ELECTRICAL WORKSHOP & MACHINE LAB

(EE – 225 – F)

LAB MANUAL

III SEMESTER

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CONTENTS

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 Volt 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

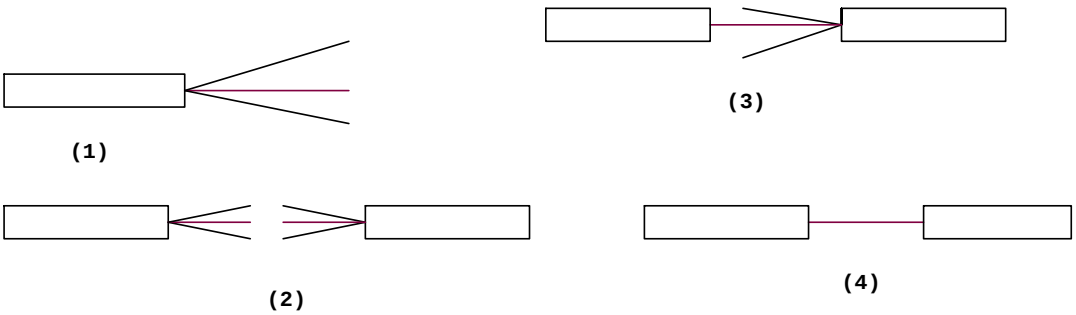
EXPERIMENT - 2

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.

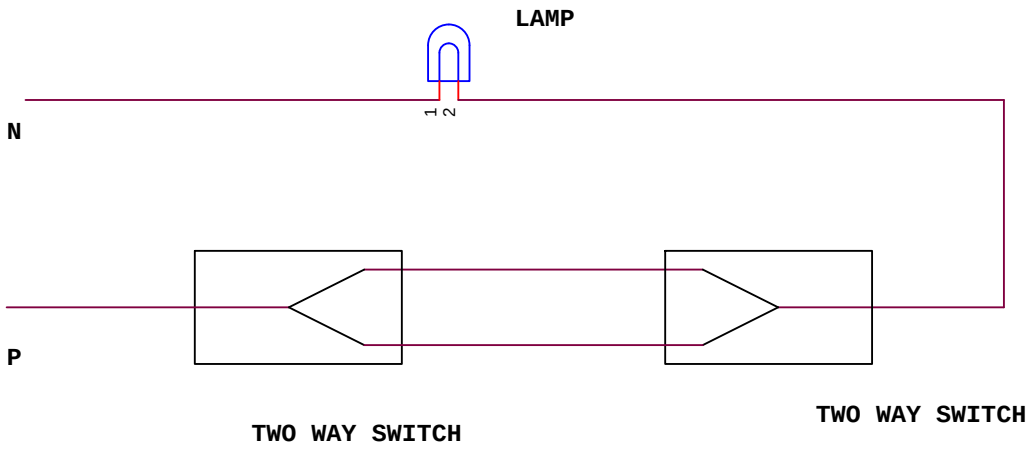
TOOL USED: Tenon saw screwdriver 8 cm (8”), Screwdriver 15(6”), connector Screwdriver, Hammer, Plier drill machine, Try square, chisel, File, Poker knife.

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?	Lamp symbol
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

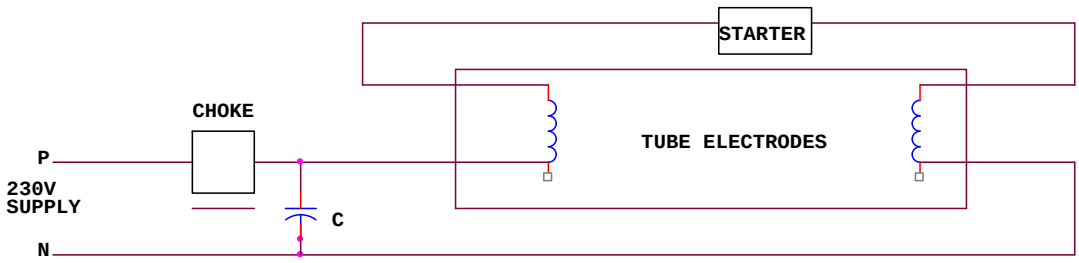
EXPERIMENT –4

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 the construction of D.C. machine

APPARATUS: D.C. machine assembly

THEORY: D.C. Machine:

DC Machines are of two types:

1. D.C. motor
2. D.C. generator

Following are the main parts of D.C. machines:

1. Magnetic Yoke
2. Pole core and pole shoes
3. Pole coils
4. Armature core
5. Armature coils
6. Commutator
7. Brushes and bearings
8.

PROCEDURE:

The assembly of D.C. machine is observed and following parts are studied in detail as described below:

1. Magnetic Yoke: Magnetic Yoke serves the double purpose:

a) It carries the magnetic flux produced by the poles.
b) It provides the mechanical support for the pole and acts as a protecting cover for the whole machine.

2. Pole Core & Pole Shoes: Pole core & pole shoes serve the following purpose:

a) Pole core spreads the flux in the air gap to reduce the reluctance of magnetic path
b) Pole shoes provide the support for the pole coils.

They are made up of thin laminations of steel with thickness 0.25mm to 1mm.

3. Pole Coils: Pole coils are made up of copper wire. These are placed on pole core.

4. Armature Core: It houses armature coils & causes them to rotate, hence cuts the flux produced by field winding. It is cylindrical & made up of laminations of approx 0.5mm thickness. It is keyed to the shaft laminations are used to reduce the eddy currents.

5. Armature Windings: These are usually former wound. Various conductors are placed in armature slots, which are lined with insulating material.

6. Commutator: The function of commutator is to collect the current from the armature conductors. It converts the a.c. of armature conductor into unidirectional current in external load. It is cylindrical structure with wedge shaped segments insulated from each other by thin sheets of mica. Number of segments is equal to number of armature conductors.

7. Brushes & Bearings: Brushes collect the current from commutator. They are made of carbon & are of rectangular shape. Brush holder is mounted on spindle & brushes can slide. Ball bearings are used for less wear and tear.

QUIZ:

Q.1 What are the main parts of D.C. Machine?

A1 Stator,rotor,commutator,brushes &shaft.

Q.2 What is function of commutator?

A2 It converts a.c. in to d.c.

Q.3 What is mechanical rectifier?

A3 Commutator

Q.4 Name the differrnt section of stator?

A4 Stator core & stator winding

Q5 What are the different types of D.C. Machine?

A5 Seies,shunt & compound.

Q.6 What is the most important precaution in any exp. With D.C. shunt motor?

A6 Resistance is added in series with armature winding

Q.7 Name the different parts of rotor?

A7 Rotor core & rotor winding

Q.8 Which kind of supply is given to stator &rotor in case of D.C. Machine?

A8 D.C.supply

Q.9 what are the different losses in D.C. Machine?

A9 Copper losses,frictional losses

Q.10 What is the material of brushes?

A10 Carbon brus

EXPERIMENT - 6

AIM: Speed control of a DC motor by armature control and field control methods**.**

APPARATUS: D.C. series motor ,ammeter,voltmeter,rheostat and tachometer.

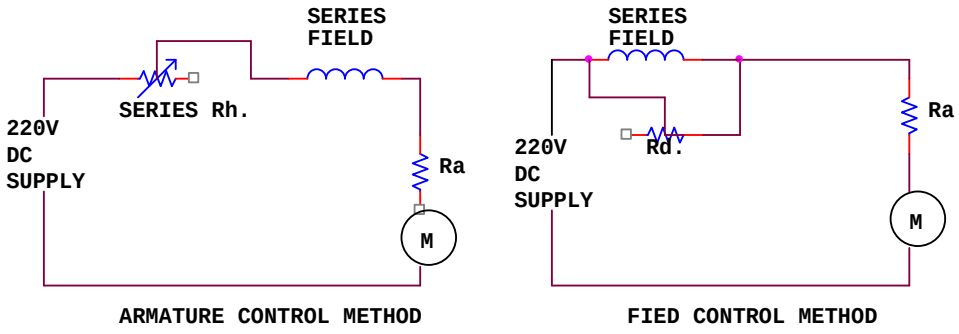
THEORY: The speed of a D.C. motor is given by the relationship:

$$N=V- IaRa/K\phi$$

This shows that the speed of D.C. series motor depends on the supply voltage V, the armature Circuit resistance Ra and field flux which is produced by field current.Depending upon the above factors there are two methods of speed control of D.C. series motor.

1. Armature Resistance control: In this method a variable series resistance is connected in series with the armature circuit.In this case the current and hence the flux are affected by the variation of armature circuit resistance The voltage drop in the Rse reduces the voltage applied to armature and so speed of motor is reduced.
2. Variation of field flux: Since the flux is produced by the field current so the control of speed in this method is done by control of field current.A variable resistance Rd is connected across the series field,which is called a diverter. A part of main circuit is diverted through Rd.Thus the current flow through the field winding is reduced.This reduces the field flux and speed of motor is Increased.

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in fig.
2. Switch on the main supply and start the motor .
3. Note down the readings of all the meters and speed.
4. Vary the value of rheostat in the armature circuit.

5. As we increase the resistance, voltage is reduced in turn ,speed is also reduced.
6. Now vary the value of rheostat in parallel with the series field.
7. As we decrease the resistance more current is diverted through diverter. Therefore the current flow through the field is lessThus less flux is produced and speed of motor is increased.

OBSERVATION TABLE:

S.NO.	ARMATURE CONTROL METHO		FIELD CONTROL METHOD	
	Ia (AMPS)	N (RPM)	IF (AMPS)	N (RPM)

RESULT: The speed of D.C. motor varies directly proportional to armature current and inversely proportional to field flux.

PRECAUTIONS:

1. Make sure that all connections are tight.
2. Vary the value of rheostat slowly.
3. Take the readings carefully and accurately.
4. Don't touch the naked connection ,it may give shock.

QUIZ:

Q1. What range of speed can you get with the armature control method of speed control of d.c. shunt motor.

A1. Lower than rated speed

Q2 .What range of speed can you get with the field control method of speed control of d.c. shunt motor.

A2 .Higher than rated speed

Q3 .If the rated speed of a d.c. shunt motor is 1440 rpm ,which method of speed control Would you suggest to obtain a speed of 1000 rpm

A3. .Armature control method

Q4 .What are the limitations of armature control method for speed control of d.c. shunt motor.

A4 .Speed regulation is poor , speed above rated speed can not be obtained.

Q5 .What would you do to reverse the direction of rotation of a d.c. shunt motor.

A5 .By reversing the connections of armature or field winding

Q6 .What will happen if the shunt field winding of a loaded d.c. shunt motor accidentally breaks?

A6 .Speed will be very high.

Q7 .Name the advantages of field control for controlling the speed of d.c. shunt motor.

A7 .A large variation above the rated speed can be obtained.

Q8 .What will happen if d.c. shunt motor running on no load has shunt field winding opened accidently.

A8 .The motor can fly away due to excessive sped.

Q9 .Why the speed d.c. shunt motor practically constant?

A9 .As the V, Ra and flux are the constant quantity

Q10. Name a method which can be used for both increasing and decreasing of speed.

A10 .Ward Leonard method.

EXPERIMENT-7:

AIM: To perform open circuit and block rotor tests of an induction motor.

APPARATUS: Ammeter, voltmeter, two wattmeters, three phase variac

THEORY:

During the no load test full rating voltage of 440V is applied to motor and the motor is run without load.During block rotor test the rotor is blocked by mechanical load and a small voltage just sufficient to full load current to flow is applied to motor. Following observations are taken:

Power= √3 VoIoCosΦ

Cos Φ = Power /√3 VoIo

Iw =Io CosΦ

Iu=IoSinΦ

Ro=Vo/Iw

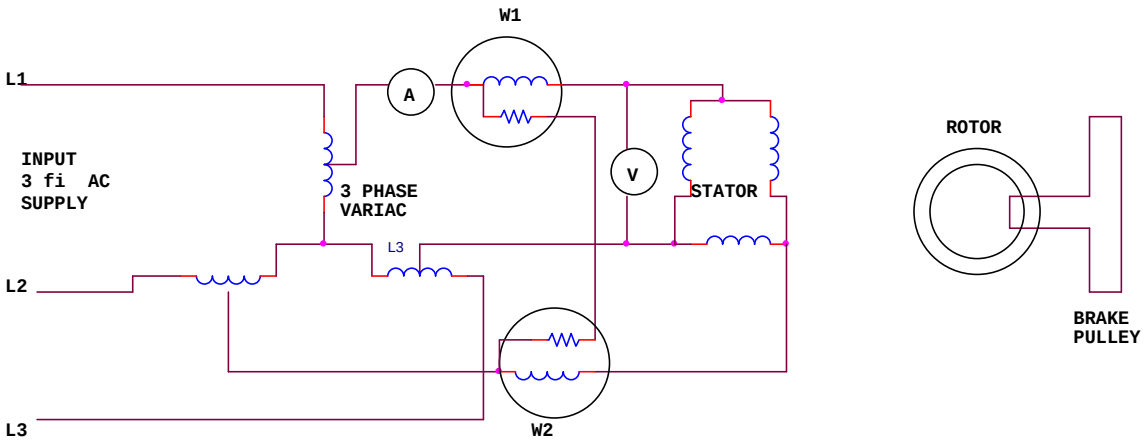
Xo=Vo/Iu

Req=Pb/Ib2

Zeq= Vb/Ib

Xeq= √ Zeq2-Req2

CIRCUIT DIAGRAM:



PROCEDURE:

No-load test:

- Connect the circuit as shown in the diagram.
- The variac should be at zero voltage and motor should be unloaded.
- Switch on the three phase a.c. supply.
- Start the motor at reduced voltage and slowly increase the supply voltage.
- Observe the direction of rotation and to reverse the direction of rotation change the phase sequence.
- Take the readings of all the meters.
- Increase the load on motor gradually and take the reading.
- Switch off the supply.

Block Rotar test:

- Block the rotar by mechanical load
- Slowly increase the voltage to allow the full rating current to flow.
- Take the readings of all the meters and calculate the parameters using above formulae
- Switch off the supply

OBSERVATION TABLE:

NO-LOAD TEST

S.NO.	V0 VOLT	I0 AMPS	W1 WATT	W2 WAT	W0=W1+W2 WATTS

BLOCK ROTOR TEST

S.NO.	VSC VOLTS	ISC AMPS	W1 WATT	W2 WAT	WSC=W1+W2 WATTS

RESULT: The total power drawn by the motor is equal to the sum of two wattmeters readings.

W=W1+W2

DISCUSSION:

The No load test and block rotor test is helpful in finding different parameters of the motor like Series and shunt parameters.

PRECAUTIONS:

1. All connections should be neat and tight.
2. Connecting leads should be perfectly insulated.
3. There should be no error in ammeter and voltmeter.

QUIZ:

Q1. What should be the speed of D.C shunt generator during the experiment?

A1. Rated speed of D.C. shunt generator

Q2. What is the unit of rating of D.C. generator.

A2. KW

Q3. What will happen if a machine is driven below the rated speed?

A3 .Overheating of the machine

Q4 .Why the resistance of field winding of a D.C. shunt generator kept low?

A4 .The generator will fail to build up the voltage

Q5 .What do you mean by external characteristics of d.c. generator?

A5 .The graph between terminal voltage and load current

Q6 .What are the different factors on which the shape of external characteristics depend?

A6 .voltage drop in armature winding,voltage drop due to armature reaction ,brush contact voltage drop.

Q7 .Write the voltage equation of generator.

A7 .V= Eg-IaRa

Q8.What are the different types of generators?

A8 .Series ,shunt and compound

Q9 .What do you mean by OCC of D.C. shunt generator?

A9 .Graph between terminal voltage and load current

Q10. What is the most essential condition for the voltage built up for D.C. shunt generator?

A10 .Residual magnetism on the poles

EXPERIMENT - 8

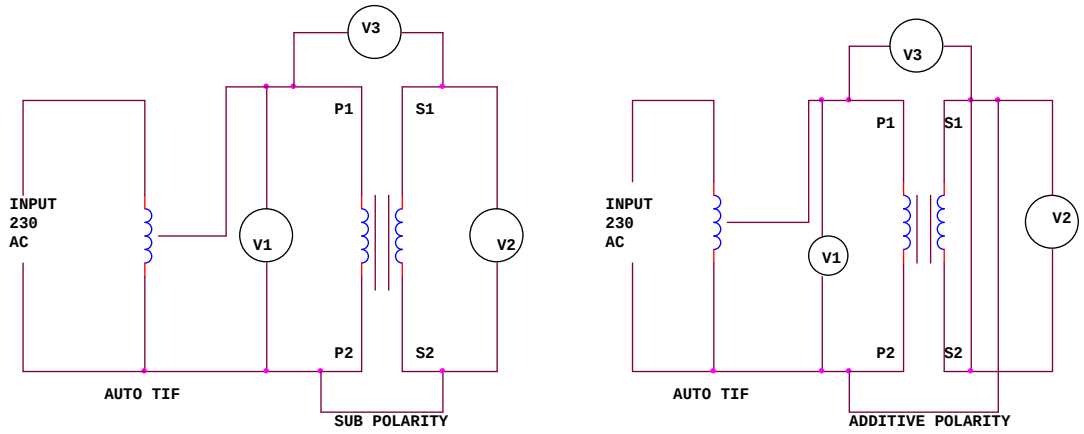
AIM : To find the polarity and turns ratio of a single phase transformer.

APPARATUS: One transformer, two voltmeters, one autotransformer

THEORY:

It is essential to know the relative polarity at any instant of primary and secondary terminals for making correct connections. When the two transformers are to be connected in parallel to share the load on the system. The marking is correct if voltage V3 is less than V1.,such a polarity is termed as subtractive polarity. The standard practice is to have subtractive polarity because it reduces the voltage stress between adjacent loads. In case V3 > V1 , the emf induced in primary and secondary have additive relation and transformer is said to have additive polarity.

CIRCUIT DIAGRAM:



PROCEDURE:

a) Polarity test:
- connect the circuit as shown in the diagram.
- Switch on the single phase a.c. supply.
- Record the voltages V1, V2 and V3 .In case V3<V1 polarity is subtractive.
- Repeat the step 3 after connecting terminals A1 and a2 .In case V3> V1 polarity is additive.
- Switch off the a.c. supply

b) Turn Ratio Test:
- Connect the circuit as shown in the diagram.
- Switch on the a.c. supply.
- Record voltage V1 across primary and V2 across various tappings of secondary.
- If V1>V2 then transformer is step down.
- If V2> V1 then transformer is step up.
- Switch off a.c. supply.

OBSERVATION TABLE:

SUB-POLARITY

S.NO.	V1	V2	V3=V2-V1

ADD-POLARITY

S.NO.	V1	V2	V3=V1+V2

TURN RATIO

S.NO.	V1	V2	TURN RATE V1/V2

RESULT:

If V2>V1 then transformer is step up otherwise step down.

DISCUSSION:

The turns ratio of transformer is greater than one if it is step up transformer and less than one if it is step down transformer.

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.

QUIZ:

Q1 What is transformer?

A1 Transformer is a static device which is used to change the level of voltage or current with out changing the frequency and power .

Q2 What do you mean by turns ratio of transformer?

A2 Turns ratio of a transformer is the ratio of primary turns to the secondary turns.

Q3 What is transformation ratio of transformer?

A3 Transformation ratio is the ratio of secondary side turns to primary side turns.

Q4 What are the different polarities of transformer?

A4 Positive and negative polarity.

Q5 What is the condition of additive polarity?

A5 When the sum of voltages is more than individual voltages , then it is called additive Q6 What is the condition for subtractive polarity.

A6 When the sum of voltages is less than individual voltages ,then it is called subtractive Q7 What are the different types of transformer?

A7 The different types of transformer are : step up and step down

Q8 What is the use of autotransformer ?

A8 Autotransformer is used for increasing or decreasing the voltage with the use of one winding

Q9 What is the use of polarity test?

A9 The polarity test is performed to find the positive and negative polarity of transformer.

Q10 What is the transformation ratio of step-up transformer?

A10 It is always more than unity

EXPERIMENT- 9

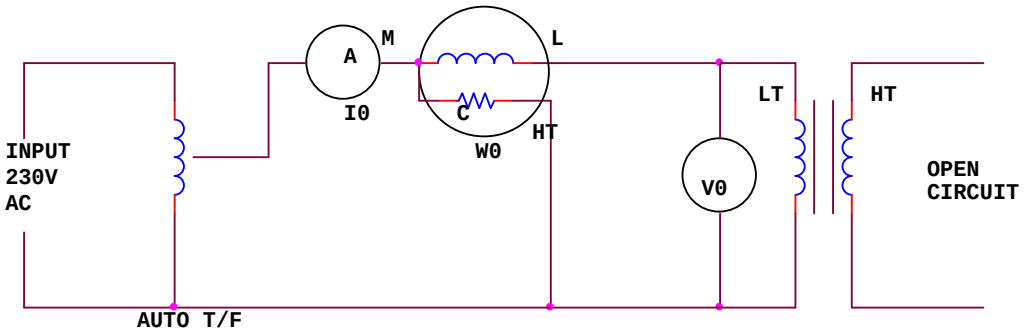
AIM: To perform the open circuit test on single phase transformer.

APPARATUS: One transformer, Ammeter, Voltmeter ,wattmeter and autotransformer

THEORY:

This test is performed to find the core losses.The H.V. side is open circuited.The rated voltage is applied on the L.V. side.The shunt parameters can also be find out like Loss component of no load current,magnetizing component of no load current,Ro and Xo.

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in the diagram
2. Apply rated voltage on the primary side.
3. Take the readings of Vo, Io and Wo.
4. Calculate the shunt parameters.
5. Switch off the a.c. supply

OBSERVATION TABLE:

S.NO.	V0 (V0LTS)	IO(AMPS)	W0(Watts)
1.			

SAMPLE CALCULATIONS:

The total iron loss=Wo

No load power factor=Wo/VoIo

Core loss component of the current=Iw=IoCosϕ

Magnetising component of current=Iu=IoSinϕ

Ro=V1/Iw

Xo=V1/Iu\

RESULT:

The shunt parameters and core loss can be find out with open circuit test.

DISCUSSION:

Open circuit test is performed to find out the core losses and shunt parameters of transformer.

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.

QUIZ:

Q1 What information do you get from open circuit test on single phase transformer?

A1 open circuit test is performed to find out the core losses and shunt parameters

Q2 Which side is kept open in case of open circuit test?

A2 High voltage side

Q3 Which kind of supply is given on supply side of a single phase transformer?

A3 Full rated supply

Q4 What is the relation between magnetizing component, iron loss component and no load current of a single phase transformer?

A4 No load current =√ (Magnetising current)2+(Loss component of current)2

Q5 What is the power factor of a transformer under no load condition?

A5 0.2

Q6 What is the magnitude of no load current w.r.t . full load current?

A6 No load current is 5 percent of full load current.

Q7 What do you mean by equivalent circuit of transformer?

A7 The equivalent circuit is the representation of primary and secondary winding Resistances and reactances along with losses.

Q8 Why indirect testing of transformers is necessary?

A8 To apply the whole load is not easy to calculate the various parameters.

Q9 How does the copper losses vary with variation of load on transformer.

A9 Copper losses are directly proportional to load on the transformer.

Q10 What do you understand by all day efficiency of transformer?

A10 All day efficiency is the ratio of output energy to input energy.

EXPERIMENT -10

AIM: To perform the short circuit test on single phase transformer.

APPARATUS: One transformer,ammeter ,voltmeter ,wattmeter and autotransformer

THEORY:

This test is carried out to find the copper losses of a transformer. In this test low voltage side is short circuited and apparatus are connected on high voltage side.

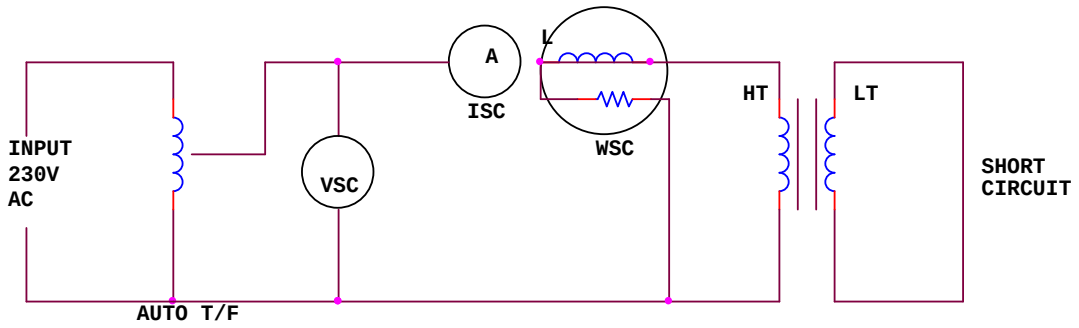
Total copper loss=Wsc

R= Wsc/ Isc2

Z= Vsc/Isc

X= √Z2-R2

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in the diagram
2. Slowly increase the supply voltage till the current is full load current.
3. Record the short circuit current and applied voltage.
4. Find the full load current.
5. Switch off the a.c. supply.

OBSERVATION TABLE:

S.NO.	Vsc (V0LTS)	Isc(AMPS)	Wsc(Watts)
1.			

SAMPLE CALCULATIONS:

Total copper loss=Wsc

R= Wsc/ Isc2

Z= Vsc/Isc

X= √Z2-R2

RESULT:

The short circuit test is performed to find the copper losses and series parameters like the resistance and reactance

DISCUSSION:

In this test low voltage side is short circuited and apparatus are connected on high voltage side.

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.

QUIZ:

Q.1 Why do you perform short circuit test on transformer?

A1. To find the copper losses & series parameters of the transformer.

Q.2 Which side is short circuited in short circuit test?

A2. Low voltage side

Q.3 Which supply is given in short circuit test?

A3 5 % to 10 % of rated voltage

Q.4 What are the different losses in transformer?

A4 Core losses & copper losses

Q.5 Which kind of losses are found during short circuit test?

A5 Copper losses

Q.6 What are the different type of transformer?

A6 Step up & step down

Q.7 What is the power factor of transformer?

A7 Not defined

Q.8 Name different winding of transformer?

A8 Primary & secondary

Q.9 What is working principle of transformer?

A9 mutual induction

Q.10 What are the different parts of transformer?

A10 Windings core,breather,conservator tank, cooling oil,buchholz relay.

EXPERIMENT - 11

AIM: Star-delta starting of a three phase induction motor

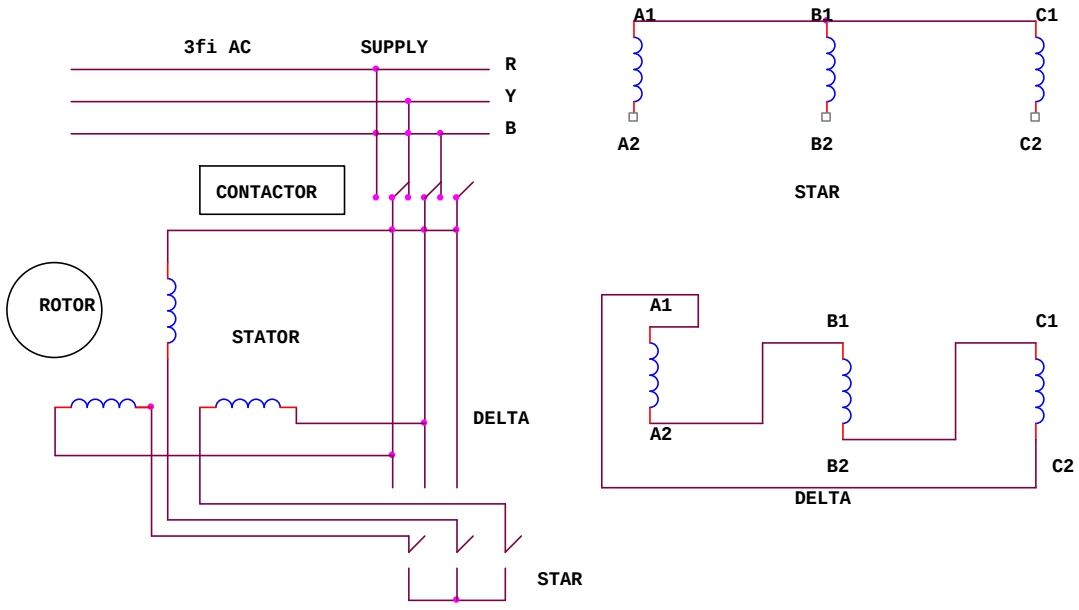
APPARATUS: Three phase induction motor,star delta starter.

THEORY:

NEED FOR STARTER:

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.

CIRCUIT DIAGRAM:



PROCEDURE:

Star Delta method of starting:

All the six terminals of stator winding are brought out and are connected as shown in Fig. In the starting the stator winding is connected in start and full voltage is applied across these terminals. The voltage of each phase is 1/3 of normal value. As the motor picks up the speed, the change over switch disconnects the winding of motor. Now it connects the winding in delta across supply terminals.

This method reduces the current taken by the motor to one third the current it would have drawn if it was directly connected in delta. However, the starting Torque is also reduced to one third. This method is cheap, but it should be used when high starting torque is not required like machine tools, pumps, motor generator etc.

DISCUSSION:

Star Delta method is a safe method for starting of induction motor as the inrush current in the starting is very high without the starter.This is due to the absence of back emf at the starting.

PRECAUTIONS:

1. Make sure that all connections are tight.
2. The connections should be according to circuit diagram.
3. Don't touch the naked connection ,it may give shock.

QUIZ:

Q1 Are the three phase induction motor self starting?

A1 Yes

Q2 Why the three phase induction motors need starter?

A2 To reduce the starting current

Q3 Why reduced voltage is used for starting large power rating squirrel cage induction motor.

A3 As it reduces the starting current

Q4 For which type of motors the direct on line starting can be used.

A4 For small rating motor

Q5 In which types of starters used for three phase induction motor reduced voltage is applied to stator.

A5 Star Delta and autotransformer

Q6 What is the maximum rating of 3-phase induction motor which can be started without using a starter?

A6 Very small rating

Q7 Does the direct on line starter reduces the starting current?

A7 No

Q8 What are the different safety devices provided in various types of starters?

A8 No load release and over load release

Q9 How can we reduce the starting current?

A9 By using the starters

Q10 Does the direct – on – line starter reduces the starting current?

A10 No

EXPERIMENT - 12

AIM: To perform Brake –Test and direct load test . on D.C shunt motor and D.C. series motor and calculate it's efficiency.

APPARATUS: D.C. shunt motor ,D.C. series motor with brake arrangement ,ammeter, voltmeter and rheostat.

THEORY:

Brake test is carried out on a D.C. shunt motor and D.C. series motor to determine its parameters including efficiency.In this test a belt is wound round a pulley and two ends are attached to two springs.The force acting on pulley is equal to the difference between readings of two spring balances If R is the radius of the pulley and w1 and w2 are weights on two springs then shaft torque is given by :S

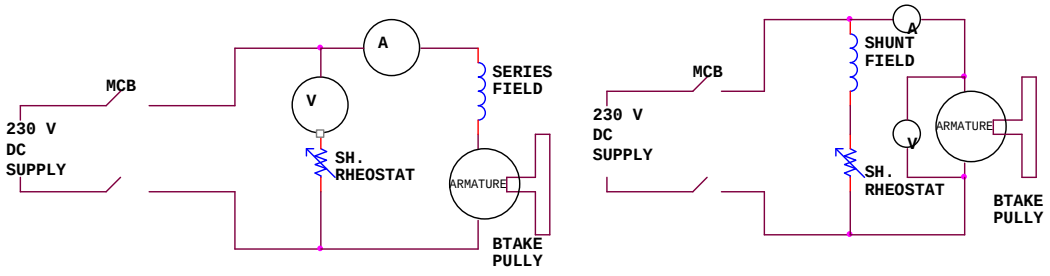
Shaft torque Tsh= (w1-w2)*R Kgm

Motor output Poutput=2*3.14*N*T*9.81/60 watts

Motor input= V*I watts

Efficiency= Poutput/Pinput*100%

CIRCUIT DIAGRAM:



PROCEDURE:

D.C. shunt Motor:

1. connect the circuit as shown in the figure
2. Apply rated voltage of 200v D.C. to the motor.
3. Increase the load on the motor slowly to it's full capacity.
4. Note down the reading of ammeter ,voltmeter,w1,w2 and diameter of pulley.
5 .Using above formula calculate shaft torque,input power,output power and efficiency of the motor.

D.C. series motor:

1. Connect the circuit as shown in the figure.

2 .Apply some load on the motor.

3 .Switch on the D.C. mains and start the motor.

4 .Increase the load slowly to the rated value.

5 .Note the readings of all meters, speed and both spring balances.

6 .Remove the load slowly and switch off the motor.

7 Measure the diameter of pulley.

OBSERVATION TABLE:

DC SERIES MOTOR

S.NO.	V (VOLT)	I (AMPS)	N RPM	W1 KG	WZ KG	η=P0/PiX100

DC SHUNT MOTOR

S.NO.	V (VOLT)	I (AMPS)	N RPM	W1 KG	WZ KG	η=P0/PiX100

RESULT:

The efficiency of D.C. shunt motor is = and D.C. series motor is =

PRECAUTIONS:

1. Increase the load on the motor slowly

2. While measuring RPM keep the tachometer in line with the pulley.
3. Take the readings of ammeter and voltmeter accurately.
4. Give a gap of some time between two tests to avoid overheating of motor.
5. Do not touch any naked connection of the circuit.

QUIZ:

Q1 Why we perform the direct load test on D.C. shunt and D.C. series motor?

A1 To obtain output vs speed char. , output vs motor current char. And output vs efficiency char.

Q2 What is the percentage fall in speed of D.C. shunt motor when it is loaded from no load to full load?

A2 5%

Q3 At the time of starting ,why the field rheostat in D.C. shunt motor circuit be kept at minimum?

A3 To get high starting torque

Q4 Why the field rheostat of D.C. shunt generator be kept at it's maximum value?

A4 The terminal voltage of the generator would be minimum

Q5 As the load on d.c. motor increases how does it adjusts itself automatically to meet the load requirement?

A5 Because of back emf

Q6 What are the aims of performing a load test on a d.c. shunt motor?

A6 To obtain the different characteristics

Q7 Will a d.c. shunt motor start on a.c. supply?

A7 No

Q8 What another arrangement of loading can be used for performing this experiment?

A8 Mechanical loading with belt and pulley arrangement

Q9 What are aims of performing a load test on d.c. shunt motor.

A9 To draw the different characteristics

Q10 What are the different types of D.C. machines?

A10 Series ,shunt and compound motor

EXPERIMENT -13

AIM: - To Plot V Curve Of Synchronous Motor.

APPARATUS REQUIRED :- Synchronous motor ,ammeter, volt meter and wattmeter.

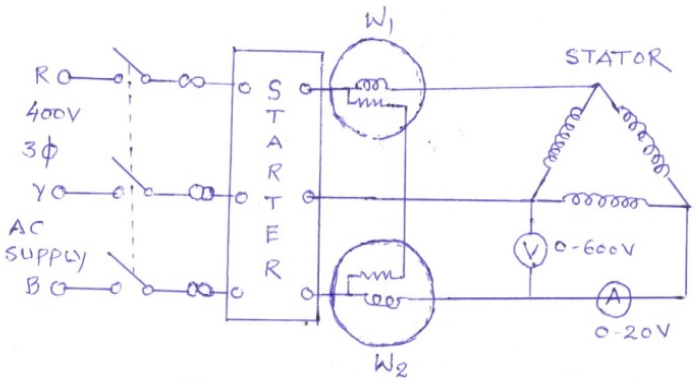
THEORY:- with constant mechanical load on the synchronous motor, the variation of field current changes the armature current drawn by the motor and also its operating power factor. As such the operation of synchronous motor is described below under three modes of excitation.

Normal excitation: - the armature current is minimum at a particular value of field current. The operating power factor is unity and thus the motor is like a resistive load.

Under excitation: - when the field current is decreased the armature current increases and the power factor is lagging and the motor is like an inductive load.

Over excitation: - when field current is increased the armature current also increases , the power factor is leading and the motor is like a capacitive motor.

CIRCUIT DIAGRAM :-



PROCEDURE :-

1. Connect the circuit. as per figure
2. Switch on supply and start the motor.
3. Set the rheostat of field to the position of normal excitation and note down the readings of all meters.
4. Reduce the excitation insteps and note down the armature current and readings of both wattmeters
5. Adjust the generator voltage by varying the field rheostat.
6. Load the generator to half the full load and maintain it.
7. Repeat steps 3,4, 5 under this condition of loading.
8. Remove the load from the generator slowly.
9. switch off the power to stop the motor
10. Plot the curve between armature current and field current.

OBSERVATION TABLE :-

Sr. No.	Ia	I_f

GRAPH :-

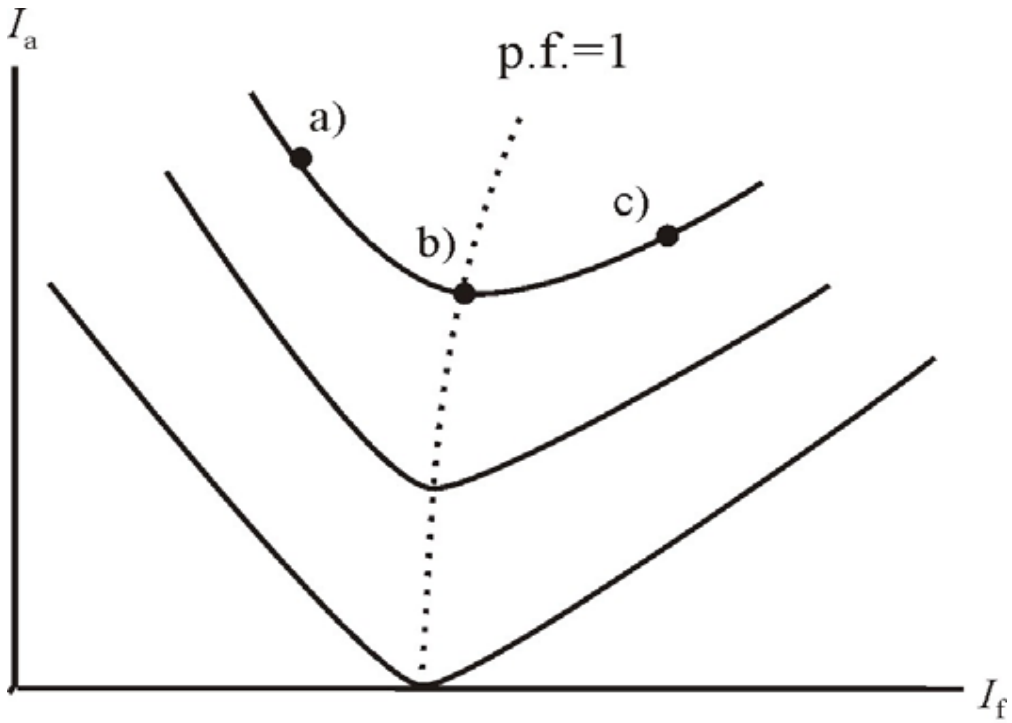


Figure 5. Synchronous motor V-curves.

PRECAUTIONS :-

1. All connections should be tight.
2. Take the readings carefully
3. Increase and decrease the excitation voltage slowly
4. Increase and decrease the load on generator slowly.

QUESTIONS :-

Q 1. Where the synchronous machines find maximum application?

A.Synchronous machines find maximum application in power system.

Q 2. What is generated voltage and frequency of synchronous generator?

A. The generated voltage and frequency of synchronous generator are 11 kv and 50 hz respectively.

Q3. Why damper windings are used in synchronous machines?

A.Damper wimdings are used in synchronous machines to reduce over voltage and damp the oscillations.

Q4. Under what circumstances synchronous machine is used as industrial machine?

A.Synchronous machine is used as industrial machine where constant speed is needed.

Q5. What are the typical charactericstics of synchronous machines?

A. V curve and inverted V curve are the typical characteristics of synchronous machine.

Q6. What are various excitations under which synchronous machine is operated?

A.The synchronous machine is operated under normal excitation, under excitation and over excitation.

Q7. What is meant by V curve of synchronous machine?

A.The curve plotted between armature current and field current is called V curve.

Q8. Which type of prime movers are used for synchronous machines?

A.Steam turbine and hydraulic turbines are used as prime movers for synchronous machines.

Q9. How the synchronous motor is started?

A.A synchronous motor is started as an induction motor.

Q10. What is operating power factor of synchronous machine under normal excitation?

A. The operating power factor of synchronous motor under normal excitation is unity.

EXPERIMENT-14

AIM: To study the parallel operation of single phase transformers

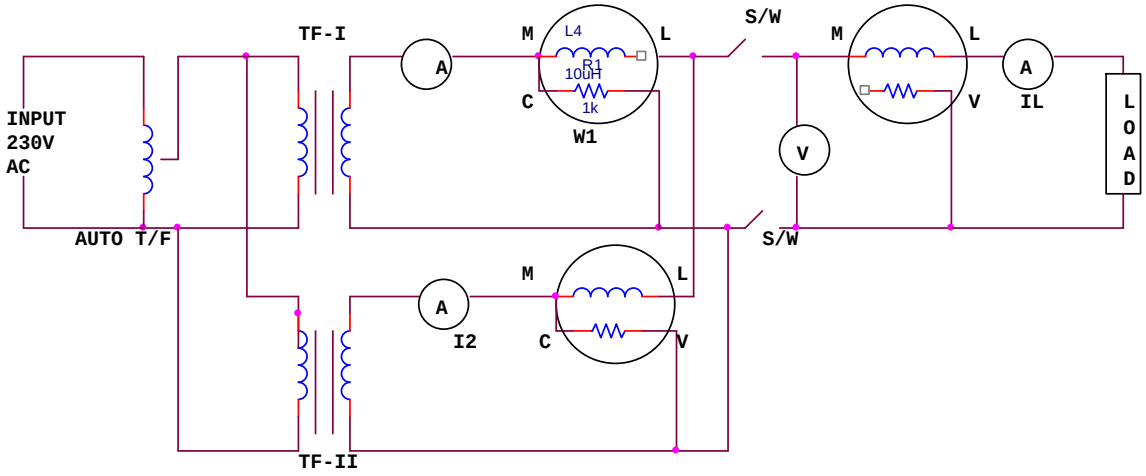
APPARATUS: Three ammeters, three wattmeters, single phase load, two transformers, autotransformer

THEORY:

Parallel operation of transformers is used for load sharing. The transformers are connected in parallel on both primary and secondary side. Following conditions to be satisfied during the parallel operation of transformers

- Same polarities should be connected.
- The two transformers should have same voltage ratio.
- The percentage impedance should be same.
- There should be no circulating current.

CIRCUIT DIAGRAM:



PROCEDURE:

1. connect the circuit as shown in the diagram.
2. Note down the readings of all wattmeters , ammeters and voltmeters for given load.
3. Repeat the above test for different values of load
4. Take atleast three readings.

OBSERVATIOBN TABLE:

S.NO.	I1 (AMPS)	W1(WATTS)	I2(AMPS)	W2(WATTS)	IL=I1+I2 (AMPS)	WL=W1+W2 (WATTS)
1.						

RESULT:

The two transformers connected in parallel share the load equally**.**

DISCUSSION:

The total load current is distributed on two transformers accordingly.

I1+I2=I l

The total wattmeter readings are distributed on two wattmeters accordingly.

W1+W2=Wl

PRECAUTIONS:

1. Transformers should be connected in such a way that they have same polarity.
2. All connections should be neat and tight.
3. Connecting leads should be perfectly insulated.

QUIZ:

Q.1 What is the minimum no. of transformers needed to conduct this exp.?

A1 Two

Q.2 What is the effect of circulating current in the circuit having two transformers in parallel ?

A2 produces additional copper losses

Q.3 when does the circulating current flow in a circuit of two transformers connected in parallel?

A3 If the two transformers have different voltage ratios

Q.4 How much circulating current can be tolerated for parallel operation of transformers?

A4 10% of rated value

Q.5 why the transformer are needed to be operated in parallel.

A5 If the load is more than rated load

Q.6 What will happen if two transformers are connected in parallel with wrong polarity?

A6 Dead short circuit on the transformers

Q.7 What are the different polarities of transformer?

A7 Positive and negative

Q8 What do you mean by impedance of transformer?

A8 combination of resistance and reactance

Q9 What is the working principle of transformer?

A9 Mutual induction

Q10 What do you mean by load sharing?

A10 The total load is distributed on transformers equally.

EXPERIMENT- 15

AIM: To perform the Sumpner's test on two identical transformers

APPARATUS: Two single phase transformers, two ammeters, three voltmeters, wattmeter

THEORY:

This test facilitates the collection of data for open ckt and short circuit testsimultaneously.Two identical transformer are needed. Primary winding f both the transformers are connected in parallel. These are fed by rated voltage at rated frequency. The secondary winding of both the transformers is connected in phase opposition. On secondary side a low voltage just sufficient to flow the full load current is connected Once the transformer is connected in such a manner, rated iron losses occur in core and copper losses occur in windings.

We can justify that the current is just twice the no load current. This means the wattmeter connected on the primary side reads the total iron loses of both the transformers.

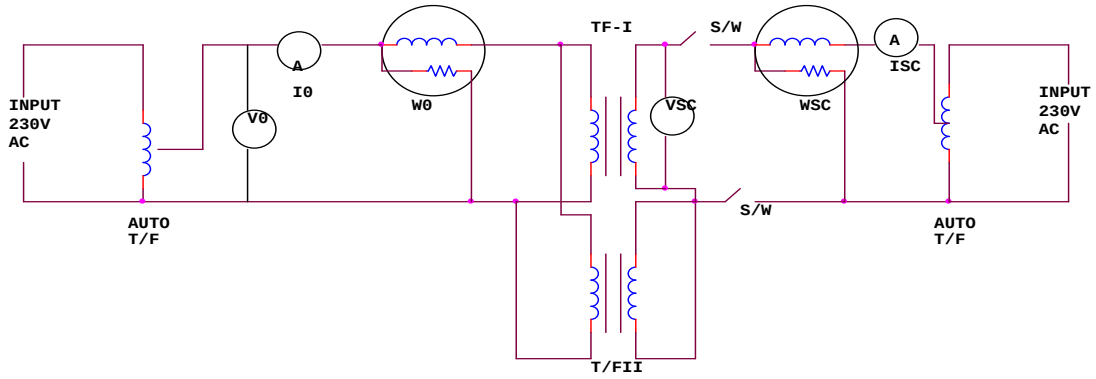
The iron loss of one transformer=1/2 Wo

The copper loss of one transformer=1/2 Wc

The total losses of one transformer=1/2 Wo+1/2 Wc

Efficiency at full load= output power/(Output power + losses)

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in the diagram
2. Apply 230v A.C. supply to primary side.
3. Note down the readings of Wo,Xo and Vo
4. Full rated current to secondary side.
5. Note down the readings of Wsc,Isc and Vsc.
6. Calculate total losse and efficiency using above formulae

OBSERVATIOBN TABLE:

	V0 (VOLTS)	I0 (AMPS)	W0 (WATTS)	VSC(VOLTS)	ISC(AMPS)	WSC(WATT)

RESULT:

Total losses of a transformer are equal to sum of iron loss plus copper losses

PRECAUTIONS:

1. All connections should be neat and tight.
2. Connecting leads should be perfectly insulated.
3. There should be no error in ammeter and voltmeter.
4. The range of instruments should be carefully chosen.

QUIZ:

Q1 How can you determine the efficiency of transformer?

A1 By load test ,open circuit and short circuit test and sumpner's test

Q2 What are the differences in Sumpner's test and open circuit and short circuit test?

A2 The sumpner's test gives the information through one test only.

Q3 Which windings are connected in parallel in this test.

A3 Primary windings

Q4 How much voltage is applied on primary side while conducting the Sumpner's test?

A4 Normal rated voltage

Q5 How much voltage is applied on secondary side while performing the experiment?

A5 10% to 15% of the rated voltage

Q6 How the secondary winding of transformers are connected for conducting the Sumpner's test.

A6 The windings are connected in phase opposition

Q7 How much current flows on primary side and secondary side of transformer while performing the experiment.

A7 5% to 7% of rated current on primary side and full rated current on secondary side

Q8 What do you mean by phase opposition in reference to Sumpner's test on transformer?

A8 When the output voltage is equal to difference of two voltages

Q9 What is the condition to be satisfied by the two transformers to be tested through Sumpner's test?

A9 Two transformers should be identical

Q10 What does the reading of wattmeter on primary side indicate?

A10 Total iron losses of both transformers