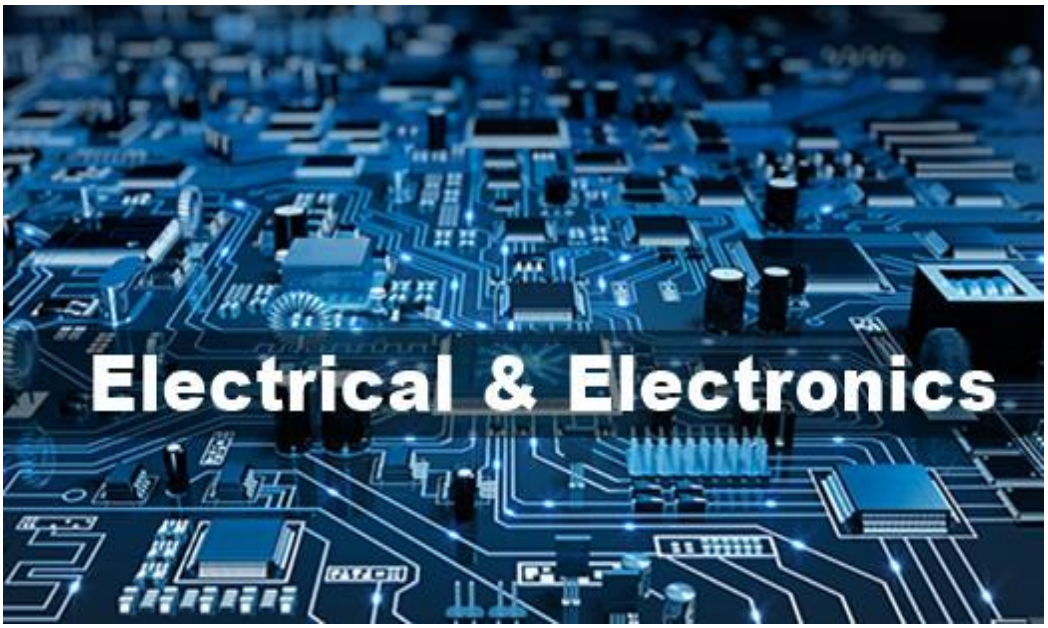
LABORATORY MANUAL

ECE279

Electrical and Electronics Engineering Laboratory



Name of the Student :……..
Registration Number/Roll No:……
Section and Group……
School of Electrical and Electronics Engineering

LOVELY PROFESSIONAL UNIVERSITY
PUNJAB (INDIA)

LOVELY PROFESSIONAL UNIVERSITY

Transforming Education Transforming India

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General guidelines for the students

Lab Safety:

- Use only tools and equipment with non-conducting handles when working with electrical devices.
- When checking an operating circuit, keep one hand either in a pocket or behind your back to avoid making a closed circuit through the body.
- Never plug leads into power source unless they are connected to an established circuit.
- Avoid contacting circuits with wet hands or wet materials.
- All current transmitting parts of any electrical devices must be enclosed.
- Maintain a work space clear of extraneous material such as books, papers, and clothes.
- Never change wiring with circuit plugged into power source.
- Place the IC's Properly in the bread board, Don't break the IC pins by forcefully inserting in bread board.
- Switch off the power supply when not in use.
- Always cut wire leads so the clipped wire falls on table top and not towards others.
- Shoes must be worn at all times.
- Remove all loose conductive jewellery and trinkets, including rings, which may come in contact with exposed circuits. (Do not wear long loose ties, scarves, or other loose clothing around machines.
- Don't switch ON the power supply without confirming the connections from the lab instructor.
- When making measurements, form the habit of using only one hand at a time. No part of a live circuit should be touched by the bare hand.
- Keep the body, or any part of it, out of the circuit. Where interconnecting wires and cablesare involved, they should be arranged so people will not trip over them.
- Be as neat as possible. Keep the work area and workbench clear of items not used in the experiment.

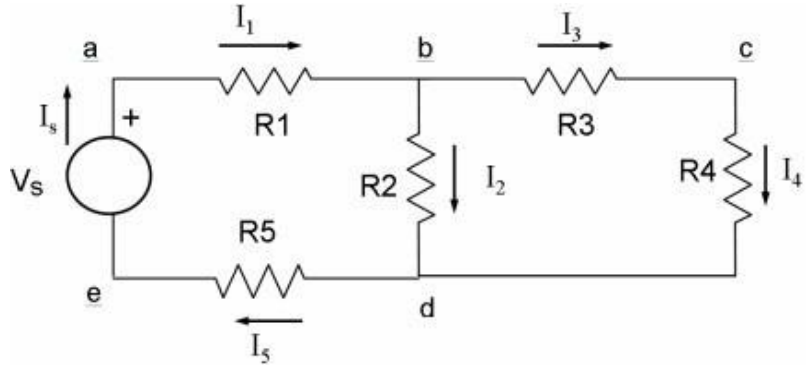
EXPERIMENT No.1

Aim: To verify Kirchhoff Voltage Law and Kirchhoff Current Law using hardware.

Apparatus required:

S. No.	Items	Specifications	Quantity
1	DC Voltage source	0-20V	01
2	Resistors	1-2 ohms	05
3	Ammeter	Digital type	01
4	Voltmeter	Digital type	01
5	Connecting wires	As per requirements	

1. Kirchhoff's Voltage Law states that the algebraic sum of all the voltages around any closed path (loop or mesh) is zero.



Applying Kirchhoff's voltage law to the first and the second loops in the circuit shown in Figure yields:

Loop 1: -Vs +V1 +V2 +V5 = 0 (1a)

Loop 2: -V2 +V3 +V4 = 0 (1b)

2. Kirchhoff's Current Law states that the algebraic sum of all the currents at any node is zero.

Applying Kirchhoff's current law to the first four nodes in the circuit shown in Figure yields the following equations;

Node a: -Is + I1 = 0 (2a)

Node b: -I1 + I2 + I3 = 0 (2b)

Node c: -I3 + I4 = 0 (2c)

Node d: -I2 - I4 + I5 = 0 (2d)

Procedure:

1. Construct the circuit shown in Figure using the values below:
   R1 = 1 KΩ R2 = 1 KΩ R3 = 1 KΩ R4 = 1 KΩ R5 = 1 KΩ
2. Set the Variable Power Supply (Vs) to 5 Volts.
3. Accurately measure all voltages and currents in the circuit using the Digital Multi-Meter (DMM).
4. Record the measurements in a tabular form containing the measured voltage and current values.
5. Verify KVL for the loops in the circuit using equations 1a and 1b.
6. Verify KCL for the nodes in the circuit using equations 2a, 2b, 2c and 2d.

Precautions:

1. All the connections should be perfectly tight.
2. Always connect ammeter in series and voltmeter in parallel
3. Use safety guards while working on live parts
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor
6. Use proper wire for connections

Worksheet of the students

Observation and Calculations:

Branch current/voltage	V [volts]	I [mA]	R [KΩ]
V1, I1			
V2, I2			
V3, I3			
V4, I4			
V5, I5			
Vs, Is			

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.2

Aim: To understand the principle of turn ratio of a transformer using hardware.

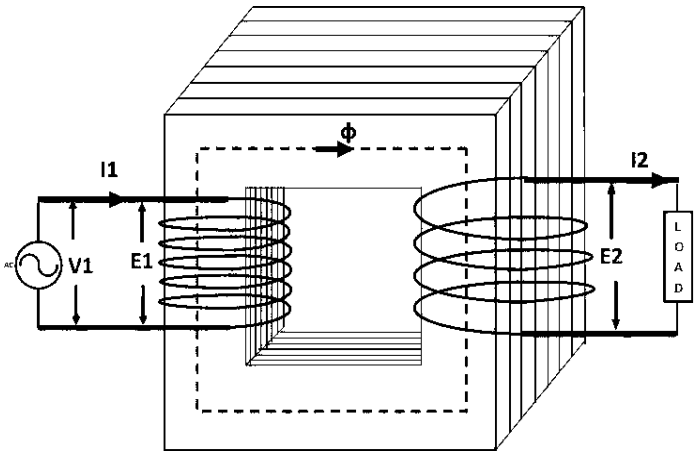
Apparatus Required:-

S. No.	Apparatus Required	Specification	Qty.
1	Transformer	1 Φ,2KVA, 220/220 V	1
2	Auto Transformer	1 Φ,0-270V	1
3	Voltmeter	Digital	1

Theory:

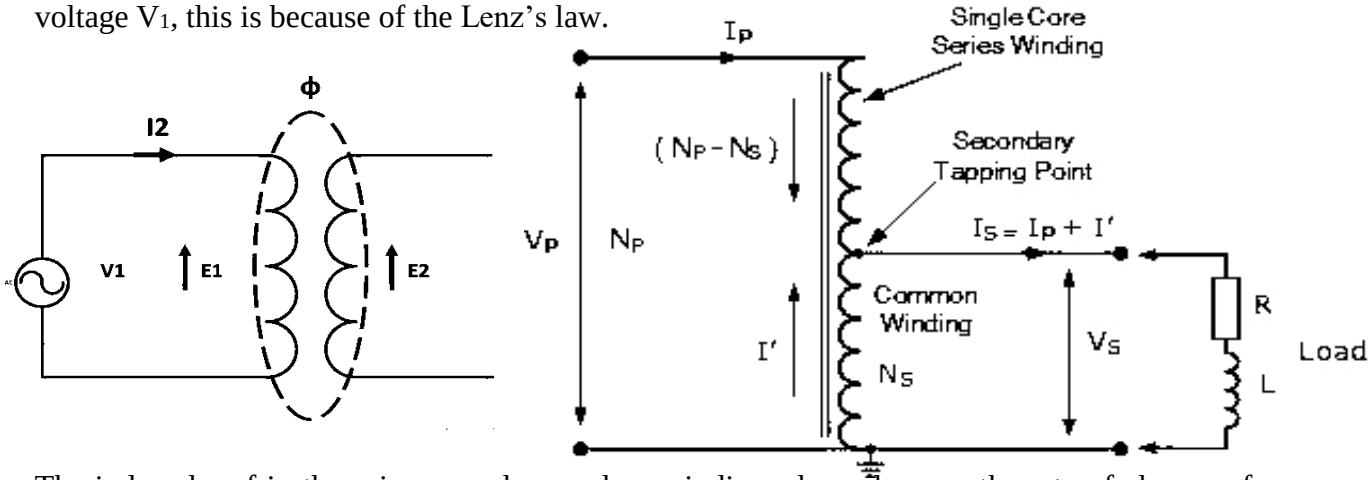
A transformer is a static device which transfers electrical energy from one circuit to another with no direct electrical connection between the two but they are magnetically coupled. It transforms power from one circuit to another without changing its frequency and KVA. A transformer can increase or decrease the voltage with corresponding decrease or increase in current. It helps in providing isolation of the secondary side from the primary side and hence provides safety for the person handling it on the load side.

Working Principle: The basic principle on which the transformer works is **Faraday's Law of Electromagnetic Induction** or **mutual induction** between the two coils. The working of the transformer is explained below.



It consists of two separate windings placed over laminated silicon steel core. The winding to which AC supply is connected is called primary winding and to which load is connected is called secondary winding. It works on the alternating current only because an alternating flux is required for mutual induction between the two windings. When the AC supply is given to the primary winding with a voltage of V_1, an alternating flux ϕ sets up in the core of the transformer, which links with the secondary winding and as a result of it, an emf is induced in

it called Mutually Induced emf. The direction of this induced emf is opposite to the applied voltage V_1, this is because of the Lenz's law.



The induced emf in the primary and secondary windings depends upon the rate of change of flux linkage that is (N dϕ/dt) where, dϕ/dt is the change of flux and is same for both the primary and secondary windings. The induced emf $E_1 \propto N_1$. Similarly $E_2 \propto N_2$.

Turns Ratio:

It is defined as the ratio of primary to secondary turns.

Turns Ratio = N_1 / N_2

If $N_2 > N_1$ the transformer is called Step up transformer

If $N_2 < N_1$ the transformer is called Step down transformer

If $N_2 = N_1$ the transformer is called Isolation transformer

Transformation Ratio

The transformation ratio is defined as the ratio of the secondary voltage to the primary voltage. It is denoted by K.

$$\text{Turns Ratio} = \frac{N_1}{N_2}$$

Procedure

1) Connect the primary side of the transformer with the auto transformer.
2) Turn on the supply
3) Measure the voltage on the secondary side using multimeter.

(NOTE: For step up transformer the percentage take tapping on the primary side should be less than the secondary side while for step down transformer it should be more than that of secondary.)

4) Calculate the value of turns ratio.

Precautions:

1. All the connections should be perfectly tight.
2. Always connect ammeter in series and voltmeter in parallel
3. Use safety guards while working on live parts
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON unti[3]l and unless the connections are checked by

Worksheet of the students

Observation and Calculations:

S.No.	V1	V2	N1	N2	Turns ratio

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No.3

Aim: To learn the use of kit-kat fuse, MCB, energy meter, house wiring, and connections of switches.

Apparatus required:

S. No.	Items	Specifications	Quantity
1	Kit Kat Fuse	0-10A	02
2	MCB	0-10A	01
3	ELCB	0-230V	01
4	Switch	0-10A	01
5	Ammeter	Digital type	01
6	Voltmeter	Digital type	01
7	Variac	1-phase, 230V	01
8	Resistive load	200-2000W	01 Set
9	Connecting wires	As per requirements	

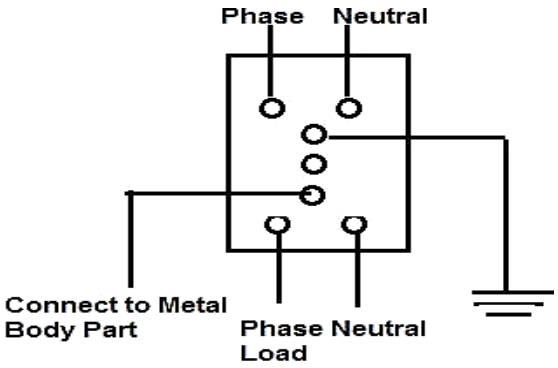
Theory: Over current protection devices are essential in electrical systems to limit threats tohuman life and property damage. Short circuits, overloading, mismatched loads, or device failure are the prime reasons for excessive current. So we need devices to prevent safety hazards to the end user. The various protecting devices used for domestic purposes are,

a. Kit Kat Fuse
b. Miniature Circuit breaker (MCB)
c. Earth Leakage Circuit breaker (ELCB)

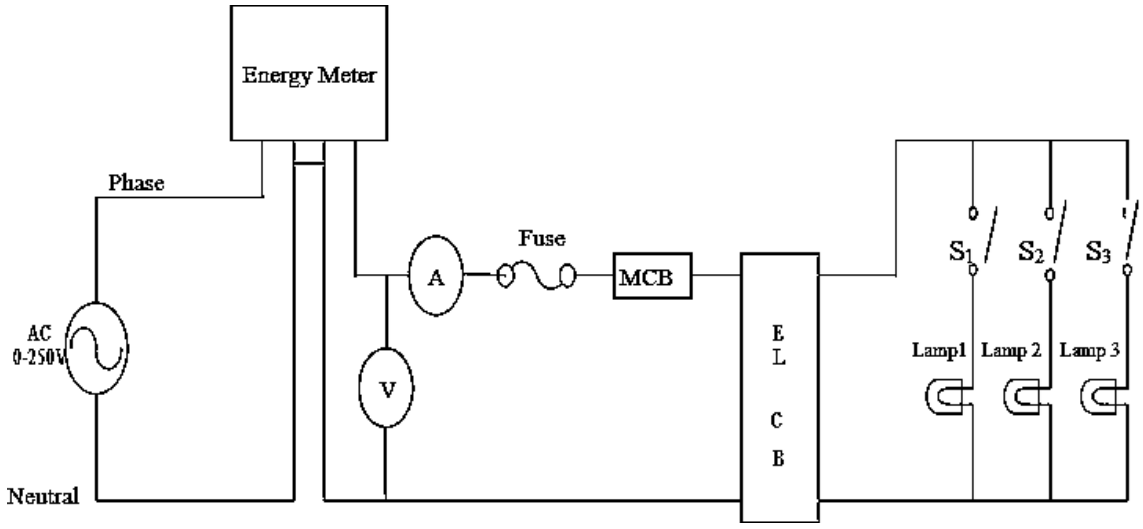
Fuse: It interrupts excessive current so that further damage by overheating or fire isprevented. It is a short length of wire, having low resistance designed to melt and separate in the event of excessive current and provide protection of either the load or source circuit.

MCB: It is abbreviated for miniature circuit breaker (MCB). It also interrupts the excessivecurrent in the circuit due to over loading, short circuiting and when live conductor comes in contact with earth surface.

Earth leakage circuit breaker (**ELCB**): It is a safety device used in electrical installationswith high earth impedance to prevent shock. It detects small stray voltages on the metal enclosures of electrical equipment, and interrupts the circuit if a dangerous voltage is detected.
The ELCB detects fault currents from live to the earth (ground) wire within the installation it protects. If sufficient voltage appears across the ELCB's sense coil, it will switch off the power, and remain off until manually reset. A voltage-sen3sing ELCB does not sense fault currents from live to any other earthed body.



Circuit Diagram:



Procedure:

1. Connect the energy meter just after the supply terminals of variac.
2. Connect MCB/FUSE/ELCB in the circuit as shown in diagram.
3. Connect the load across the supply after protecting devices as per diagram.
4. Now gradually vary the supply in the circuit, so that current flowing through the circuit increases.
5. With different size of fuse wire, connect the full load across the system and note down the value of current/voltage at which Fuse burns/MCB trips/ELCB operates independently.
6. Connect the ammeter and voltmeter as shown in circuit diagram.
7. Connect the variable resistive load and vary the load as per requirement.

Precautions:

1. All the connections should be perfectly tight.
2. Always connect ammeter in series and voltmeter in parallel
3. Use safety guards while working on live parts
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor
6. Use proper wire for connections.

Worksheet of the students

Observation :

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

Sr. No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	**Marks Obtained**	**Max. Marks**
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, discipline and cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT 4

Aim :- To compare incandescent lamps, fluorescent lamps, CFL, and LED-based light sources for its efficiency.
Switching control of a single lamp by using four 2-way switches.

Apparatus Required:-

. No.	Apparatus Required	Specification	Qty.
1	Incandescent Lamp(Bulb)	230V,40W	1
2	Fluorescent Lamp	230V,40W	1
3	CFL	230V,40W	1
4	LED	230V,40W	1
5	Luxmeter	Digital	1
6	SPDT Switch	230V,10A	2
7	Bulb	230V,60W	1
8	Wires	As per requirement	

Theory: There are various light sources used at home such as Incandescent lamp,fluorescent lamp, CFL and LED . Out of all these LED is the greenest option available in all forms of lighting. And that is because:

- It does not contain any mercury, which is harmful for environment unlike the fluorescent bulbs and lights.
- It lasts much longer (about 10-20 years) and thus their disposal is less of a concern.

Fluorescent lights and CFLs on the other hand contain mercury that is harmful for environment and their disposal is a concern.
Most fluorescent bulbs/tubes may not last more than 3-4 years (10000-15000 hrs of usage). But LEDs last much longer (upto 25000-50000 hrs of usage).

Lumens or brightness of the light:LEDs are always marketed as lighting options that givemore brightness per watt of electricity. The claim is true if LEDs are used for spotlighting. LEDs are unidirectional source of light and thus they are excellent for spot lighting. LED luminaires that are available for general-purpose lighting have inbuilt reflectors that spread the light in all directions. And the use of reflectors causes decrease in brightness per watt. This results in their efficiency come down to as low as that of fluorescent lights.

Costs: It's commonly known that LED luminaires are expensive. They cost at least 3-4 times more than T5 fluorescent lights. However their life is also much longer as compared to fluorescent lights.

	Incandescent Bulbs	CFLs	LED Bulbs
Life (4 hours daily usage)	4 months (observed)	2.5 years (observed)	10 years (advertised)
Wattage of Bulb Required	40	8	5
Savings (compared to Incandescent Bulbs)	0%	45.74%	73.98%
Lumen / Watt	16	50 - 70	90 - 100
Total Cost of Ownership per year (C = A + B)	Rs. 545.24	Rs. 295.82	Rs. 141.82
Cost of Bulb / Year (B)	Rs. 75.00	Rs. 74.00	Rs. 46.90
Cost of Bulb	Rs. 25.00	Rs. 185.00	Rs. 469.00
Electricity Cost per Year (Rs. 6.75/KWH) (A)	Rs. 470.24	Rs. 221.82	Rs. 94.92

Wiring Standards: Wires **and** cables **are** rated by the circuit voltage, temperature and environmental conditions in which they can be used, and their maximum current. Wiring safety codes vary by country, and the International Electro-technical Commission (IEC) is attempting to standardize wiring amongst member countries. Colour codes are used to distinguish line, neutral and earth (ground) wires.

Wire Rating: The conductor material, insulation, size and the number of cores, specifies the electrical wires. These are important parameters as they determine the current and voltage handling capability of the wires. The wires may be of single strand or multi strand. The conductors are specified as 1/20,3/22,7/20etc.The numerator indicates the number of strands while the denominator corresponds to the diameter of the wire in SWG (Standard Wire Gauge).As the SWG number increases the thickness of the wire decreases. The selection of the wire is made depending on the requirement considering factors like current and voltage ratings, cost and application

Colour coding: Electrical wires follow standard colour coding that helps classify each wirefunction in the circuit. **In India wires are RGB mode i.e. Red- Green- Black**. Each of these RGB wire have different functions.

Red –Red wire signifies the phase in electric circuit. It is he live wire which cannot beconnected to another red wire or black wire. When the switch is turned on, the wire becomes hot that's why it's known as hot wire.

Black –Black wires signifies neutral wire in electric circuit. Black wire can be connected to black wire only and no other colour wire. Black wire being neural, it does carry charge/current. It mainly carries the unbalanced load i.e. the return current that we call.

Green –Green wire stands for grounding/ earthing in electric circuit. A green wire can be connected to green wire only (no other wire). Grounding wires are usually not meant for

lights and fan purposes. Green wires are chiefly used for socket purpose. Socket could be for AC, geyser, TV, microwave, etc. Normally, switches have only 2 wires i.e. neutral and phase.

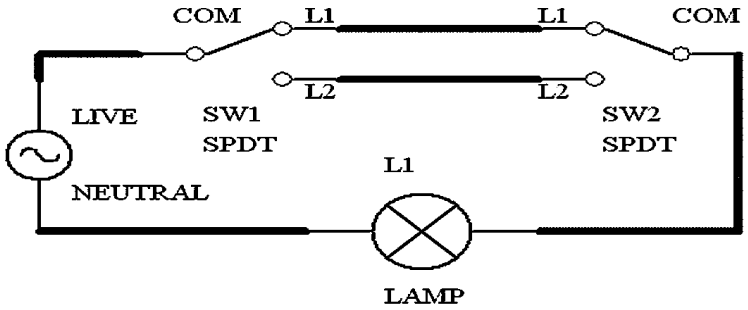
Function	*India Color Code (Old)*	*India Color Code (New)*
Single Phase Line		
Single Phase Neutral		
Single Phase Protective Ground or Earth		
Three Phase Line (L1)		
Three Phase Line (L2)		
Three Phase Line (L3)		
Three Phase Neutral (N)		
Three Phase Protective Earth or Ground (PE)		

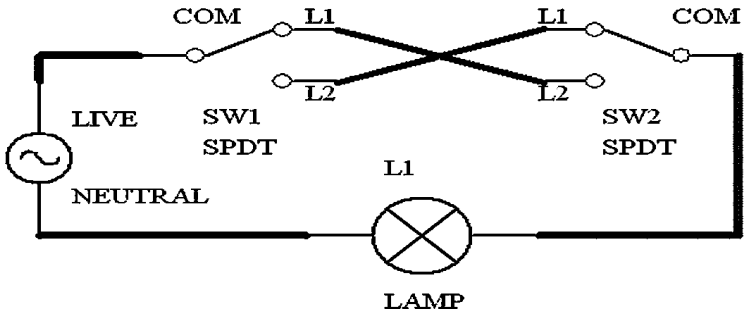
Two Way Switch: 2 way switching means having two or more switches in different locationsto control one lamp. They are wired so that operation of either switch will control the light. This arrangement is often found in stairways or in long hallways with a switch at either end. The switches can be connected either in cross or parallel in order to have different switching conditions.

SWG TO mm CONVERSION TABLE

SWG	Dia(mm)	SWG	Dia(mm)	SWG	Dia(mm)	SWG	Dia(mm)
1	7.62	14	2.032	27	0.4166	40	0.1219
2	7.0104	15	1.8288	28	0.3759	41	0.1118
3	6.4008	16	1.6256	29	0.3454	42	0.1016
4	5.8928	17	1.4224	30	0.315	43	0.0914
5	5.3848	18	1.2192	31	0.2946	44	0.0813
6	4.8768	19	1.016	32	0.2743	45	0.0711
7	4.4704	20	0.9144	33	0.254	46	0.061
8	4.064	21	0.8128	34	0.2337	47	0.058
9	3.6576	22	0.7112	35	0.2134	48	0.0406
10	3.2512	23	0.6096	36	0.193	49	0.0305
11	2.9464	24	0.5588	37	0.1727	50	0.0254
12	2.6416	25	0.508	38	0.1524		
13	2.2368	26	0.4572	39	0.1321		

Circuit Diagram:-





Procedure:

1) Connect the Incandescent bulb in series to the power supply.
2) Connect voltmeter in parallel and ammeter in series to the incandescent bulb
3) Place the lux meter at some specific distance from incandescent bulb. If required, take help of scale for this purpose.
4) Note down the lumens and fix this lumens as reference for rest of the bulbs.
5) Note down the reading of voltmeter and ammeter.
6) Repeat steps 1 to 5 for the fluorescent lamp, CFL and LED bulbs.

Precautions:

2. All the connections should be perfectly tight.
3. Use safety guards while working on live parts.
4. Don't touch the bare conductor when supply is ON.
5. Supply should not be switched ON until and unless the connections are checked by the Faculty/Lab Instructor.

Worksheet of the students

Observation and Calculations:

Sr. No	Type of Bulb	Voltage(V)	Current(A)	Power Input(W) P=VI	Power Outage Rating(W) Conversion Factor 1Lumen=0.00147W	Percentage Efficiency (%)

Truth table for Switching control:

Results and Discussion:

Learning Outcome (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, Discipline and Cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

EXPERIMENT No. 5

Aim: To verify Thevenin's and Norton's theorems in DC circuits using hardware.

Experiment No. 5.1: Verification of Thevenin's theorem.

Apparatus required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1Kohm, 220ohm. 330ohm	3,1
4	Bread Board	--	Required
5	DRB	--	1

Statement:

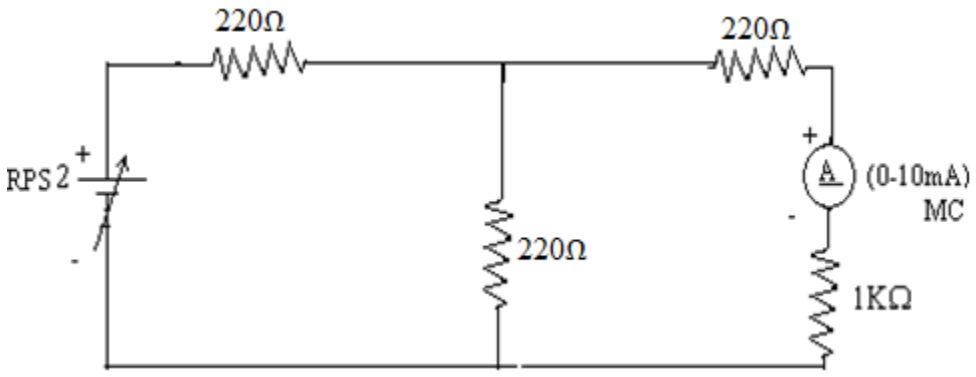
Any linear bilateral, active two terminal network can be replaced by a equivalent voltage source (V_{TH}). Thevenin's voltage or V_{OC} in series with looking back resistance R_{TH}.

Procedure:

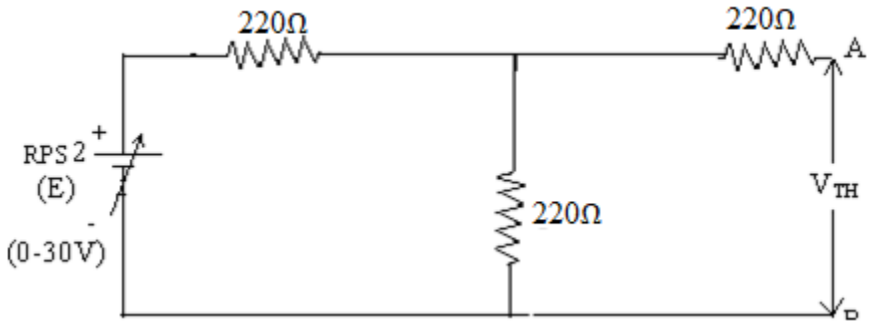
1. Connections are given as per the circuit diagram.
2. Set a particular value of voltage using RPS and note down the corresponding ammeter readings.
3. To find V_{TH} : Remove the load resistance and measure the open circuit voltage using multimeter (V_{TH}).
4. To find R_{TH} : Remove the RPS and short circuit it and find the R_{TH} using multimeter.
5. Give the connections for equivalent circuit and set V_{TH} and R_{TH} and note the corresponding ammeter reading.
6. Verify Thevenins theorem

Circuit Diagrams:

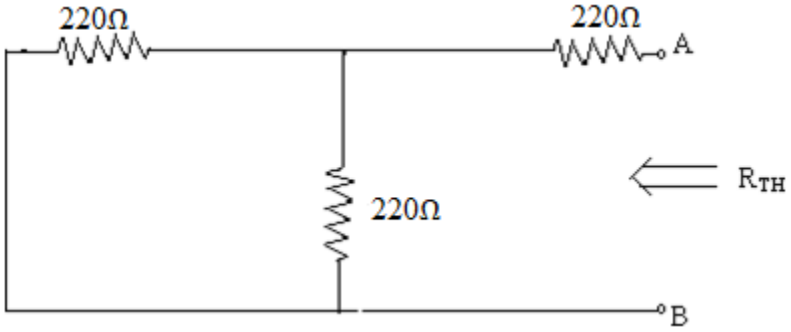
Circuit - 1 : To find load current



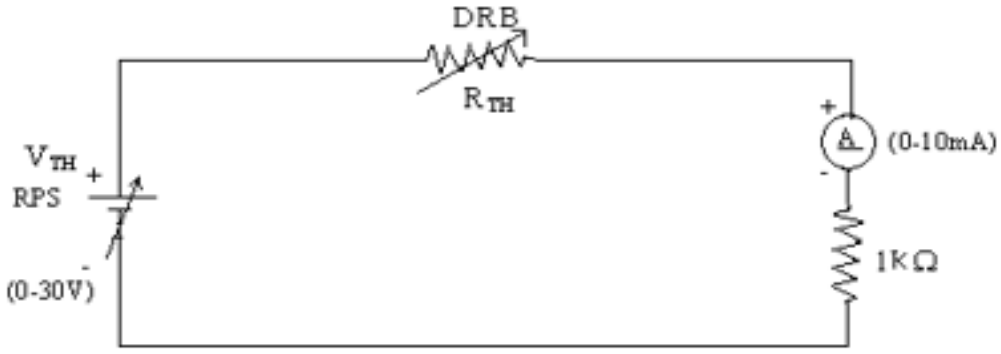
Circuit 2: To find V_{TH}



Circuit 3 : To find R_{TH}



Thevenin's Equivalent Circuit:



Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position

Worksheet of the student

Date of Performance: Registration Number:

Observation Table:

Load current from Circuit 1	V_{TH} from Circuit 2	R_{TH} from Circuit 3	Equivalent circuit current

Calculations:

Results and Discussion:

Learning Outcomes (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		20
2	Observations and analysis including learning outcome		20
3	Completion of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total Marks Obtained**	

Experiment No. 5 .2: Verification of Norton's theorem.

Apparatus required:

Sl.No.	Apparatus	Range	Quantity
1	RPS (regulated power supply)	(0-30V)	2
2	Ammeter	(0-10mA)	1
3	Resistors	1Kohm, 220ohm, 330ohm	3,1
4	Bread Board	--	Required
5	DRB	--	1

Statement:

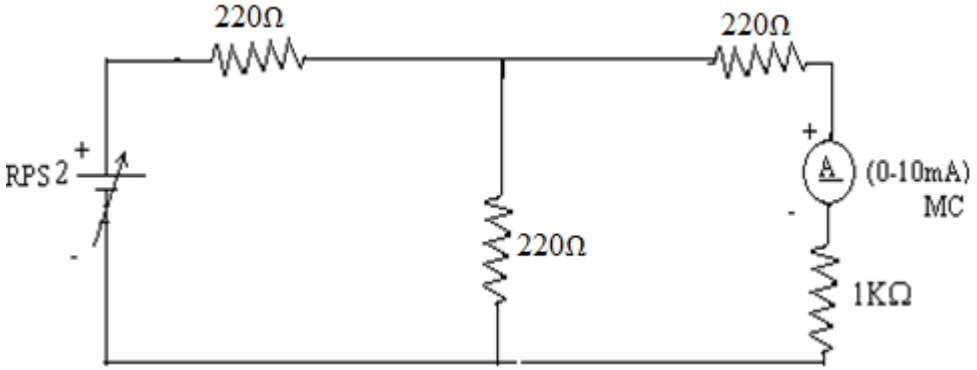
Any linear, bilateral, active two terminal network can be replaced by an equivalent current source (I_N) in parallel with Norton's resistance (R_N)

Procedure:

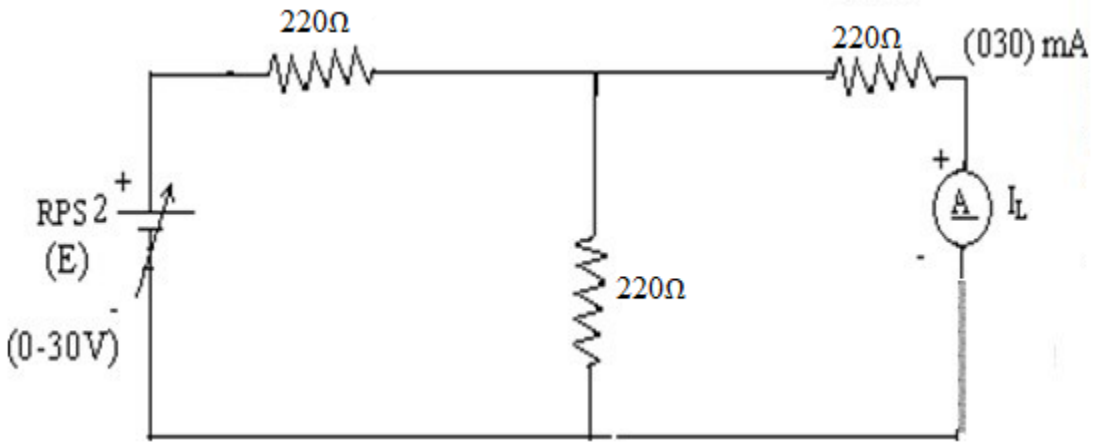
1. Connections are given as per circuit diagram.
2. Set a particular value in RPS and note down the ammeter readings in the original circuit.
3. To Find I_N: Remove the load resistance and short circuit the terminals.
4. For the same RPS voltage note down the ammeter readings.
5. To Find R_N: Remove RPS and short circuit the terminal and remove the load and note down the resistance across the two terminals.
6. Equivalent Circuit: Set I_N and R_N and note down the ammeter readings.
7. Verify Norton's theorem.

Circuit Diagrams:

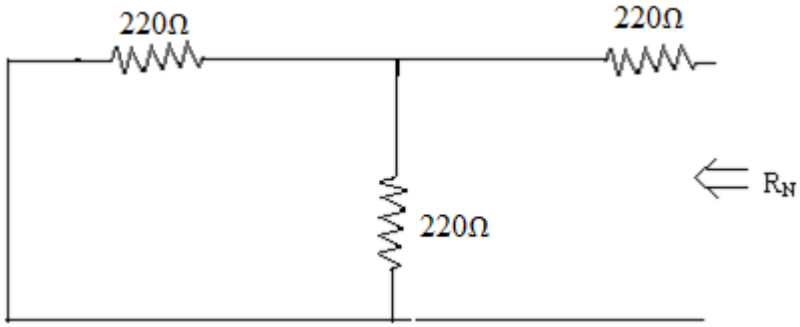
Circuit 1: To find load current



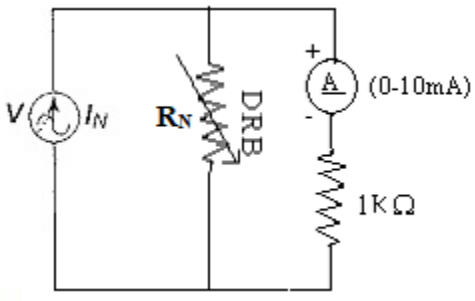
Circuit 2: To find I_N . 220Ω



Circuit 3: To find R_N



Norton's Equivalent Circuit:



Precautions:

1. Voltage control knob of RPS should be kept at minimum position.
2. Current control knob of RPS should be kept at maximum position.

Worksheet of the student

Date of Performance: Registration Number:

Observation Table:

Load current from Circuit 1	I_N from Circuit 2	R_N from Circuit 3	Equivalent Circuit current

Calculations:

Results and Discussion:

Learning Outcomes (what I have learnt):

To be filled by faculty:

S.No.	**Parameters**(Scale from 1-10, 1 for very poor and 10 for excellent)	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/ apparatus		**20**
2	Observations and analysis including learning outcome		**20**
3	Completion of experiment, Discipline and Cleanliness		**10**
	Signature of Faculty	**Total Marks Obtained**	

Experiment 6

1. Aim: To analyze and implement Boolean Expressions using Basic Logic Gates (AND, OR, NOT, NOR, NAND and XOR gates).

Apparatus Required: IC 7408, 7432, 7404, IC 7486, 7400, 7402, 7486 and Digital Training Kit.

2. Learning Objectives: This experiment enables a student to learn

- How to analyze logic gates
- How to express Boolean expression using logic gates
- How to check equivalence of two Boolean expressions using logic gates
- How to check equivalence of two logic circuits consisting of multiple gates

3. Theory: Analysis of Logic gates using 7408, 7432, 7404 Power Supply. Diagrams of each chip are shown in figures

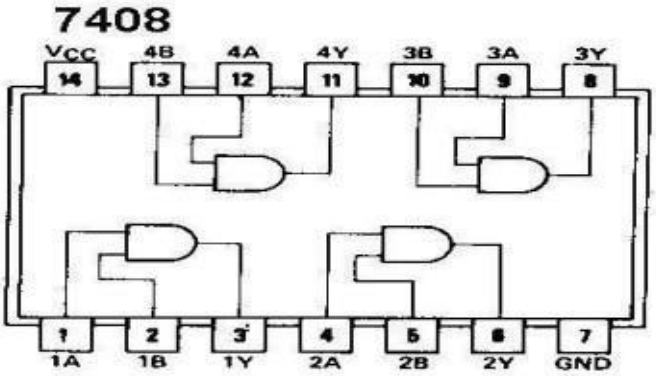


Figure1

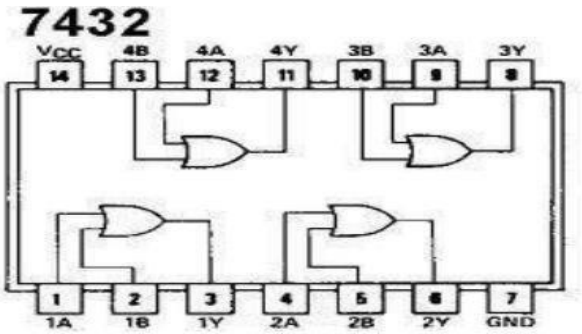


Figure2

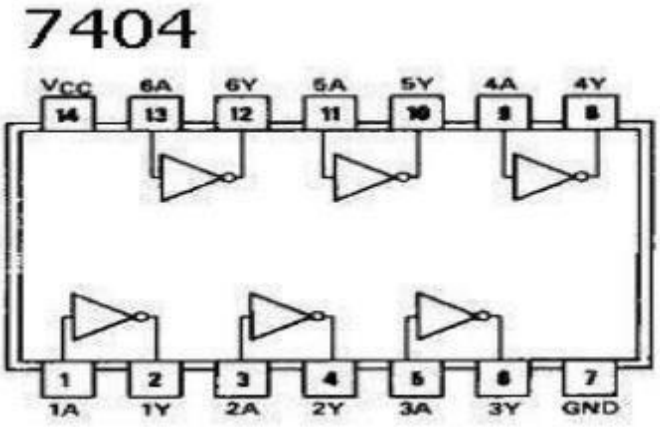


Figure 3

Fig: 1 .7408(quad 2 input AND gates) Fig: 2. 7432 (quad 2 input OR gates) Fig: 3. 7404(HEX inverter)

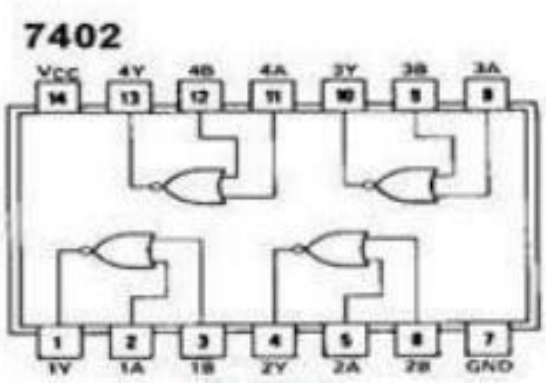


Figure 4

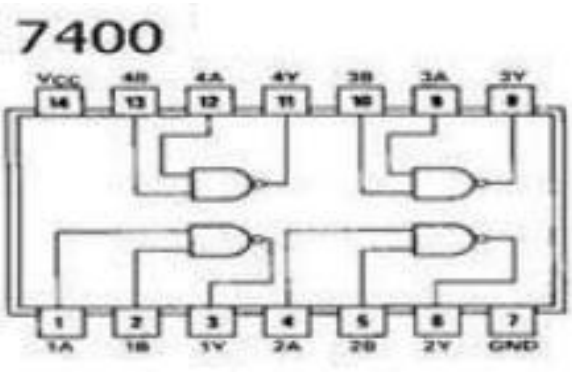


Figure 5

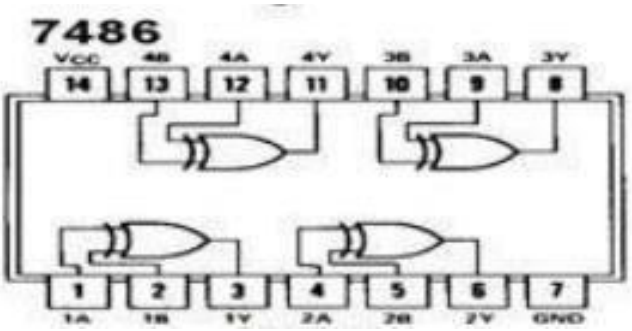
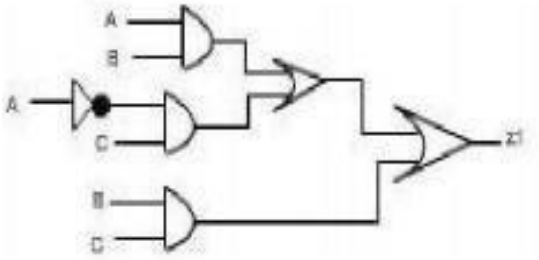


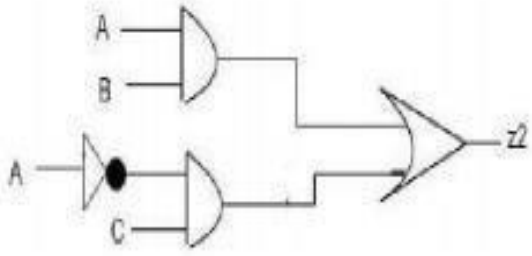
Figure 6

Fig: 4.7432(quad 2 input NOR gates) Fig: 5. 7400 (quad 2 input NAND gates) Fig: 6. 7486(quad 2 input XOR gates)

(a) AB+A'C+BC=AB+A'C

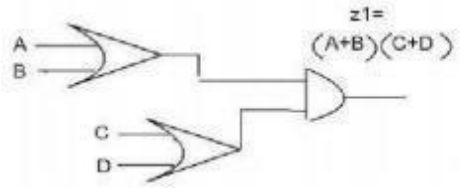
According to consensus theorem, the Boolean identity holds.

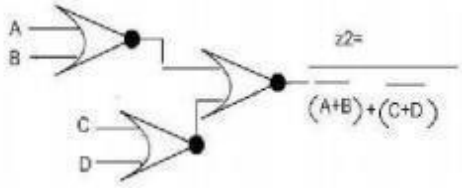




In the above picture both circuits are equivalent.

(b) Verify equivalence of OR-AND and NOR-NOR structure

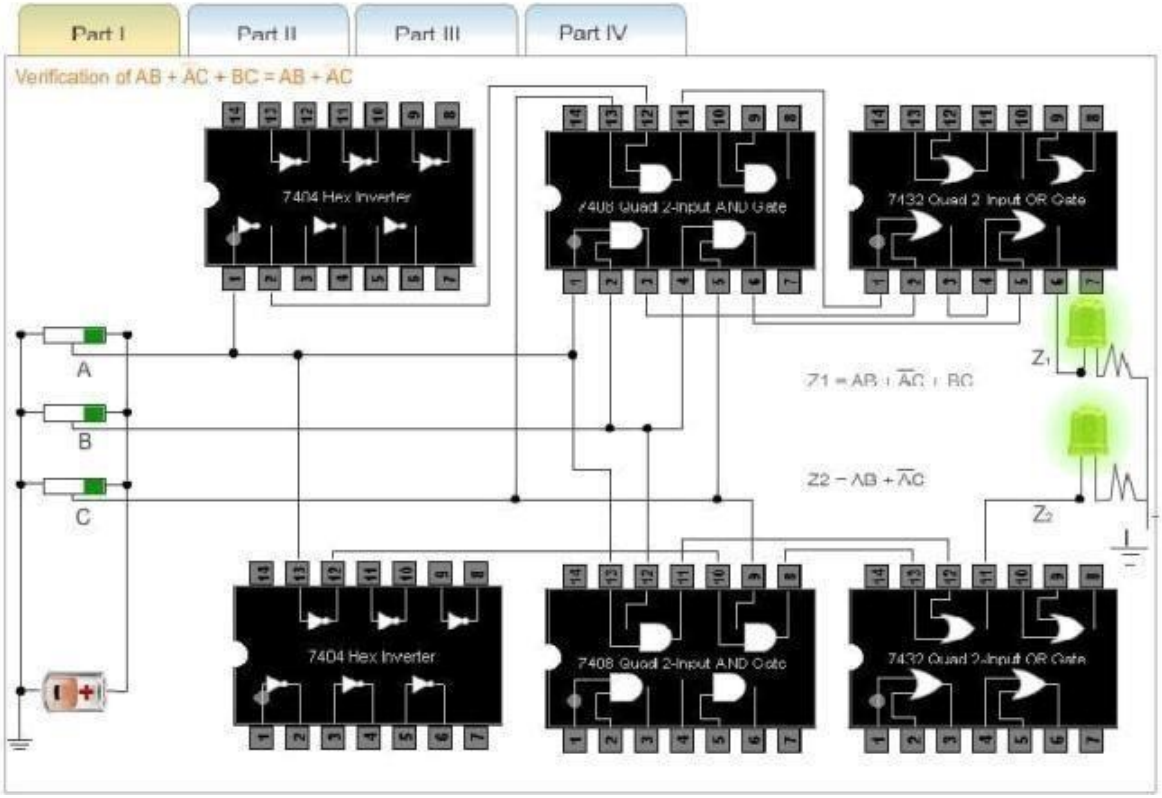


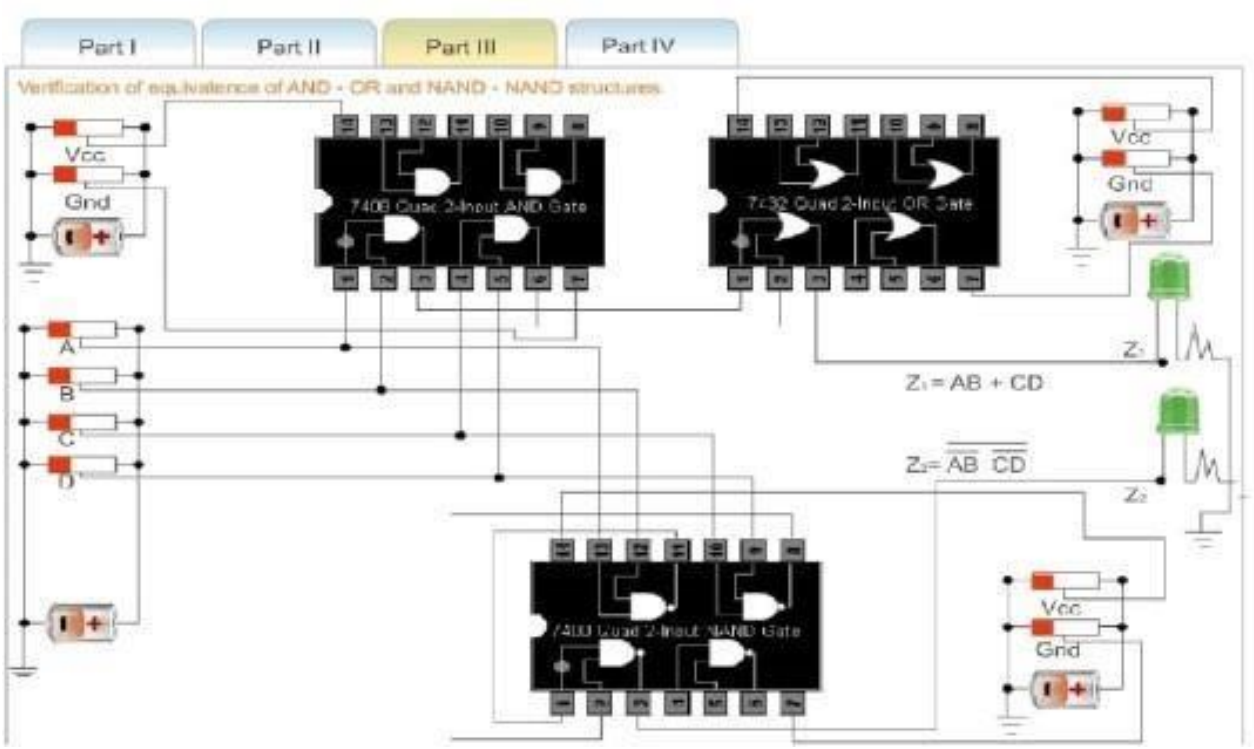


In the above picture both circuits are equivalent. Student may be asked to wire up the network of gates shown in the above figures. They can next verify that the output of the two circuits, viz z1 and z2.

4. Procedure: Follow these steps to do the experiment.

1. At first go through the structure of 7404 Hex inverter, 7408(quad 2-input AND gates), 7432(quad 2-input OR gates).
2. Next, apply a high level voltage to all the inputs A, B, C.
3. Next, check that both LEDs glow. This is because both the outputs z1 and z2 attain the same value.
4. Thus, AB+A'C+BC=AB+A'C holds for the condition A=B=C="1".
5. For all the combinations of the variables A, B, and C verify that both the LEDs are glowing or not glowing. If the LED glows, it indicates that the corresponding output has reached logic 1 level. Similarly, a dark LED indicates low level output voltage.





5. Required Results:

A	B	B	Z1	Z2
L	L	L	L	L
L	L	H	H	H
L	H	L	L	L
L	H	H	H	H
H	L	L	L	L
H	L	H	L	L
H	H	L	H	H
H	H	H	H	H

6. Precautions:

1. Do not press the IC on breadboard until pins are aligned with pours.
2. Make connection properly.
3. There should not any short circuit in the circuit.
4. Avoid the heating of IC 7.

7. Learning Outcomes: Students will be able to understand the analysis and synthesis of Boolean expressions.

Circuit Diagram or Pin Diagram:

Observations:

Learning Outcomes (What I have learnt):
To be filled by faculty

S. No.	Parameter	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/apparatus.		**20**
2	Observations and analysis including learning Outcomes		**20**
3	Completion of experiment, Discipline and Cleanliness		**10**
	Signature of Faculty	**Total marks obtained**	

Experiment 7

Aim: To design a circuit for Full adder and full subtractor using X-OR and basic gates

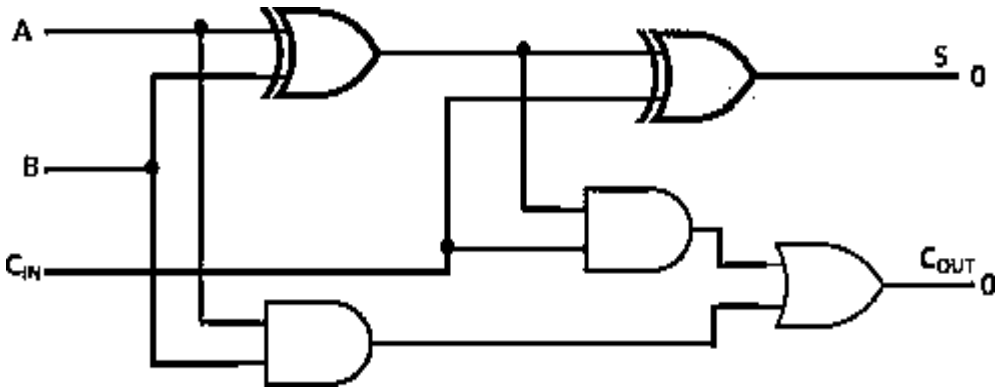
1. **Apparatus Required: -** IC 7486, IC 7432, IC 7408, IC 7400, IC 7404 etc.
2. **Learning objective**:
    a) How to realize the functionality full adder.

3. Theory:

1) Using X – OR and Basic Gates to implement full Adder:

A full adder adds binary numbers and accounts for values carried in as well as out. A one-bit full adder adds three one-bit numbers, often written as A, B, and Cin ; A and B are the operands, and Cin is a bit carried in from the next less significant stage. The full-adder is usually a component in a cascade of adders, which add 8, 16, 32, etc. binary numbers. The circuit produces a two-bit output sum typically represented by the signals Count and S.
In this implementation, the final OR gate before the carry-out output may be replaced by an XOR gate without altering the resulting logic. Using only two types of gates is convenient if the circuit is being implemented using simple IC chips which contain only one gate type per chip. In this light, Cout can be implemented as. A full adder can be constructed from two half adders by connecting A and B to the input of one half adder, connecting the sum from that to an input to the second adder, connecting Ci to the other input and OR the two carry outputs. Equivalently, S could be made the three-bit XOR of A, B and Ci, and Cout could be made the three-bit majority function of A, B, and Ci.

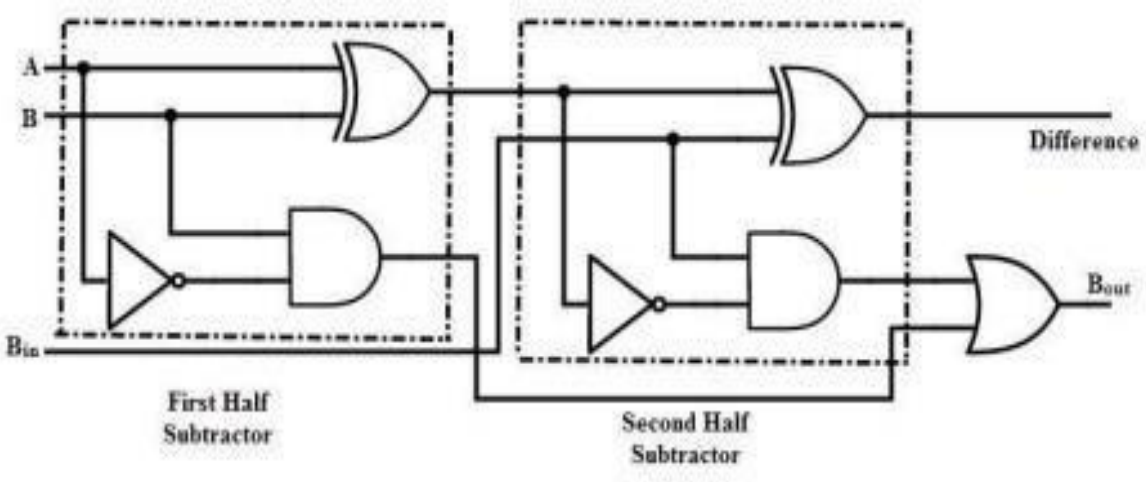
Full Adder using half adders:



Using X – OR and Basic Gates to implement Full Subtractor:

As in the case of the addition using logic gates, a full subtractor is made by combining two half subtractors and an additional OR-gate. A full subtractor has the borrow in capability (denoted as

B_{IN} in the diagram below) and so allows cascading which results in the possibility of multi-bit subtraction. The circuit diagram for a full subtractor is given below.



5. Procedure:

1. Verify the gates.
2. Make the connections as per the circuit diagram
3. Switch on VCC and apply various combinations of input according to the truth table.
4. Note down the output readings for half/full adder sum and the carry bit for different combinations of inputs.

6. Cautions:

1. Do not press the IC on breadboard until pins are aligned with pours.
2. Make connection properly.
3. There should not any short circuit in the circuit.
4. Avoid the heating of IC.

7. Learning Outcomes: Students will be able to understand the implementation of adders with the help of logic gates.

Worksheet of the student

Date of Performance: _____ **Registration Number:**_____ **Roll Number:** _____

Aim:

Circuit Diagram or Pin Diagram:

Observations:

Learning Outcomes (What I have learnt):

To be filled by faculty

S. No.	Parameter	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/apparatus.		**20**
2	Observations and analysis including learning Outcomes		**20**
3	Completion of experiment, Discipline and Cleanliness		**10**
	Signature of Faculty	**Total marks obtained**	

Experiment-8

Aim: Understanding the combinational logic by implementing the boolean function using multiplexer
Apparatus required: Multiplexer ICs (dual 4:1 mux 74153),7404, Chords.

1. Learning objectives:

a) How to realize functionality of Dual 4 Line to 1 Line Multiplexer using 74153 IC.

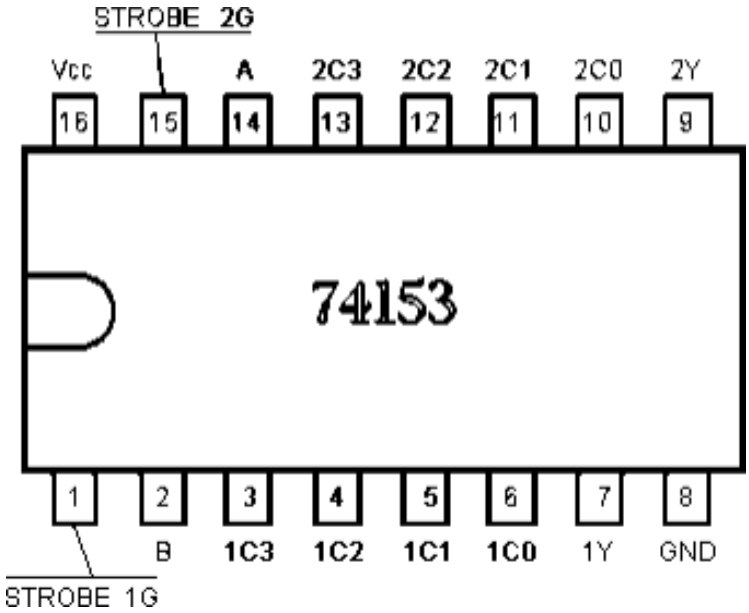
b) How Dual 4 Line to 1 Line Multiplexer select the particular input to be sent to the output.

2. Theory:

It quite often happens, in the design of large-scale digital systems, that a single line is required to carry two or more different digital signals. Of course, only one signal at a time can be placed on the one line. What is required is a device that will allow us to select, at different instants, the signal we wish to place on this common line. Such a circuit is referred to as a Multiplexer. A multiplexer performs the function of selecting the input on any one of 'n' input lines and feeding this input to one output line.

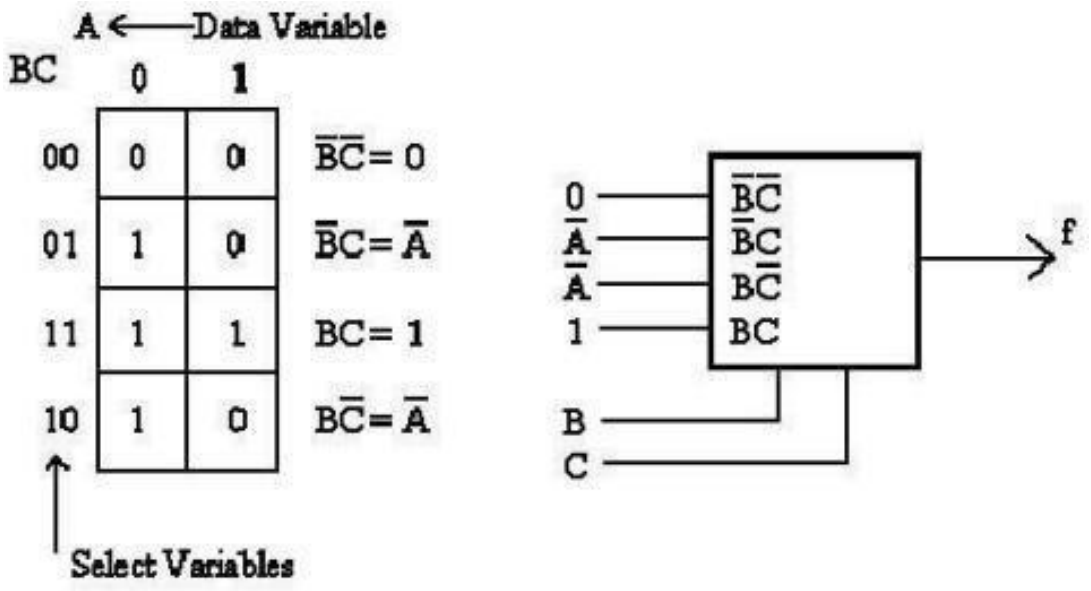
Multiplexers are used as one method of reducing the number of integrated circuit packages required by a particular circuit design. This in turn reduces the cost of the system.

Assume that we have four lines, C0, C1, C2 and C3, which are to be multiplexed on a single line, Output (Y). The four input lines are also known as the Data Inputs. Since there are four inputs, we will need two additional inputs to the multiplexer, known as the Select Inputs, to select which of the C inputs is to appear at the output. Call these select lines A and B. The gate implementation of a 4-line to 1-line multiplexer is shown below:



Implementation of a Boolean function using 4:1 mux:

Consider the function: In this example we could have picked any variable to be the data variable and the other two as select variables. Suppose one were to take A as the data variable. The corresponding Karnaugh map is then:

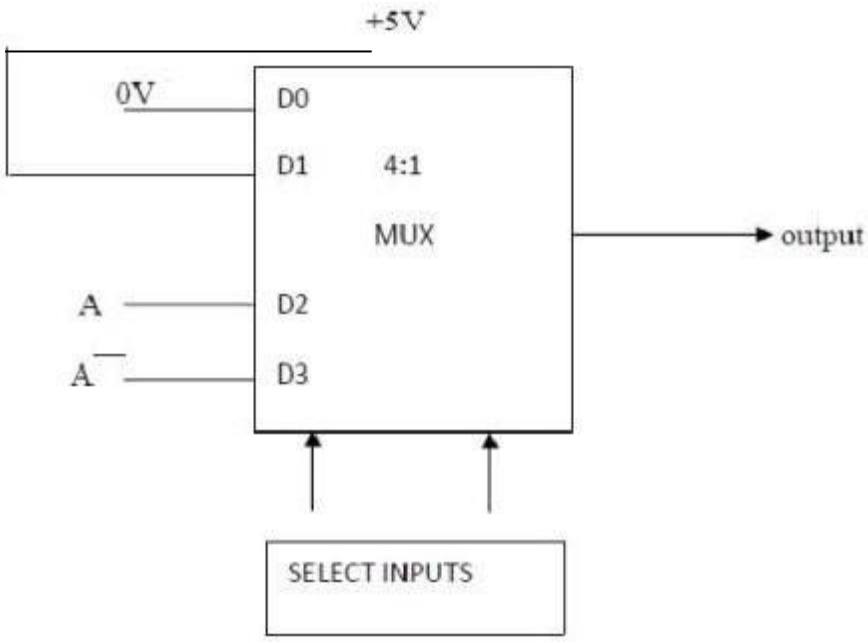


Alternate method:

Implementation of a following function using 4:1 mux: $F(A,B,C)= \Sigma(1,3,5,6)$

The given function has three variables. Hence, it can be implemented using a multiplexer with two select inputs and four data inputs. The implementation table of the given function as shown in table below:

	D_0	D_1	D_2	D_3
$\bar{A}$	0	(1)	2	(3)
A	4	(5)	(6)	7
	0	1	A	$\bar{A}$



3. Procedure

a) At first go through the structure of 74153.Then apply high level voltage to Vcc and low level voltage to GND. If Vcc and ground are not connected properly then error message will be shown and no output will be generated.
b) Next, apply high level voltage to Strobe1G or strobe 2G. If STROBE 1G is low, 1st Multiplexer is activated. If STROBE 2G is low, then 2nd Multiplexer is activated.
c) Next, apply low level voltage to the select inputs A and B (A Most Significant Bit, B Less significant bit). Then apply a high level voltage to 2C0. Now check that how Dual 4 Line to 1 Line Multiplexer select the particular input to be multiplexed and to be applied to the output IY {1 = 1, 2}.
d) For all the combinations of the select inputs A, B verify that both the LEDs are glowing or not glowing. If the LED glows, it indicates that the corresponding output has reached logic 1 level.
Similarly, a dark LED indicates low level output voltage.
e) If both the Strobe inputs are low then both Multiplexers are activated.

4. Cautions:
1. Do not press the IC on breadboard until pins are aligned with pours.
2. Make connection properly.
3. There should not any short circuit in the circuit.
4. Avoid the heating of IC.

Worksheet of the student

Date of Performance: _____ **Registration Number:**_____ **Roll Number:** _____

Aim:

Circuit Diagram or Pin Diagram:

Observations:

Learning Outcomes (What I have learnt):

To be filled by faculty

S. No.	Parameter	Marks Obtained	Max. Marks
1	Understanding of the student about the procedure/apparatus.		20
2	Observations and analysis including learning Outcomes		20
3	Completion of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total marks obtained**	

Experiment 9

1. **AIM**: Understanding the sequential logic by implementing the flip flop with the help of logic gates.

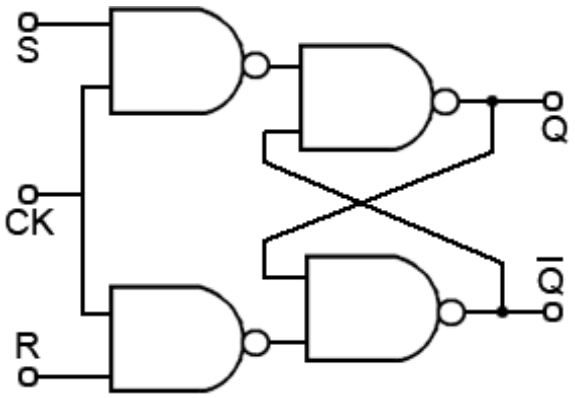
2. **Apparatus required:** IC 7410, 7408, 7432, 7404, IC 7486, 7400, 7402, Power supply and LEDs.

3. **Learning Objectives:**
   How to realize the functionality of sequential circuits using basic flip-flops

4. **Theory**

The logic circuits whose outputs at any instant of time depend not only on the present input but also on the past outputs are called sequential circuits.
The simplest kind of sequential circuit which is capable of storing one bit of information is called latch. The operation of basic latch can be modified, by providing an additional control input that determines, when the state of the circuit is to be changed. The latch with additional control input is called the Flip-Flop. The additional control input is either the clock or enable input.
Flip flop is formed using logic gates. Flip flop are fundamental building blocks in the memory of electronic devices. Each flip flop can store one bit of data.
Based on their operations, flip flops are basically 4 types. They are
S-R flip flop
D flip flop
J-K flip flop
T flip flop

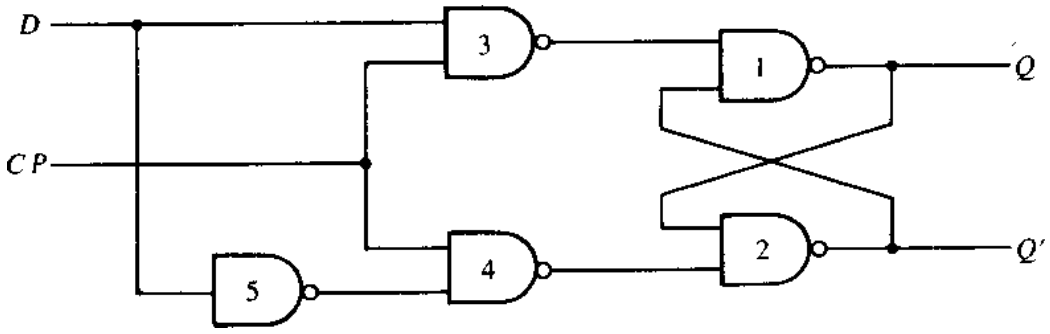
S-R flip-flop



Truth table

Flip-flop inputs		*Present output*	*Next output*
S	R	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	X
1	1	1	X

D flip-flop



Truth Table:

Q	D	Q(t + 1)
0	0	0
0	1	1
1	0	0
1	1	1

J-K flip-flop

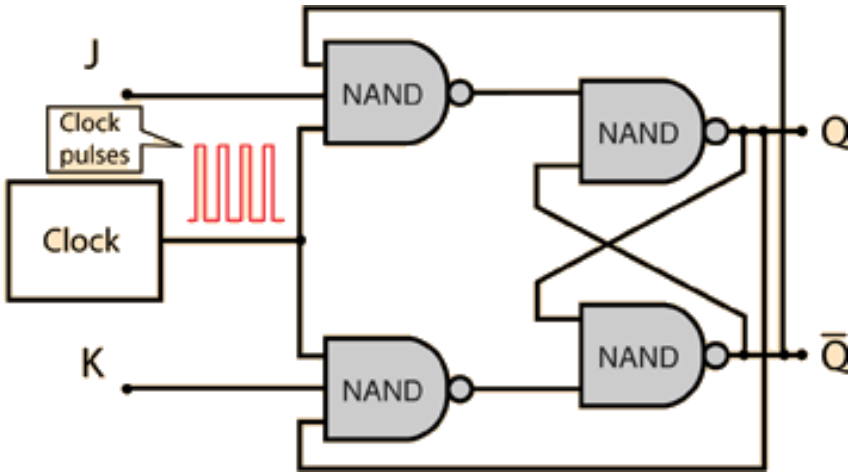
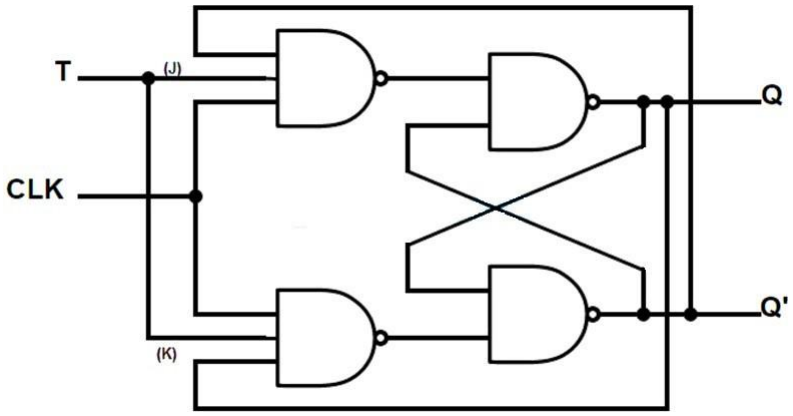


Figure: J-K Flip flop using NAND gate

Truth table

J	K	Q(t+1)
0	0	Q(t)
0	1	0
1	0	1
1	1	$\overline{Q}$ (t)

T flip-flop



Truth table:

T	Q_n	Q_{n+1}
0	0	0
0	1	1
1	0	1
1	1	0

5. Procedure

1. Make the connections as per the desired flip-flop.
2. Enable the "Clock Start" button.
3. Apply the inputs and note the correction outputs i.e., present state output and corresponding next state outputs.
4. Tabulate all the readings and verify the output with theoretical values.

6. Cautions:

Do not press the IC on breadboard until pins are aligned with pours.
Make connection properly.
There should not any short circuit in the circuit.
Avoid the heating of IC.
Provide proper clock pulse.

7. Learning Outcomes: Student will be able to learn the working of flip flops

Date of Performance **Worksheet of the student** **Registration Number**

Aim:

Observation Table for J-K Flip Flop

J	K	Q(t)	Q(t+1)

Learning Outcomes (what I have learnt):

To be filled in by Faculty

S.No.	Parameter	Marks obtained	Max. Marks
1	Understanding of the student about the procedure/apparatus.		20
2	Observations and analysis including learning Outcomes		20
3	Completion* of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total marks obtained**	

Experiment 10

1. **Aim:** To visualize the output of decade counter on seven segment display.

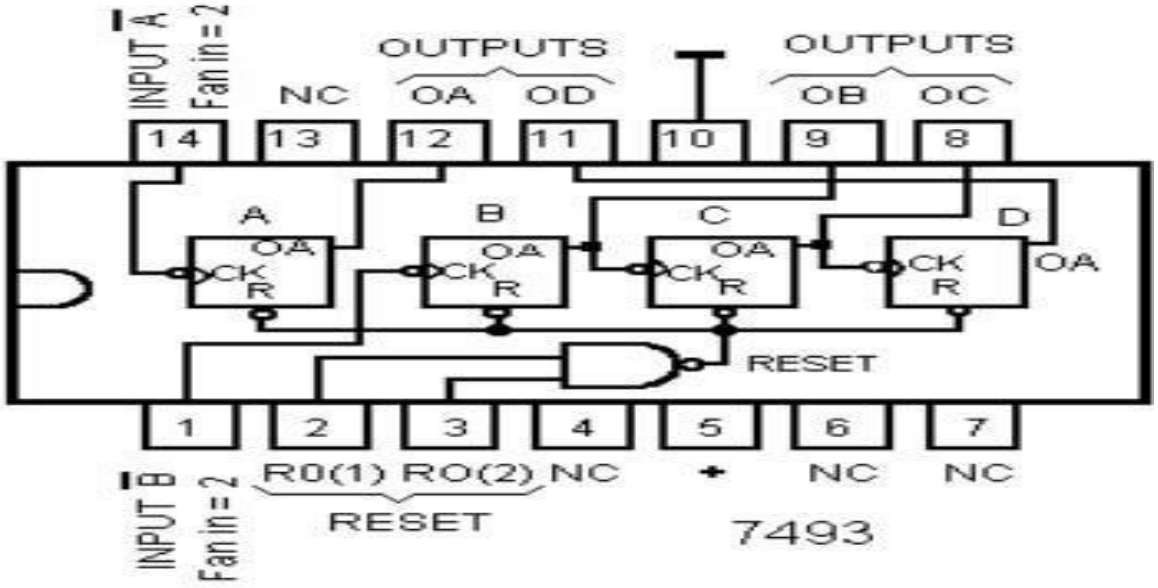
2. **Apparatus required:** IC 7490, 7493, IC 7447 Decoder, Seven Segment display, Power supply,LEDs.

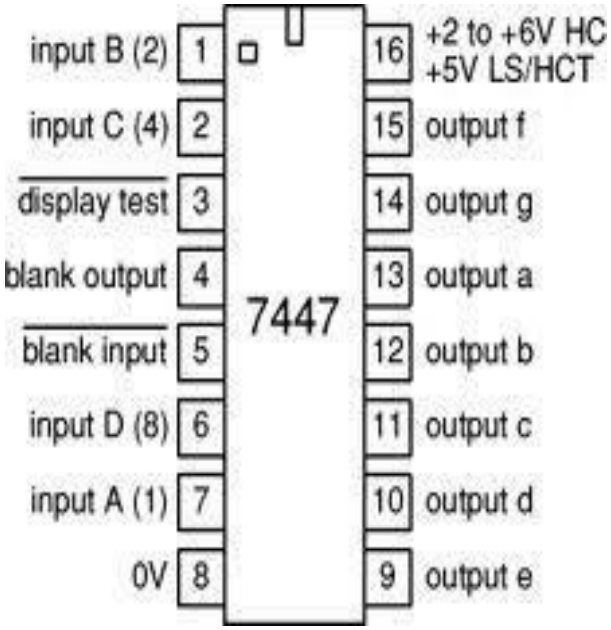
3. **Learning Objectives:** To learn to realize the functionality of sequential circuits using basic flip-flops.

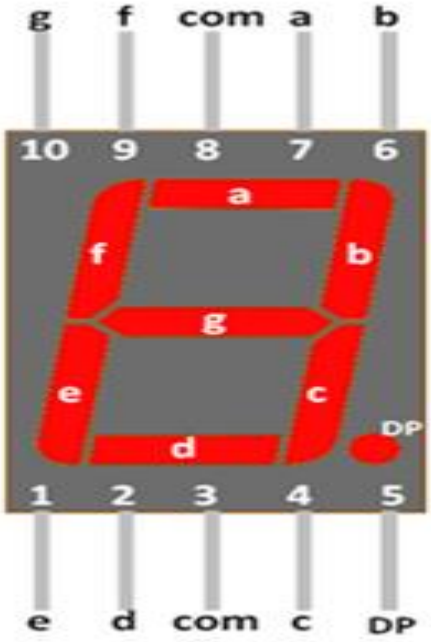
4. **Theory:** A decade counter requires resetting to zero when the output count reaches the decimal value of 10, i.e. when 1010 and to do this we need to feed this condition back to the reset input. A counter with a count sequence from binary 0000 through to 1001 is generally referredto as a BCD binary code decimal counter because its ten state sequences is that of BCD code.

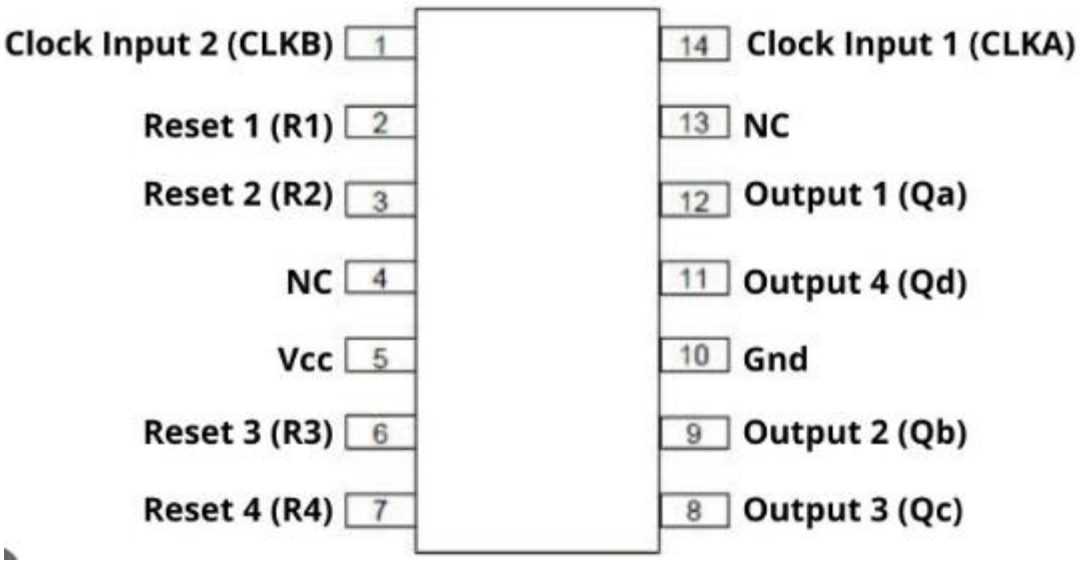
Decade Counter Truth Table

Clock Count	Output bit Pattern				Decimal Value
	QD	QC	QB	QA	
1	0	0	0	0	0
2	0	0	0	1	1
3	0	0	1	0	2
4	0	0	1	1	3
5	0	1	0	0	4
6	0	1	0	1	5
7	0	1	1	0	6
8	0	1	1	1	7
9	1	0	0	0	8
10	1	0	0	1	9
11	Counter Resets its Outputs back to Zero				


INPUT A
Fan in = 2
NC
OUTPUTS
OA OD
OUTPUTS
OB OC
14 13 12 11 10 9 8
A B C D
OA
CK
R
RESET
1 2 3 4 5 6 7
INPUT B
Fan in = 2
R0(1) R0(2) NC
RESET
+
NC NC
7493


input B (2) 1
input C (4) 2
display test 3
blank output 4
blank input 5
input D (8) 6
input A (1) 7
0V 8
7447
16 +2 to +6V HC
+5V LS/HCT
15 output f
14 output g
13 output a
12 output b
11 output c
10 output d
9 output e


g f com a b
10 9 8 7 6
a
f b
g
e c
d
DP
1 2 3 4 5
e d com c DP



IC 7490 pin diagram

Procedure:

1. Design the circuit as given below.

2. Apply clock pulse of 1 Hz frequency and check the output.
3. The output of counter is connected to IC7447 decoder and decoder output to 7-segment display unit.

5. Cautions:

1. Do not press the IC on breadboard until pins are aligned with pours.
2. Make connection properly.
3. There should not any short circuit in the circuit.
4. Avoid the heating of IC.
5. Provide proper clock pulse.

6. **Learning Outcomes:** Student will be able to design counter using flip flop.

Date of Performance **Worksheet of the student** **Registration Number**:

Aim:

Observation Table for decade counter output

Pulse	Qd	Qc	Qb	Qa	Output display

Learning Outcomes (what I have learnt):

To be filled in by Faculty

S.No.	Parameter	Marks obtained	Max. Marks
1	Understanding of the student about the procedure/apparatus.		20
2	Observations and analysis including learning Outcomes		20
3	Completion of experiment, Discipline and Cleanliness		10
	Signature of Faculty	**Total marks obtained**	