ELECTRICAL WORKSHOP

LAB MANUAL
(EE – 213 – F)

III SEMESTER

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
DRONACHARYA COLLEGE OF ENGINEERING,
KHENTAWAS, GURGAON – 123506

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EXPERIMENT- 1

AIM: Introduction of tools, electrical materials and abbreviations.

TOOLS:

1. **PLIER**: Generally three types of pliers are used in the electrical workshop. They are:-

- **FLAT NOSE PLIER**: Used for holding jobs or holding wires. It has got only two slotted jaws, which are tapered. Thus it is used for tightening or loosening small nuts.

- **SIDE CUTTING PLIER**: Used for cutting of thin wires and removing insulations from them. It has got cutting edge on its one of its sides.

- **ROUND NOSE PLIER**: Used only to hold or cut the wires. It has no gripping jaws. Its cutting edge is long and rounded on the top.

2. **SCREW DRIVER:** It is used to loosen or tighten or to keep screws in position. It has a wooden or plastic handle and a blade of high carbon steel.

3. **CHISEL:**

- FIRMER CHISEL: Generally used for carpentry works and can be used by hand pressure or with the help of mallet. It has flat blade, which varies from 12mm to 15mm.
- COLD CHISEL: Used for cutting iron pieces (cold). It has cutting angle from 30° to 45°and is made of high carbon steel.

4. **HAMMER:** Most commonly used in the workshop. The head is made of cast iron or forged; the claw is hardened and tampered. The striking place is slightly convex. The head is fitted with a wooden handle of various lengths.

5. **HACKSAW:** Used to cut metal such as iron strips, core pipes etc. it has a blade made of high steel or tungsten.

6. **ELECTRICAL TOOLS**

- **TUMBLER SWITCH:** (6 A for light), this switch was used 3-4 decade ago. It is made of Bakelite.

- **MCB BOX:** Known as the Miniature Circuit Breaker Box.

7. **METAL CONDUIT PIPE WITH JUNTION BOX:** Metallic hollow pipe, which is used as a passage for electrical house, hold wires. It is fixed to walls with the help of metallic saddle.

8. **METAL BEND:** Hollow metallic pipe bend to an angle of 90° to allow smooth movement of wires inserted through the walls during wiring .

9. **BATTEN WIRING:** It is an old fashioned wiring used 4-5 decades ago.

10. **PVC CASING AND LAPPING:** Long rectangular box made of 2 parts. It is made of PVC and used mainly to pass wires through walls during wiring.

11. **PVC BEND:** Work similarly as metal bends but it is made up of PVC that makes it lighter, cheaper and more durable.

12. **BATTEN LAMP HOLDER:** mainly used to hold electric bulbs and lamps.

13. **SWITCH BOARD WITH SWITCHES:** it contains the following:
    - SOCKET OUTLETS: it is a type of electrical material through which electric current flows from wires to various electrical appliances. It is of 6A.
    - TWO WAY SWITCH: it is mainly used in staircase wiring to either on or off the light. It is of 6A.
    - ONE-WAY SWITCH: it is a device used to switch on lights of 6A.

14. **7/20 SWG (POWER WIRE):** they are used in power purposes for duty electrical appliances. 7/20 means 7 numbers of wires in the cable and 20 strands for thickness or gauge size.

15. **3/20 SWG (PHASE WIRING):** mostly used for house wiring purposes.

16. **3/22 SWG (NEUTRAL WIRE):** it is also used for house wiring purposes.

17. **1/18 SWG:** it is used for earthing.

18. **FLEXIBLE CABLE:** This is a temporary wire used for both power and light but temporarily. It is used as extension wire.

ABBREVIATIONS:

S.NO.	NAME OF THE UNIT	ABBREVIATION
1.	VOLTS	V
2.	AMPERES	Amp
3.	LOW TENSION	LT
4.	HIGH TENSION	HT

5.	OIL CIRCUIT BREAKER	OBC
6.	KILO-VOLTS	KV
7.	MAIN SWITCH	MS
8.	SUB-MAIN SWITCH	SMS
9.	DISTRIBUTION BOARD	DB
10.	IRON CLAD DISTRIBUTION BOARD	ICDB
11.	CONTROL BOARD	CB
12.	SWITCH BOARD	SB
13.	NORMALLY OPEN	NO
14.	NORMALLY CLOSED	NC
15.	TIME DELAY RELAY	TDR
16.	NO VOLT RELEASE	NVR
17	SUB-DISTRIBUTION BOARD	SDB
18.	OVER LOAD RELEASE	OLR
19.	DIRECT ON LINE	DOL
20.	DOUBLE POLE IRON CLAD	DPIC
21.	ALL ALLUMINIUM CONDUCTOR	AAC
22.	ALTERNATING CURRENT	AC
23.	DIRECT CURRENT	DC
24.	TRIPLE POLE IRON CLAD	TPIC
25.	AIR CIRCUIT BREAKER	ACB
26.	CURRENT TRANSFORMER	CT
27.	CAB TYPE SHEATHED	CTS
28.	CAPACITIVE VOLTAGE TRANSFORMER	CVT
29.	EARTH LEAKAGE CIRCUIT BREAKER	ELCB
30.	EXTRA HIGH VOLTAGE	EHV
31.	ELECTROMOTIVE FORCE	EMF

32.	FIELD EFFECTIVE TRANSISTOR	FET
33.	HIGH PRESSURE Hg VAPOUR LAMP	HPMVL
34.	HIGH RAPTURE CAPACITY FUSE	HRCF
35.	HIGH VOLTAGE	HV
36.	LOW VOLTAGE	LC
37.	INTRIGATED CIRCUIT	IC
38.	JUNCTION FIELD EFFECT TRANSISTOR	JFET
39.	KILO VOLT AMPERE	KVA
40.	KILO WATT	KW
41.	KILO WATT HOUR	KWh
42.	LIGHTENING ARRESTER	LA
43.	LIGHT DEPENDENT RESISTANCE	LDR
44.	LOW PRESSURE Hg VAPOUR LAMP	LPMVL
45.	LOW VOLTAGE	LV
46.	LIGHT EMITTING DIODE	LED
47.	MINIATURE CIRCUIT BREAKER	MCB
48.	METAL OXIDE FIELD EFFECT TRANSISTOR	MOFET
49.	MEGA WATT	MW
50.	NEUTRAL LINK	NL
51.	OVER LOAD TRIP COIL	OLPEC
52.	PHASE	Ph
53.	POTENTIAL TRANSFORMER	PT
54.	POLYVINYL CHLORIDE	PVC
55.	PAPER INSULATED LEAD COVERED	PILC
56.	SERIES	Se
57.	SHUNT	Sh
58.	SILICON CONTROL SWITCH	SCS

59.	LIGHT ACTIVATED SILICON CONTROL SWITCH	LASCS
60.	SUB MAIN SWITCH	SMS
61.	SINGLE POLE	SP
62.	SINGLE POLE DOUBLE THROW	SPDT
63.	SINGLE POLE SINGLE THROW	SPST
64.	STANDARD WIRE GAUGE	SWG
65.	TRIPLE POLE SWITCH	TPS
66.	SODIUM VAPOUR LAMP	SWL
67.	SODIUM UNILATERAL SWITCH	SUS
68.	SILICON CONTROL RECTIFIER	SCR
69.	TRIPLE POLE WITH NEUTRAL	TPN
70.	TRIPLE POLE IRON CLAD	TPIC
71.	TRIPLE POLE DOUBLE THROW	TPDT
72.	TRIPLE POLE SINGLE THROW	TPST
73.	THERMAL RELAY	TR
74.	TOUGH RUBBER SHEATHED	TRS
75.	UNIJUNCTION TRANSISTOR	UJT
76.	VOLT AMPERE	VA
77.	VULCANISED INDIAN RUBBER	VIR
78.	WATER TIGHT	WT
79.	WEATHER-PROOF CABLE	WPC
80.	CATHODE RAY OSCILLATOR	CRO
81.	RESISTANCE	R
82.	CAPACITOR	C
83.	INDUCTANCE	L
84.	BATTERY	E
85.	UNIJUNCTION TRANSISITOR	UJT

QUIZ/ANSWERS

Q1.	What is the abbreviation of kva?	Kilo Watt Amperes
Q2.	Name the standard of the wires according to their gauges?	1/8, 3/20, 7/20, 7/22
Q3.	What is the use of lamp holder?	Hold in particular position
Q4.	What is the symbol of the ceiling fan?	
Q5.	What is the function of hawk saw?	To cut pipes, metal sheet & wooden pieces
Q6.	How many types of pliers we used?	Flat nose, long nose, cutting & combination
Q7.	What do you meant by RPM?	Revolutions per minute
Q8.	What is the function of chisel?	Cutting metal pieces
Q9.	What is the function of screwdriver?	According to length of a bit
Q10.	Why we use flexible wires?	Increasing the length of the supply cable

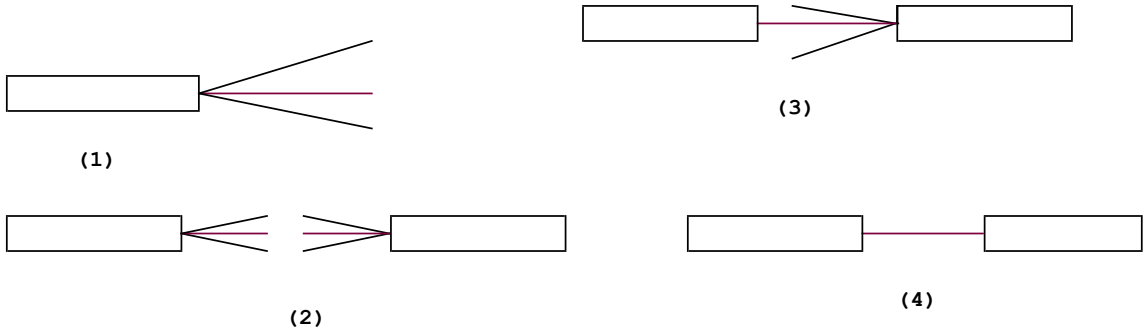
EXPERIMENT - 2

AIM: To study staircase wiring.

APPARTUS: 3/22 SWG wires, lamp holders, two way switch, 40w bulb 3
PVC casing, strips and pliers.

THEORY: It is that wiring which makes use of 2 switches to operate bulb at the beginning of the stair lights and the bulb gives off by pushing the button in the end. One of the terminals of the bulb is connected to the main line whose power line is connected to middle slot of two-way switch. Remaining first of there slots is connected in parallel as in crossed node.

CIRCUIT DIAGRAM:



PROCEDURE:

1. Plan the wiring and casing according to the circuit diagram.
2. With the help of plier and stripper share the ends of wire of required length.
3. Connect the wire carrying the current to the central pin of the two-way switch.
4. Connect the remaining ends A and B to the corresponding other two way switch.
5. Connect the center pin wire of second two-way switch to the lamp.
6. Connect the second point to the neutral for completing the circuit.
7. Use PVC case wiring to cover expose wiring.
8. Switch ON and OFF the two switches alternatively to the bulb.

PRECAUTIONS:

1. Tools should be used carefully.
2. Fitting should be tightly fitted.
3. Connection should be tight.
4. Wire should be on the conduit, power gripped properly.

QUIZ:

Q1.	Which type of switch we use in stair case wiring?	Two way switch
Q2	What do you meant by CTS?	Tough Sheath
Q3.	Where we use two-way switches?	Staircase wiring & long godown
Q4.	Which tools are used for wiring?	Plier, cutter, screwdriver, hammer.
Q5.	What is TW batten?	Teak Wood Batten
Q6.	What is the main precaution for staircase wiring?	No connection should be naked
Q6.	What is the function of saw?	Cutting sheet, wood & pipes
Q7.	What is the link clips?	Holding wires
Q8.	Where we use three pin plugs?	Connecting the load
Q9.	What is the function of megger?	Measure insulation of cable
Q10.	What do you meant by 3/22	3- wires & 22gauge of wire

EXPERIMENT –3

AIM: To study hose wiring.

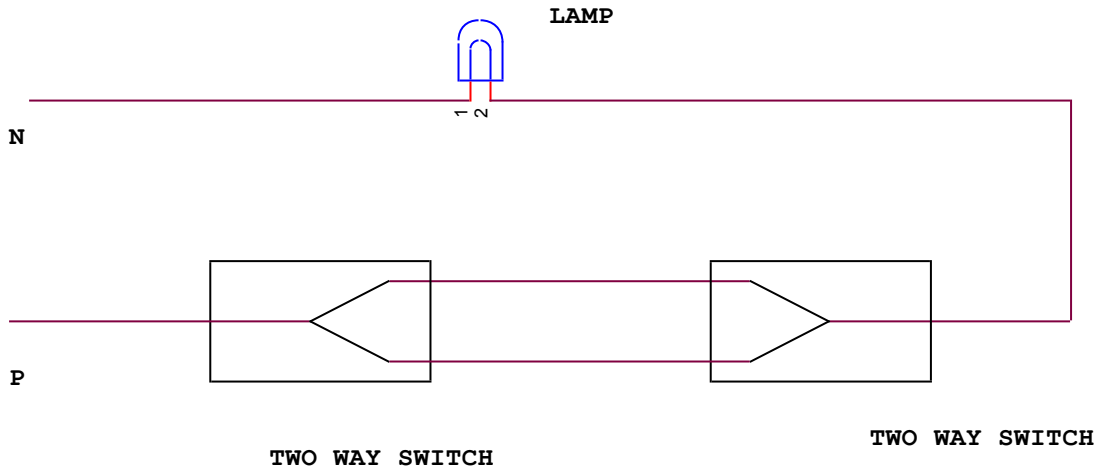
TOOL USED: Tenon saw screwdriver 8 cm (8”), Screwdriver 15(6”), connector Screwdriver, Hammer, Plier drill machine, Try square, chisel, File, Poker knife.

MATERIAL AND QUATITY:

1)	T.W Batten 19mm x 13mm	42m
2)	T.W batten 13mm x 13mm	10m
3)	CTS/ T.R.S wire 13/. 039(3/22)	250v
4)	Batten holder	2 no.
5)	Plug 3pin, 5amp	1 no.
6)	Tumbler Switch one-way 5amp	3 no.
7)	T.W round blocks (7.75cm x 2.5)	3 no.
8)	T.W board	40 mm(1+1/2”)
9)	Hink clip	40 mm(1/2”)
10)	Wood Screw	

THEORY: This type of wiring is used in houses. The two terminal of supply are connected to meter and other two terminals are joined to DPIC. One end is attached to N-link of fuse is joined to switch board of a room and neutral pole is also connection to switch board according to our need.

CIRCUIT DIAGRAM:



TYPES OF HOUSE WIRING:

1. **CLEAT WIRING**: - This is of wiring suitable only for temporary wiring purpose. In lamp or wet location the wire used should be moisture proof and a weather proof.
2. **P.V.C OCNDUCT WIRING**:- This uses a conduit pipe for the mechanical protection of wire. In this system of wiring, wires are carried through P.V.C conduit pipe for giving converging to pipes conduit pipe has certain advantage like it is moisture proof and durable.
3. **P.V.C CASTING WIRING**: -This type of wiring is mostly used for fixing cables on a wooden structure called batten by means of metal. It is the surface wiring system whenever wires are broken for connecting to switch on the right point junction box made up of either part plastic or metal C.I must be used and provided same means of earthing.
4. **P.V.C CASTING WIRING**: -This type of wiring is mostly used for indoor and domestic wiring carried through a P.V.C casing wiring

PROCEDURE:

1. Draw the tangent or wiring on the board with cholk.
2. Cut the required length of T.W batten file and link chips on then and file the batten with screw of 3mm size.
3. Cut the C.T.S wire in required length and put them on batten gripped by link chips or per circuit diagram.
4. Fix the T.W round blocks and board after drilling the holes for wire.
5. Fix the batten holder, 3-pin plug and switch on round block.
6. After completing wiring it should be checked before supplying current.

PRECAUTIONS:

1. Tools should be used carefully.

2. Fitting should be tightly fitted.

3. Connection should be tight.

4. Wire should be on the conduit, power gripped properly.

QUIZ:

Q1.	How much voltage in a single-phase supply?	AC 230 volt
Q2.	What do you meant by DPIC?	Double pole iron clad
Q3.	What is the bus bar?	To take many connections
Q4.	How we represent the lamp?	
Q5.	Why we use regulator?	To regulate supply voltage
Q6.	What is the max. Load on a switchboard?	10 switches or 1000W
Q7.	What is MCB?	Miniature circuit breaker
Q8.	What is cleat wiring?	Used for moist wiring
Q9.	What is the colour code of wiring?	R-Y-B phase
Q10.	What do you meant by PVC?	Polyvinyl chloride

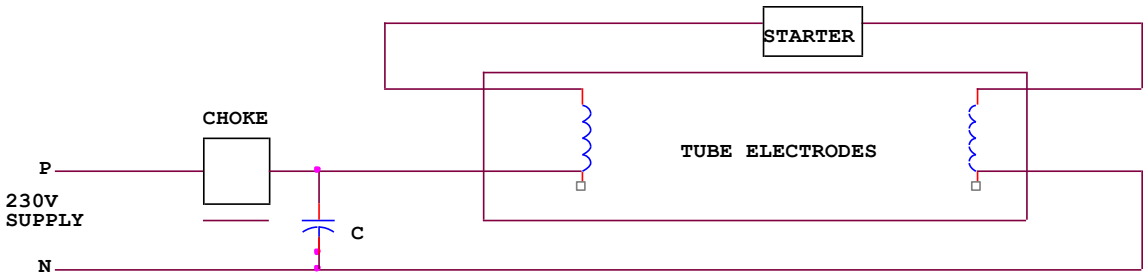
EXPERIMENT –4

AIM: To study fluorescent tube light.

APPARATUS: tube, tube base, starter, choke, and wire.

CONSTRUCTION: Fluorescent tube is a low-pressure mercury vapour lamp. The lamp is in the form of long glass tube due to low pressure, with fluorescent powder coating to its inner surface. Tungsten filaments coated with barium oxide are placed at each side of the tube. The tube contains small amount of mercury with small quantity of argon gas at low pressure. When the temperature increases mercury changes into vapour form. At each end of the tube, electrode in spiral form is made of tungsten coated with electrons emitting barium. A capacitor is connected across the circuit to improve the power factor.

CIRCUIT DIAGRAM:



PROCEDURE:

1. Fix the tube holder and the choke on the tube base.
2. Phase wire is connected in the choke and neutral direct to the tube.
3. Fix the fluorescent tube between the holders.
4. Finally connect the starter in series with the tube.

PRECAUTIONS:

1. Tools should be used carefully.
2. Fitting should be tightly fitted.
3. Connection should be tight.
4. Wire should be on the conduit, power gripped properly

QUIZ:

Q1.	What is the standard dia. of the tube light?	25 mm
Q2.	Which material is used for coating the tube?	Argon gas or neon
Q3.	Which gas is used in tube light?	Zinc silicate cadmium silicate.
Q4.	What are the standard lengths of tube light?	6m, 1.2m and 1.5m.
Q5.	What is the function of starter?	Yes, by shorting the two wires temporarily.
Q6.	Why we use choke in tube light?	To supply high voltage during starting
Q7.	Name any two types of the starter?	Glow type, thermal type.
Q8.	How much power consumed by the tube light?	40 watt approximately.
Q9.	At which supply the tube is operated?	230 volt ac
Q10.	Can we start the tube light with out a starter?	To complete the circuit initially

EXPERIMENT – 5

AIM :- To study moving iron, Moving coil, Electrodynamic and Induction type meter.

APPARATUS REQUIRED:- Moving iron, moving coil, electrodynamic and induction type meters

THEORY:-

1. Moving Iron Meters :- The operation of moving iron meters is based on the reaction of the magnetic field set up by the current in instrument coil with a single or several moving cores of ferromagnetic materials. as the deflection torque is obtained either by attraction or repulsion between two bars positioned within a coil. There are two types of meters, attraction type moving and repulsion type moving iron meters both types of meters can be used either AC or DC supply. In most cases the control torque is obtained from a helical spring and damping torque pneumatically.

2. Moving Coil Meters :- There are two types of moving coil instruments.

a) Permanent magnet moving coil(PMMC) Instruments
b) Dynamo type moving coil instruments.

(a) PMMC :- The principle used in the operation of PMMC instruments is that a current passing through a conductor generates a magnetic field around the conductor and if this field is arranged to interact with a field produced by a permanent magnet a force acts on the current carrying conductor.if the conductor is constrained to move in a rotary manner, an angular deflection proportional to the current may be obtained.

(b) Electrodynamic moving coil instrument:- Permanent magnet type moving coil instruments are not suitable for AC current and voltage therefore electrodynamic type moving coil instruments are introduced which are suitable for both AC and DC supply measurement. The essential feature of a dynamo type instrument is that the permanent magnet is replaced by one or two fixed coils which carry the current to be measured .these coils are air cooled. The deflecting torque is always positive regardless of the direction of current as with change in direction of current in moving coil instrument the field of the fixed coil also changes its direction.

3. Induction type instruments: - These types of instruments are operated by the reaction between alternating magnetic fluxes and current induced in the moving element of the instrument. In this instrument an aluminum disc is placed in the air gap of electromagnets is fitted on the spindle holding the pointer of the instrument. The flux produced by the current acts on the pointer which moves accordingly. These instruments can be used as ammeter, voltmeter, wattmeter and energy meter.

Quiz Question:

Q.1. What is the working principle of moving iron instruments?

A. It works on the principle of reaction between flux produced by two coils.

Q.2. What are the types of moving iron instruments?

A. Moving iron instruments are of two typs, permanent magnet type and electrodynamic type.

Q.3. PMMC type instruments can be used for measuring which supply?

A. These instruments are used to measure DC supply only.

Q.4. Electrodynamic type instruments can be used for which supply?

A. Electrodynamic type instruments can be used to measure both AC and DC supply.

Q.5. What are the applications of induction type meters?

A. Induction type meters can be used as ammeters, voltmeters, wattmeters and energymeters.

EXPERIMENT - 6

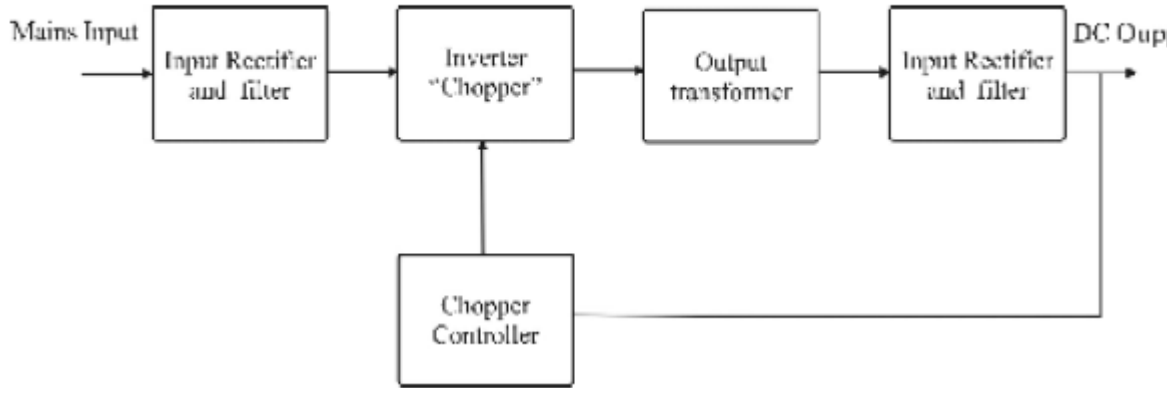
AIM : To study circuit of SMPS.

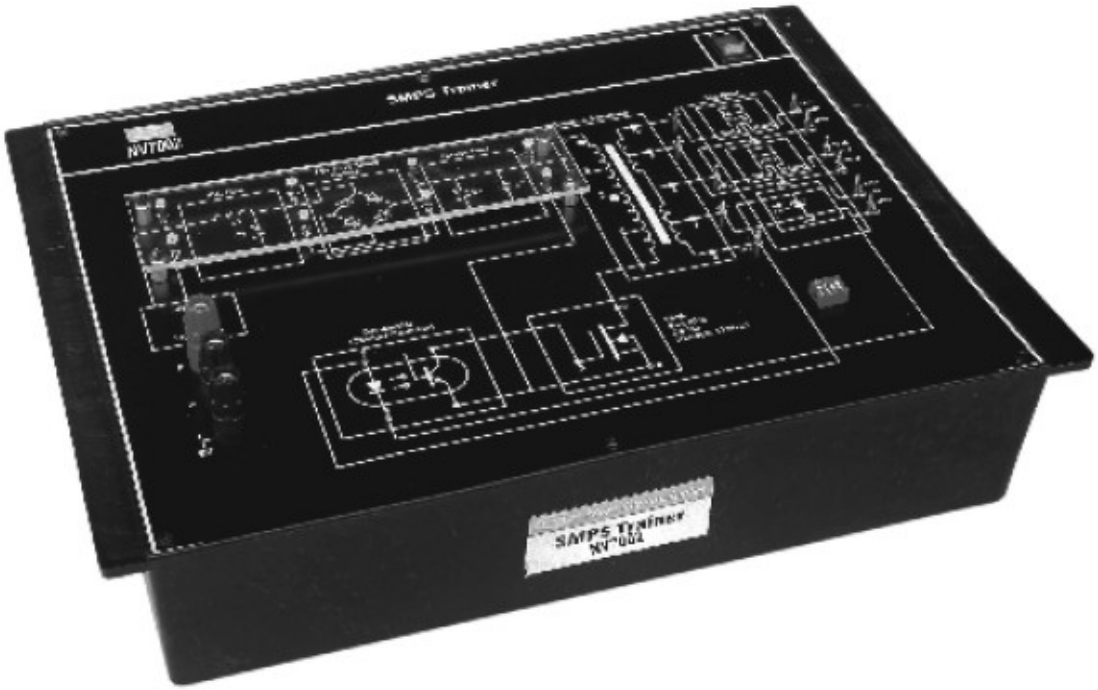
APPARATUS: SMPS Trainer Kit

THEORY: **SMPS trainer** is a very adaptable kit has been designed to explain a veryremarkable and frequently used switching based power supply-The SMPS (Switched Mode Power Supply).The kit is designed keeping in mind that a student can comprehend each block of SMPS in a very easy way. Different test points have been provided so that one can observe the inputs and outputs of each block contained. Being different from a conventional block diagram internal structures of different blocks are also shown. Switching Transformer and Chopper (The Heart of SMPS) are presented in such a way that a student can readily understand their functioning and pin configuration. Since SMPS is different from a traditional power supplies because it can be used for different voltage inputs (from 80V to 300V AC).If the SMPS has an AC input, then its first job is to convert the input to DC. This is called rectification. The rectifier circuit can be configured as a voltage doubler by the addition of a switch operated either manually or automatically. This is a feature of larger supplies to permit operation from nominally 120volt or 240volt supplies. The rectifier produces an unregulated DC voltage which is then sent to a large filter capacitor. The current drawn from the Mains supply by this rectifier circuit occurs in short pulses around the AC voltage peaks. These pulses have significant high frequency energy which reduces the power factor. Special control techniques can be employed by the following SMPS to force the average input current to follow the sinusoidal shape of the AC input voltage thus the designer should try correcting the power factor. A SMPS with a DC input does not require this stage. A SMPS designed for AC input can often be run from a DC supply, as the DC passes through the rectifier stage unchanged.

CIRCUIT DIAGRAM:

How an SMPS works?





APPLICATIONS:

Switched-mode PSUs in domestic products such as personal computers often have universal inputs, meaning that they can accept power from most Mains supplies throughout the world, with rated frequencies from 50Hz to 60Hz and voltages from 100V to 240V (although a manual voltage "range" switch may be required). In practice they will operate from a much wider frequency range and often from a DC.

PRECAUTIONS:

1. All connections should be tight.
2. The circuit should be according to circuit diagram.
3. The power should be on when the circuit is checked completely.

EXPERIMENT- 7

AIM: To study circuit and working of UPS..

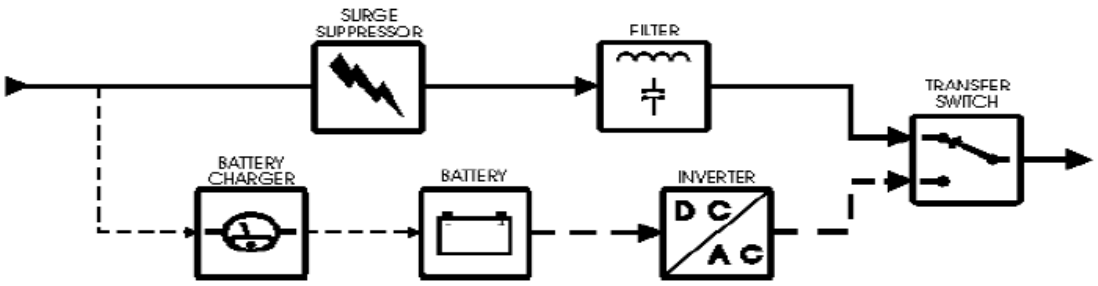
THEORY:

When electrical utility power fails or drops to an unacceptable level, Uninterruptible Power Systems (UPS) are key in saving and protecting valuable computer data. UPS equipment provides power conditioning, power regulation and, in case of power outages, provides the crucial backup power needed for an orderly shutdown of computer processes and files. UPS are also used for emergency power supplies for Hospitals, data centers, municipalities, industrial and commercial centers to supply power in case of power failure from main supply authority.

UNINTERRUPTIBLE POWER SUPPLY:

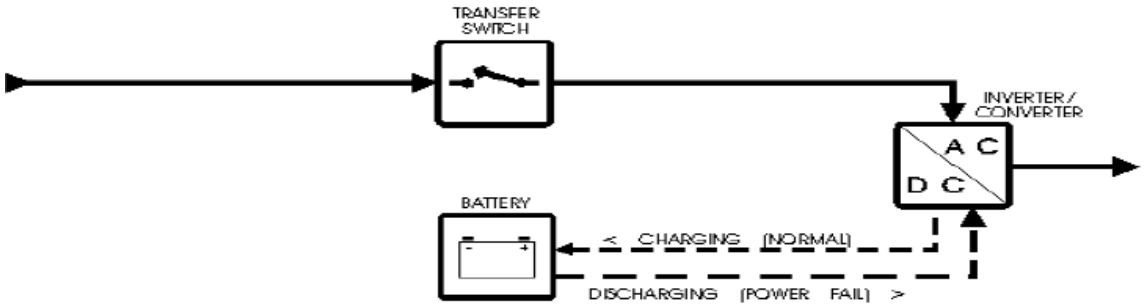
All UPS include core circuitry that manipulates electricity, converting it from the ACpower produced by the utility company to DC power stored in the battery, and backagain for use by your equipment via an inverter. The exact type, nature, size and quality of this circuitry depend on the type of UPS, and more specifically the make and model you have chosen.Most modern UPS are microprocessor-controlled. There is actually a small computer embedded within the UPS itself that controls the key functions of the UPS. This includes detecting AC power failures, handling switching between power sources, monitoring the status of the battery, controlling the status indicators and so on.

CIRC UIT DIAGRAM:



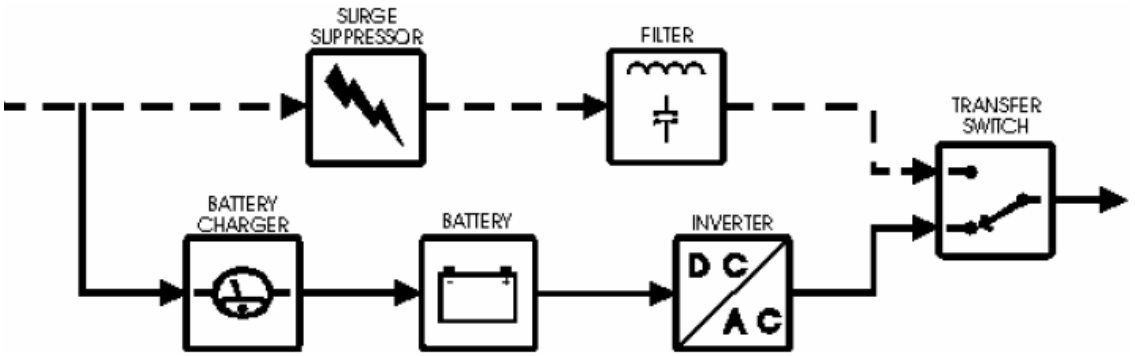
Block schematic of a standby UPS

Figure 1



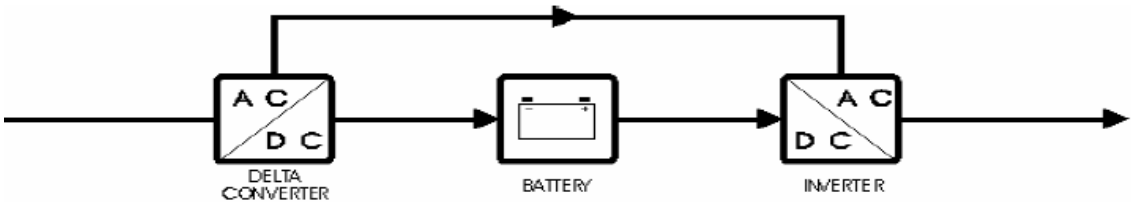
Block schematic of a line-interactive UPS

Figure 2



Block schematic of an online.

Figure 3



Simplified block schematic of a delta-conversion online UPS.

Figure 4

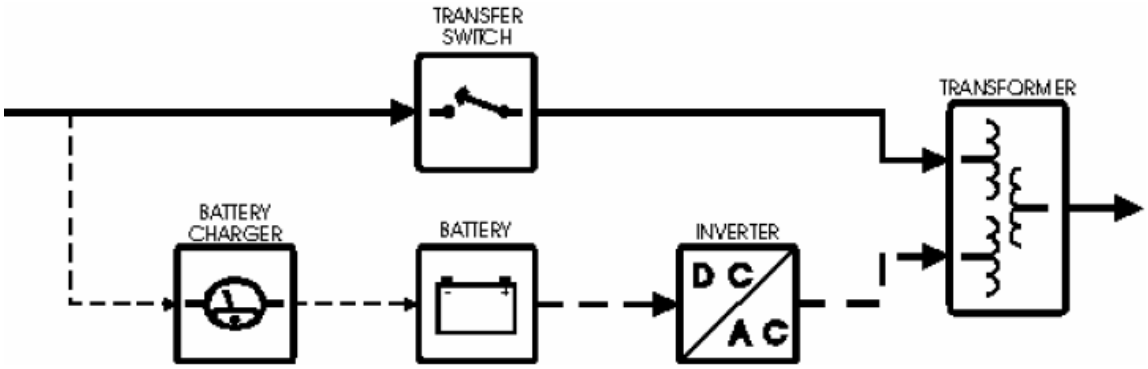


Figure 5

These UPS are available for different Power output range such as: Standby UPS are usually available in a size range of up to about 1000 VA. The Line-interactive UPS isan improved design that is commonly used in units for home and business use, available in sizes up to 3,000 VA or so. It is superior to the standby UPS, but it stillhas a transfer time like standby UPS. Online UPS are typically used only for large servers, and for backing up multiple pieces of equipment in data centers. They are available in sizes from about 5,000 VA up to hundreds of thousands of VA and even larger. Ferro resonant standby UPS are usually available in a size range of up to about 15,000 VA, making them suitable.

EXPERIMENT -8

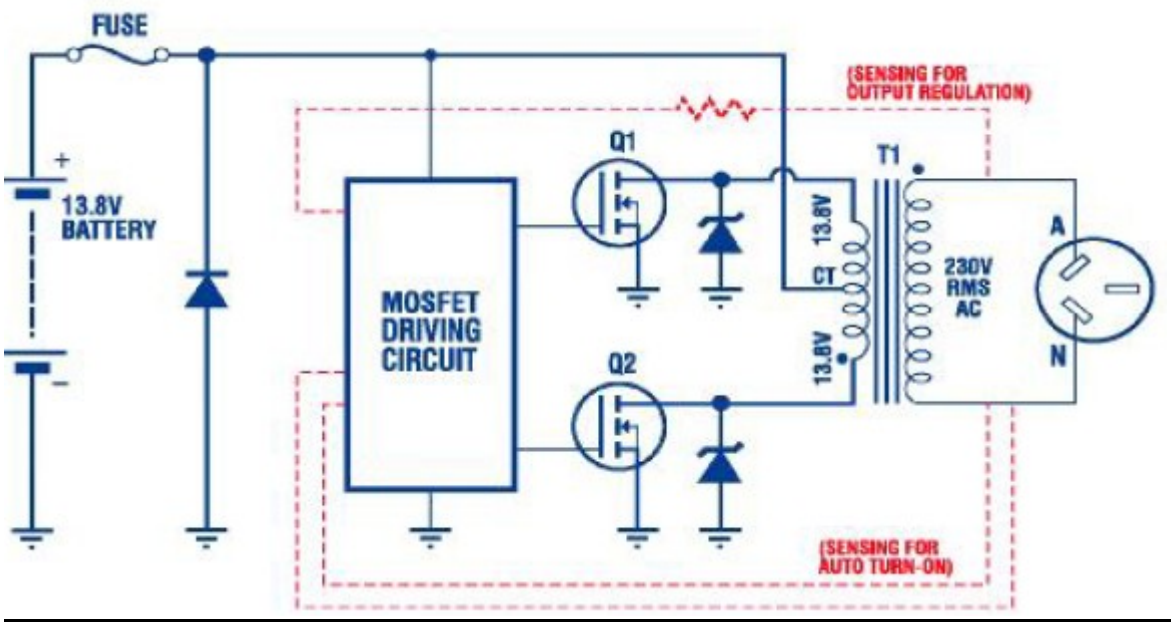
AIM: To study circuit and working of home inverter

APPARATUS: Home inverter

THEORY: Inverter is named so because it inverts DC voltage into AC voltage. It is very useful in industries application basically a DC input voltage converted into AC output voltage with the help of pulse width modulator, oscillator. With help of pulse width modulator, oscillator and a step–up transformer, constant amplitudes pulses are generated and the width of these pulses is modulated to control inverter output voltage with the help of oscillator required. Frequency is generated (50Hz for India) this generated frequency is the frequency of output voltage now this modulated signal of required frequency is supplied to the step-up transformer so that it converts into required voltage with respective frequency. Our inverter trainer kit is fixed at 50Hz ±5% frequency 220 V AC ±10% voltage. It provides with test points at every important section where observation of different type of signal and voltage can be measured with help of multi meter and CRO. Also this trainer is provided with a rechargeable battery. Since kit is carrying high voltage precaution for the safety purpose should be taken always.

DC–AC inverters are electronic devices used to produce 'mains voltage' AC power from low voltage DC energy (from a battery or solar panel) this makes them very suitable for when you need to use AC power tools or appliances but the AC mains power is not available.Most inverters do their job by performing two main functions, first they convert incoming DC into AC and then they step up the resulting AC to Mains voltage level using a transformer.Modern Inverters use a basic circuit scheme like that shown in figure as you can see the DC from the battery is converted into AC very simply by using a pairs of power MOSFETS (Q1 & Q2) acting as very efficient electronics switches.

CIRCUIT DIAGRAM:



PROCEDURE:

The positive 12V DC from the battery is connected to the centre- tap of the transformer primary, while each MOSFET is connected Between one end of the primary and earth (battery negative), so by the switching on Q1, the battery current can be made to flow through 'top 'half of the primary and to earth via Q1.conversely by the switching on Q2 instead, the current is made to flow the opposite way through the 'lower' half the primary and to earth.Therefore by switching the two MOSFET on alternately, the current is made to flow first in one half of the primary and then in the other, producing an alternating magnetic flux in the transformer core. As a result a corresponding AC voltage is induced in the transformers secondary winding, and as the secondary has about 24 times the number of turns as compared to the primary, the induced AC voltage is much higher around 650V peak to peak.In MOSFET based Inverter it is not feasible to control the peak-to peak output, because this is largely fixed by the battery voltage and the transformer's step-up ratio. So in this type of cases regulation is achieved by varying the width of the pulses. This is called 'Pulse Width Modulation' (PWM), and is usually done by the having a feedback system which senses the inverter's output (or load current). When this feedback senses that the load on the inverter's output has increased, the inverter's control circuitry acts to increase the width of the pulses which turn on MOSFETS. So the MOSFETS turn 'On' for longer each half cycle.

PRECAUTIONS:

1 All connections should be tight.

2 Never touch or try to touch any test point in Inverter Trainer Kit :

3 The circuit should be according to circuit diagram.

4. Don't reverse polarity of Battery Input :

5. Never short circuit terminals of battery :

EXPERIMENT – 9

AIM: To study fuses MCBs and importance of earthing.

THEORY:

EARTHING: ***Earthing*** *or grounding* of equipment refers to the connection of non-current carrying parts of electrical equipment to the earth to maintain earth potential. In domestic systems, the earthing circuit is usually earthed by connecting to metallic water pipes buried in ground. An effective earthing (grounding) system avoids having dangerous potentials on the equipment even during electrical faults and also ensures the proper operation of electrical protection equipment during fault conditions (this will be discussed under the operation of Earth
Leakage and Residual Current Circuit Breakers).

FUSES: Fuses are the earliest means of protection against overcurrents in circuits. Basically, the fuse consists of a short length of suitable material (often a thin wire). When the current flow is greater than the fusing current of the fuse, it will get hot and burn (melt), thus interrupting the fault current before damage could be caused. The size of the wire is designed to carry indefinitely the normal circuit current (rated current) and usually designed to fuse (melt/burn) at about 1.7 – 2 times the rated current carrying capacity. They have inverse time characteristics as shown in Figure 1. Accordingly, the operation of the fuse is faster when the fault current is larger. In addition to operating for short circuits between the live and neutral, fuses are expected to operate under overload conditions. Over-loading occurs when extra power is taken from the supply. The increased current due to over-loading will have an immediate effect on the cables; they will begin to heat up. If the over-loading is sustained the result could be an accelerated deterioration of the cable insulation and its eventual breakdown to cause an electrical fault. A heavy-sudden over-load for a very short period (e.g. such as in Motor starting) is not very serious since the over-load current flows for a short time and the rise in cable temperature is not very high. At the standstill the motor behaves as the short circuit secondary transformer and it draws heavy current from mains, which can cause the damages at the starting. It can cause the heavy drops in power line. So direct online starting of motor is not desirable. The motor has to be started at reduced voltage. For heavy duty motors some starting methods are used or resistance has to be included in the circuit at starting.

FULLY ENCLOSED (CARTRIDGE) FUSE was developed to overcome the disadvantages of the re-wirable type of fuse. In its simplest form, the fuse wire is enclosed in an evacuated glass tube with metal end caps. Non-deterioration of the fuse element is one of the most reliable features and is usually more accurate. However, cartridge fuses are more expensive to replace. Both re-wirable and cartridge type fuses are usually of low rupturing capacity (product of maximum current which the fuse will interrupt, and the supply voltage). They are used in general house-hold, commercial and small scale industrial applications.

HIGH RUPTURING CAPACITY (HRC) FUSES are used for high current applications.The HRC fuse is usually a high-grade ceramic barrel containing the fuse element. The barrel is usually filled with sand, which helps to quench the resultant arc produced when the element melts. The barrel is able to withstand the shock conditions which occur when a high fault current is interrupted. Normally, the fuse elements are in parts connected in the middle by bridges which have a very precise melting point of about 230 oC. These are very accurate. With a specific current, the temperature rises and the bridge melts producing a break in the circuit. The metal vapour diffuses with silica powder and the product is of high resistance. The HRC fuses are expensive to replace once blown.

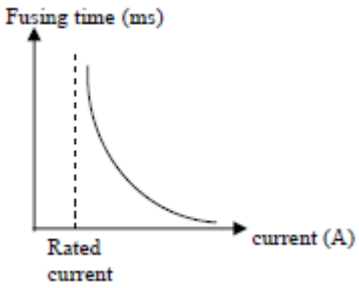
CIRCUIT BREAKERS FOR OVER CURRENT PROTECTION

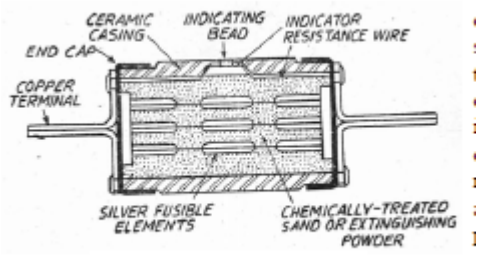
The circuit breaker is a device for making and breaking a circuit (under normal and abnormal conditions). A circuit breaker is selected for a particular duty taking the following into consideration (a) the normal current it will have to carry and (b) the amount of current which the supply system will feed into the circuit under a fault (which current the circuit breaker will have to interrupt without damage to itself). It is able to provide a more accurate degree of over current protection than that normally provided by either semi-enclosed or cartridge fuses.The circuit breaker has a mechanism which, when it is in the closed position, holds the contacts together. The contacts are separated when the release mechanism of the circuit breaker is operated by hand or automatically.
Miniature Circuit Breakers (mcb), which are commonly used in domestic installations, incorporate most of the features of the circuit breaker in a compact form and are being fitted in place of fuses in consumer units in the home or office. An MCB eliminates the cost of fuse replacement and may be used as a switch for isolating circuits. In the mcb, the automatic operation is by magnetic or thermal means. The reason for the two characteristics is to have proper operation during both short circuit and overload conditions.
Magnetic mechanism The magnetic mechanism uses a solenoid with an iron piece. It is used for short circuit (fault) protection, as high fault currents have to be isolated almost instantly. When the circuit current is above a certain level, the magnetic field strength increases to cause the iron piece to move in the direction of solenoid. This operates the tripping linkage and open the contacts.

MCB Miniature Circuit Breaker (MCB) is a device which can open or close a circuit either manually or automatically under all conditions like no load, full load and fault conditions. it consists of a moving contact and affixed contact. It is so designed that it can operate manually under normal condition and automatically under fault condition. Under normal conditions the contacts of MCB remain closed and carry normal full load current. When the fault occurs the secondary current of CT increases thus energizing the trip coil, there by the CB contacts are opened and circuit is disconnected from the bus bar. The main advantage of MCB is that when it trips off due to a fault it can not be switched on again until the fault is rectified.

EARTHING OR GROUNDING

Earthing is carried out in an electrical installation for the purpose of,
(a) limiting the potential (voltage) of current carrying conductors forming a part of the system − "*neutral earthing*"
(b) limiting the potential of non-current carrying metal work associated with equipment, apparatus and appliances in the system − "*equipment earthing*". The potential of an installation is measured with respect to the general mass of the earth or commonly called *earth*. Thus the potential is limited with respect to earth.*Neutral earthing*: This is important because the performance of the system in terms of short circuits, stability, protection, etc., is greatly affected by the state of the neutral conductor. When the neutral is properly grounded, voltages of the phases are limited to near phase to ground voltage.
Equipment earthing: This refers to grounding of all metal work of equipment other than the parts which are normally current carrying. This is governed by various regulations such as the IEE regulations. The objective of this grounding is to ensure effective and rapid operation of the protective gear in the event of earth fault currents which might otherwise be undetected and cause fire and also protect against danger to life through shock due to installation metal work being maintained at a dangerous potential relative to earth.





Section of HRC fuse

Quiz Questions

Q.1. What is the purpose of fuse?

A. A fuse is used to protect the circuit from over load or short circuit.

Q.2. What is the material used for fuse ?

A. The material used for fuse is chromium.

Q.3. What is the function of a relay?

A. A relay detects the fault and gives information to CB to trip.

Q.4. What is the use of contactor?

A. A contactor is used to operate a heavy duty circuit.

Q.5. What is the full form of MCB?

A. The full form of MCB is Miniature Circuit Breaker