E_1 = B_1'B_0' + B_1B_0$

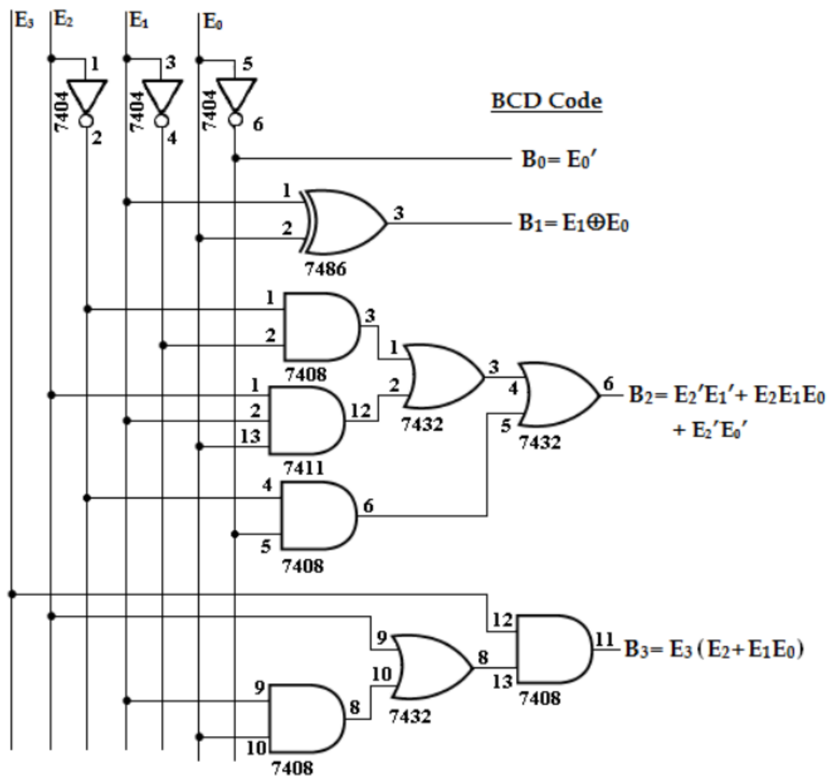
$= B_1 \odot B_0$

For E_0

B_3B_2 \ B_1B_0	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	x	x	x	x
10	1	0	x	x

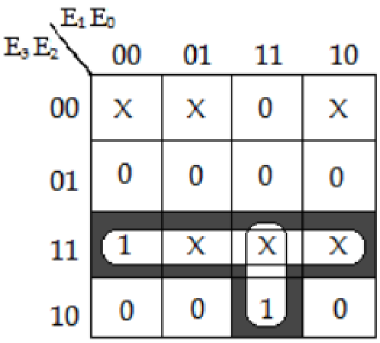
$E_0 = B_0'$

Excess-3 Code



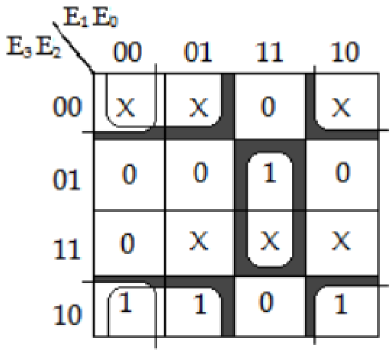
K-Map Simplification:

For B_3



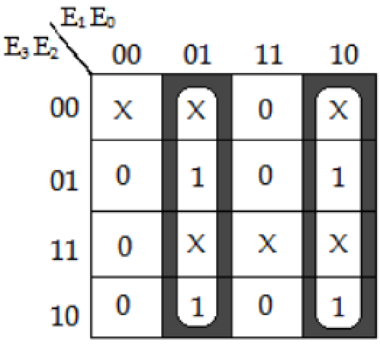
$B_3 = E_3E_2 + E_3E_1E_0$

For B_2



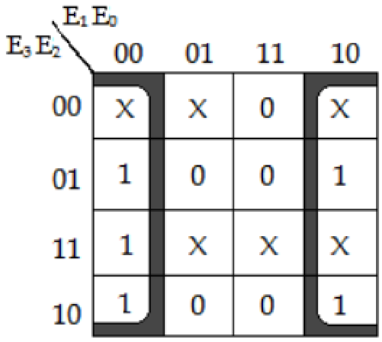
$B_2 = E_2'E_1' + E_2E_1E_0 + E_2'E_0'$

For B_1



$B_1 = E_1'E_0 + E_1E_0'$
$= E_1 \oplus E_0$

For B_0



$B_0 = E_0'$

Truth Table - Binary to Excess 3 code

B3	B2	B1	B0	E3	E2	E1	E0
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0

Truth Table - Excess 3 to Binary code

E3	E2	E1	E0	B3	B2	B1	B0
0	0	1	1	0	0	0	1
0	1	0	0	0	0	0	0
0	1	0	1	0	0	1	1
0	1	1	0	0	0	1	0
0	1	1	1	0	1	0	1
1	0	0	0	0	1	0	0
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	1	0	0	1
1	1	0	0	1	0	0	0

Procedure

1. Connections are given as per the logic diagram.
2. Logic inputs are given as per the truth table.
3. Observe the logic output and verify with the truth tables

Result

Binary to excess-3 code and vice versa converted & verified using truth table.

6. Construction of Multiplexer and Demultiplexer using ICs.

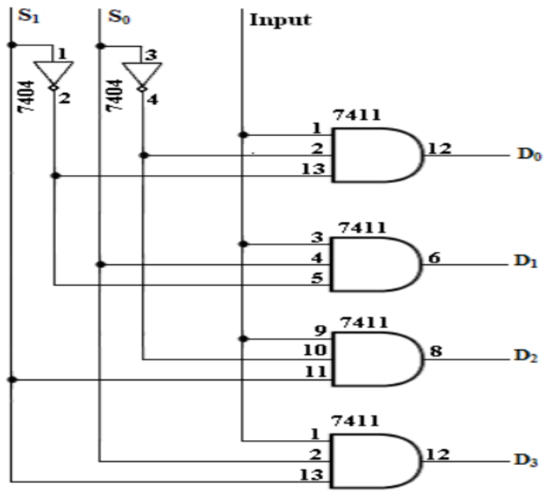
Aim

To construct Multiplexer and Demultiplexer using ICs.

Apparatus required

IC Trainer kit, IC7411, IC7404, IC7432, connecting wires etc.,

Circuit diagram



Truth Table

INPUT			OUTPUT			
S1	**S0**	**I/P**	**D0**	**D1**	**D2**	**D3**
0	0	0	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	0	0	0
0	1	1	0	1	0	0
1	0	0	0	0	0	0
1	0	1	0	0	1	0
1	1	0	0	0	0	0
1	1	1	0	0	0	1

Procedure

1. Connections are given as per the logic diagram.
2. Logic inputs are given as per the truth table.
3. Observe the logic output and verify with the truth tables.

Result

The multiplexer and demultiplexer was designed and implemented using logic

gates

7. Shift register and Ring counter and Johnson counter- IC7476/IC7474

Aim

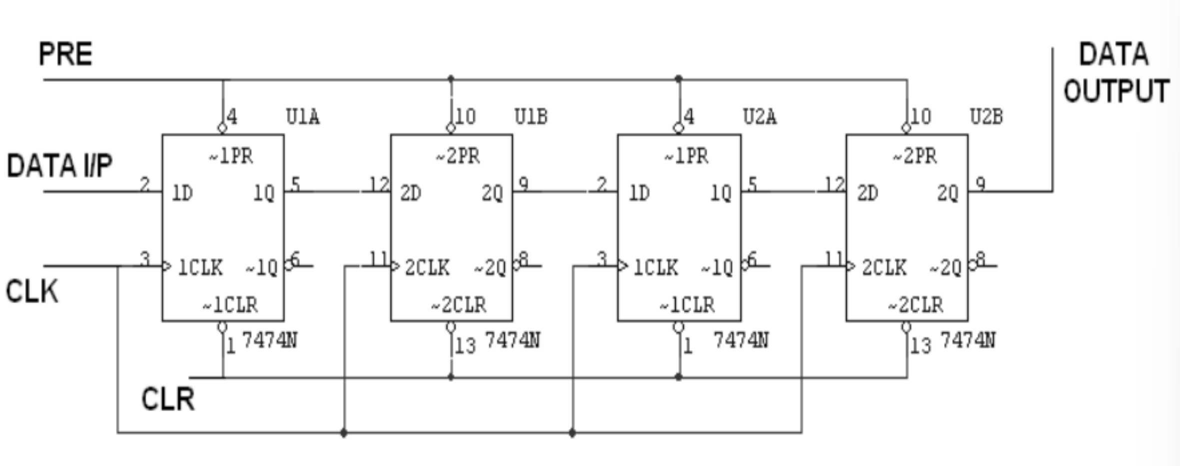
To study the shift register, Ring and Johnson counter

Apparatus required

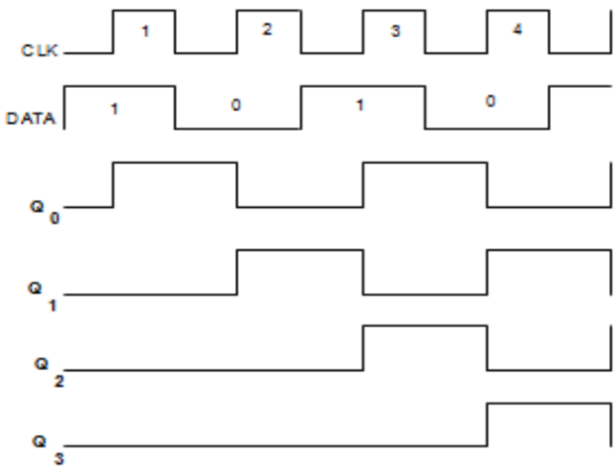
Digital IC trainer kit, IC 7476, IC7474

Circuit diagram

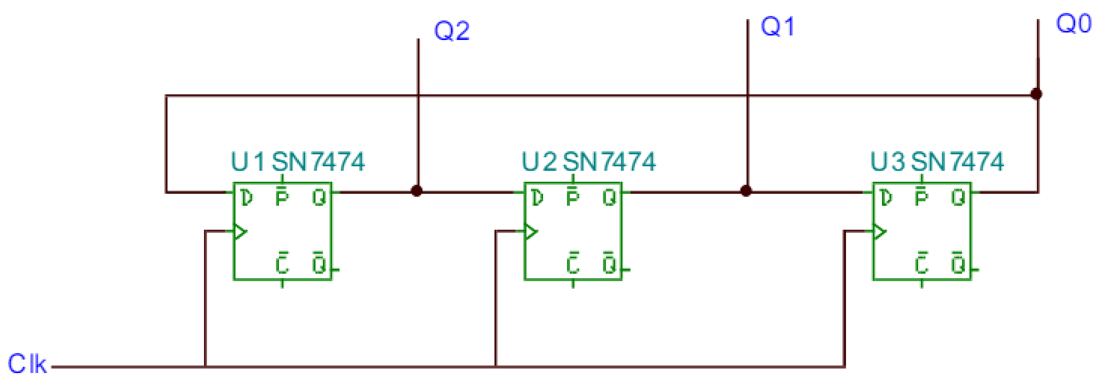
Shift register:



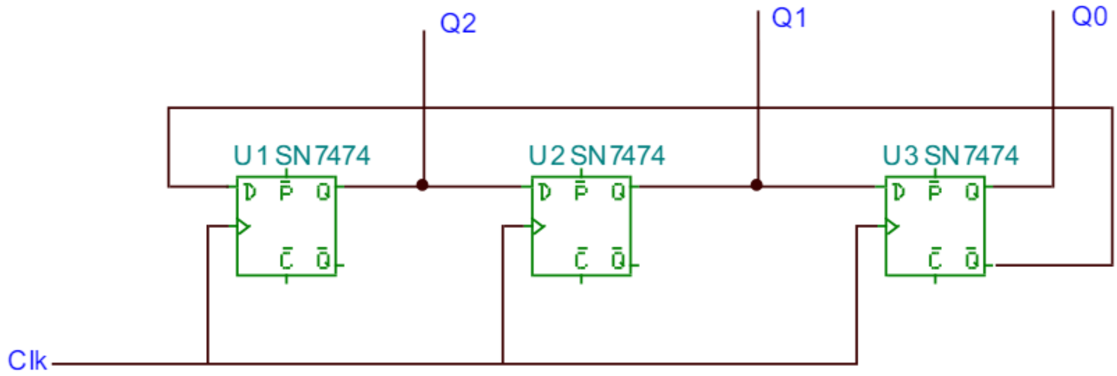
Output waveform



Ring counter:



Johnson counter:



Truth table

Shift register:

Clk	Serial in	Serial out
1	1	0
2	0	0
3	0	0
4	1	1
5	X	0
6	X	0
7	X	1

Ring counter:

Clk	Q_2	Q_1	Q_0
0	1	0	0
1	0	1	0
2	0	0	1
3	1	0	0

Johnson counter:

Clk	Q_2	Q_1	Q_0
0	0	0	0
1	1	0	0
2	1	1	0
3	1	1	1
4	0	1	1
5	0	0	1
6	0	0	0

Procedure

1. Connect the circuit as shown in shift register
2. Verify using the truth table
3. Check the D flip flop for its working.
4. Rig up the circuit as Ring counter.
5. For ring counter set the first flip flop to logic 1(using preset), second and third to logic 0 (using clear) to set the data as 1 0 0 and then leave the preset and clear open.
6. Observe the output and verify the truth table.
7. For Johnson counter set the data as 0 0 0 (using clear) and observe the output and verify the truth table.

Result

Shift register, Ring and Johnson counter were constructed and studied by verifying the truth table