LABORATORY MANUAL

BASIC ELECTRICAL ENGINEERING LAB

B.Tech. (Electrical Engineering), 1st & 2nd Semester

Department of Electrical Engineering
Veer Surendra Sai University of Technology,
BURLA

Vision

To be recognized as a center of excellence in education and research in the field of Electrical Engineering by producing innovative, creative and ethical Electrical Engineering professionals for socio-economic development of society in order to meet the global challenges.

Mission

Electrical Engineering Department of VSSUT Burla strives to impart quality education to the students with enhancement of their skills to make them globally competitive through:

1. M1. Maintaining state of the art research facilities to provide enabling environment to create, analyze, apply and disseminate knowledge.
2. M2.Fortifying collaboration with world class R& D organizations, educational institutions, industry and alumni for excellence in teaching, research and consultancy practices to fulfil 'Make in India' policy of the Government.
3. M3. Providing the students with academic environment of excellence, leadership, ethical guidelines and lifelong learning needed for a long productive career.

Program Educational Objectives

The program educational objectives of B.Tech. in Electrical Engineering program of VSSUT Burla are to prepare its graduates:

1. To have basic and advanced knowledge in Electrical Engineering with specialized knowledge in design and commissioning of electrical systems/renewable energy systems comprising of generation, transmission and distribution to become eminent, excellent and skillful engineers.
2. To succeed in getting engineering position with electrical design, manufacturing industries or in software and hardware industries, in private or government sectors, at Indian and in Multinational organizations.
3. To have a well-rounded education that includes excellent communication skills, working effectively on team-based projects, ethical and social responsibility.
4. To have the ability to pursue study in specific area of interest and be able to become successful entrepreneur.
5. To have broad knowledge serving as foundation for lifelong learning in multidisciplinary areas to enable career and professional growth in top academic, industrial and government/corporate organizations.

LIST OF EXPERIMENTS

1. Preliminary: Preparation of symbol chart for various systems & components as per ISS, to study the constructional & operational features for Voltmeter, Ammeter, Wattmeter, Frequency meter, multi-meter and Rheostat, Study of safety rules as per ISS.
2. Measurement field & armature resistance of a D.C M/C by volt-amp method.
3. Speed control of D.C shunt motor by armature voltage control & Field flux control method.
4. Determination of open circuit characteristics (O.C.C) of D.C shunt generator when separately excited at different speeds.
5. Calibration of Single Phase energy meter by direct loading.
6. To study the B-H curve.
7. To measure the power & power factor of fluorescent tube.
8. To measure the 3Øactive power & Power factor of 3-Phase balanced & Unbalanced loaded from a balanced source using 2 single phase wattmeter methods.
9. To measure the resistance of the earth.

COURSE OUTCOMES

Upon completion of the subject the students will demonstrate the ability to:

CO1: Express the safety rules as per ISS and symbols of different electrical components and the use of various electrical instruments in laboratory.

CO2: Demonstrate the working and operational characteristics of dc motor and dc generator.

CO3: Evaluate the voltage, current, power and power factor of fluorescent lamp.

CO4: Implement the measurement of earth resistance and insulation resistance and demonstrate the internal structure of different machines.

CO5: Analyze the connection and calibration of single phase energy meter, three phase power and power factor by two wattmeter method and basic idea about converters.

Safety rules followed by students in the laboratories

This is to inform all students conducting experiments in the Laboratories of Electrical Engineering Department that for safety of personal and Protection of Machines and equipments the following measures will be adopted with immediate effect and all students are directed to follow the same otherwise they will not be allowed to conduct experiments in the Laboratories where most of the machines and equipments are operating at high voltages.

1. **The students must draw the circuit diagram of the experiments to be conducted and fill up other details in the prescribed form available in the Lab.**
2. **The procedure to be conducted in the text must be thoroughly know by the students concerned and is to be explained before the teachers-in-charge.**
3. **After getting approval from the teacher-in-charge the student will be issued with instruments by submitting the indent form dully signed by the teacher-in-charge/instructor-in-charge of the Lab.**
4. **The students connect the equipments and instruments as per the circuit diagram and request to teacher-in-charge/instructor-in-charge for verification of connection.**
5. **Power supply to the test circuit should be given only after connection is verified/checked by the teacher-in-charge/instructor-in-charge in their presence.**
6. **The students shall conduct the experiments strictly following the relevant procedure.**
7. **After the experiment they should show the readings/results to the teacher-in-charge for verification. If the reading or results are not satisfactory, the teacher may ask the student to conduct the experiments once again.**
8. **After the experiments all the students are required to return all the instruments and wires indented at proper place.**
9. **The students must remain stand near their own test panel and not allowed to move for here and there during test.**

10. **Each group of the students must bring with them one set of accessories like neon tester, screw driver, cutting pliers and rubber gloves required during the test.**
11. **All the girl students must put on APPRON during conduct of experiments in the Laboratories. They must not remain close to the rotating machine during the test.**
12. **All the student must use shoes during the test.**
13. **Care must be taken to maintain discipline and not to create unnecessary noise inside the Lab.**
14. **Students are not allowed to sit on the foundation of the machines or anywhere in the Lab.**
15. **Student should not touch any live terminals, equipments/instruments of the panel other than the panel of their own experiments.**
16. **In case of any doubts/problems, they must refer to the teacher-in-charge/instructor-in-charge immediately.**

Sd/-

Head of the Department

Dt.

Memo. No./VSSUT/Elect/ /09

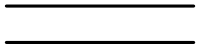
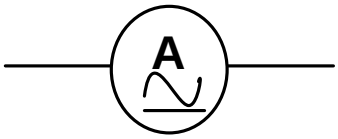
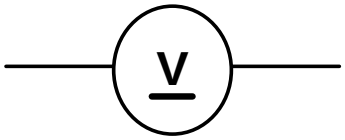
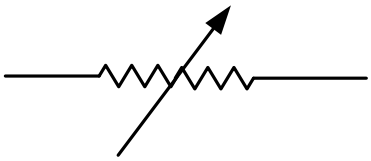
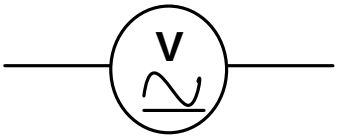
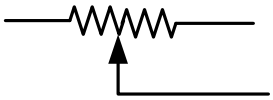
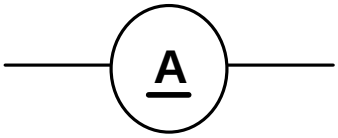
Copy to:1. The Principal, VSSUT, Burla for your kind information.

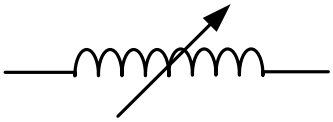
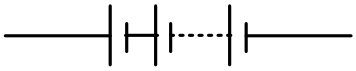
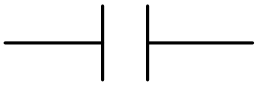
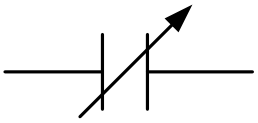
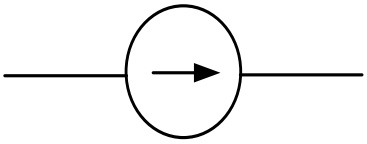
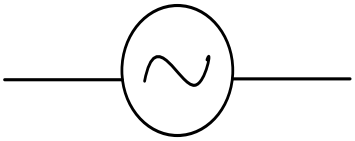
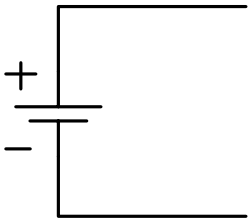
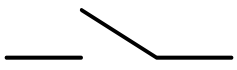
2. **All HODs for your kind information and necessary action.**
3. **College/Dept. Notice Boards.**
4. **All teachers and instructors of Elect. Engg. for your information and necessary action.**

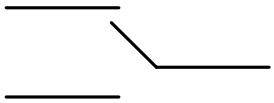
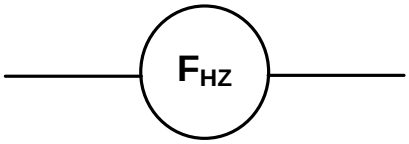
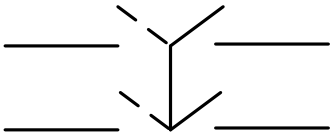
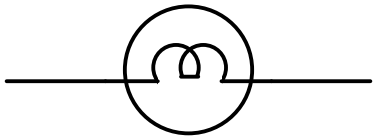
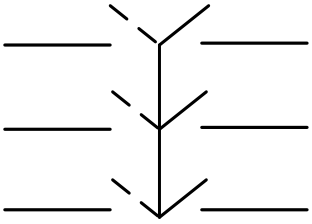
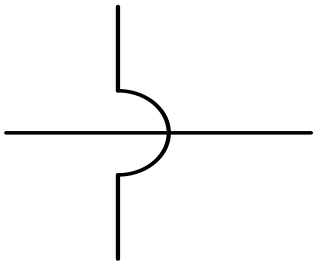
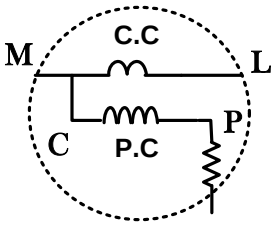
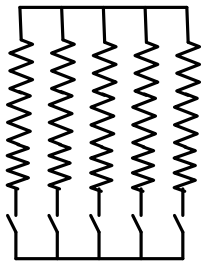
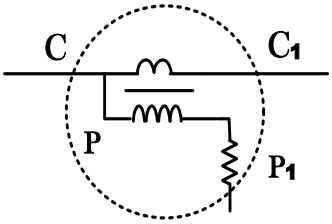
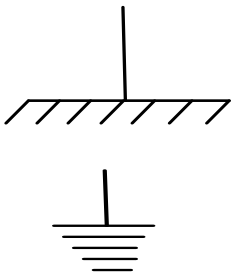
Head of Department

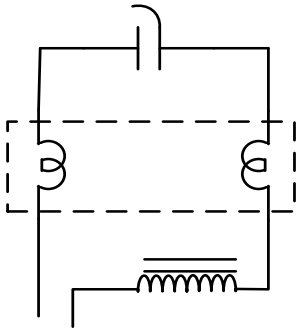
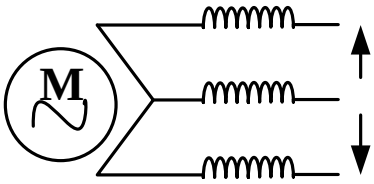
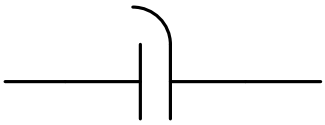
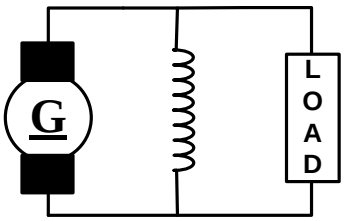
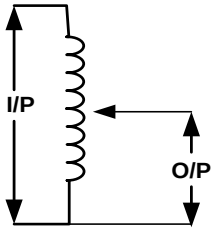
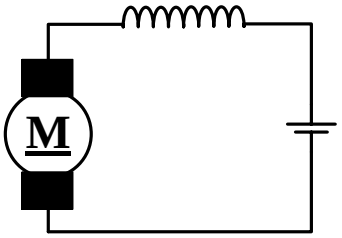
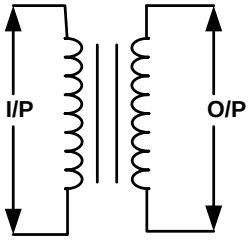
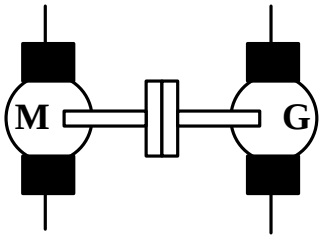
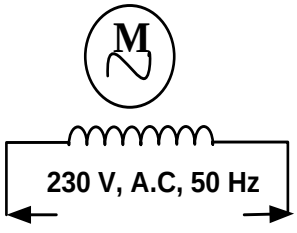
Experiment-1

List of Basic Electrical Symbols

1	Direct Current		**6**	A.C/D.C. Ammeter	
2	Alternating Current		**7**	Resistor	
3	D.C.Voltmeter		**8**	Variable Resistor	
4	A.C/D.C Voltmeter		**9**	Rheostat Or Adjustable Resistor	
5	D.C. Ammeter		**10**	Inductor	

11	Variable Inductor		**16**	Battery Source, Cell	
12	Capacitor		**17**	Longer Line Positive	
13	Variable Capacitor		**18**	Current Source	
14	Choke		**19**	A.C. Source	
15	D.C. Source		**20**	Single Pole Single Through Switch (SPST)	

21	Two way Switch		**26**	Frequency meter	
22	Double Pole Double Through Switch (DPDT)		**27**	Incandescent Lamp	
23	Three Pole Double Through Switch (TPDT)		**28**	Crossing without electric connection	
24	Wattmeter		**29**	Load Box	
25	Energy Meter		**30**	Earthing Or Grounding	

31	Fluorescent Lamp		**36**	Three Phase Induction Motor	
32	Startor		**37**	D.C. Shunt Generator	
33	Autotransformer		**38**	DC Series Motor	
34	Transformer		**39**	Motor Generator set (or) Coupled	
35	Single Phase Induction Motor		**40**	Crystal Piezo Electric	

Experiment 2

AIM OF THE EXPERIMENT:

Measurement field & armature resistance of a D.C M/C by volt-amp method.

OBJECTIVE:

To know about the resistance of field & armature of D.C Machine.

MACHINE SPECIFICATION:

D.C. Machine: 7.5Kw, 230V, 32A, 1440Rpm

INSTRUMENT REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Ammeter(D.C)	(0-30)A, (0-5)A	2	
02	Voltmeter(D.C)	(0-250)V, (0-50)V	2	
03	Rheostat	300Ω,1.7A; 50Ω,10A	2	
04	Connecting Wire	4mm ^{2}	Asper required	

CIRCUIT DIAGRAM:

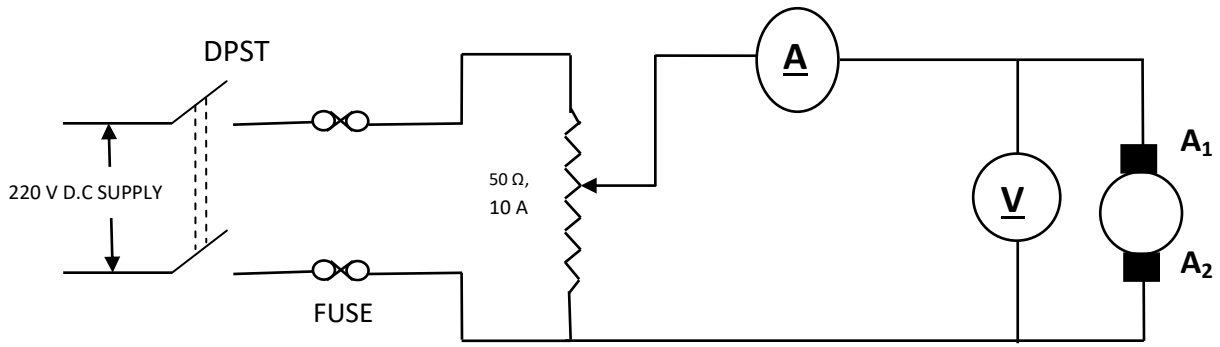


Fig. 1. MEASUREMENT OF ARMATURE RESISTANCE BY POTENTIO DIVIDER METHOD

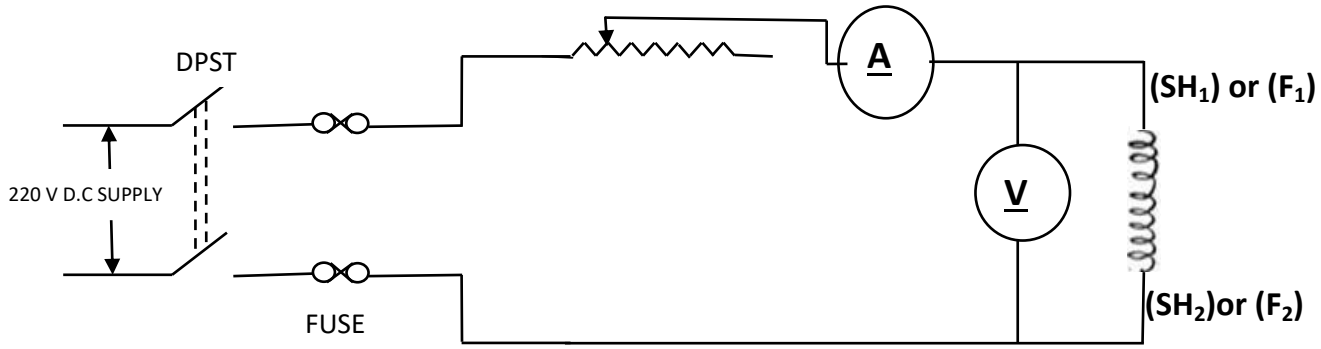


Fig.2. MEASUREMENT OF FIELD RESISTANCE BY REHOSTATIC DIVIDER METHOD

THEORY:

By Ohm's Law $R = \frac{V}{I}$

Where, R=Resistance of Field or Armature Circuit in ohm
I=Current through the field or Armature Circuit in amp.
V=Voltage across the Field or Armature Circuit in volt.

PROCEDURE:

For Armature circuit (Figure-1)

1) The circuit is connected as per the armature resistance Diagram.
2) Potential divider is set in such a way that at a position to apply zero voltage is observe across armature terminal.
3) Rheostat position kept at maximum resistance or current magnitude is increased by varying rheostat.
4) The voltage magnitude is increased gradually through potential divider.
5) Different instrument readings are taken for different positions.
6) Switch is made OFF after getting set of reading.
7) The armature resistance is calculated taking the avg. value for the above set of reading.

For field circuit (figure-2)

1) The circuit is connected as per the diagram.
2) The rheostat is set in such a position, so that the current will be at minimum value.
3) Gradually the position of the rheostat is varied for different ammeter & voltmeter reading.
4) Switch is made OFF after getting set of reading.
5) The field resistance is calculated taking the avg. value for the above set of reading.

OBSERVATION/TABULATION:

Table 1(Resistance of field):

Sl. No.	Voltage in volts (V)	Current In Amp. (I)	Resistance In ohm (V/I)	Mean Resistance in Ohm
01				
02				
03				
04				
05				

Table 2 (Resistance of Armature)

Sl. No.	Voltage in volts (V) D.C	Current In Amp. (I) D.C	Resistance In ohm (V/I)	Mean Resistance in Ohm
01				
02				
03				
04				
05				

PRECAUTION:

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher/ Instructor in-charge
3. Ensure the Rheostat stat at zero position before switch ON.
4. Ensure that the needle of the instrument is set vertical to the zero position to avoid parallax error.
5. The current flowing through the rheostat should not exceed their ratings.

CONCLUSION:

The conclusion will be drawn from the theoretical & practical point.

DISCUSSION:

1. Define Ohm's Law.
2. Which winding of the D.C machine is more cross sectional area and why?
3. What are the types of winding in D.C machine?
4. Classify different types of D.C machine.
5. Give the uses of different D.C machine (motor)
6. Draw the voltage Vs current curve.

Experiment 3

AIM OF THE EXPERIMENT:

Speed control of D.C shunt motor by armature voltage control & Field flux control method.

OBJECTIVE:

To show the relation between speed and field flux at the rated voltage of the machines (field control) and the relation between speed and armature voltage at constant excitation (armature voltage control)

MACHINE SPECIFICATION:

D.C. Shunt Motor: 5 BHP, 220V, 21 A, 1450 RPM

INSTRUMENT REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Ammeter(D.C)	(0 – 2.5)A	1	
02	Voltmeter(D.C)	(0 - 300)V	1	
03	Rheostat	100 Ω, 5A	1	
04	Tachometer	(0 - 1500)RPM	1	
05	Connecting Wires		As per req.	

CIRCUIT DIAGRAM:

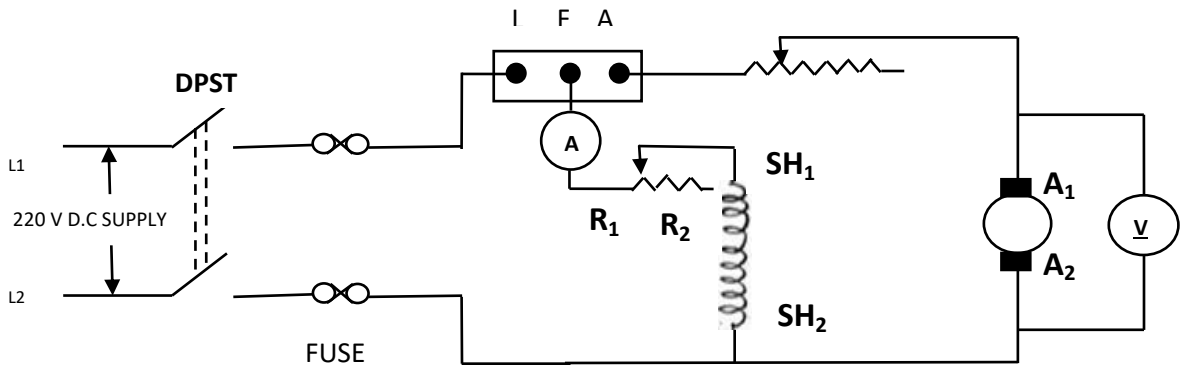


Fig. 1. SPEED CONTROL OF DC SHUNT MOTOR

THEORY:

Speed of the D.C motor is given by

$$N = \frac{V - I_a R_a}{K\phi}$$

Where

Shunt motor speed can be controlled by two ways

(a) Flux control method

(b) Armature resistance control method

Field Control method or flux control method

In this method the magnetic field or flux of the motor was varied. The field current was varied by the field circuit rheostat. Field rheostat control is best suited to drives requiring increased torque at low speeds.

Armature control method

Armature circuit resistance control results in obtaining reduced speeds by inserting external series resistance in the armature circuit. This method is suitable for constant torque drives.

PROCEDURE:

1. Do the connections as per the circuit diagram given in fig. keep both the rheostats at their minimum resistance positions.
2. After verification switch on the DPST of Distribution panel also switch on the DPST of Tested Panel
3. Then Start the DC shunt motor with the help of three point starter.
4. Gradually increase the resistant of the rheostat connected in the field circuit & don't change the armature circuit rheostat. Write down the reading on voltmeter, ammeter & speed of motor on no load.
5. Decrease the field rheostat to zero position and bring the motor to rated speed.
6. Then gradually increase the armature circuit rheostat & do not change the field circuit rheostat. Note the reading of voltmeter, ammeter & speed of M/C.
7. Repeat the procedure for various loading.
8. Switch is made OFF after getting set of reading.

TABULATION:

Flux control method

Sl. No.	Armature Voltage (in volts)	Field Current (in Amp)	Speed (In RPM)
01			
02			
03			

Armature control method

Sl. No.	Armature Voltage (in volts)	Field Current (in Amp)	Speed (In RPM)
01			
02			
03			
04			
05			

SAMPLE CALCULATION: (if any)

PRECAUTION

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher / Instructor in-charge
3. Ensure the Rheostat stat at zero position.
4. Resistance position before switching the supply ON
5. Avoid error due to parallel while reading the meters.
6. The current flowing through the rheostat should not exceed their ratings.
7. Don't touch live terminals & Rotating M/C, were leather shoe & also were apron (For Girls only).

CONCLUSION:

The conclusion will be drawn from the theoretical & practical point.

DISCUSSION / REPORTS:

1. Draw Curves
   (a) Speed Vs field Current at constant armature voltage.
   (b)Speed Vs Armature Voltage at constant excitation.
2. Discuss the merits and demerits of the different methods of speed control of D.C motor.
3. Which method gives the speed above the rated speed? Explain why.
4. Which method gives the speed below the rated speed? Explain why.
5. What will happen if the field winding gets open circuited while the motor is running? Explain why?
6. Why is a starter necessary for starting of a DC motor? Explain the symbols L, F, A as have been used in the three point starter.
7. Why are the rheostats kept at minimum during starting the experiment?
8. Can the d.c starter be used for speed control?
9. What is the difference between speed control and speed regulation of a motor.

Experiment 4

AIM OF THE EXPERIMENT:

1. To obtain the open circuit characteristics (O.C.C) of D.C shunt generator when separately excited
2. To determine the OCC at $\frac{3^{th}}{4}$ speed.
3. To determine the critical speed and critical field resistance at rated speed.

OBJECTIVE:

Know the no-load characteristics of DC Separately excited generator and find critical speed and critical field resistance of generator.

INSTRUMENTS REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter	(0-300) V	1	
02	Ammeter	(0-3) A	1	
03	Rheostat	100Ω, 200Ω	2	
04	Tachometer	(0-1500) Rpm	1	
05	Connecting Wire	$4mm^2$	As per req.	

MACHINE SPECIFICATION:

D.C. Shunt Motor(Prime Mover): 3 KW, 220 V, 12.5 A,1450 RPM

D.C. Shunt Generator: 2.5 KW, 220 V, 10.5 A, 1500 RPM

CIRCUIT DIAGRAM:

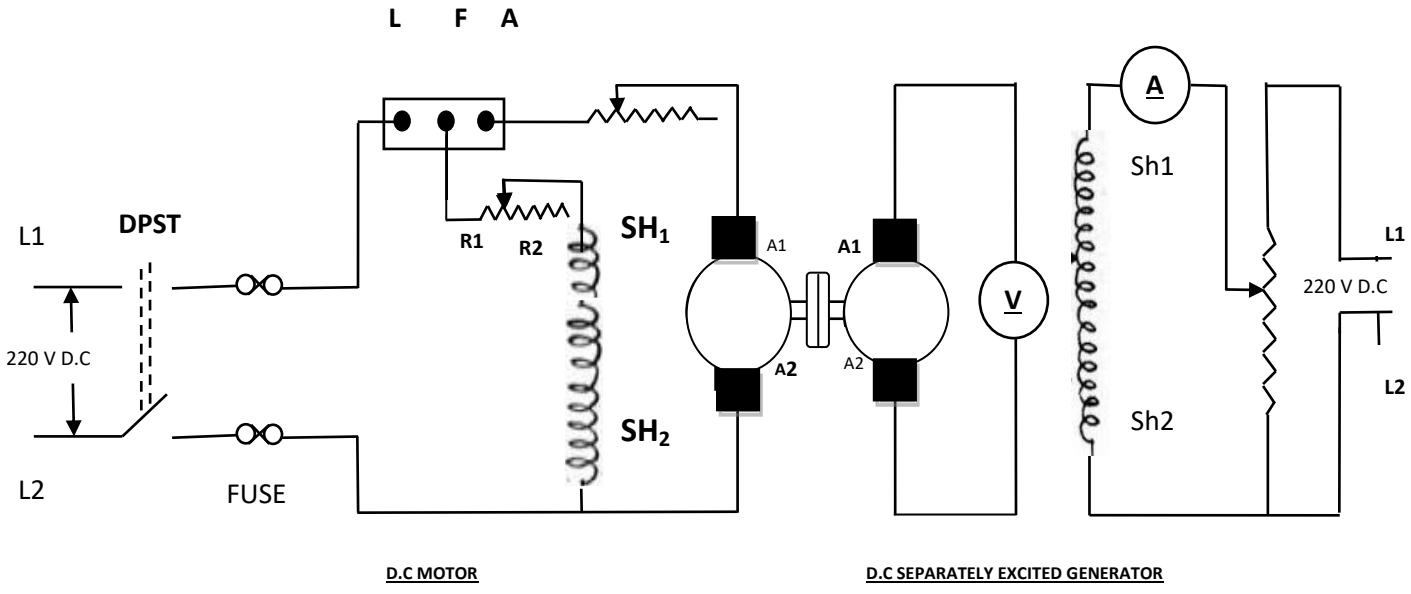


Fig. 1. OPEN CIRCUIT CHARACTERISTICS (O.C.C) OF D.C SHUNT GENERATOR WHEN SEPARATELY EXCITED

THEORY:

Open circuit characteristic curve shows the relation between the generator E.m.f at no-load (E_0) & the field current (I_f) at constant speed. It is also known as magnetic characteristics or no-load saturation curve. Its shape is practically the same for all generators whether separately or self excited.

The data for O.C.C curve are obtained experimentally by operating the generator at no load and constant speed and recording the change in terminal voltage as the field current is varied.

Generated E.m.f = $\frac{P\text{ø}ZN}{60A} = \frac{PZ}{60A} \times \text{ø}N$

For a given generator the quantities $\left(\frac{PZ}{60A}\right)$ are constant

Generated E.m.f α øN

Thus the generated E.m.f in a generator is directly proportional to the flux /pole and to the speed.

MATHEMATICAL FORMULA:

TABULATION:

For constant speed:

Sl. No.	Field Current(If)	Voltage(V)	Rated Speed
01			
02			
03			
04			

For different speed:

Sl. No.	Field Current(If)	Voltage(V)	Rated Speed
01			
02			
03			
04			

PROCEDURE:

1. Connections were made as per the circuit diagram.
2. After checks minimum position of motor field rheostat, minimum position of separately excited generator field potentio-devider. DPST switch is closed to given supply to motor.
3. Then start the D.C shunt motor with the help of three point starter.
4. Run the motor at rated speed of D.C generator by adjust motor field rheostat gradually.
5. Note the Ammeter & Voltmeter reading by gradually increasing the generator rheostat zero to maximum position (120% of rated value)
6. Reduce gradually the generator field current to zero .

7. Again note ammeter & voltmeter reading at 3/4th of rated speed.
8. After finish the experiment switch off the supply.

PRECAUTION:

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher / Instructor in-charge
3. Ensure the Rheostat stat at zero position.
4. Resistance position before switching the supply ON
5. Avoid error due to parallel while reading the meters.
6. The current flowing through the rheostat should not exceed their ratings.
7. Don't touch live terminals & Rotating M/C, were leather shoe & also were apron (For Girls only).

CONCLUSION:

The conclusion will be drawn from the theoretical & practical point.

DISCUSSION/REPORTS:

1. Plot the no-load saturation for both cases and explain why different values of voltages and obtained particular excitation.
2. Draw the critical field resistance line corresponding to the rated speed and determine its value
3. Plot the graph of open ckt. Voltage Vs Speed or constant excitation.
4. What is meant by 'residual magnetism'
5. Why does the curve for ascending value coincide?
6. Determine approximately what proportional of total field mmf is require for the gap
7. Why can a generator not operated at greatly reduced speed if normally voltage is required.
8. What is critical speed and critical resistance
9. State the condition for voltage buildup in a dc shunt generator.

Experiment 5

AIM OF THE EXPERIMENT:

Calibration of Single Phase energy meter by direct loading.

OBJECTIVE:

To calibrate the 1 phase energy meter at variable loads unity P.F by performing short run test &long period dial test

INSTRUMENTS REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	1 Ø Voltmeter (A.C.)	(0 - 300)V	1	
02	1 Ø Ammeter (A.C.)	(0 - 15)A	1	
03	Wattmeter	230V, 20A, 50Hz	1	
04	Stop watch			
05	Energy Meter	12.5 A, 250 V	1	
06	Connecting Wire		As per req.	
07	Load Box	250 V, 10Kw	1	

MACHINE SPECIFICATION:

Energy Meter: 250 V (A.C.), 12.5 A, 50Hz,

1Kwh=800n

Load Box: 250 V, 10 Kw

CIRCUIT DIAGRAM :

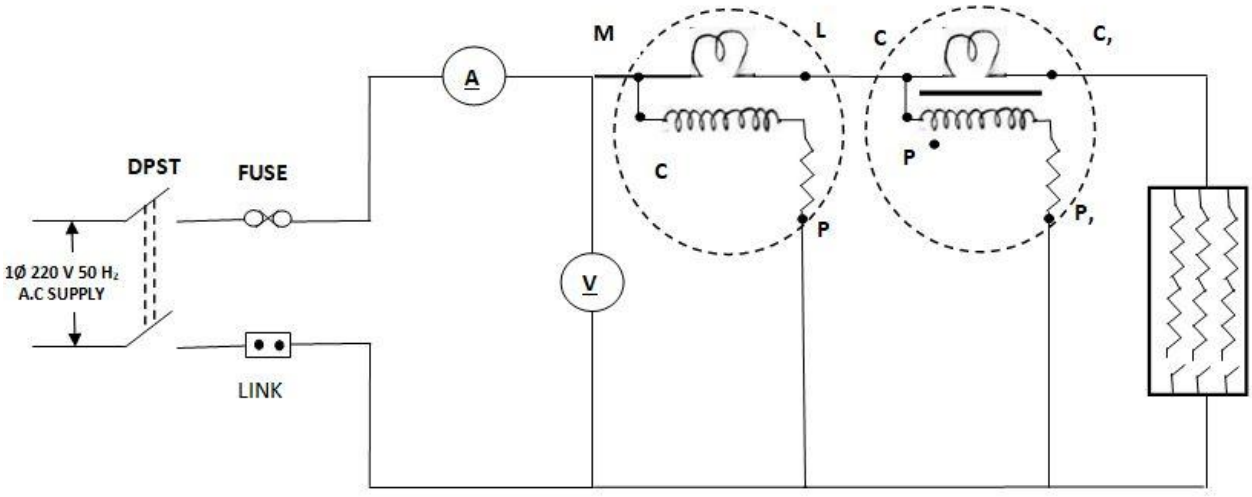


Fig. 1. SINGLE PHASE ENERGY METER

THEORY:

Short run test is for checking meter constant

Long period dial test is for checking registers mechanism

$$\% \text{ Error} = \left(\frac{indicated\ \ value\ -True\ value}{True\ \ vaule}\right) \times 100$$

TABULATION:

Short Run Test

Sl. No	Supply Voltage	Current In Amp	Wattmeter Reading	Power In Kw	Time In sec.	True Value M.C (X)	No. of Revolution	Indicated Value M.C (Y)	% error $\frac{Y-X}{X} * 100$
01									
02									
03									
04									
05									
06									

Long Period Dial Test

Sl. No	Supply Voltage	Current In Amp	Load (K watt)	Wattmeter Reading in watt	Initial Reading (Khw)	Final Reading (Khw)	Time In sec.	% error
01								
02								

PROCEDURE:

1. The circuit was connected as per the circuit diagram shown in the figure.
2. In short run test different load conditions the number of revolutions of the disc was counted during 60 seconds & then error in meter constant was calculated for Short run test.
3. In Long period dial test initial & final reading of energy meter were taken. The load was on and the meter was run for 15 minutes. Then the energy was calculated and compared with actual reading and error in resisters mechanism was calculated.
4. After finish the experiment switch off the supply.
5. Note the specifications of the energy meter as given on its name plate.
6. Select suitable ranges of the ammeter and voltmeter such that energy meter can be tested over its complete range.
7. Connect the circuit as shown in the diagram.
8. Before switching on the supply, ensure that the loading rheostat switches (all) are open.
9. Note down the initial reading of the energy meter.
10. Set the desired load by selecting a suitable combination of Switches on the loading rheostat.
11. Switch on the supply and wait for the red indicator of the energy meter disc to come in the front. At this moment start the stopwatch. Note down the voltmeter and ammeter readings.
12. Measure the time (T) for (N) revolutions (say 20 revolutions) switch off the stopwatch immediately. Switch off the supply.
13. By adjusting the loading BOX take 8 to 10 sets of readings covering the full current range of the energy meter and tabulate the observation as in table

SAMPLE CALCULATION: (If any)

PRECAUTION:

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher / Instructor in-charge
3. Ensure the Rheostat stat at zero position.
4. Resistance position before switching the supply ON
5. Avoid error due to parallel while reading the meters.
6. The current flowing through the Energy Meter should not exceed their ratings.
7. Don’t touch live terminals were leather shoe & also were apron (For Girls only).

CONCLUSION:

The conclusion will be drawn from the theoretical & practical point.

DISCUSSION/REPORTS

1. Calculate the meter constant in each case in short time test calculate the error as 0% of given meter constant in each cases and mention whether the meter runs fast or slow plot the error curve against load.
2. Calculate the error from the dial test mention whether the meter runs slow or fast compare this result obtained in the short time test at full load.
3. If the observed meter constant is for to less than that given in the meter then the consumer gains or loss
4. State whether the meter reading is effect by a fluctuation to the supply.
5. What is meant by calibration of the energy meter?
6. What is the standard used for calibration of energy meter.
7. How does an induction type energy meter work
8. What is the disadvantage of direct load method?

Experiment 6

AIM OF THE EXPERIMENT:

To study the B-H curve.

OBJECTIVE:

To understand the magnetic properties of a material and its magnetization behavior.

INSTRUMENTS REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter (A.C.)	(0 - 300)V	2	
02	Ammeter (A.C.)	(0 - 1)A	1	
03	Rheostat	350Ω, 4.5A ; 750Ω, 15A	2	
04	C.R.O	500 MHz	1	
05	C.R.O. chord	1:1, 1:10	2	
06	Capacitor	35 uF	1	
07	Connecting wire		As per req.	

MACHINE SPECIFICATION:

Transformer: 1KVA (1:1), 50Hz, 4A

Variac (Auto-Transformer): I/P= 240V, O/P= (0 – 270)V, Freq= 50Hz
Max. Load= 10A

CRO: Dual Channel

CIRCUIT DIAGRAM:

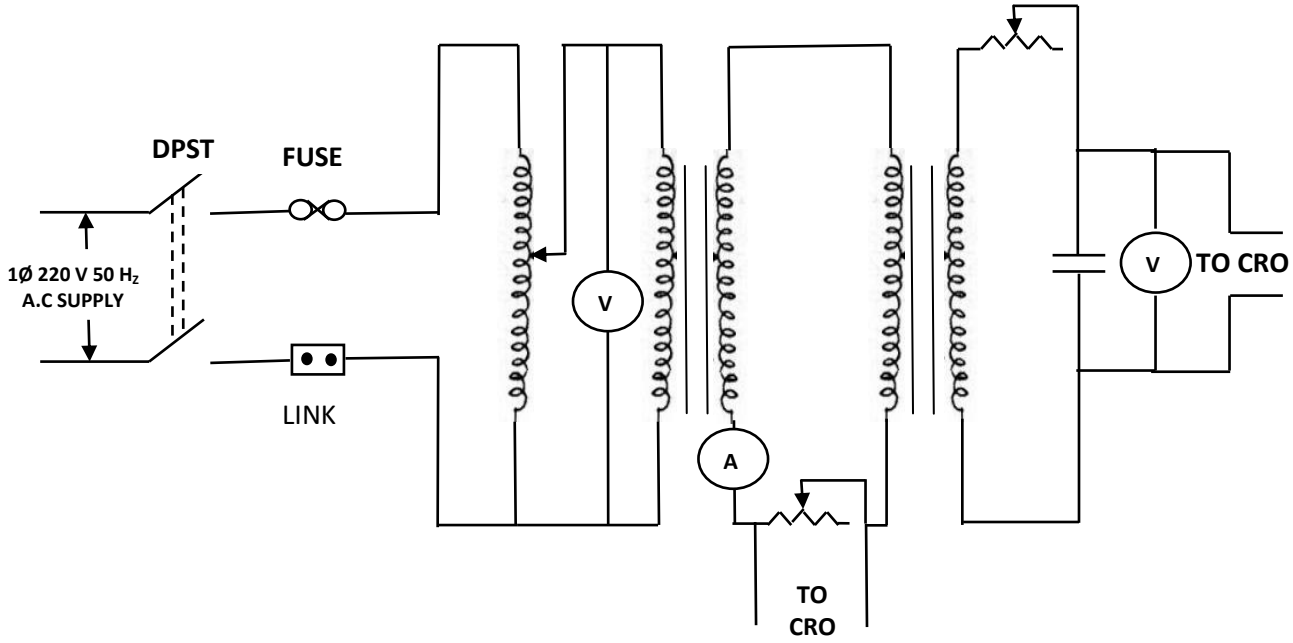


Fig. 1. B-H CURVE

THEORY:

Magnetic hysteresis is one of the important considerations in choosing & designing the cores of transformers & other electric machines.

Magnetic Hysteresis

It is defined as lagging of magnetization inductor flux density **(B)** behind the magnetic forces **(H).**

Permittivity:

It is defined as the property by virtue of which the magnetization remains on the material even after removal of magnetic field.

Coercivity:

The value of magnetic force required to wipe of the residual magnetism is called coercivity.

Area of Hysteresis :

This represents the net energy spent in the iron core through 1cycle of magnetization.

Total work done in a one complete cycle of magnetization

$$W = A l \oint H.dB$$

$$V_{rms} = \frac{Peaktopeakreadingofoutputvoltage \times \frac{volts}{division} \times multiplyingfactor}{2\sqrt{2}}$$

$$\text{Calculated current} = \frac{V_{rms}}{standardresistance}$$

$$\%\ \text{error in voltage} = \frac{Calculatedvoltage - ActualVoltage}{ActualVoltage} \times 100$$

$$\%\ \text{error in Current} = \frac{Calculatedcurrent - ActualCurrent}{ActualCurrent} \times 100$$

TABULATION:

Sl. No.	**I/P Voltages**	**Voltage Reading**		**Current Reading**		**% error**	
		Voltmeter Reading	C.R.O Reading	Ammeter Reading	C.R.O Reading	Voltage Reading	Current Reading
01							
02							
03							

PROCEDURE:

1. Connect the circuit as shown in figure.
2. Increase supply voltage gradually by changing Variac.
3. Take the reading of ammeter and voltmeter.

4. Increase supply voltage to suitable value at 180v and 200v.
5. Enter the reading in observation table shown.
6. B-H curve and waveform of Voltage & current from CRO
7. Also Calculate the % of error of voltage & current
8. After finish the experiment switch off the supply.

SAMPLE CALCULATION: (if any**)**

PRECAUTION:

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher / Instructor in-charge
3. Ensure the Rheostat stat at zero position.
4. Resistance position before switching the supply ON.
5. Avoid error due to parallel while reading the meters.
6. The current flowing through the rheostat should not exceed their ratings.
7. Don't touch live terminals & were leather shoe & also were apron (For Girls only).

CONCLUSION:

The conclusion will be drawn from the theoretical & practical point.

DISCUSSION/REPORTS:

1. What are the different types of materials ?
2. What are the different types of magnetic materials ?
3. Draw B-H curve of non magnetic material , Explain ?
4. Why Current waveform is non-sinusoidal?

Experiment 7

AIM OF THE EXPERIMENT:

To measure the power & power factor of fluorescent tube.

OBJECTIVE:

To know the internal connection of a fluorescent tube & calculate the power & power factor.

INSTRUMENTS REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter(A.C)	0-300V	01	
02	Ammeter(A.C)	0-1A	01	
03	Wattmeter (LPF)	115V,2.5A,75W	01	
04	Connecting wire	$4mm^2$	As per required	

MACHINE SPECIFICATION:

Fluorescent Lamp: 230V (A.C.), 40W, 50Hz, Cos Ø=0.5

Choke= (BP 136/140) LPF

CIRCUIT DIAGRAM:

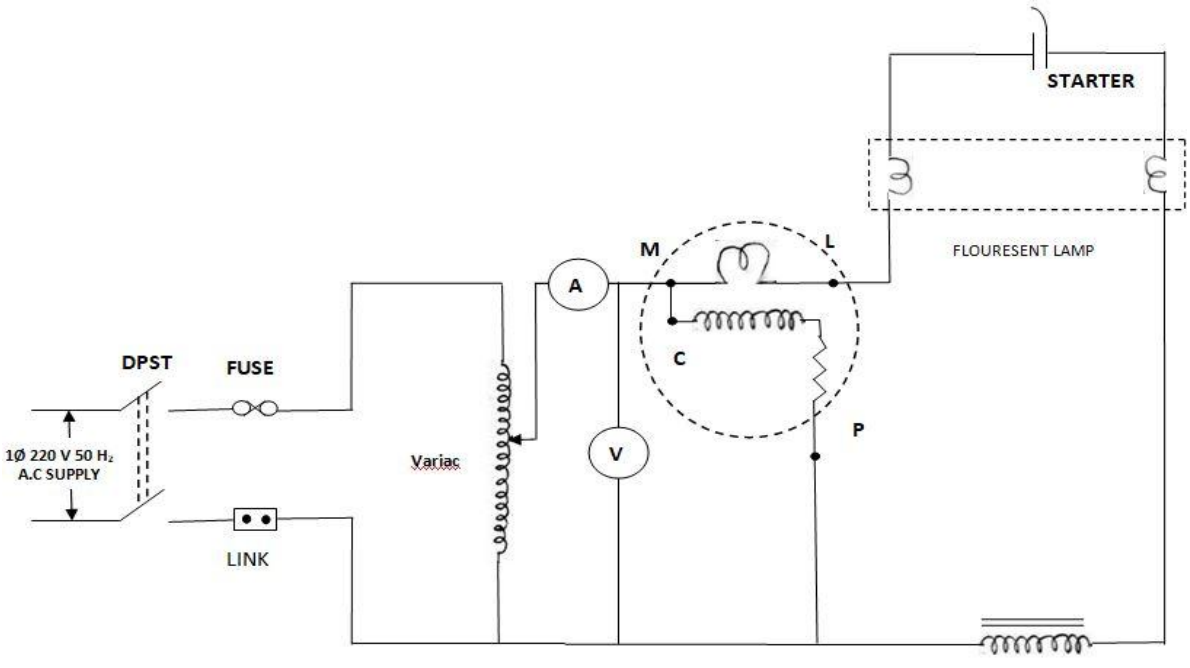


Fig.1. MEASUREMENT THE POWER & POWER FACTOR OF FLOURESCENT LAMP

THEORY:

Power = VI cos Ø

Cos Ø= Power/VI

MATHEMATICAL FORMULA:

TABULATION:

Sl. No	Line Current	Line Voltage	Power in watt	Power factor
01				
02				
03				
04				
05				
06				

PROCEDURE:

1. At first connections were made as per the given circuit diagram.
2. The voltage is varied through the single phase variance till the lamp glows and the voltage is noted.
3. Then the voltage is increased and the current values noted for different voltage values.
4. The cut off voltage & cut-off current were noted & form the values of different instruments given the power factor is calculated.
5. After finish the experiment switch off the supply.

SAMPLE CALCULATION: (if any**)**

PRECAUTION:

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher / Instructor in-charge
3. Ensure the Variac start at zero position.
4. Avoid error due to parallel while reading the meters.
5. Don’t touch live terminals, were leather shoe & also were apron (For Girls only).

CONCLUSION:

The conclusion will be drawn from the theoretical & practical point.

DISCUSSION/REPORTS:

1. What is the necessity of a choke?
2. What is the necessity of a starter?
3. What will happen if the starter is removed while the tube is glowing?
4. What can you do in order to improve the power factor?
5. Why does the choke get heated up while the tube is glowing?

Experiment 8

AIM OF THE EXPERIMENT:

To measure the 3Ø active power & Power factor of 3-Phase balanced & Unbalanced loaded from a balanced source using 2 single phase wattmeter methods.

OBJECTIVE:

1. To know the starting of a 3- Phase conduction motor.
2. Determination of power & power factor of 3Ø loads.

INSTRUMENTS REQUIRED:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter (A.C)			
02	Ammeter (A.C)			
03	1Ø Wattmeter(A.C)			
04	Voltmeter (D.C)			
05	Ammeter (D. C)			
06	1Ø Load Box			
07	Connecting Wire			

MACHINE SPECIFICATION:

(Note from machine Name plate both Machine)

THEORY:

In D.C circuit power is given by the product of voltage & Current. In case of A.C Circuit the real power is VI Cos ø is power factor. The measurements known as wattmeter method.

A wattmeter comprises of two coils. Only two single phase wattmeter are to measure the total power consumed by a three phase balanced circuit. These current coils carry the line currents I_r & I_Y respectively and the pressure coils connected to B lines known as blue line.

MATHEMATICAL FORMULA:

$$W_1 + W_2 = \sqrt{3} V_L I_L \text{ Cos } ø,$$

$$W_1 - W_2 = V_L I_L \text{ Sin } ø$$

Where, ø =Phase Angle

$$\tan ø = \frac{\sqrt{3}\,(W1 - W2)}{W1 + W2}$$

$$\text{So} \qquad ø = \cos^{-1}\left(\tan^{-1}\left[\frac{\sqrt{3}\,(W1 - W2)}{W1 + W2}\right].\right)$$

Power Factor = Cos Ø

CIRCUIT DIAGRAM:

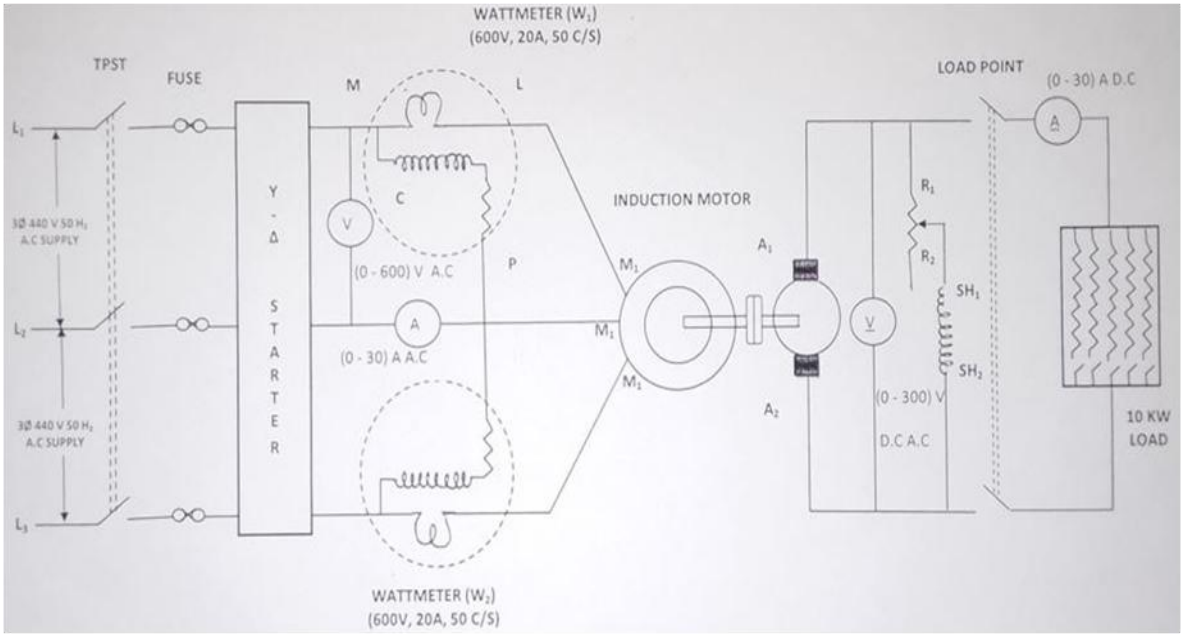


FIG.1. STARTING OF INDUCTION MOTOR & MEASUREMENT OF THREE PHASE POWER & POWER FACTOR OF BY TWO WATTMETER METHOD

TABULATION:

Sl No.	V_L in volts	I_L in Ampere	W_1 in watt	W_2 in watt	Total W_1+W_2 in watt	W_1-W_2 in watt	tanø	Cos ø
01								
02								
03								
04								
05								
06								
07								
08								
09								
10								
11								
12								
13								
14								

PROCEDURE:

1. Do the connection as per the circuit diagram.
2. Push the green button of star – Delta stator & see that the 3 – Phase induction motor starts rotating.
3. After 2 to 3 minute it will run at Nr speed
4. Then it will seen that the one of the wattmeter reads –ve and other read +ve .
5. Increase the load at the DC generator side.
6. Note down the reading of the two wattmeter &Eg, Ia
7. Switch off the supply & change the terminal of –ve wattmeter.
8. Switch on the supply and you will see the –ve wattmeter gives + ve reading.
9. Continue the no. 5 & 6
10. After finish the experiment switch off the supply.

SAMPLE CALCULATION: (if any**)**

PRECAUTION:

1. All connections should be perfectly tight.
2. Do not switch on the supply until and unless the connections are checked by the teacher / Instructor in-charge
3. Ensure the All load switch are at off state .
4. Avoid error due to parallel while reading the meters.
5. The current flowing through the Induction Motor & DC Generator should not exceed their ratings.
6. Don't touch live terminals & Rotating M/C, were leather shoe & also were apron (For Girls only).

CONCLUSION:

DISCUSSION/REPORTS:

1. Calculate the power factor in each case from the following formula. $\tan ø = \frac{\sqrt{3}\,(W1-W2)}{W1+W2}$ and check your results by the formula $\cos ø = \frac{P}{\sqrt{3}V_l I_2}$
2. What will be the power factor in the following cases
   (a) Both wattmeter read equal power
   (b) One of them reads half that of other.
   (c) One of them wattmeter's reads zero.
   (d) Both wattmeters have read equal but one is –ve.
3. How will the wattmeterreads forth following loads
   (a) Pure resistive Load
   (b) Pure Capacitive Load
   (c) Pure Inductive Load
4. How do you record –ve power in wattmeter
5. Why is it essential to measure reactive power?

Experiment 9

AIM OF THE EXPERIMENT:

To measure the resistance of the earth.

APPARATUS REQUIRED:

1. Earth Tester-1 No.
2. Spikes- 2 No.s

PROCEDURE:

1. Put to spikes acting as current &potential electrode into the ground at a distance of 25 m & 12.5m from the earth electrode under test.
2. Connect the two spikes to C2 &P2 terminals respectively.
3. Short the P1 & C1 terminals of motor & connect it to earth electrode under test.3. place the megger on horizontal firm stud.
4. Turn the handle of megger to speed slightly higher than the rated speed& note down the deflection of the needle.
5. Take down the 3 to 4 readings by keeping the distance same and placing the electrodes at the other positions.
6. Take the average of these readings which is equal to earth resistance.

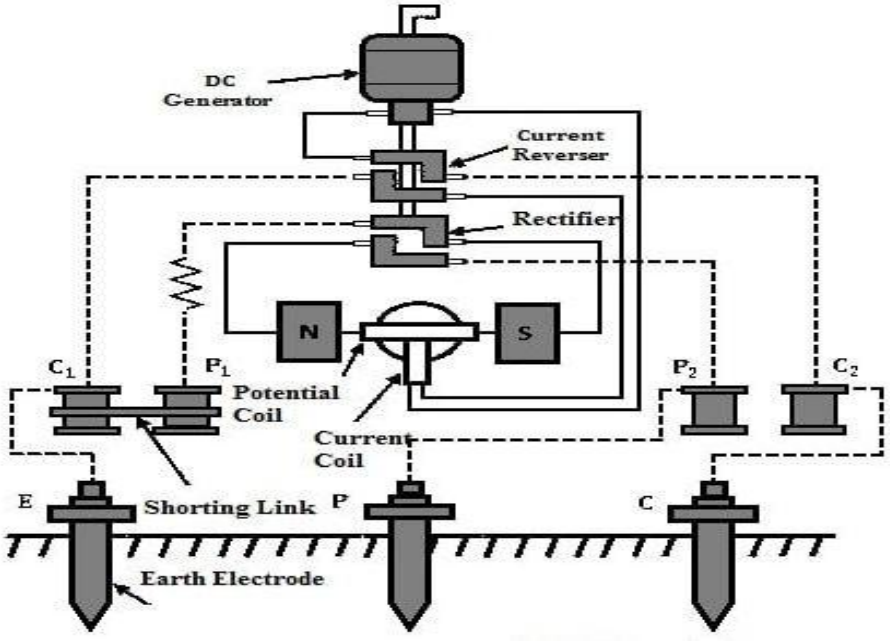


FIG. EARTH TESTER CIRCUIT

CONCLUSION:

The value of earth resistance by direct method is _____Ω .