VEER SURENDRA SAI UNIVERSITY OF TECHNOLOGY: ODISHA, BURLA

DEPARTMENT OF ELECTRICAL ENGINEERING

BASIC ELECTRICAL ENGINEERING LAB

List of experiments:

1. Measurement of field and armature resistance of a D.C machine by volt-amp method
2. Speed control of D.C shunt motor by armature voltage control and field flux control method.
3. To obtain the open circuit characteristics (O.C.C) of D.C shunt generator when separately excited to determine the OCC at $3/4^{th}$ speed, to determine the critical speed and critical field resistance at rated speed.
4. To study B~H curve.
5. To measure the power and power factor of fluorescent tube.
6. To measure the 3 phase active power & power factor of 3 phase balanced &unbalanced loaded from a balanced source using 2 single phase wattmeter methods.

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

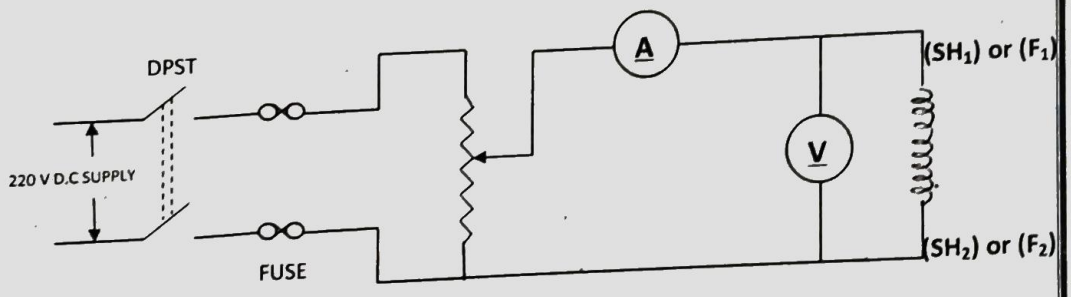
Objective: To know about the resistance of field & armature of D.C Machine

Machine Specification: (Note from the machine name plate)

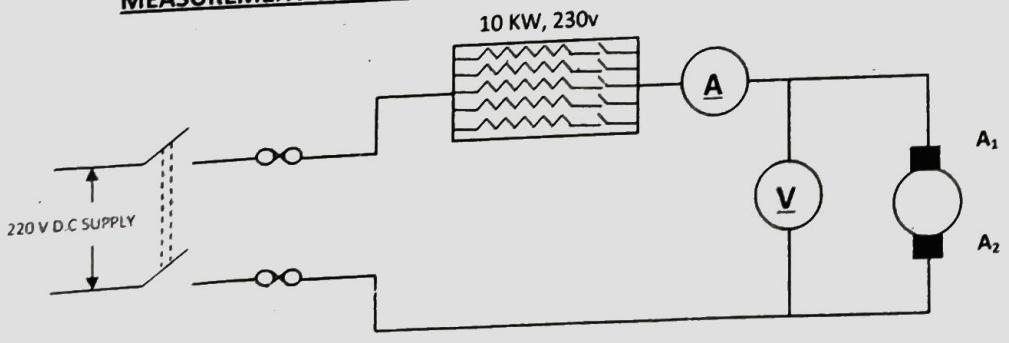
Instrument Required:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Ammeter(D.C)			
02	Voltmeter(D.C)			
03	Rheostat			
04	Connecting Wire			

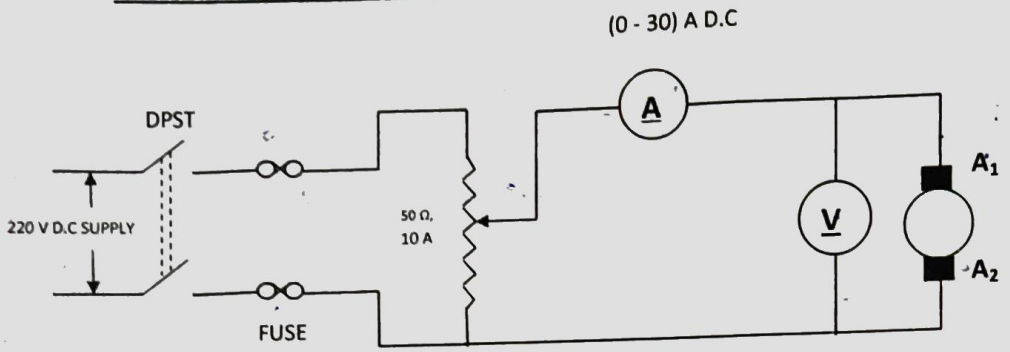
Circuit Diagram:



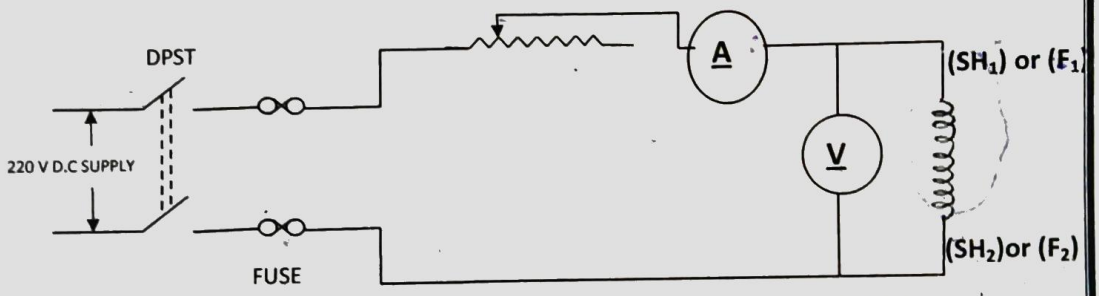
MEASUREMENT OF FIELD RESISTANCE BY POTENTIO DIVIDER METHOD(1)



MEASUREMENT OF ARMATURE RESISTANCE BY REHOSTATIC METHOD(2)



MEASUREMENT OF ARMATURE RESISTANCE BY POTENTIO DIVIDER METHOD(3)



MEASUREMENT OF FIELD RESISTANCE BY REHOSTATIC DIVIDER METHOD(4)

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 field circuit (Figure-1)

1) The circuit is connected as per the field Resistance Diagram.
2) Potential divider is set in such a way that at a position to apply zero voltage is observe across field circuit.
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 field resistance is calculated taking the avg. value for the above set of reading.

For Armature Circuit (Fig.-2)

1. The circuit is connected as per the circuit diagram of fig.-2.
2. Initially all the switches of the load box are set to switch off position.
3. After circuit verification, DPST switch (for distribution panal) is ON and then DPST switch (tested panel) is ON.
4. The ammeter & voltmeter readings are taken for different load box switches till the shaft of the machine rotates.
5. Switch is made OFF after getting set of reading.
6. The armature resistance is calculated taking the avg. value for the above set of reading.

For Armature circuit (Figure-3)

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-4)

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.

AIM-:

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

Objective:

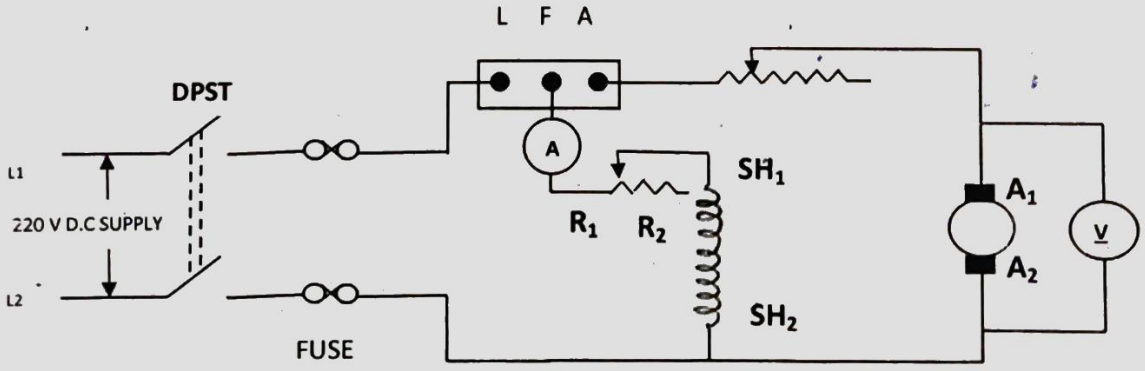
To show the relation between speed and field flux at the rated voltage of the machines (field control) and the relation between speed and armature voltage at constant excitation (armature voltage control)

Machine specification: (Note from the machine name plate

Instrument required:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Ammeter(D.C)			
02	Voltmeter(D.C)			
03	Rheostat			
04	Tachometer			
05	Connecting Wires			

CIRCUIT DIAGRAM :



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. All the connection are done as per the Circuit Diagram keeping both the rheostats at their minimum resistance position.
2. The DPST of distribution panel is switched ON and then one DPST of Tested Panel is switched ON.
3. The DC shunt motor is started with the help of three point starter.
4. The resistance of the rheostat connected in the field circuit is gradually increased keeping armature circuit field rheostat constant. The reading on voltmeter, ammeter & speed of the motor on no load is noted down at each step.
5. The field rheostat is then decrease to zero position and the motor is brought to rated speed.
6. The armature circuit rheostat is then gradually increased keeping unchanged the field circuit rheostat. The reading of voltmeter, ammeter & speed of the machine is noted down.
7. The procedure for various loading is repeated.
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.

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AIM-:

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.

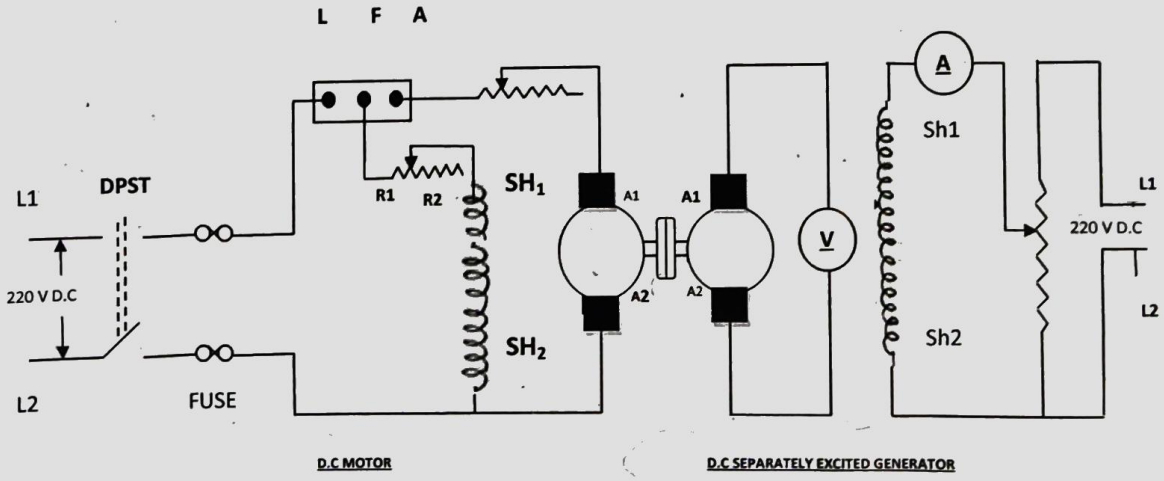
Objective: Know the no-load characteristics of DC Separately excited generator and find critical speed and critical field resistance of generator

Instruments Required:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter			
02	Ammeter			
03	Rheostat			
04	Tachometer			
05	Connecting Wire			

Machine Specification: (Note from the machine name plate)

Circuit diagram:



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. It s 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 = $\frac{PoZN}{60A} = \frac{PZ}{60A} \times \phi N$

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

Generated E.m.f α ϕN

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	1		
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 potentiodevider. 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 $3/4^{th}$ 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:

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.

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AIM-:

To study the B-H curve

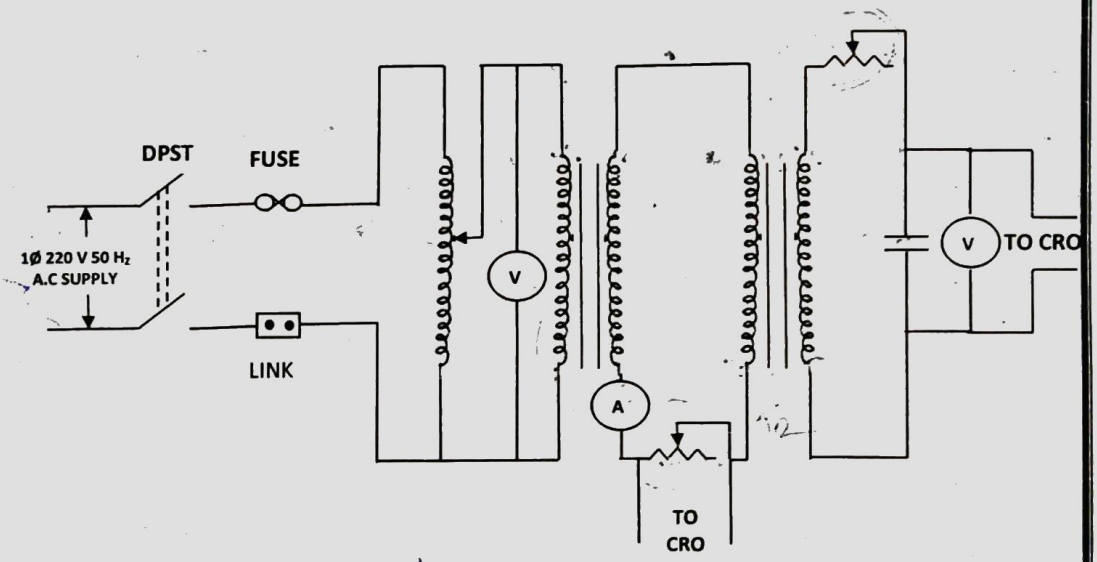
Objective:

Instruments Required:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter			
02	Ammeter			
03	Rheostat			
04	C.R.O			
05	C.R.O. chord			
06	Capacitor			
07	Connecting wire			

Machine Specification: (Note the range the transformer & CRO specification)

Circuit Diagram:



B-H CURVE

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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

$$W = A \oint H \, dB$$

$$V_{rms} = \frac{Peak\ to\ peak\ reading\ of\ out\ put\ voltage \times \frac{volts}{division} \times multiplying factor}{2\sqrt{2}}$$

$$\text{Calculated current} = \frac{V_{rms}}{standard\ resistance}$$

$$\%\ \text{error in voltage} = \frac{Calculated\ voltage - Actual\ Voltage}{Actual\ Voltage} \times 100$$

$$\%\ \text{error in Current} = \frac{Calculated\ current - Actual\ Current}{Actual\ Current} \times 100$$

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) Plot 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:

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:

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?

(6) -1

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AIM:-

To measure the power & power factor of flourescent tube.

Objective:

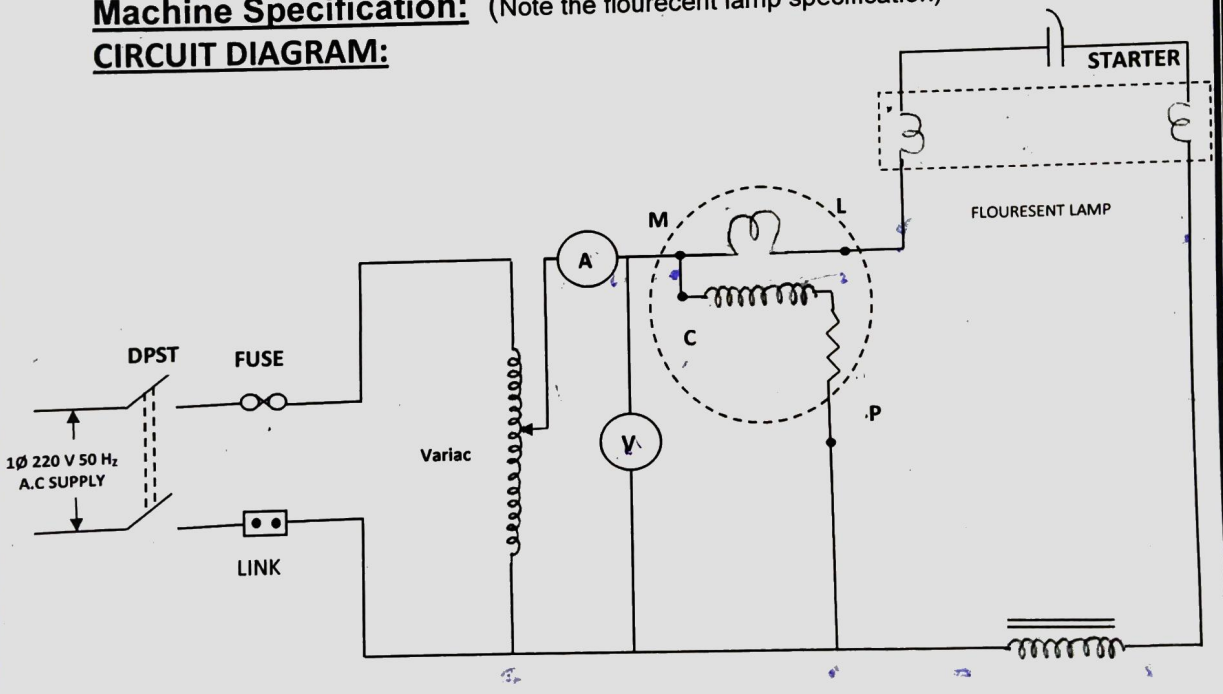
To know the internal connection of a flourescent tube & calculate the power & power factor.

Instruments Required:

Sl. No.	Apparatus	Range	Quantity	Remark
01	Voltmeter(A.C)			
02	Ammeter(A.C)			
03	Wattmeter (LPF)			
04	Connecting wire			

Machine Specification: (Note the flourecent lamp specification)

CIRCUIT DIAGRAM:



MEASUREMENT THE POWER & POWER FACTOR OF FLOURESCENT LAMP

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Theory:

Power = VI cos Ø

Cos Ø= Power/VI

Circuit diagram:

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:

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 stat 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

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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?

AIM-:

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.

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:

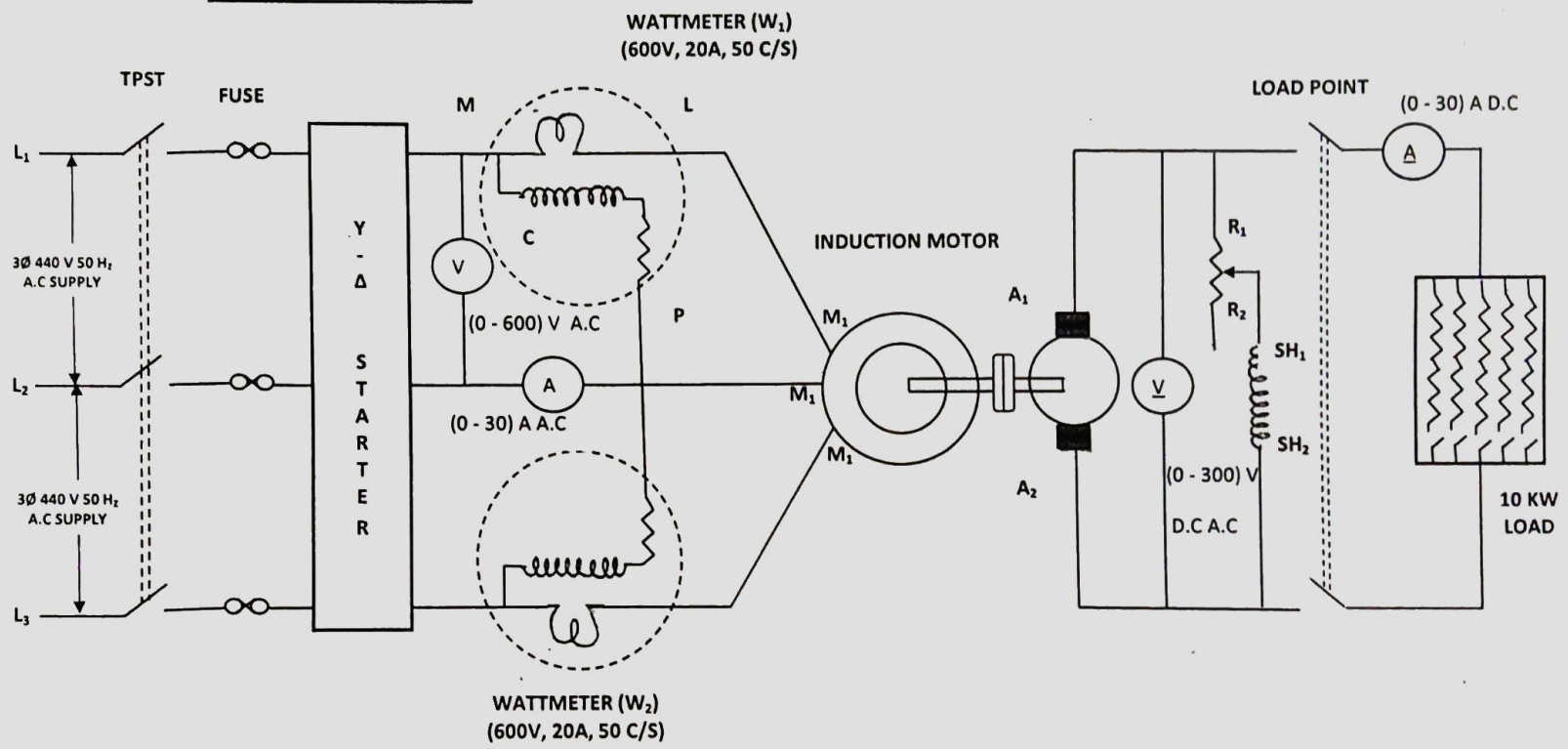
$W_1 + W_2 = \sqrt{3} V_L I_L \cos ø$, Where ø =Phase Angle

$W_1 - W_2 = V_L I_L \sin ø$

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

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

CIRCUIT DIAGRAM



Starting of Induction motor & Measurement of three phase power & Power Factor of by 2 wattmeter method.

Power Factor = Cos ø

Circuit diagram:

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	tan Ø	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 + reading.
9. Continue the no. 5 & 6
10. After finish the experiment switch off the supply.

Sample Calculation:

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

Reports:

1. Calculate the power factor in each case from the following formula.

   $\tan \phi = \frac{\sqrt{3}(W_1 - W_2)}{W_1 + W_2}$ and check your results by the formula

   $\cos \phi = \frac{P}{\sqrt{3} V_l I_2}$

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 wattmeter reads 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?