NEHRU COLLEGE OF ENGINEERING AND RESEARCH CENTRE
(Accredited by NAAC, Approved by AICTE New Delhi, Affiliated to APJ Abdul Kalam Technological University, Kerala)
Pampady, Thiruvilwamala (PO), Thrissur (DT), Kerala 680 588

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

LAB WORK BOOK

ESL130 ELECTRICAL AND ELECTRONICS WORKSHOP

VISION OF THE INSTITUTION

To mould true citizens who are millennium leaders and catalysts of change through excellence in education.

MISSION OF THE INSTITUTION

NCERC is committed to transform itself into a center of excellence in Learning and Research in Engineering and Frontier Technology and to impart quality education to mould technically competent citizens with moral integrity, social commitment and ethical values.

We intend to facilitate our students to assimilate the latest technological know-how and to imbibe discipline, culture and spiritually, and to mould them in to technological giants, dedicated research scientists and intellectual leaders of the country who can spread the beams of light and happiness among the poor and the underprivileged.

ABOUT DEPARTMENT

- Established in: 2002
- Course offered : B.Tech in Computer Science and Engineering

  M.Tech in Computer Science and Engineering

M.Tech in Cyber Security

- Approved by AICTE New Delhi and Accredited by NAAC
- Certified by ISO 9001-2015
- Affiliated to the University of A P J Abdul Kalam Technological University.

DEPARTMENT VISION

Producing Highly Competent, Innovative and Ethical Computer Science and Engineering Professionals to facilitate continuous technological advancement.

DEPARTMENT MISSION

1. To Impart Quality Education by creative Teaching Learning Process
2. To Promote cutting-edge Research and Development Process to solve real world problems with emerging technologies.
3. To Inculcate Entrepreneurship Skills among Students.
4. To cultivate Moral and Ethical Values in their Profession.

PROGRAMME EDUCATIONAL OBJECTIVES

PEO1: Graduates will be able to Work and Contribute in the domains of Computer Science and Engineering through lifelong learning.

PEO2: Graduates will be able to Analyse, design and development of novel Software Packages, Web Services, System Tools and Components as per needs and specifications.

PEO3: Graduates will be able to demonstrate their ability to adapt to a rapidly changing environment by learning and applying new technologies.

PEO4: Graduates will be able to adopt ethical attitudes, exhibit effective communication skills, Team work and leadership qualities.

PROGRAM OUTCOMES (POS)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex

engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1: Ability to Formulate and Simulate Innovative Ideas to provide software solutions for Real-time Problems and to investigate for its future scope.

PSO2: Ability to learn and apply various methodologies for facilitating development of high quality System Software Tools and Efficient Web Design Models with a focus on performance optimization.

PSO3: Ability to inculcate the Knowledge for developing Codes and integrating hardware/software products in the domains of Big Data Analytics, Web Applications and Mobile Apps to create innovative career path and for the socially relevant issues.

COURSE OUTCOMES:

After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols.
CO 3	Develop the connection diagram; identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings.

MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2

Note: H-Highly correlated=3, M-Medium correlated=2, L-Less correlated=1

MAPPING OF COURSE OUTCOMES WITH PROGRAM SPECIFIC OUTCOMES

	PSO1	PSO2	PSO3
CO1	-	-	2
CO2	-	-	1
CO3	-	-	-

Note: H-Highly correlated=3, M-Medium correlated=2, L-Less correlated=1

PREPARATION FOR THE LABORATORY SESSION GENERAL INSTRUCTIONS TO STUDENTS

1. Read carefully and understand the description of the experiment in the lab manual. You may go to the lab at an earlier date to look at the experimental facility and understand it better. Consult the appropriate references to be completely familiar with the concepts and hardware.
2. Make sure that your observation for previous week experiment is evaluated by the faculty member and you have transferred all the contents to your record before entering to the lab/workshop.
3. At the beginning of the class, if the faculty or the instructor finds that a student is not adequately prepared, they will be marked as absent and not be allowed to perform the experiment.
4. Bring necessary material needed (writing materials, graphs, calculators, etc.) to perform the required preliminary analysis. It is a good idea to do sample calculations and as much of the analysis as possible during the session. Faculty help will be available. Errors in the procedure may thus be easily detected and rectified.
5. Please actively participate in class and don't hesitate to ask questions. Please utilize the teaching assistants fully. To encourage you to be prepared and to read the lab manual before coming to the laboratory, unannounced questions may be asked at any time during the lab.
6. Carelessness in personal conduct or in handling equipment may result in serious injury to the individual or the equipment. Do not run near moving machinery/equipment. Always be on the alert for strange sounds. Guard against entangling clothes in moving parts of machinery.
7. Students must follow the proper dress code inside the laboratory. To protect clothing from dirt, wear a lab coat. Long hair should be tied back. Shoes covering the whole foot will have to be worn.
8. In performing the experiments, please proceed carefully to minimize any water spills, especially on the electric circuits and wire.
9. Maintain silence, order and discipline inside the lab. Don't use cell phones inside the laboratory.
10. Any injury no matter how small must be reported to the instructor immediately.
11. Check with faculty members one week before the experiment to make sure that you have the handout for that experiment and all the apparatus.

AFTER THE LABORATORY SESSION

1. Clean up your work area.
2. Check with the technician before you leave.
3. Make sure you understand what kind of report is to be prepared and due submission of record is next lab class.
4. Do sample calculations and some preliminary work to verify that the experiment was successful

MAKE-UPS AND LATE WORK

Students must participate in all laboratory exercises as scheduled. They must obtain permission from the faculty member for absence, which would be granted only under justifiable circumstances. In such an event, a student must make arrangements for a make-up laboratory, which will be scheduled when the time is available after completing one cycle. Late submission will be awarded less mark for record and internals and zero in worst cases.

LABORATORY POLICIES

1. Food, beverages & mobile phones are not allowed in the laboratory at any time.
2. Do not sit or place anything on instrument benches.
3. Organizing laboratory experiments requires the help of laboratory technicians and staff. Be punctual.

SYLLABUS

ESL 130	ELECTRICAL & ELECTRONICS WORKSHOP	CATEGORY	L	T	P	CREDIT	YEAR OF INTRODUCTION
		ESC	0	0	2	1	2019

Preamble: Electrical Workshop is intended to impart skills to plan and carry out simple electrical wiring. It is essential for the practicing engineers to identify the basic practices and safety measures in electrical wiring.

Prerequisite: NIL

Course Outcomes: After the completion of the course the student will be able to

CO 1	Demonstrate safety measures against electric shocks.
CO 2	Identify the tools used for electrical wiring, electrical accessories, wires, cables, batteries and standard symbols.
CO 3	Develop the connection diagram, identify the suitable accessories and materials necessary for wiring simple lighting circuits for domestic buildings.

Mapping of course outcomes with program outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	-	-	-	-	-	3	-	-	-	-	-	1
CO 2	2	-	-	-	-	-	-	-	-	1	-	-
CO 3	2	-	-	1	-	1	-	1	2	2	-	2

Mark distribution

Total Marks	CIE	ESE	ESE Duration(Internal)
100	100	-	1 hour

Continuous Internal Evaluation Pattern:

Attendance	: 20 marks
Class work/ Assessment /Viva-voce	: 50 marks
End semester examination (Internally by college)	: 30 marks

End Semester Examination Pattern: Written Objective Examination of one hour

Syllabus PART 1

ELECTRICAL

List of Exercises / Experiments

1. a)Familiarization/Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)

   b) Identify different types of cables, wires, switches, fuses, fuse carriers, MCB, ELCB and MCCB with ratings.
2. Wiring of simple light circuit for controlling light/ fan point (PVC conduit wiring)
3. Wiring of light/fan circuit using Two way switches . (Staircase wiring)
4. Wiring of Fluorescent lamps and light sockets (6A) with a power circuit for controlling power device. (16A socket)
5. Wiring of power distribution arrangement using single phase MCB distribution board with ELCB, main switch and Energy meter.
6. a)Identify different types of batteries with their specifications. b)Demonstrate the Pipe and Plate Earthing Schemes using Charts/Site Visit.

INDEX

EXPERIMENT NO: 01A

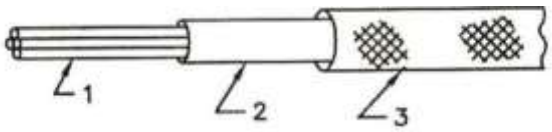
IDENTFY DIFFERENT TYPES OF CABLES/WIRES AND SWITCHES AND THEIR USES.

TYPES OF WIRES

The following are the various types of wires used.

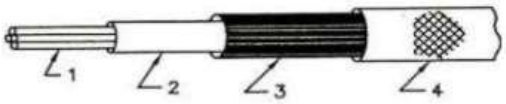
1.VIR (Vulcanized Indian Rubber)Wires:

In this type of wires conductors are made up of aluminum or copper. A layer of vulcanized rubber is provided over it. Thickness of rubber insulation depends on the grade of voltage i.e.250V or 660V.



1. CONDUCTOR 2. RUBBER INSULATION 3. BRAIDING

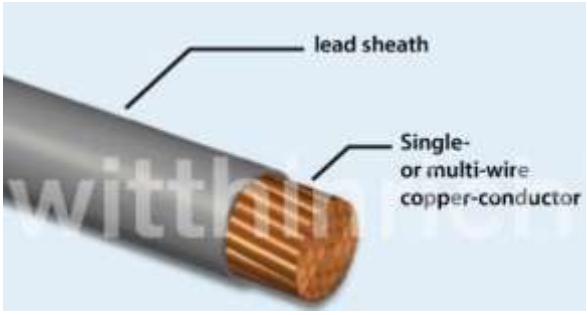
2. CTS/TRS Wires: In this type of wire layer of strong and durable rubber is provided over the conductor. Its mechanical strength is more than that of the VIR wire. T.R.S wires are available in single core, twin core and three core. The cores are being insulated from each other and covered with common sheathing.



1. CONDUCTOR 2. RUBBER INSULATION
3. RUBBER SHEATH 4. BRAIDING

3. LEAD SHEATHED wires

This type of wires is similar in construction with TRS as far as core section is concerned but having outer sheath of lead or lead alloy. The use of lead sheath covering is to improve mechanical protection.



4. PVC wires

In this type of wire insulation made of poly vinyl chloride is provided over copper or aluminum conductor. PVC wires are widely used. PVC insulation is harder than rubber, therefore cotton taping and

braiding is not required for mechanical protection. Varieties of materials are used during PVC manufacture to obtain different properties, like mechanical strength, flexibility, mold ability and electrical properties etc.

These materials are -

a) Fillers: Various types of fillers are wood flour, cotton flocks, asbestos, glass fibers, powdered mica, and talc.

b) Stabilizers: Protect the PVC from degradation. Different types of stabilizers used are metal soaps, calcium carbonate, calcium oxide etc.

c) Plasticizes: Increase the flexibility of PVC insulator material. Normally used plasticizes are tricresyl phosphate, dibutyl phthalate.

d) Supplementary additives: They are used for colouring and lubricating purposes. Red, Yellow and Blue coloures for the three phases.

Application of PVC: House wiring, Power cable, Control cable, Communication and signal wiring.

Characteristics of PVC: (a) Immunity to corrosion, abrasion and moisture. (b) More flexible (c) Low jointing cost (d) Fire retarding (e) High resistance to chemical action

5. WEATHER PROOF wires

Weather proof wires are used for outdoor work as service lines. The conductors are insulated first with rubber then braiding of cotton thread. This braiding material is dipped in water proof compound.

6. FLEXIBLE wires

These wires have the property of flexibility and the materials used being such as to offer flexibility. - The insulation used in flexible wires is pure rubber or P. V. C

SIZES OF WIRES

Wires are specified according to the type of insulation provided above the conductor, material of the conductor, number of strands and gauge number of conductor wire. For example in 7/20 P.V.C. insulated copper wire, 7 stands for the number of strands, 20 for gauge number, P.V.C. is the insulation and copper is the conducting material used.

To find out the gauge number of a conductor, British Standard Wire Gauge (B.S.W.G.) is used. It is a circular metallic disc, consisting of several slots. Each slot corresponds to a gauge number. The gauge number and diameter are inversely proportional to each other. i.e. Higher the gauge number, smaller the diameter.

Current carrying capacity of PVC insulatedCopperwire

Normal area (mm^2)	No.of strands in Gauge no.	No.of strands diameter in mm	Amperes
0.968	1/18	1/1.12	5A
1.29	3/22	3/0.73	10A
1.94	3/20	3/0.925	13A
2.9	7/22	7/0.73	15A
4.52	7/20	7/0.925	22A

LIGHTING ACCESSORIES

1. SWITCHES

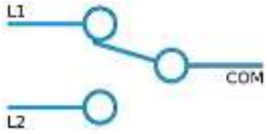
Switches are used to make or break electric circuits. The different types of switches are

1. Surface type switches 2. Flush type switches 3. Push button switches 4. Pull switch…etc.

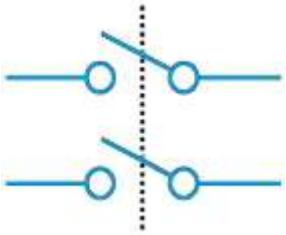
A. Surface type switch: This type of switch is fixed directly on to the mounting block and they project outside. There are different surface type switches.

(1) **SPST** (Single Pole Single Throw) One - way switch. (2)
SPDT (Single Pole Double Throw) Two-way switch. (3)
DPST (Double Pole, Single Throw) Switch.
(4) **DPDT** (Double Pole Double Throw) Switch.

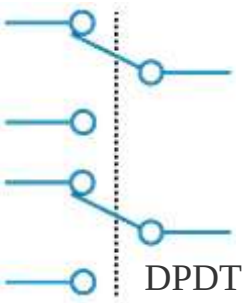
SPST Switch



SPDT switch.

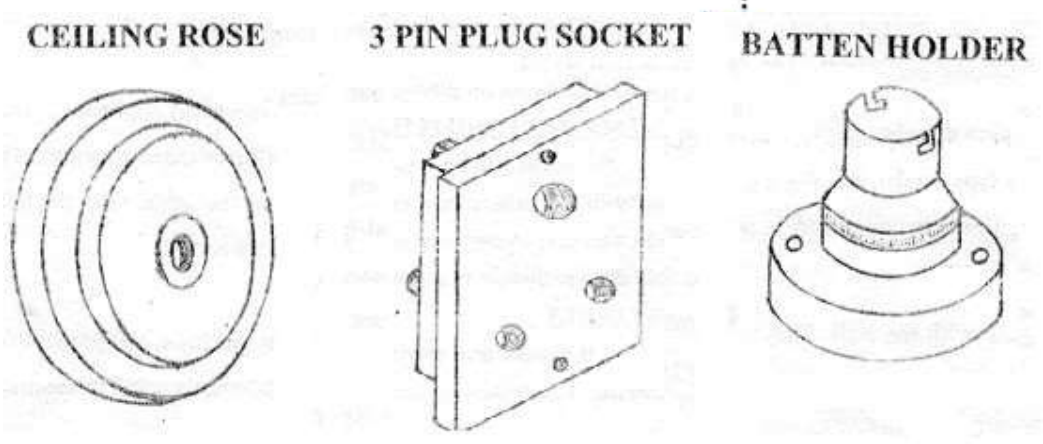


DPST Switch



DPDT switch

2. LAMP HOLDERS: They are used for holding electrical lamps. Different types of holders are Batten lamp holder and Bracket lamp holder.



3. LAMP HOLDER ADAPTER: They are used for taking electrical supply from lamp holders.

4. CEILING ROSE: They are used on the ceiling of the building for giving connections to lamps, fluorescent tubes, fans etc.

5. PLUG AND SOCKETS: It is used for giving electrical supply to various electrical appliances.

ELECTRICAL CONNECTOR

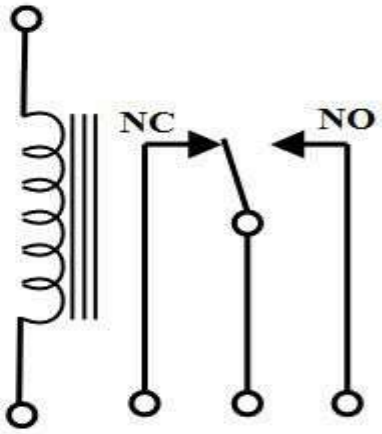
It is an electromechanical device used to join electrical terminations and create an electrical circuit. Most of the electrical connectors have a gender – i.e. the male and female component. Male part is called a plug. Female part is called socket.

Method used to fix or join these connectors to the electrical cables is called crimping. Crimping is done with special tools know as crimping tool. As per the size of cable we have to choose correct size tool.

RELAYS

A relay is an electrically operated switch. Relay uses an electromagnet to mechanically operate a switch. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor.

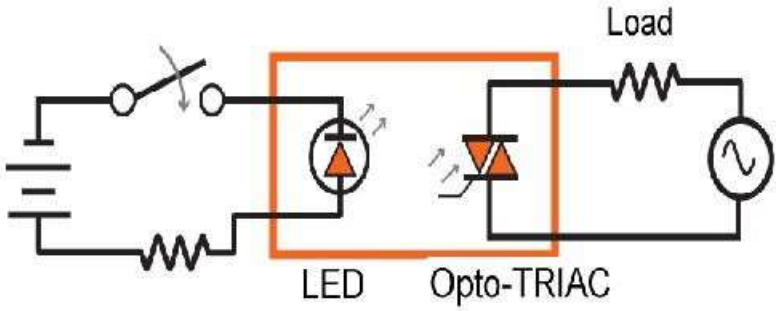
An Electromechanical Relay



Equivalent Electrical Circuit

Now a day's there are relays with other operating principles such as solid-state relays. A **solid-state relay** (**SSR**) is an electronic switching device that switches on or off when a small external voltage is applied across its control terminals. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching.

Solid State Relay (SSR)



Equivalent Circuit

FASTENERS

A **fastener** or **fastening** is a hardware device that mechanically joins or affixes two or more objects together. In general, fasteners are used to create non-permanent joints. For example welding is a permanent joint. The joint which can be removed or dismantled without damaging the joining components is called Non-permanent joint.

Steel fasteners are usually made of stainless steel, carbon steel, or alloy steel

RESULT:

Identified different types of cables, wire, switches, relays, connectors, fasteners, heat shrink and their uses.

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EXPERIMENT NO: 01B

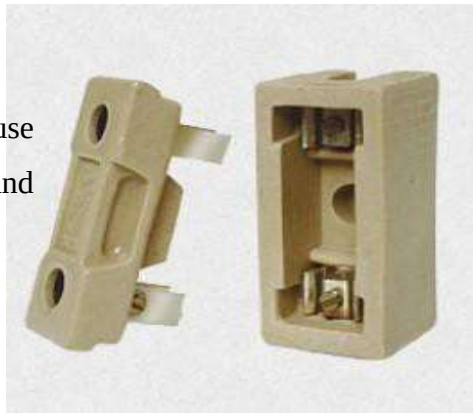
IDENTIFY DIFFERENT TYPES OF FUSES AND FUSE CARRIERS, MCB AND ELCB, MCCB WITH RATING AND USAGES

What is a Fuse:

Fuse is a short piece of metal, inserted in the circuit, which melts when excessive current flows through it and thus protect the electrical equipment from over current. The following are the three types of fuse units normally used in electrical circuits.

a. Kit-Kat type re-wire able fuse units.
b. H. R. C. (High rupturing capacity) fuse units. c.
Cartridge fuse units.

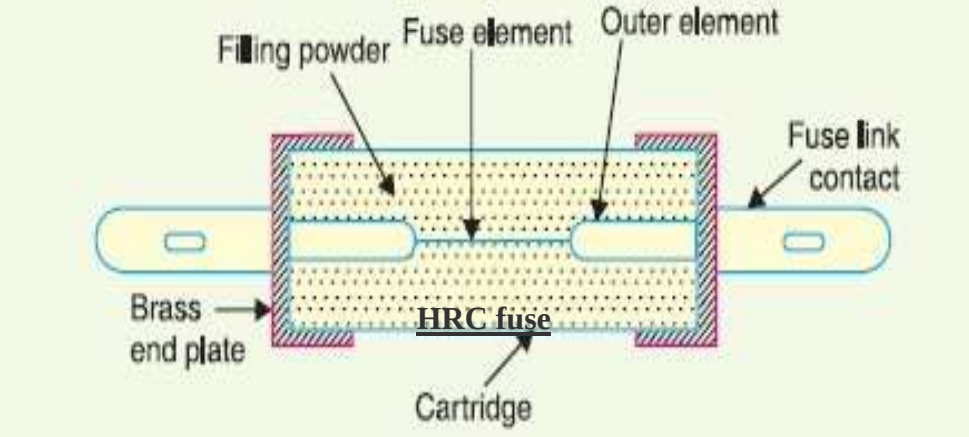
a. Kit-Kat type re-wire able fuse units:



Usually in house wiring circuits Kit-Kat type re-wire able fuse units are used. This type of fuse unit consists of two parts - fuse base and fuse carrier. Fuse base consists of two fixed contacts inside and the fuse carrier carries the fuse wire.

b. H. R. C. (High rupturing capacity) fuse units:

This type of fuse contains a fuse wire in it, which carries the short circuit current safely for a given time period. HRC fuse manufacturing and construction based on different factors. Its external enclosure is made fully airtight in order to avoid the effect of atmosphere on the fuse materials.



HRC fuse

c. Cartridge fuse units:

Cartridge fuses are used to protect electrical appliances such as motors, air-conditions, refrigerators, pumps etc, where high voltage rating and currents required. There are two types of Cartridge fuses.

1. **General purpose fuses** with no time delay.
2. **Heavy-duty cartridge fuses** with time delay

CIRCUIT BREAKERS

MCB (Miniature Circuit Breaker)

Rated current not more than 100 A; Trip characteristics normally not adjustable; Thermal or thermal-magnetic operation.

ELCB (Earth Leakage Circuit Breaker)

An Earth Leakage Circuit Breaker (ELCB) is a device used to directly detect currents leaking to earth from an installation and cut the power supply. There are two types of ELCBs,

1. Current Earth Leakage Circuit Breaker (Current-ELCB)
2. Voltage Earth Leakage Circuit Breaker (voltage-ELCB).

MCCB (Molded Case Circuit Breaker):

They are used for rated current up to 1000 A. MCCB Trip current may be adjustable. They also have two type operations, Thermal or thermal-magnetic operation.

RESULT:

Identified different types of Fuses, Circuit Breakers, ELCB's with its ratings and usage.

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EXPERIMENT NO: 02

WIRING OF SIMPLE LIGHT CIRCUIT FOR CONTROLLING LIGHT

AIM

To wire up a circuit having one lamp controlled by one switch in surface conduit system of Wiring.

TOOLS REQUIRED

Insulated cutting pliers, Screwdriver, Pocket knife, Poker, Neon tester, Ball peen hammer, Hacksaw, Chisel and Connector.

ESTIMATE

SL.No	PARTICULARS	UNIT	QUANTITY	REMARKS
1	1/2inchPVC conduit	cm	72	20 % allowance
2	1/18 PVC insulated copper wire	cm	114	20 % allowance
3	Single way switch-250V, 5A,Flush type	No	1	
4	Incandescent lamp-230V, 60W	No	1	
5	.PVC Round block	No	1	For fixing holder.
6	Bakelite batten lamp holder	No	1	
7	PVC Gang box	No	1	For fixing switch.
8	Kit-kat type re-wirable fuse unit- 250V, 16A	No	1	
9	1/2 inch GI saddle clip	No	6	
10	1/2 inch PVC Tee-bow	No	1	

11	Screws (a) 45mm x 8mm (b) 35mm x 8mm (c) 20mm x 6mm (d) 15mm x 5mm (e) 12mm x 4mm	No No No No No	2 1 1 2 12	For fixing gang box For fixing round block For fixing fuse unit For fixing holder For fixing clamps

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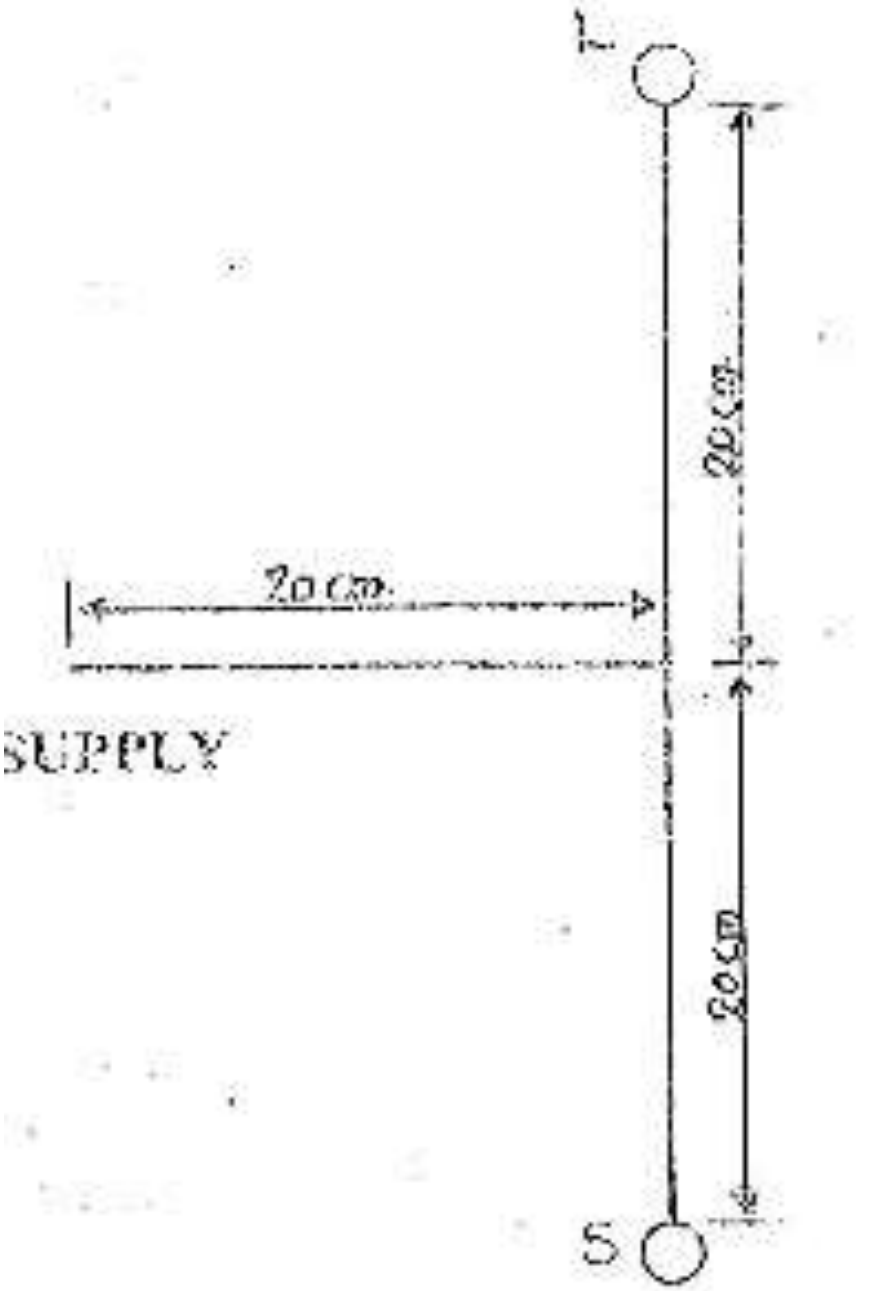
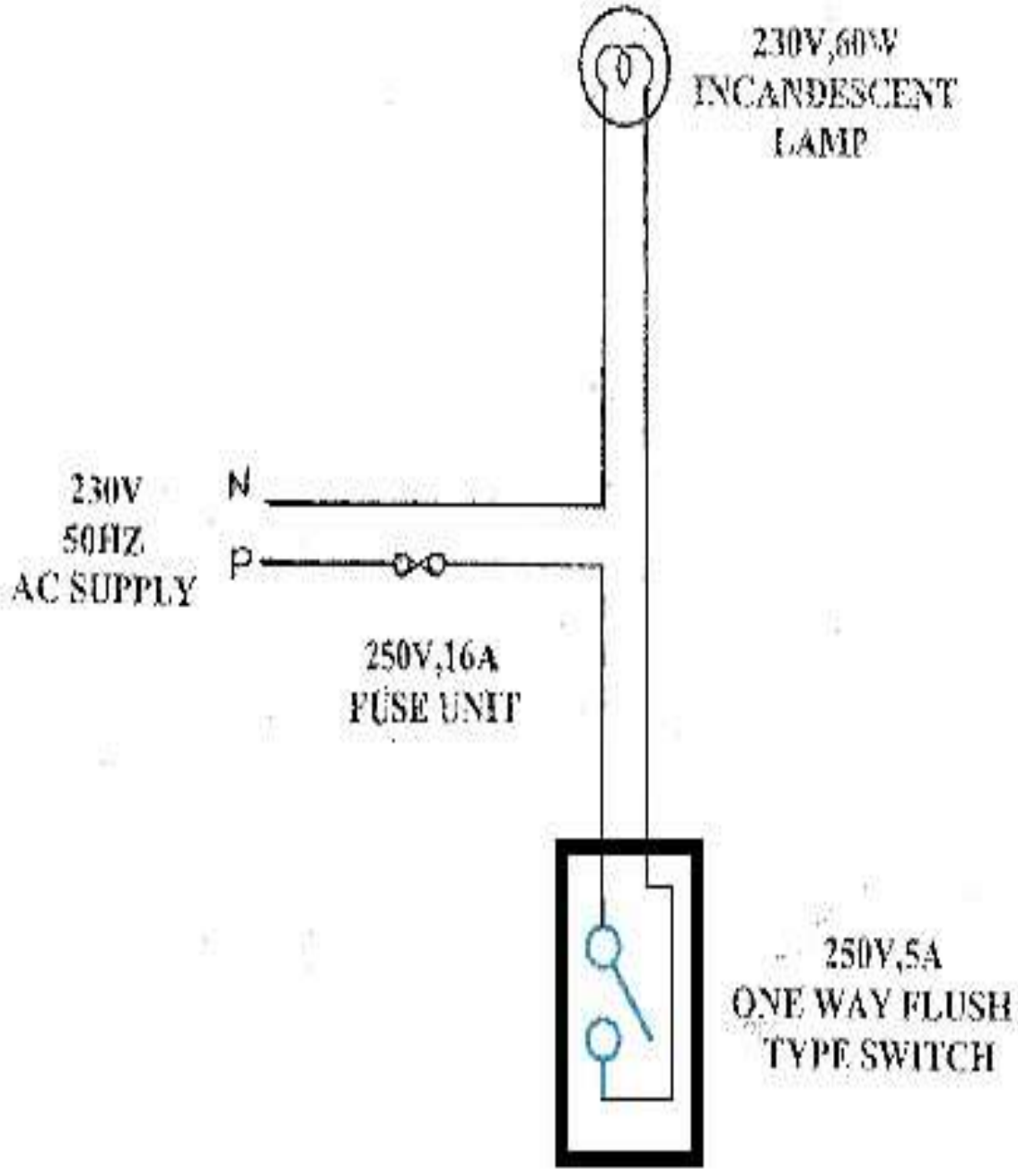


LINE DIAGRAM



CONNECTION DIAGRAM

PROCEDURE

1. . Arrange the pipes and joints as per the lay out diagram.

2. Wires are drawn/taken through the pipes according to connection diagram with RED colour wire for Phase and BLACK colour wire for Neutral.

3. The pipes are fixed to the board using holding saddles/clips and screws.

4. Fixed the round block and gang box in proper place with suitable size screws. Wires are taken out through the holes provided.

5. The terminals of lamp holders and switches are connected as per the connection diagram.

6. Fix the lamp holders and switches on the round block and gang box respectively by suitable size screws.

7. Push the FUSE carrier in to its base. Put the bulbs on the holder then the wiring is completed.

RESULT

The control of one lamp by one switch was wired up in surface conduit system of wiring and tested.

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EXPERIMENT NO: 03

ONE LAMP CONTROLLED BY TWO SWITCHES (STAIRCASE WIRING)

AIM

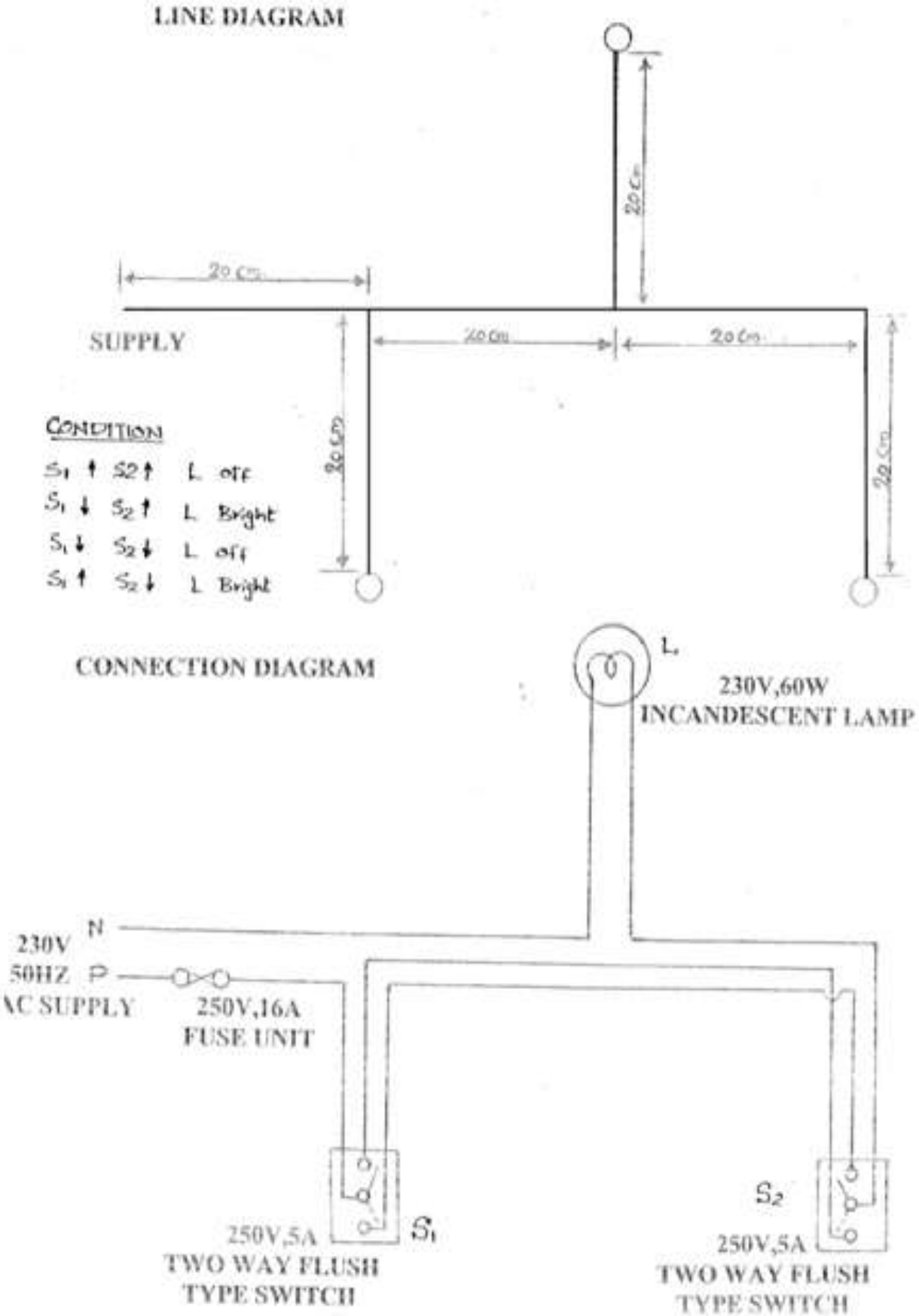
To wire up a circuit having one lamp controlled by two switches in surface conduit system of wiring.

TOOLS REQUIRED

Insulated cutting pliers, Screwdriver, Pocketknife, Poker, Neon tester, Ball Peen hammer, Hacksaw, Chisel and Connector.

ESTIMATE

SL.No	PARTICULARS	UNIT	QUANTITY	REMARKS
1	1/2 inch PVC conduit	Cms	144cms	. 20% allowance
2	1/18 PVC insulated copper wire	Cms	384cms	20% allowance
3	Two way switch - 250V,5A,Flush type	No	2	
4	Incandescent lamp - 230V, 60W	No	1	
5	PVC Round block	No.	1	For fixing holder.
6	Bakelite batten lamp holder	No.	1	
7	PVC Gang box	No	2	For fixing switch.
8	Kit-kat type re-wirable fuse unit-250V,16A	No	1	
9	1/2 inch GI saddle clip	No	12	
10	1/2 inch PVC, Tee-bow	No	2	
11	1/2 inch PVC Elbow	No		
12	Screw (a) 45mm x 8mm (b) 35mm x 8mm (c) 20mm x 6mm (d) 15mm x 5mm (e) 12mm x 4mm	No No No No No	4 1 1 2 24	For fixing gang box For fixing fuse unit For fixing holder For fixing clamps


LINE DIAGRAM
20 cm
20 cm
SUPPLY
20 cm
20 cm
20 cm
20 cm
CONDITION
S1 ↑ S2 ↑ L off
S1 ↓ S2 ↑ L Bright
S1 ↓ S2 ↓ L off
S1 ↑ S2 ↓ L Bright
CONNECTION DIAGRAM
L
230V,60W
INCANDESCENT LAMP
N
230V
50HZ P
AC SUPPLY
250V,16A
FUSE UNIT
S1
250V,5A
TWO WAY FLUSH
TYPE SWITCH
S2
250V,5A
TWO WAY FLUSH
TYPE SWITCH

PROCEDURE

1. Arrange the pipes and joints as per the lay out diagram.

2. Wires are taken through the pipes according to connection diagram with RED colour wire for Phase and BLACK colour wire for Neutral.

3. The pipes are fixed to the board using holding saddles/clips and screws.

4. Fixed the round block and gang box in proper place with suitable size screws. Wires are taken out through the holes provided.

5. The terminals of lamp holders and switches are connected as per the connection diagram.

6. Fix the lamp holders and switches on the round block and gang box respectively by suitable size screws.

7. Put the bulbs into the holder then the wiring is completed.

8. Check and ensure the fuse wire for its good condition. Push the FUSE carrier in to its base. Then, with the presence of STAFF Switch ON the power supply and check the working as per the given conditions.

RESULT

The control of one lamp by two switches was wired up in surface conduit system of wiring and tested.

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EXPERIMENT NO: 04

FLUORESCENT LAMP CIRCUIT

AIM

To control a fluorescent lamp and a 3 - pin plug socket with independent switches.

TOOLS REQUIRED

Screw driver, Side cutting pliers, Chisel, Hammer, Long nose pliers etc.

MATERIALS REQUIRED

1) Fluorescent tube frame with side holders : 1 No.
2) Choke 40 W : 1 No.
3) Starter : 1 No.
4) Connecting wires (1/18 copper wire)
5) Flush type, 3 pin plug socket, 250 V, 5 A : 1 No.
6) 1/2 inch PVC conduit
7) Single way, Flush type switch - 250V,5A : 1 No.
8) Gang box for fixing 2 switches and one plug : 1 No.

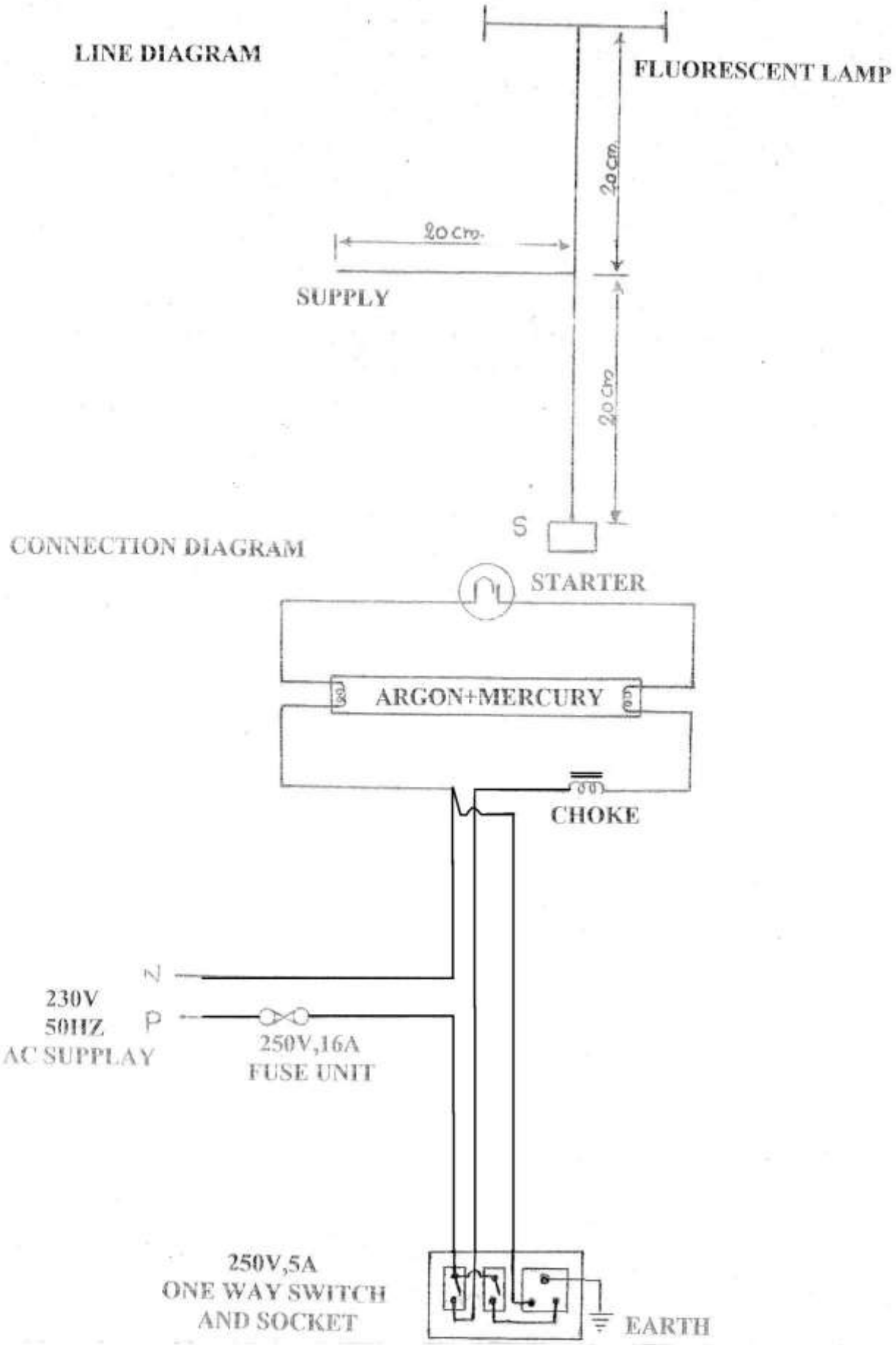
WORKING PRINCIPLE

The choke, left electrode, glow starter and the right electrode are connected in series and is connected across the supply. At the time of starting, there is no contact between the bimetallic strips inside the glow starter. Hence full voltage comes across the starter terminals and this voltage causes the bimetallic strip to bend around and come in contact with each other and the circuit is completed. The two tungsten filaments are heated. This heat vaporizes the mercury and causes the emission of electrons. At the same time the glow ceases resulting in the cooling of the bimetallic strips of the starter and they are opened. Thus a sudden interruption occurs in the circuit and due to this, the choke delivers a high voltage known as kick voltage and this voltage helps the flow of electrons from one filament to the other, through the argon gas filled inside the tube. The collision of the electrons produce ultra-violet rays and these rays fall on the coated fluorescent powder inside the tube. They glow brightly and produce visible rays in the form of white light.

FUNCTIONS OF CHOKE

1. It provides a high voltage for the tube to operate.

2. It limits the current supply.


LINE DIAGRAM
FLUORESCENT LAMP
20 cm.
20 cm.
SUPPLY
20 cm.
S
CONNECTION DIAGRAM
STARTER
ARGON+MERCURY
CHOKE
N
230V
50HZ
AC SUPPLAY
P
250V,16A
FUSE UNIT
250V,5A
ONE WAY SWITCH
AND SOCKET
EARTH

FUNCTIONS OF STARTER

1. To complete the circuit for turn on the electrodes.
2. To interrupt the circuit for producing a high voltage by the choke (Kick voltage).

ADVANTAGES OF FLUORESCENT TUBE

Nowadays instead of incandescent lamps, fluorescent tubes are commonly used due to its high efficiency, less heat output and low glare level.

PROCEDURE

1. Arrange the pipes and joints as per the lay out diagram (Cut the wires and pipes in required length).
2. Wires are taken/ drawn through the pipes according to connection diagram with RED colour wire for Phase and BLACK colour wire for Neutral.
3. The pipes are fixed to the board using holding saddles/clips and screws.
4. Fixed the round block and gang box in proper place with suitable size screws. Wires are taken out through the holes provided.
5. The terminals of tube set and switches are connected as per the connection diagram.
6. Fix the tube set and switches on the board and gang box respectively by suitable size screws.
7. Put the tube into the holder and connect any load to the plug point, and then the wiring is completed.

Check and ensure the fuse wire for its good condition. Push the FUSE carrier in to its base. Then with the presence of STAFF Switch ON the power supply and check the working as per the given conditions.

RESULT

The given circuit was wired on the given wiring board as per the given diagram, checked and found correct.

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EXPERIMENT NO- 05

WIRING OF MAIN SWITCH BOARD

AIM

To wire up a main switch board consisting of Iron Clad Double Pole (**ICDP**) switch, Distribution Board (**DB**), MCB's, and ELCB's

TOOLS REQUIRED

Insulated cutting plier, Screw driver, Pocket knife, Pocker, Neon tester, Ball peen Hammer, Hacksaw, Chisel and connector.

ESTIMATE

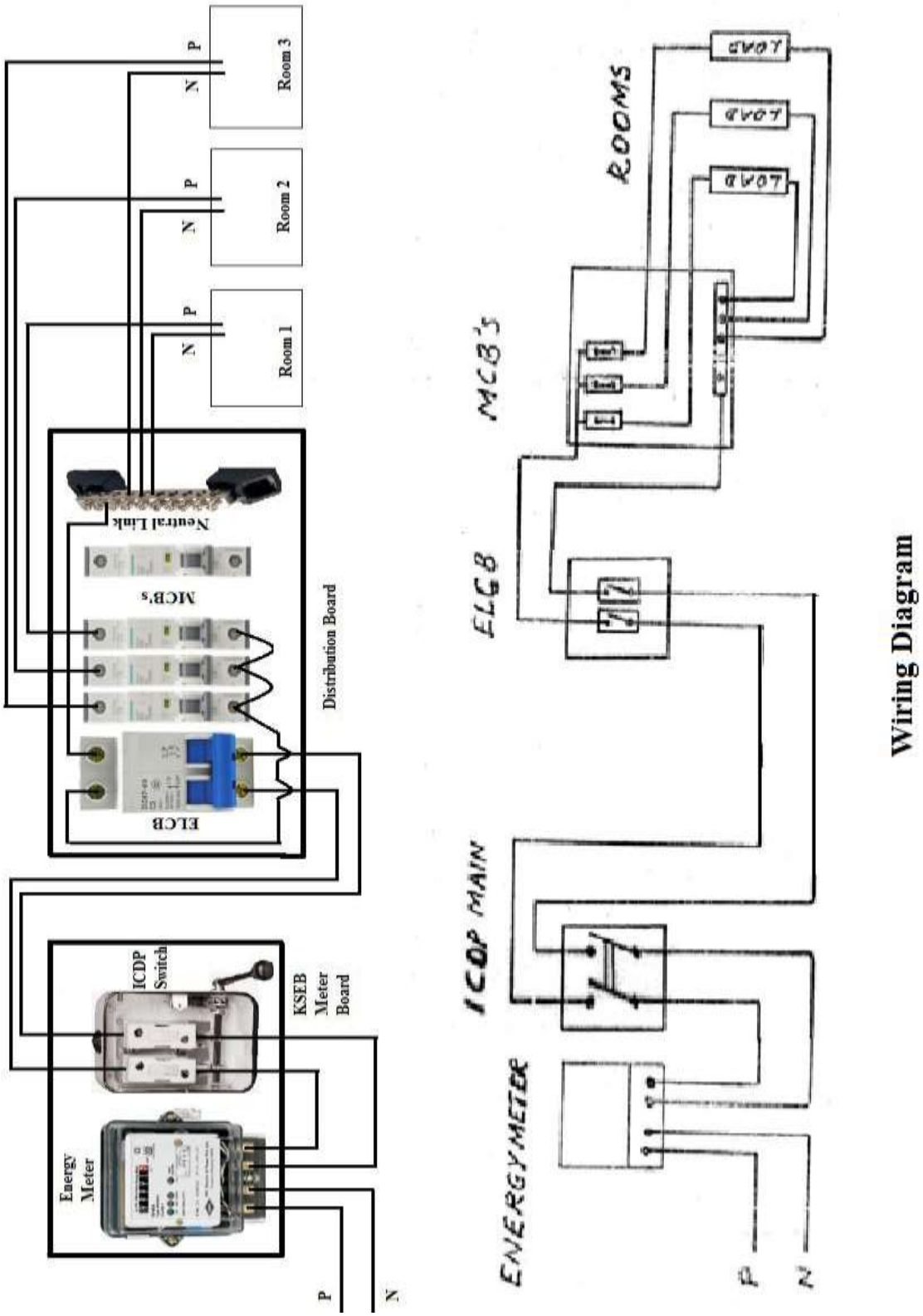
SL.No	PARTICULARS	UNIT	QUANTITY	REMARKS
1.	1/18 PVC insulated copper wire	Cms		
2.	ICDP Switch – 240V, 16A	No.	1	
3.	ELCB – 40A, 240V, In 0.03A	No.	1	
4.	MCB – 10A, 240V	Nos.	3	
5.	Neutral link	No.	1	
6.	DB	No.	1	
7.	1/2 inch GI saddle clip	Nos.	30	
8.	Screws	Nos.	60	
9.	Copper wire – 14 SWG	M	10	

PROCEDURE

1. Arrange the pipes and joints as per the lay out diagram (Cut the wires and pipes in required length).
2. Wires are taken/ drawn through the pipes according to connection diagram with RED colour wire for Phase and BLACK colour wire for Neutral.

3. Fix the ICDP main switch, ELCB, MCBs and Neutral link in proper places.

4. Make the connections according to the diagram.



Wiring Diagram

RESULT

The given circuit is wired on the wiring board as per the diagram, checked and found correct.

EXPERIMENT NO-06A

IDENTIFY BATTERIES AND DIFFERENT TYPES OF CONNECTIONS.

A battery is a collection of one or more cells that go under chemical reactions to create the flow of electrons within a circuit. Battery cells are usually made up of three main components, the Anode (Positive Electrode), the Cathode (Negative Electrode) and the electrolytes.

Types of Batteries: - Batteries generally can be classified into different categories and types, ranging from chemical composition, size and use, but under all of these are two major battery types;

1. Primary Batteries. 2. Secondary Batteries.

Primary Batteries: - Primary batteries are batteries that cannot be recharged once depleted. Primary batteries are made of electrochemical cells whose electrochemical reaction cannot be reversed.

Secondary Batteries: - Secondary batteries are batteries with electrochemical cells whose chemical reactions can be reversed by applying a certain voltage to the battery in the reversed direction

Secondary batteries can be further classified into several other types based on their chemistry**.** There are basically four major chemistries for rechargeable batteries;

1. Lithium-ion(Li-ion)
2. Nickel Cadmium(Ni-Cd)
3. Nickel-Metal Hydride(Ni-MH)
4. Lead-Acid

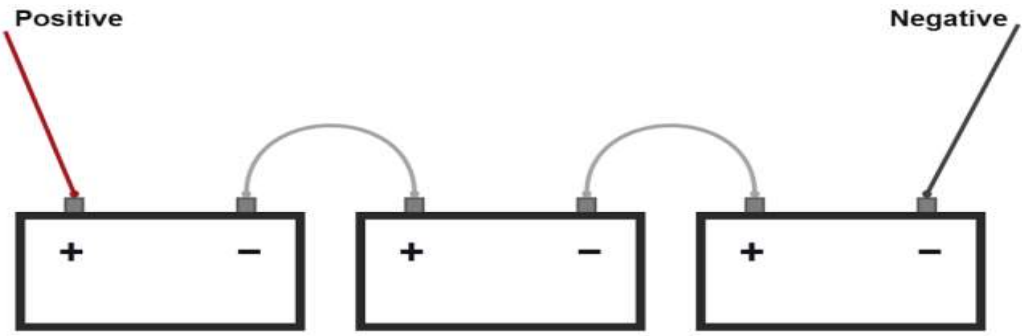
Lead-Acid Batteries

Lead acid batteries are a low-cost reliable power workhorse used in heavy duty applications. They are usually very large and because of their weight, they're always used in non-portable applications such as solar-panel energy storage, vehicle ignition and lights, backup power and load levelling in power generation/distribution. The lead-acid is the oldest type of rechargeable battery and still very relevant and important into today's world. Its low cost makes these batteries attractive for use in several high current applications like powering automobile starter motors and storage in backup power supplies.

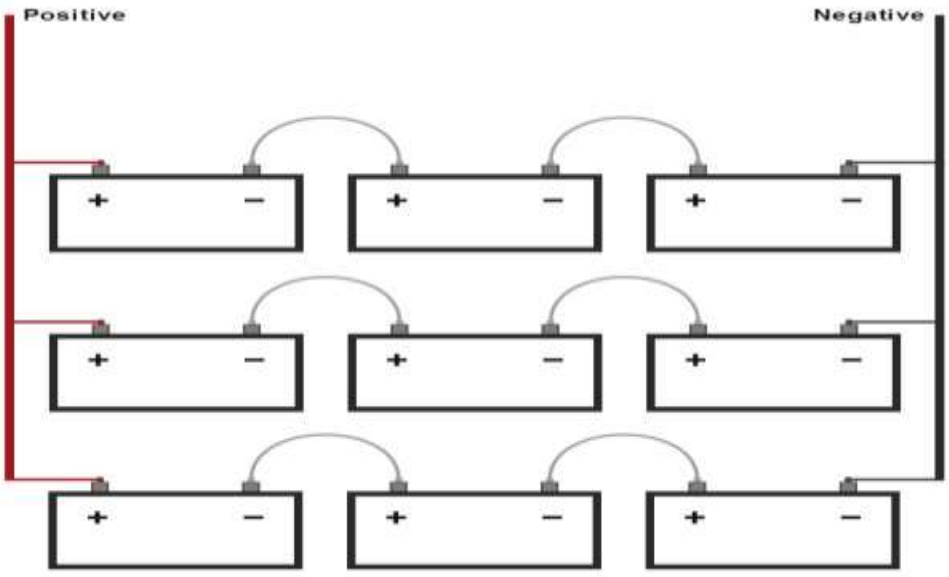
Battery Connections:

As per our requirements we can connect the batteries in series, parallel and series parallel connection. Batteries in Parallel Connection (Parallel Battery Pack): - In this type of battery bank, batteries are connected, positive terminal (+) of one battery is connected with positive (+) terminal of other battery and negative terminal (-) of one battery with negative terminal (-) of other battery. Connecting batteries in parallel keeps the **voltage of whole pack same** but multiplies the storage capacity and energy in **Ampere hour capacity**. See the diagram below for more idea:

Batteries in Series Connection (Series Battery Pack): - Batteries are connected that positive (+) terminal of one battery is connected with negative (-) terminal of other battery and negative terminal (-) of one battery is connected with positive terminal (+) of other battery. Connecting batteries in series **multiplies the voltage** but keeps the capacity in Ampere hour (Ah) same. See the diagram for more idea:



Batteries In Series and Parallel Combination: - In series-parallel batteries combination, one pack of batteries connected in series is joined in parallel with another pack of batteries connected in series. Therefore, the overall output voltage of series packs remains the same. But charge storage capacity is increased.



Batteries with different capacity but same voltage can be connected in parallel but it is preferable not to do this. There will be slight difference in terminal voltages, which may lead to internal current flow. To minimize such risks and troubles, buy similar capacity and voltage batteries of same brand made by the same company. Never mix different brands of batteries from the same or different manufacturers.

Never connect different capacity batteries in series to each other. If connected, smaller capacity battery will charge first but larger battery will still be empty. This will result in heating and over charging of smaller battery. In discharge mode, smaller battery will get empty first resulting in deep discharge of that battery. To make series battery bank, buy similar capacity and voltage batteries of same brand and company.

Never mix old and new batteries. Old batteries which have fairly worn out do not retain the voltage like new batteries. So, if old batteries are mixed with new batteries, this will shorten the life span of new batteries and damage old batteries too.

RESULT: Understood the different connections and batteries.

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EXPERIMENT NO- 06B

EARTHING

METHODS OF EARTHING

The meaning of the term "EARTHING" or "GROUNDING" is to connect the electrical equipment to the general mass of earth by wire. of negligible resistance. The earthed or connected with the earth, means connected with the general mass of the earth in such manner as to ensure at all times, an immediate discharge of energy without danger. There are mainly four methods of earthing.

1. ROD EARTHING

This method of earthing is simple, cheap and does not need the earth excavation. It is suitable for the areas which are having loose soil condition or sandy. In this system of earthing, a rod of not less than 2.5m driven vertically into the ground either manually or by hammer.

2. STRIP OR WIRE EARTHING

In this method of earthing a metal strip or wire is used as earthing electrode. This type of earthing is preferred at places where soil is rocky with a earth bed over it, because the excavation is difficult at such places. In this system 25 x 4mm G.I strip or 25 x 1.6mm copper strip is buried in horizontal trenches of minimum depth 0.5m. The length of the strip or wire depends upon the requirements of the earth resistance. It shall however be not less than 15m.

3. PIPE EARTHING

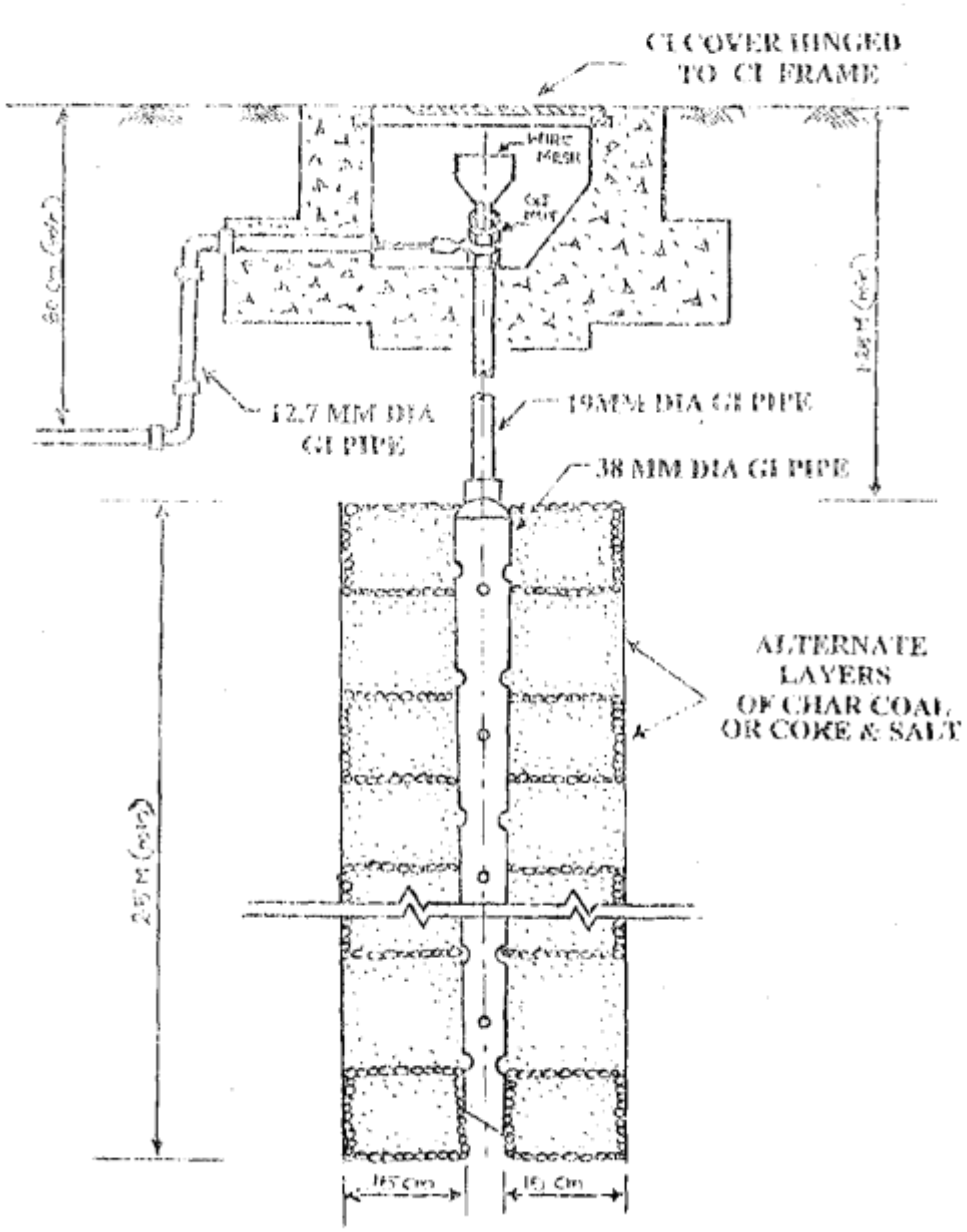
In this method of earthing a 38mm internal diameter, perforated galvanized pipe of length 2.5m is placed vertically in a permanently wet soil. Where rock is encountered at a depth of less than 2.5m, the electrode may be buried inclined to the vertical. The inclination should not be more than 30^{o} from the vertical. The pipe is surrounded by pieces of coke or charcoal and salt in alternate layers of about 15cm around the pipe to decrease the earth resistance. Another pipe of 19mm dia and length 1.25m is connected to the buried pipe through reducing socket. At the top of the19mm pipe a funnel is fitted and is fastened in a cement concrete work. For effective earthing water should be poured, two to four buckets now and then though funnel particularly in summer. The earth wire is carried in a G.I pipe of 12.7mm diameter at a depth of 60cm from the ground level.

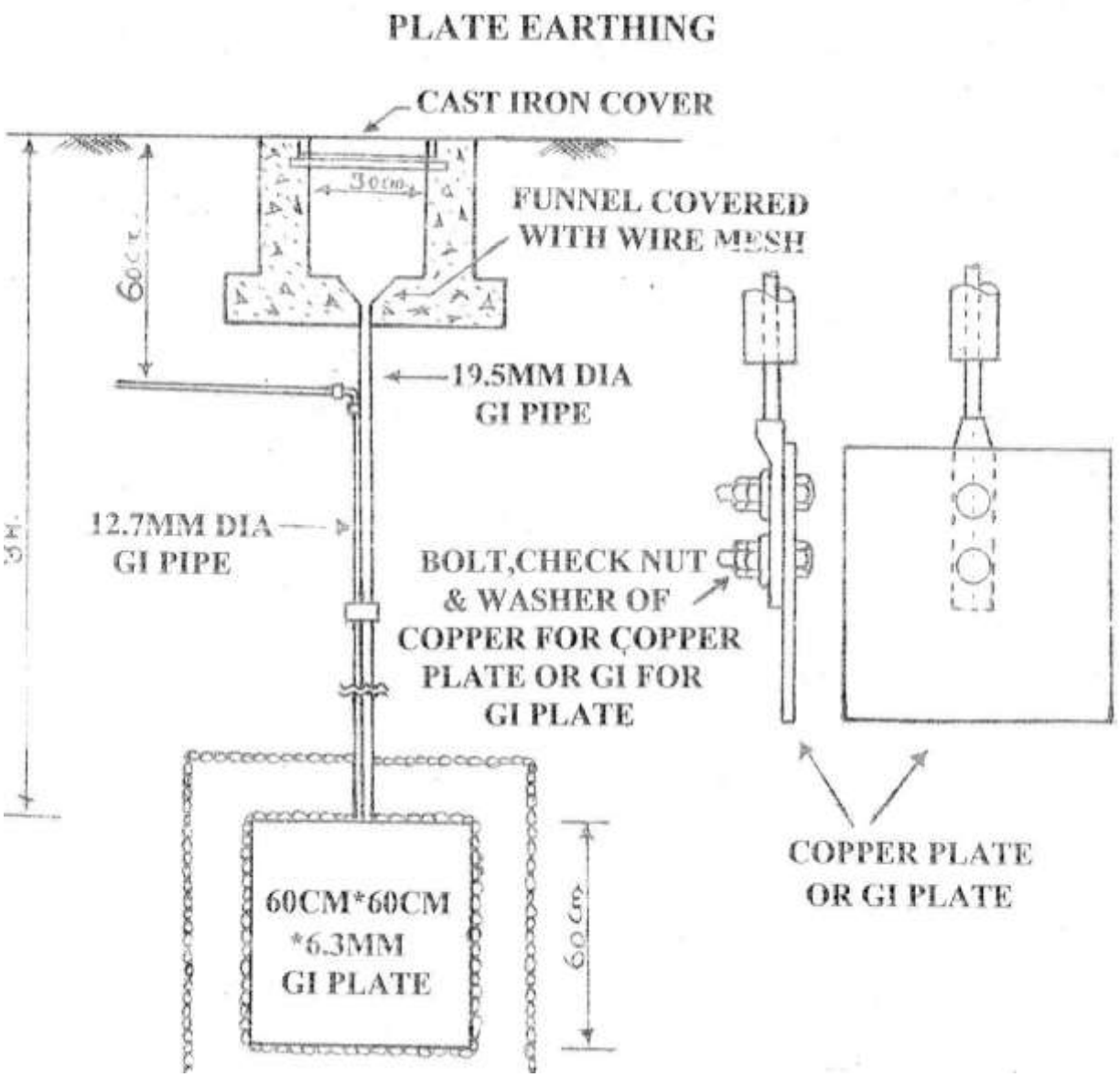
4. PLATE EARTHING

In this type of earthing a copper plate of dimensions 60cm x 60cm x 3.15mm or G.I plate of 60cm x 60cm x 6.3mm is used as earth electrode. Plate electrode should be buried with its face vertical such that the top edge is at a depth of not less than 1.5m below the surface of the ground. The electrode is

surrounded by alternate layers of broken pieces of coke or coal and salt. The earth wire is securely bolted to the earth plate with the help of a bolt, nut washer made of copper electrode and G.I for G.I electrode.

PIPE EARTHING





MEASUREMENT OF EARTH RESISTANCE

The earth resistance is dependent upon many factors as detailed below and as such its value can vary. a.

Material of electrode and earth wire

b. Size of electrode and earth wire c.

Temperature of soil

d. Moisture of the soil

e. Depth to which it is embedded

f. Quantity of coal and salt in the electrode pit.

g. Soil condition (Black soil, Red soil, Rocky soil etc.)

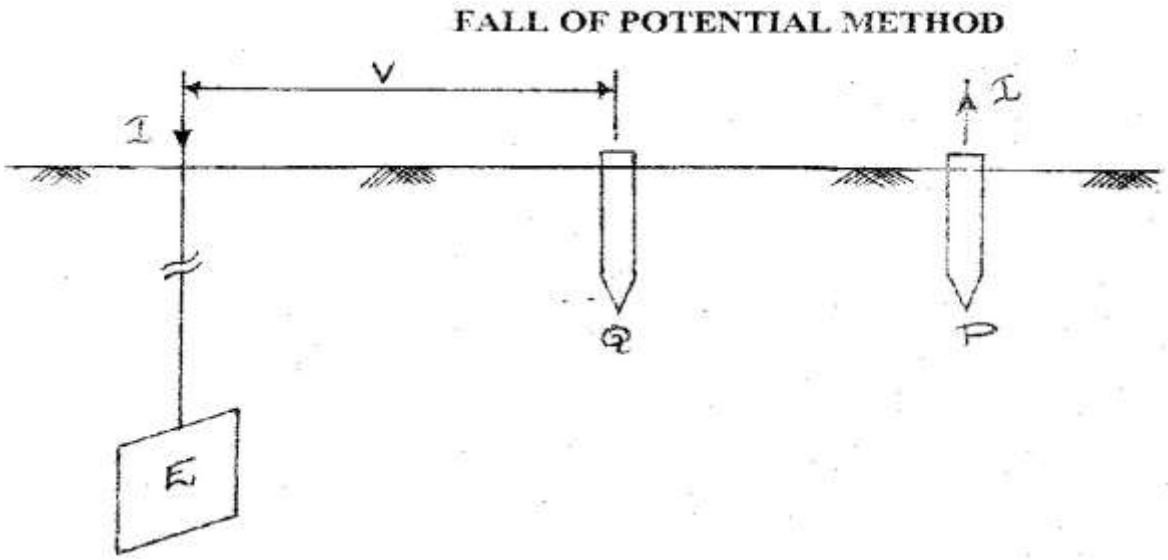
h. Quality of coal or char coal pieces/powder

The following are the practical methods of determining the earth resistance

1. The fall of potential method.
2. Direct measurement with earth testing instrument.

Fall of Potential Method

A current I is passed through the earthing plate E to an auxiliary electrode P in the ground at a considerable distance away from the plate. A second electrode Q is inserted between the plate E and the electrode P. The potential difference V between E and Q is measured for the current I. The resistance of earth connection is given by $R_E = V / I$. The value of R_E depends mainly on the placing of the auxiliary electrodes. When the earth resistance is low, the distance between the earth plates and the auxiliary electrodes may need to be between 50m and 100m.



DIRECT MEASUREMENT OF EARTH RESISTANCE

The Meggar Earth Tester works on the fall of potential method explained earlier. It also requires temporary current and potential electrodes. The instrument is so designed that the readings are not affected either by stray alternating or direct current or by electrolytic back e.m.f, and it gives resistance directly without calculations. The Megger Earth Tester is essentially a direct reading ohmmeter and hand driven generator, which supplies the testing current. The ohmmeter consists of two coils (current coil and potential coil) mounted at a fixed angle to each other on a common axle. The current coil carries current proportional to the current flowing in the test circuit, while the potential coil carries current proportional to the potential across the resistance under test. Thus the potential coil acts as a voltmeter in the fall of potential method while current coil acts as an ammeter in that experiment. Since the deflection of the needle is proportional to the ratio of the current in the two coils, it gives resistance directly.

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