EXP 1: MAGNETISATION CHARACTERISTICS & SPEED VERSUS VOLTAGE CURVE OF OF A D.C. SEPARATELY & SELF EXCITED GENERATOR

AIM: To obtain the magnetization characteristics (O.C.C) of a D .C. separately excited generator & self excited generator & plot its speed Vs voltage characteristics

NAME PLATE DETAILS:

EQUIPMENTS REQUIRED:

SL.NO	NAME OF EQUIPMENT	TYPE	RANGE	QUANTITY
1	Ammeter	M.C	0-1A	1
2	Voltmeter	M.C	0-300V	1
3	Rheostat	Wire wound	1000Ω/1A	1
4	Rheostat	Wire wound	500Ω/1.8A	1

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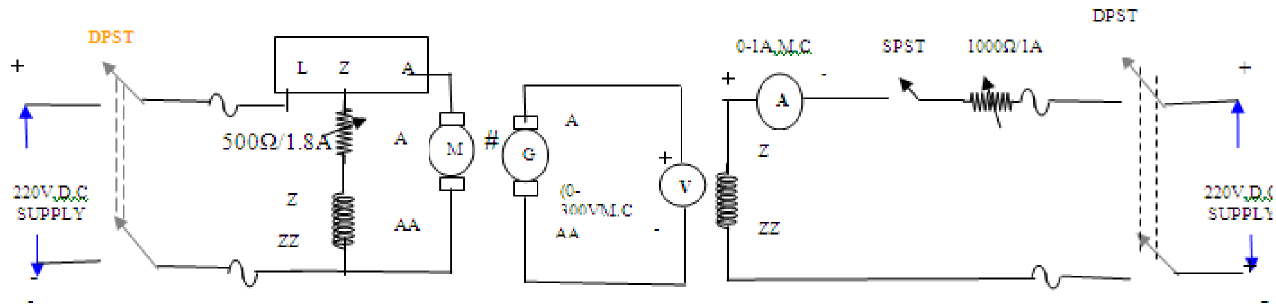
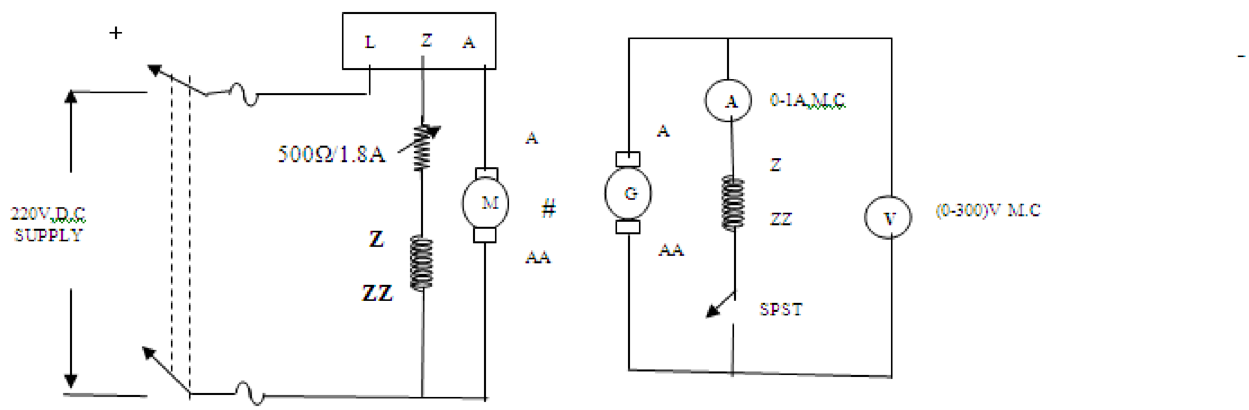
CIRCUIT DIAGRAM:



CIRCUIT DIAGRAM FOR SEPARATELY EXCITED GENERATOR



CIRCUIT DIAGRAM FOR SELF EXCITED GENERATOR

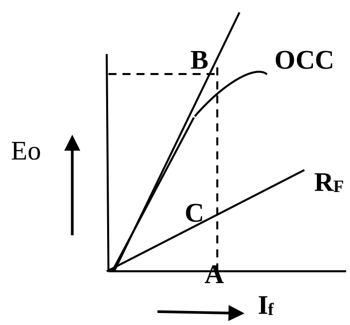
PROCEDURE:

1. Make the connections as per the diagram, choosing the meters suitable to the ratings of the machines.
2. Keep the motor field rheostat in the minimum position, that of the generator field rheostat in the maximum position and start the motor by means of a starter.
3. Run the set at rated speed.
4. Note down the terminal voltage of the M-G set with SPST switch open. This e.m.f is due to the residual magnetism.
5. Close the SPST switch note down the field current of the generator and e. m. f induced by the generator.
6. Increase the field current of the generator in steps by cutting out the resistance of the field rheostat.
7. Note down the corresponding value of e.m.f induced by the generator.
8. The resistance should be changed in one direction.

9. The same procedure should be repeated with decreasing values of field current. Finally open SPST switch and note down the value of e.m.f generated by residual magnetism.
10. Draw the graph for the e.m.f generated Vs field current (both increasing and decreasing values
11. Tangent to the mean of increasing and decreasing curve from the origin.
12. Find the critical resistance of the machines by taking the slope of the tangent.
13. Draw o.c.c at some other speed i.e. other than rated speed.
14. For critical speed measure the field resistance and draw field resistance line along with o.c.c graph
15. Drop a perpendicular on o.c.c in such a way that it cuts R_c line at B and field resistance at C.
16. Thus $(N_C/N)=(AC/AB)$

$$(N_C)=(AC/AB)\times N$$

GRAPHS :



OBSERVATIONS:

S.NO	I_F	E_O(INCREASING)	E_O(DECREASING)	Eo(average)

PRECAUTIONS:

1. All the connections should be clear and tight.
2. The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be measured.

3. The field current should not be increased to cross rated value.

RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

- What is the utility of plotting magnetizing curve of a d.c machine?
- If the generator speed is changed 120% of rated speed what will be effect on its magnetizing curve?
- What is the nature of magnetizing curve for comparatively low values of field current for generator run rated speed?
- When does magnetizing curve approaches saturation and what would be the nature of curve after saturation?
- What does the name plate of d.c generator indicates?
- A d.c shunt generator builds up 230v when run in clock wise direction. what could be the voltage build up if the direction of rotation of prime mover is reversed?
- What is the most essential condition for voltage build up for a d.c generator?

EXP 2: LOAD CHARACTERISTICS OF SEPARATELY EXCITED & D.C. SHUNT GENERATOR

AIM: To conduct load test on a separately excited & D.C. shunt generator and to draw its internal and external load characteristics.

NAME PLATE DETAILS:

D.C. Shunt Motor

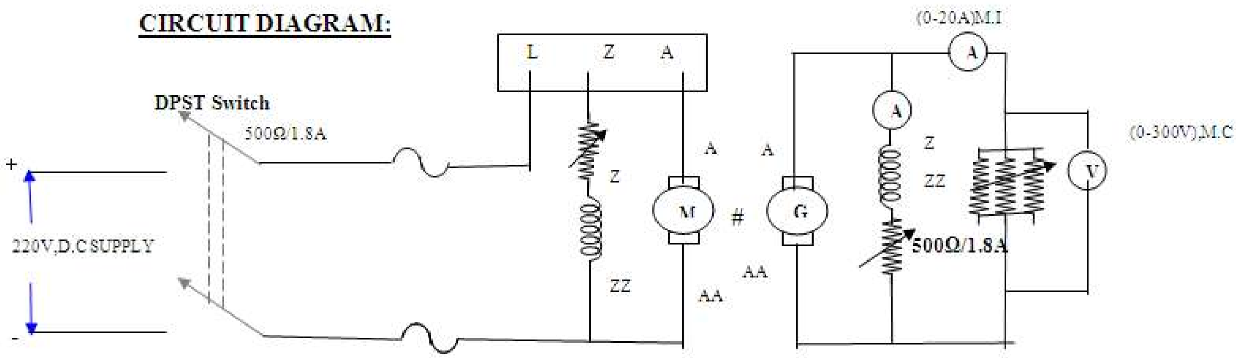
volts-------------- Amps ----------------

power--------------- speed---------------------

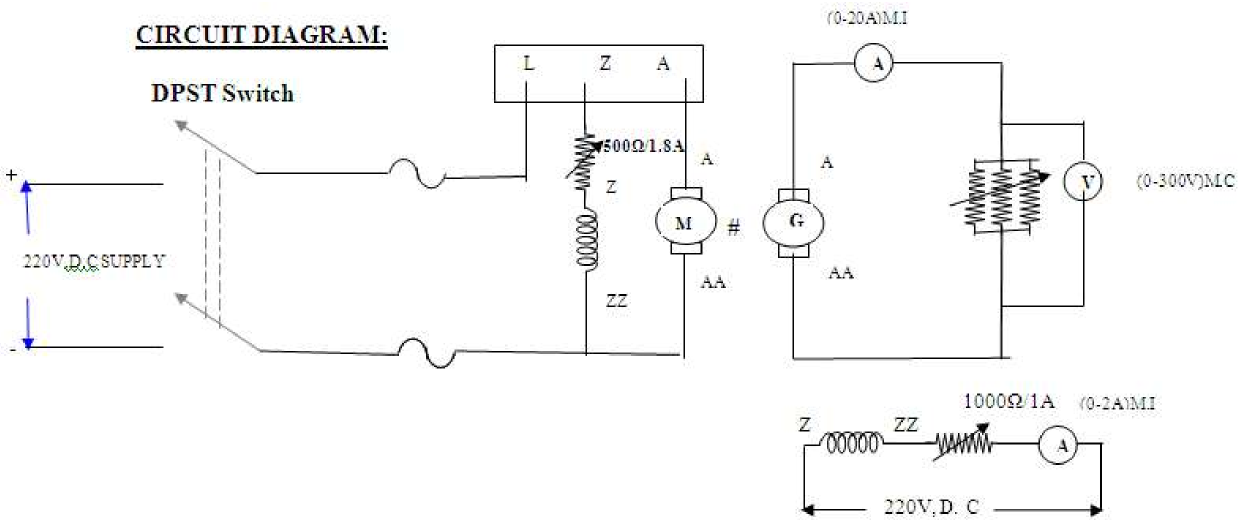
EQUIPMENTS REQUIRED:

SL.NO	NAME OF EQUIPMENT	TYPE	RANGE	QUANTITY
1	Voltmeter	M.C	0-300V	1
2	Ammeter	M.C	0-5A	1
3	Ammeter	M.C	0-20A	1

CIRCUIT DIAGRAM:



CIRCUIT DIAGRAM:



PROCEDURE:

- Make the connections as per the diagram, choosing the meters suitable to the ratings of the machines.
- Keep the motor field rheostat in the minimum position, and that of generator field resistance maximum, the set is started and brought up to the rated speed and is maintained constant.
- The terminal voltage of the generator is adjusted to the rated value with the help of the generator field rheostat and this position is maintained constant.
- Put on the load and note the value of the load current I_L and the terminal voltage V and field current I_f for different values of load. Until load current exceeds the full load value by 20%
- Assume armature Resistance (Ra) as 2 ohms.
- The generator voltage E for each load current is calculated using

$$E_g = V + Ia * Ra$$

Where $Ia = I_L + I_f$

- Draw the external characteristics V Vs I_L
- Internal characteristics E_g Vs Ia.

OBSERVATIONS:

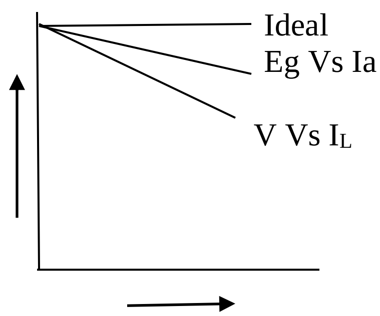
S.NO	If	I_L	Ia= I_L+If	V	Ea=V+Ia*Ra

PRECAUTIONS:

- All the connections should be clear and tight.
- The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be measured.
- The field current should not be increased to cross rated value.
- During the experiment the speed of prime mover should remain constant.

GRAPHS:

Plot the following graphs
1. V Vs I_L (external characteristics) .
2. Eg Vs Ia (internal characteristics).



RESULTS:

VIVA:

1. What are the various factors on which the shape of external characteristics depends?
2. Establish the relation between terminal voltage and load current for a d.c shunt generator.
3. How can you obtain internal characteristics from external characteristics of a D.C. shunt generator?
4. Is the terminal voltage of a D.C. shunt generator on load same as its induced voltage. Why?
5. Give applications of shunt generator..

EXP 3 LOAD CHARACTERISTICS OF D.C. COMPOUND GENERATOR

AIM: To conduct load test on a D.C. compound generator and to draw its load characteristics.

NAME PLATE DETAILS:

D.C. Shunt Motor/D.C Compound Generator

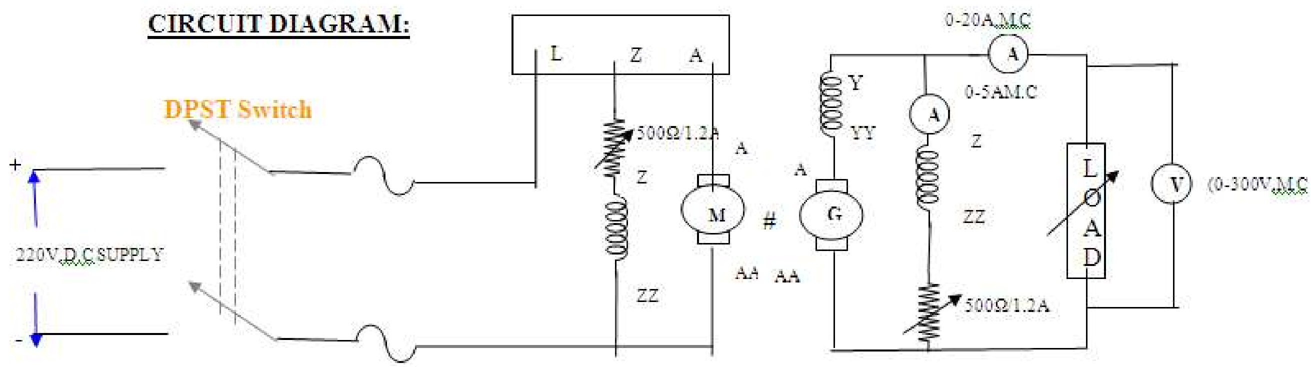
volts-------------- Amps ----------------

power--------------- speed---------------------

EQUIPMENTS REQUIRED:

SL.NO	NAME OF EQUIPMENT	TYPE	RANGE	QUANTITY
1	Voltmeter	M.C	0-300V	1
2	Ammeter	M.C	0-5A	1
3	Ammeter	M.C	0-20A	1
4	Rheostats	Wire Wound	500Ω/1.8A	2

CIRCUIT DIAGRAM:



PROCEDURE:

- Make the connections as per the diagram, choosing the meters suitable to the ratings of the machines.
- Keep the motor field rheostat in the minimum position, and that of generator field resistance maximum, the set is started and brought up to the rated speed and is maintained constant.
- The terminal voltage of the generator is adjusted to the rated value with the help of the generator field rheostat and this position is maintained constant.
- Put on the load and note the value of the load current I_L and the terminal voltage V and field current I_f for different values of load. Until load current exceeds the full load value by 20%
- Repeat the above step for differential compound connection by reversing the connection of series field .

OBSERVATIONS:

S.NO	If	I_L	V

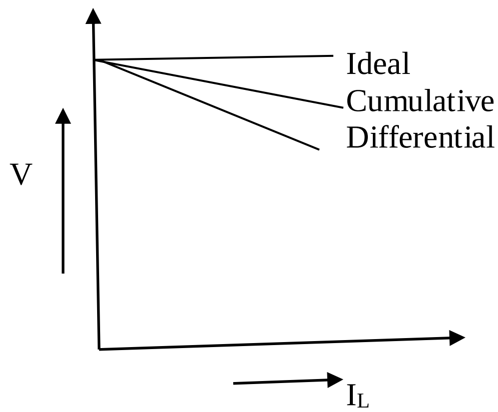
PRECAUTIONS:

- All the connections should be clear and tight.
- The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be measured.
- The field current should not be increased to cross rated value.
- During the experiment the speed of prime mover should remain constant.

GRAPHS:

Plot the following graphs

1. V Vs I_L (external characteristics) .
2. Eg Vs Ia (internal characteristics).



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

6. What are the various factors on which the shape of external characteristics depends?
7. Establish the relation between terminal voltage and load current for a d.c shunt generator.
8. How can you obtain internal characteristics from external characteristics of a D.C. shunt generator?
9. Is the terminal voltage of a D.C. shunt generator on load same as its induced voltage. Why?
10. Give applications of shunt generator..

EXPT 4: PERFORMANCE CHARACTERISTICS OF D.C. SERIES MOTOR

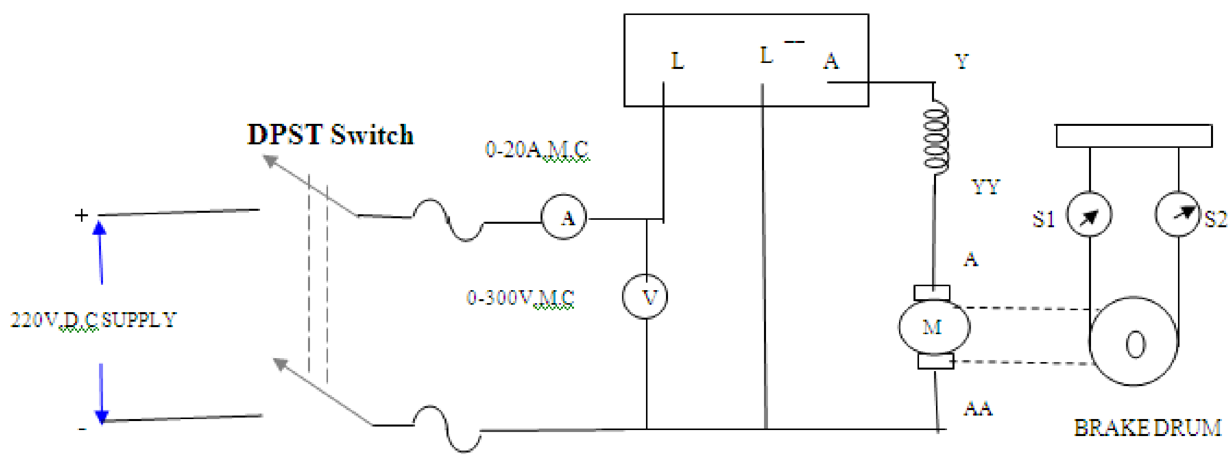
AIM : To perform brake test on D. C. series motor and draw the performance characteristics.

NAME PLATE DETAILS:

EQUIPMENTS REQUIRED:

SL.NO	EQUIPMENTS	RANGE	QUANTITY
1	M.C. Voltmeter	0-300V	1
3	M.C. Ammeter	0-20A	1
5	Tachometer		1

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the series motor and the apparatus as per the circuit diagram.
2. Before Switching on the supply, apply some initial load by using brake drum
3. Start the motor with the help of two point starter..
4. Note down the initial load readings of the meters.
5. Gradually increase the brake load and note down the readings and speed for different steps up to rated value.
6. Mean while pour water into the drum pulley for cooling.
7. After the observations of all readings reduce the load gradually and stop the motor on initial load conditions .

OBSERVATIONS:

S. no	V (volts)	I_L (amp)	N (rpm)	Brake load		Torque (N-m)	Output	Input	Efficiency
				S_1	S_2				
1									
2									
3									
4									
5									

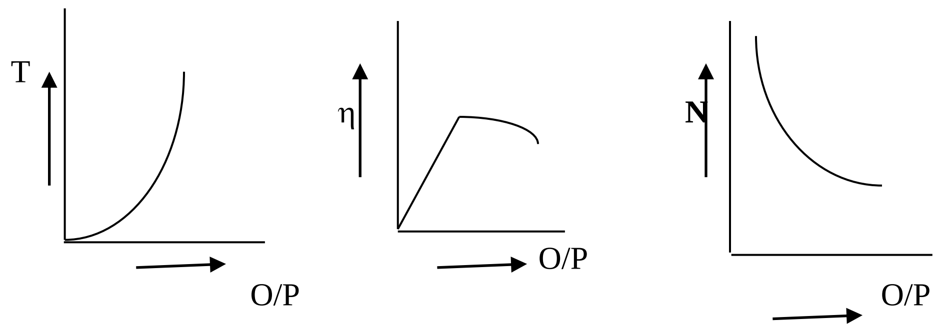
CALCULATIONS:

- Torque = (S_1- S2)×R×g in N-m. where R- Radius of brake drum.
- Output= (2∏NT)/60 in watts.
- Input= V× I_L watts
- Efficiency(%)=(output/input)*100

GRAPHS:

- Output vs efficiency.
- Torque vs output.
- Speed vs output.

EXPECTED GRAPHS:



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. Why D.C series motor are best suited where high starting torque is required ?
2. Why should there always be some load on a series motor when started ?
3. How can the direction of rotation of D.C series motor reversed?
4. Why the series field winding is thick & short whereas shunt field is thin & long ?
5. Why brake test is performed with small machines only ?

EXPT 5: PERFORMANCE CHARACTERISTICS OF D.C. SHUNT MOTOR

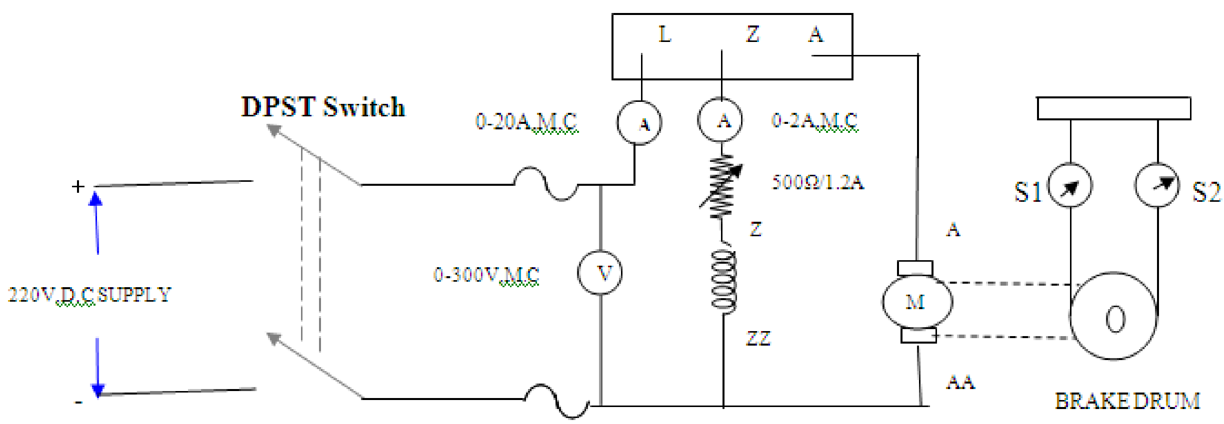
AIM : To perform brake test on D. C. shunt motor and draw the performance characteristics.

NAME PLATE DETAILS:

EQUIPMENTS REQUIRED:

SL.NO	EQUIPMENTS	RANGE	QUANTITY
1	M.C. Voltmeter	0-300V	1
2	M.C. Ammeter	0-2A	1
3	M.C. Ammeter	0-20A	1
4	Field rheostat	500Ω/1.2A	1
5	Tachometer		1

CIRCUIT DIAGRAM:



PROCEDURE:

8. Connect the shunt motor and the apparatus as per the circuit diagram.
9. Switch on the supply & start the motor with the help of starter on no load.
10. Adjust the speed up to the rated value note down the no-load readings of the meters.
11. Gradually increase the brake load and note down the readings and speed for different set of steps up to rated value.
12. Mean while pour water into the drum pulley for cooling.
13. After the observations of all readings reduce the load gradually and stop the motor on no-load.

OBSERVATIONS:

S. no	V (volts)	I_L (amp)	I_F (amp)	N (rpm)	Brake load		Torque (N-m)	Output	Input	Efficiency
					S_1	S_2				
1										
2										
3										
4										
5										

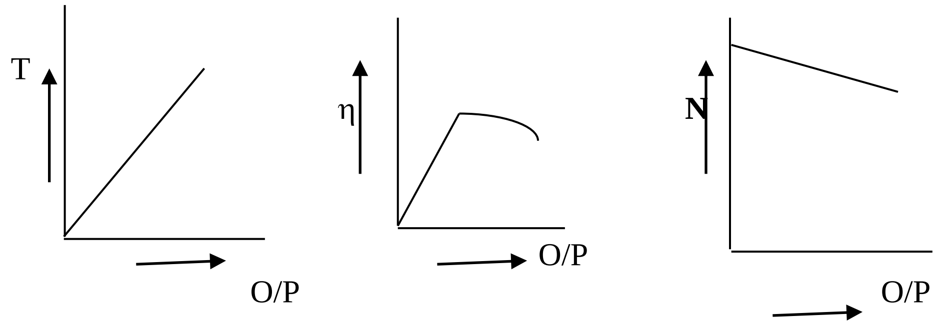
CALCULATIONS:

- Torque = (S_1- S2)×R×g in N-m. where R- Radius of brake drum.
- Output= (2∏NT)/60 in watts.
- Efficiency(%)=(output/input)*100
- Input= V× I_L watts

GRAPHS:

- Output vs efficiency.
- Torque vs output.
- Speed vs output.

EXPECTED GRAPHS:



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. Why does the speed of motor falls when it is slightly loaded& what is the percentage fall?
2. Let a D.C shunt motor is started & runs at rated speed .The value of filed current is noted .It is then allowed to run for an hour .Would the field current change after one hour ?
3. What happens when a.c supply is given to D.C shunt motor ?
4. Why the field rheostat of D.C shunt motor kept at minimum ?

EXPT 6: PERFORMANCE CHARACTERISTICS OF D.C. COMPOUND MOTOR

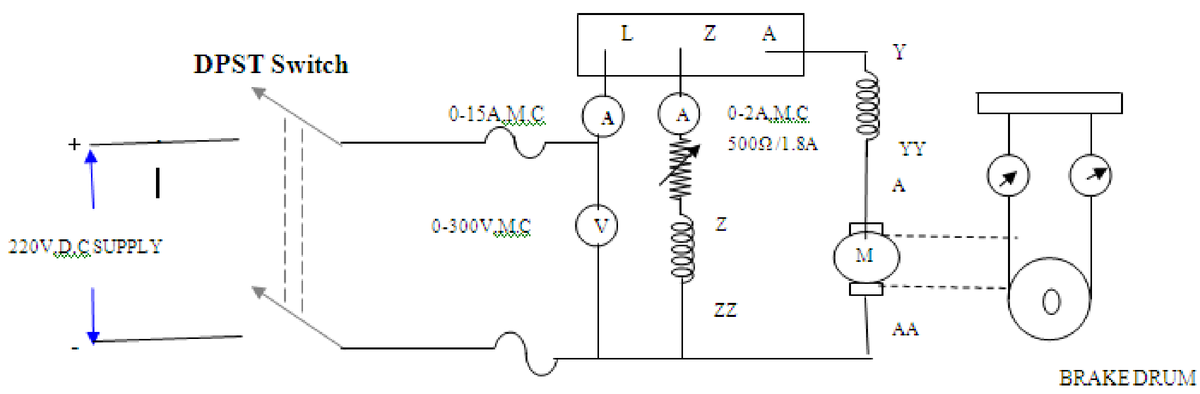
AIM : To perform brake test on D. C. Compound motor and draw the performance characteristics.

NAME PLATE DETAILS:

EQUIPMENTS REQUIRED:

SL.NO	EQUIPMENTS	RANGE	QUANTITY
1	M.C. Voltmeter	0-300V	1
2	M.C. Ammeter	0-2A	1
3	M.C. Ammeter	0-15A	1
4	Field rheostat	500Ω	1
5	Tachometer		1

CIRCUIT DIAGRAM:



PROCEDURE:

14. Connect the compound motor and the apparatus as per the circuit diagram.
15. Switch on the supply & start the motor with the help of starter on no load.
16. Adjust the speed up to the rated value note down the no-load readings of the meters.
17. Gradually increase the brake load and note down the readings and speed for different set of steps up to rated value.
18. Mean while pour water into the drum pulley for cooling.
19. After the observations of all readings reduce the load gradually and stop the motor on no-load.

OBSERVATIONS:

S. no	V (volts)	I_L (amp)	I_F (amp)	N (rpm)	Brake load		Torque (N-m)	Output	Input	Efficiency
					S_1	S_2				
1										
2										
3										
4										
5										

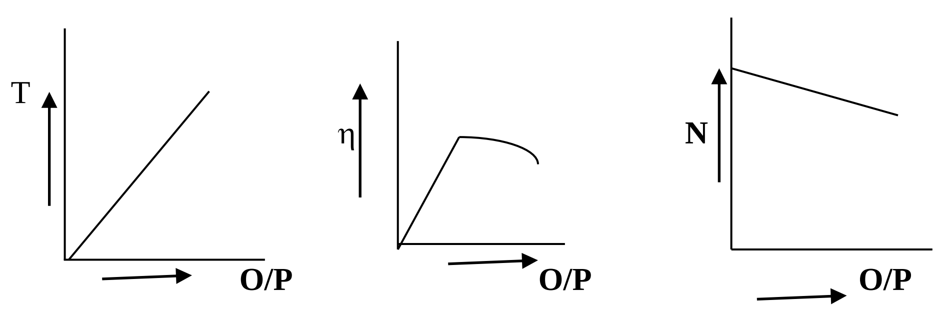
CALCULATIONS:

- Torque = $(S_1 - S2) \times R \times g$ in N-m. where R- Radius of brake drum.
- Output= $(2\prod NT)/60$ in watts.
- Efficiency(%)=(output/input)*100
- Input= $V \times I_L$ watts

GRAPHS:

- Output vs efficiency.
- Torque vs output.
- Speed vs output

EXPECTED GRAPHS:



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. What is the main drawback of brake test ?
2. Why mechanical losses occur in D.C machines ?
3. How do you reverse the direction of rotation of D.C compound motor?
4. What is the difference between differential & cumulative compound motor ?
5. List out any two applications of D.C Compound motor .

EXPT 7: SEPARATION OF IRON & FRICTION LOSSES & ESTIMATION OF PARAMETERS IN IN D.C MACHINE

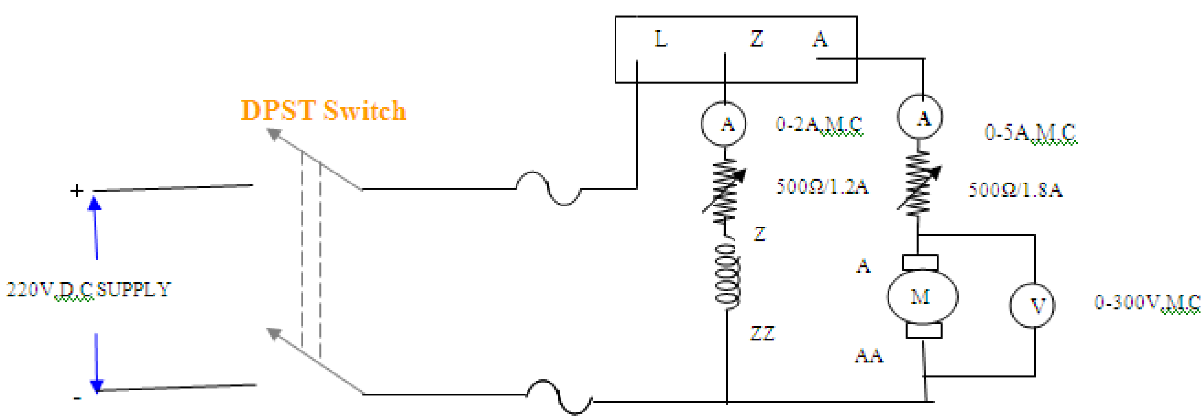
AIM : To determine the various components of constant losses of a D.C machine .

NAME PLATE DETAILS:

EQUIPMENTS REQUIRED:

SL.NO	EQUIPMENTS	RANGE	QUANTITY
1	M.C. Voltmeter	0-300V	1
2	M.C. Ammeter	0-2A	1
3	M.C. Ammeter	0-5A	1
4	Rheostat	100Ω	1
		500Ω/1.2A	1
5	Tachometer		1

CIRCUIT DIAGRAM:



PROCEDURE:

20. Connect the circuit as per the circuit diagram.
21. Keep armature rheostat in maximum position & switch on D.C supply
22. Adjust the speed up to the rated value by reducing the armature resistance .
23. Note down the readings of voltmeter ,both ammeters & speed for different set of armature resistance
24. Increase the value of field rheostat & repeat step 3 & 4
25. Bring the armature rheostat to its maximum value & switch off the supply

OBSERVATIONS:

S. no	V (volts)	I_a (amp)	I_F (amp)	N(rpm)	$P=V I_a - I_a^2Ra$	P/N
1						
2						
3						
4						
5						

CALCULATIONS:

Input to the armature $=V I_a = W$

Let $P= W- I_a^2Ra$ =(frictional losses+ windage losses)+(hysteresis losses+eddy current losses)

Frictional losses α N = AN

Windage losses α $N^2 = BN^2$

Hysteresis losses α $(B)^{1.6} f = (B)^{1.6} N = CN$

Eddy current losses α $(B)^2 N^2 = DN^2$

Combining all the above five equations

$P = AN+ BN^2 + CN + DN^2$

$P/ N = (A+C) +(B+D) N$

The above equation tells that the graph between P/N & N would be a straight line with slope (B+D) & (A+C) as Y –intercept .

However if we have to separate all the four losses , another experiment with reduced excitation is performed by increasing the field rheostat

By changing the excitation we get another curve similar to the previous graph represented by dotted line

In the second experiment the values of A & B remain unchanged but the constants C & D will change .Let C ' & D' be new values then

P'/N = (A +C') +(B+D')

Now

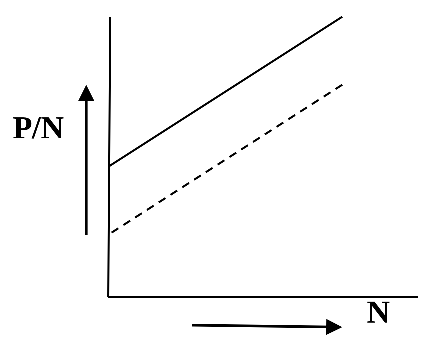
C/C' = (flux at normal excitation/flux at reduced excitation), and
D/D' = (flux at normal excitation/flux at reduced excitation)

So, if we determine the ratio (flux at normal excitation/flux at reduced excitation) we can find A, B, C, D, C' & D' .

GRAPHS:

P/N Versus N

EXPECTED GRAPHS:



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. What is the need to segregate the losses in D.C machines ?
2. How are eddy current & hysteresis losses minimized ?
3. What is the difference between stray & constant losses ?
4. Which component of loss plays a major role in a D.C machine ?

EXP 8 a) SWINBURNE'S TEST

AIM: To predetermine the efficiency of a D.C. machine when running as a motor and as a generator by conducting Swinburne's test.

NAME PLATE DETAILS:

D.C. Shunt Motor

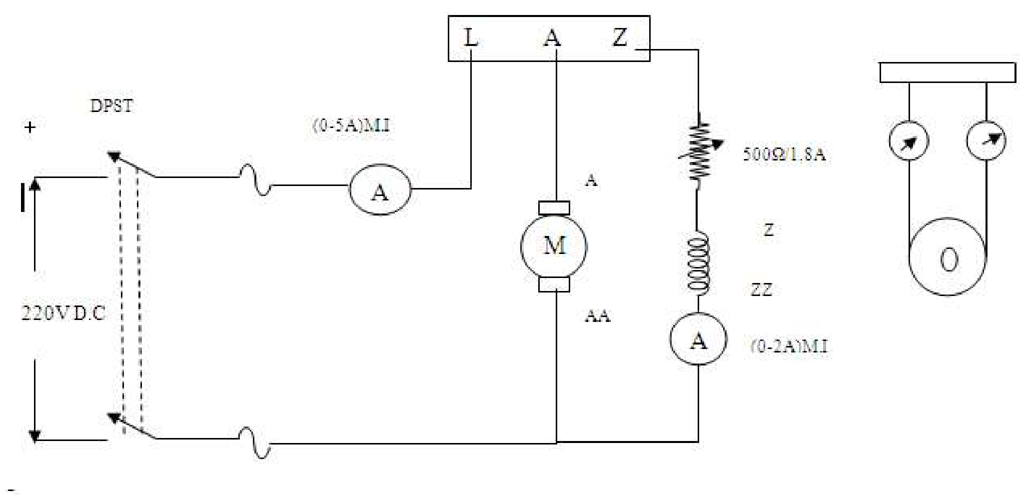
volts-------------- Amps ----------------

power--------------- speed---------------------

APPARATUS REQUIRED:

SL.NO	NAME OF EUIPMENT	RANGE	QUANTITY
1	D.C. Ammeter	0-5A	2
2	D.C. Voltmeter	0-300V	1
3	Rheostat	500Ω	1
4	Tachometer		1

CIRCUIT DIAGRAM :



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PROCEDURE:

- Make the connections as per the diagram, choosing the meters suitable to the ratings of the machines.
- Keep the motor field rheostat in the minimum position, switch on the supply and start the motor.
- Adjust the speed of the motor to the rated speed by means of the rheostat.
- Note down the supply voltage V, the line current Io and Field current If
- Calculate the efficiency of the machine as a motor and as generator assuming various values of currents as shown in the sample calculations

PRECAUTIONS:

- All the connections should be clear and tight.
- The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be measured.
- The field current should not be increased to cross rated value.

OBSERVATIONS:

Voltage---------------V NO load current I_O =---------------A

Field current Ir=-------------------------------A

SAMPLE CALCULATION:

Armature resistance= Ra (assumed).

AS A MOTOR:

Input current = I_L (assumed)
Power input to the motor =Pi =V*I_L
Armature current =Ia0 =I_L-I_F
Armature copper loss =I_{a0}^2 *Ra; I_{a0}=No load armature current.
Constant loss =Wc =V*I_L- I_{a0}^2 *Ra
Total losses =P_L = I_{a0}^2 *Ra +Wc; Ia=load armature current.
Power output of the motor =P_0 = Pi-P_L
Efficiency of the motor % = (P_0\Pi)*100

AS A GENERATOR:

Assume output current= I_L

Power output of the generator= $P_0 = V * I_F$
Armature current= $Ia = I_L + I_F$
Total losses= $(I_{a0}{}^2 * Ra) + Wc$
Power input to the generator= $P_0 = Pi - P_L$

Efficiency of the generator %= $(P_0 \backslash Pi)*100$

CALCULATIONS:

A) AS A MOTOR:

S.NO	IL	IA	PL	Pi	PO	%Efficiency

B) AS A GENERATOR:

S.NO	IL	IA	PO	PL	Pi	%Efficiency

GRAPHS:

Draw the graphs efficiency verses IL for the both the cases on the same graph sheet.

RESULTS:

DISCUSSIONS OF RESULTS:

Viva:

- Why SWINBURNES test is referred as indirect test
- Can u estimate temperature rise of DC machines by SWINBURNES test
- What is the advantages of SWINBURNES test
- State the various conditions under which the DC machine should be operated while performing SWINBURNES Test.

EXP 8b) SPEED CONTROL OF A DC SHUNT MOTOR

AIM: To vary the speed of a DC Shunt motor by (1) Field control method and(2) Armature control method .

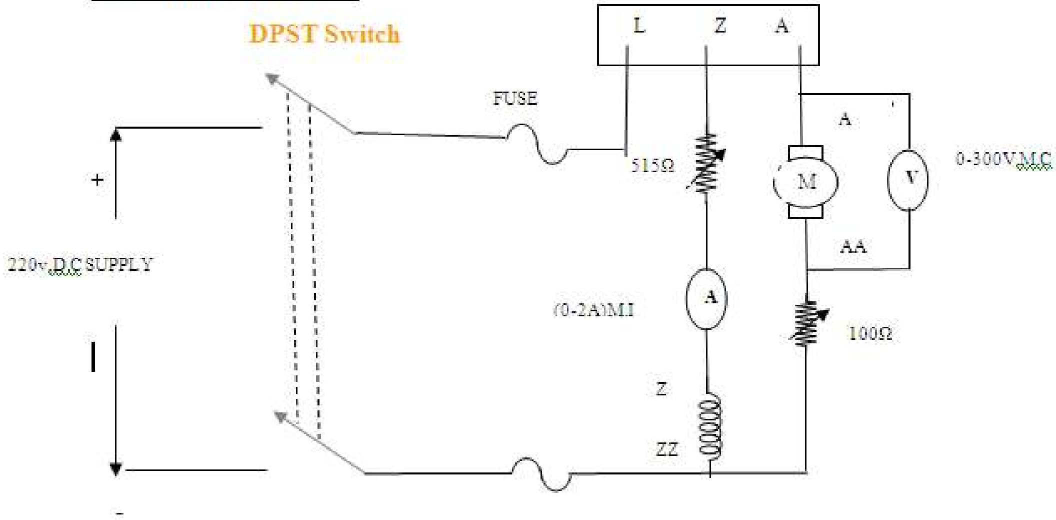
NAME PLATE DETAILS:

D.C. Shunt Motor
volts-------------- Amps ----------------
power--------------- speed---------------------

EQUIPMENTS REQUIRED:

SL.NO	NAME OF EQUIPMENT	TYPE	RANGE	QUANTITY
1	Voltmeter	M.C	0-300V	1
2	Ammeter	M.C	0-5A	1
3	Tachometer	-	-	1
4	Rheostats	-	515Ω,100Ω	

CIRCUIT DIAGRAM:



PROCEDURE:

- Make the connections as per the diagram, choosing the meters suitable to the ratings of the machines.
- Keep the motor field rheostat in the minimum position, and that of armature circuit maximum(these must be the positions of the two Rheostats every time the motor is started)
- Give the supply and start the motor. Adjust the resistance in series with armature in order to get a voltage of (say 120V) across the armature.

1. **FIELD CONTROL**

   - Keeping the voltage across armature constant, increase the resistance in series with the field winding to vary field current.
   - Note down the speed of the motor at different values of field current. abulate the readings till the field rheostat reaches its max. Value.

OBSERVATIONS:

S.NO	Field current(If) Amps	Speed (N) R.p.m

2. **ARMATURE CONTROL:**

   - Keeping the field current constant at a particular value, and vary the voltage across the armature by varying the resistance in series with armature.
   - Note down the speed at different values of voltage across the armature and tabulate the readings till the armature rheostat reaches its minimum position..

OBSERVATIONS:

S.NO	Va (Volts)	Speed (N) R.p.m

PRECAUTIONS:

- All the connections should be clear and tight.
- The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be measured.
- The field current should not be increased to cross rated value.

GRAPHS:

- Plot the following graphs
    - Field current Vs speed.
    - Armature voltage Vs. speed.

RESULTS:

DISCUSSIONS OF RESULTS:

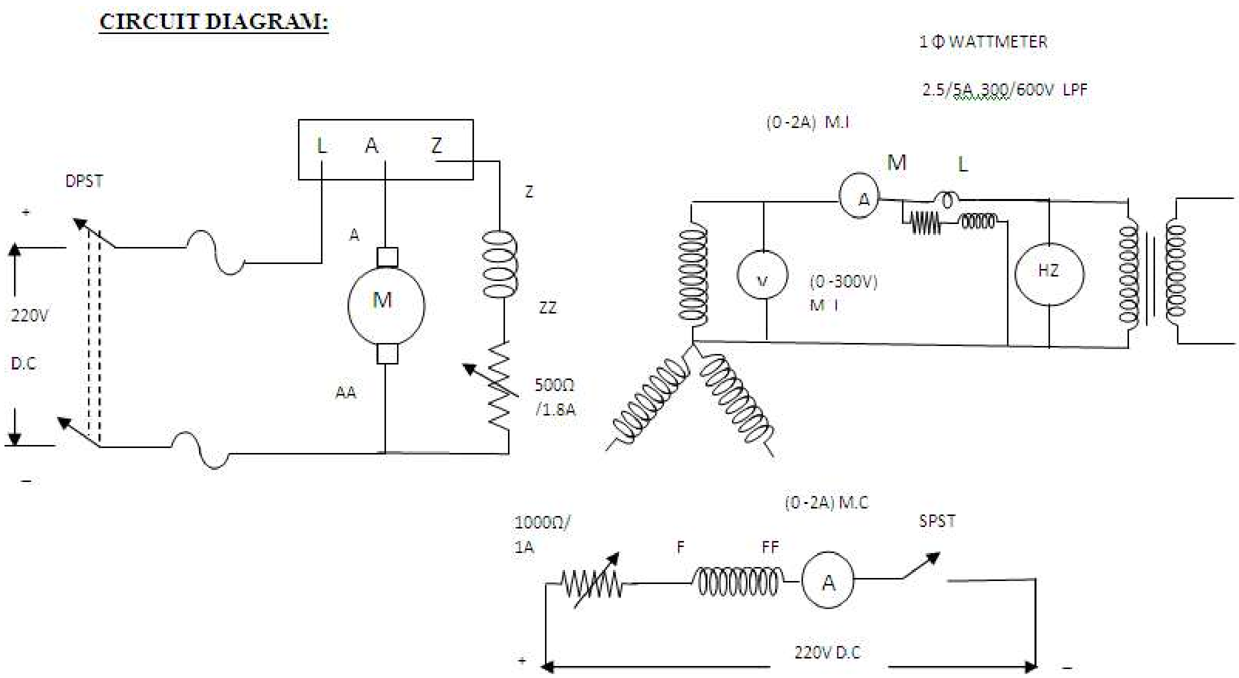
EXP 9: SEPARATION OF CORE LOSSES IN A SINGLE PHASE TRANSFORMER

AIM : To separate core losses in Single phase transformer.

NAME PLATE DETAILS :

APPARATUS REQUIRED:

SL.NO	NAME OF EQUIPMENT	RANGE	QUANTITY
1	Voltmeter(MI)	0-300V	2
2	Ammeter(MI)	0-2A	1
3	Ammeter(MC)	0-2A	1
4	L.P.F Wattmeter	2.5/5A,150/300V	1
5	Frequency meter		1
6	Rheostats	500Ω/1.8A	1
		1000Ω/1A	1



PROCEDURE:

1.Make all connections as shown in circuit diagram.

2. Start alternator and apply voltage to primary of transformer keeping secondary open.

3. Vary the speed of alternator(frequency) of supply voltage.

4.Take readings of Voltmeter, Ammeter &wattmeter and speed (frequency) keeping V/f Ratio constant.

5.Tabulate the readings and draw the graph W_i/f Versus f.

6.From the graph determine constants A and B.

OBSERVATIONS:

If(A)	Io(A)	V (Volts)	Frequency(HZ)	V/f(V/HZ)	Current I_0(A)	Wattmeter(W)	W_h (W)=Af	W_e(W)=B f^2

PRECAUTIONS:

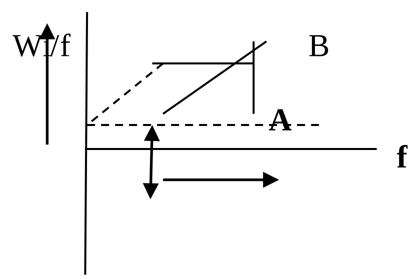
1. All the connections should be clear and tight.

2. The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be

Measured

CALCULATIONS:

EXPECTED GRAPHS:



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. A transformer is rated at 220/44V & 110VA at 50HZ . State which of the winding should have thinner conductor
2. If a 110V d.c is supplied to the primary of a 220/44V transformer ,what would be the induced voltage in the secondary of the transformer ? what else will happen ?
3. What would happen if a transformer designed for operation at 50HZ were connected to a 5 HZ supply of the same voltage ?
4. Discuss What will happen when a part of the primary winding of a transformer were accidentally short circuited
5. What is the need to segregate the iron losses ?

EXPT 10:OPEN CIRCUIT AND SHORT CIRCUIT TEST ON A SINGLE PHASE TRANSFORMER

AIM: To perform OC and SC test on a Single Phase Transformer & predetermine its efficiency & regulation at given p.f & obtain the equivalent circuit

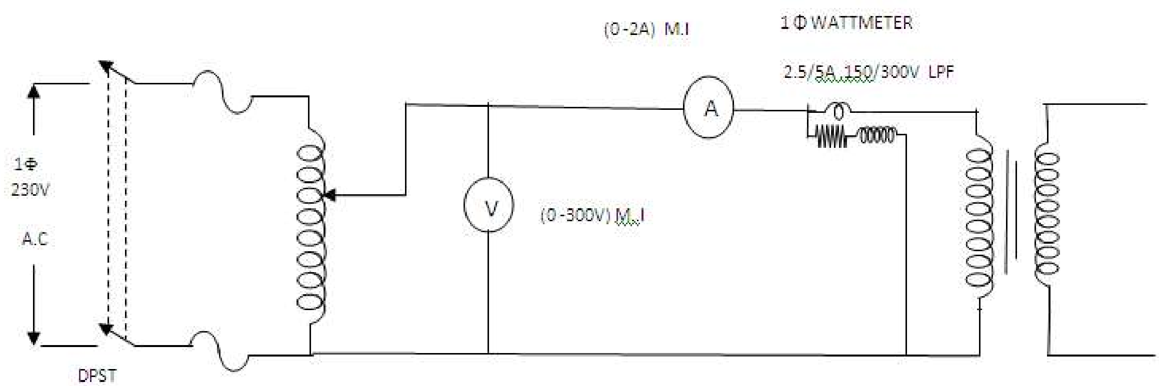
NAME PLATE DETAILS:

EQUIPMENTS REQUIRED:

SL.NO	EQUIPMENTS	RANGE	QUANTITY
1	M.I. Voltmeter	0-300V	1
2	M.I. Voltmeter	0-30V	1
3	M.I. Ammeter	0-2A	1
4	M.I. Ammeter	0-15A	1
5	L.P.F.Wattmeter	2.5/5A,150/300V	1
6	U.P.F.Wattmeter	15/30A,75/150V	1

CIRCUIT DIAGRAM:

O.C TEST

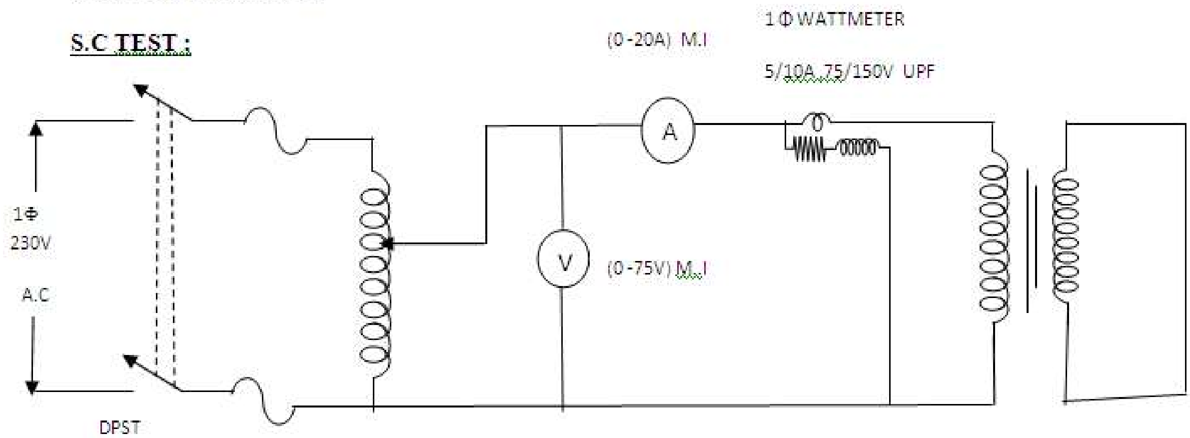


PROCEDURE:
OPEN CIRCUIT TEST:

1.Make all connections as shown in circuit diagram.
2.Increase the Voltage by means of variac until rated voltage is reached.
3. Note the values of No Load Current(I_O),Voltage(V_O),Wattmeter(P_O).
4.The variac should be brought to intial position and supply is switched off.

CIRCUIT DIAGRAM:

S.C TEST :



SHORT CIRCUIT TEST:

1.Make all connections as shown in circuit diagram.
2.Increase the Voltage by means of variac until rated voltage is reached.
3. Note the values of No Load Current(I_{SC}),Voltage(V_{SC}),Wattmeter(P_{SC}).
4.The variac should be brought to intial position and supply is switched off.

OBSERVATIONS:

OC TEST:

S.NO	V_O (Volts)	I_O (Amps)	P_O (Watts)

SC TEST:

S.NO	V_{SC} (Volts)	I_{SC} (Amps)	P_{SC} (Watts)

CALCULATIONS:

OC TEST:

$\cos Ø_o = P_O/(V_O * I_O)$
$R_o = V_O/(I_O \cos Ø_O)$
$X_o = V_O/(I_O \sin Ø_O$

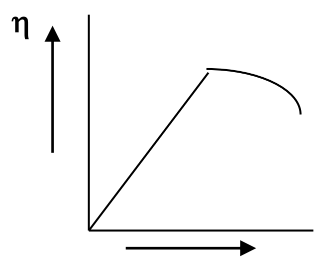
SC TEST:

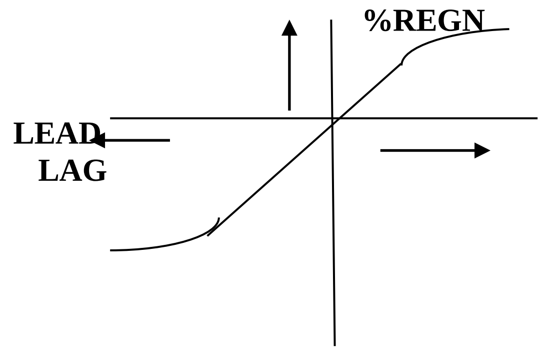
$R_{o1} = P_{SC}/ I_{SC}^2$
$Z_{o1} = V_{SC}/ I_{SC}$
$X_{o1} = ((Z_{o1})^2 - (R_{o1})^2)^{1/2}$
% regn = $(I_1R_{01}\cos\Phi \pm I_1X_{01}\sin\Phi)/V_1 \times 100$

S. no	X(Load)	Iron loss(P_O) (KiloWatts)	Copper loss=X^2* P_{SC} (KiloWatts)	Total Losses= P_O+ X^2* P_{SC} (KiloWatts)	Output =XScos Ø (KiloWatts)	Input = Output+ Total Losses (KiloWatts)	%efficiency	% regulation

SAMPLE CALCULATIONS:

EXPECTED GRAPHS:





RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. Why is indirect testing of large size transformers is necessary ?
2. What does the rating of a wattmeter indicate in case of open circuit test on a transformer ? Justify your answer
3. What does the rating of a wattmeter indicate in case of short circuit test on a transformer ? Justify your answer
4. What do you expect to happen if, full rated voltage is applied to a transformer under short circuit test?
5. While performing the open circuit test on a transformer ,Why high voltage windings are kept open?
6. While performing the short circuit test on a transformer ,Why low voltage windings are short circuited ?
7. Why is the efficiency of a transformer not determined by direct loading ?
8. What is the difference between a power transformer & distribution transformer?

EXP 10 . SUMPNERS TEST ON BANK OF TWO IDENTICAL SINGLE PHASE TRANSFORMERS

AIM: To conduct sumpners test on identical single phase transformers and to pre determine the efficiency at different loads.

NAME PLATE DETAILS:

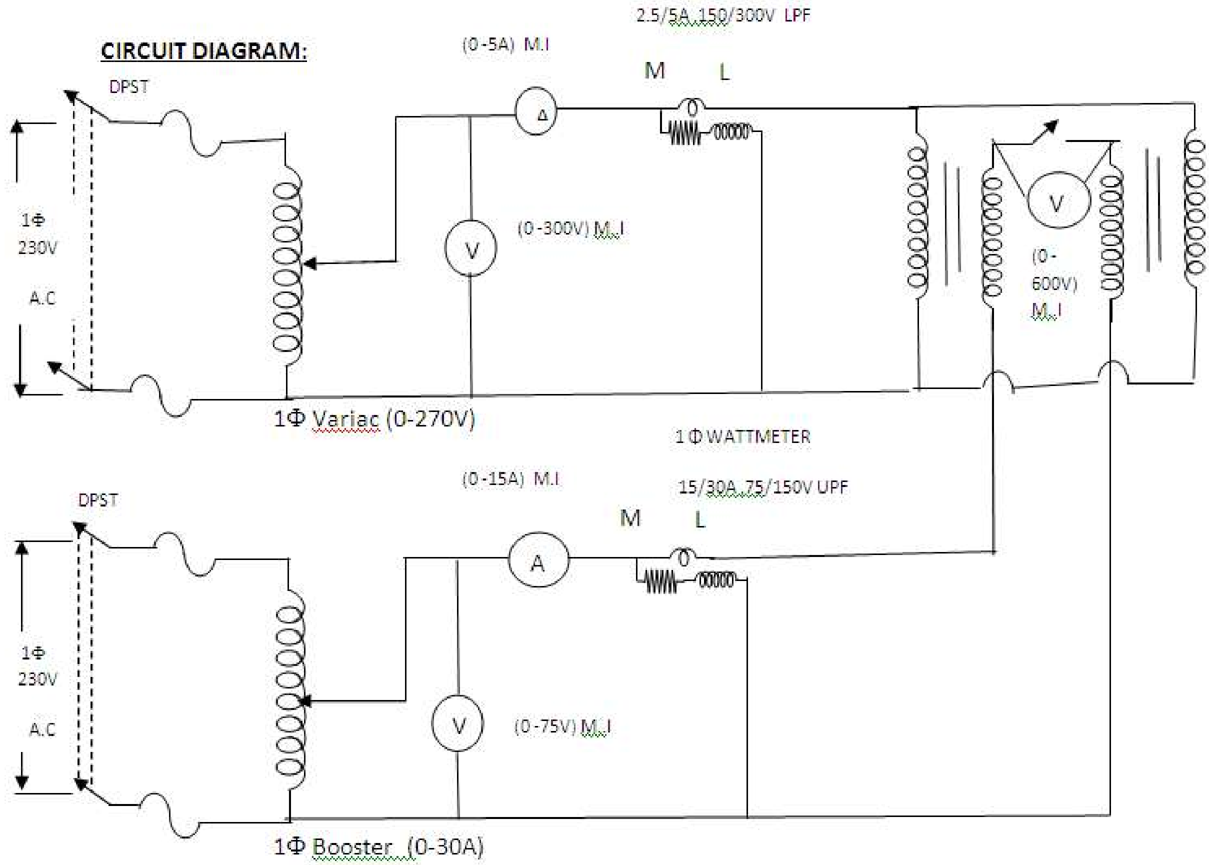
EQUIPMENTS REQUIRED:

SL.NO	EQUIPMENTS	RANGE	QUANTITY
1	M.I. Voltmeter	0-300V	1
2	M.I. Voltmeter	0-75V	1
3	M.I. Ammeter	0-2A	1
4	M.I. Ammeter	0-30A	1
5	Wattmeter	2.5-5A/150-300 LPF	1
	Wattmeter	15-30A/75-150 UPF	1
6	1-Ø identical transformers	3KVA,230/115V	2
7	Connecting wires	-	required

PROCEDURE:

1. The connections are made as per circuit diagram. Choose the voltmeter V_3 of range double that of secondary winding voltage.
2. Adjust V_1 to primary load rated voltage of transformer and keep it constant throughout the test. V_3(Voltmeter across the switch) is zero if the two secondaries are in series opposition and double if the are aiding each other.
3. If V_3 reads double switch of the power supply and reverse connection of secondary winding of one of the transformer and check the reading of V_3
4. Close Switch across V_3 when volt meter V_3 reads Zero i.e in series opposition.
5. Adjust the circulating current in secondary winding by means of Booster variac to full load of secondary.
6. Note down the readings of all meters,W_1 indicates total iron loss in two transformers T_1 and T_2 and W_2 indicates copper loss in two windings corresponding to secondary current, V_2 indicates total voltage drop in impedance of both winding under these conditions.

CIRCUIT DIAGRAM:



OBSERVATIONS:

O.C Test			S.C Test		
Primary voltage V_1(V)	Primary current I_1(A)	Wattmeter Reading W_1(W)	Secondary voltage V_2(V)	Secondary current I_2(A)	Wattmeter Reading W_2(W)

Cos Ø= 0.8

Load(X)	Iron loss(W_i)	Cu lossX^2(W_{cu})	Total losses(W)	Output=X*S* Cos Ø	Input= output losses	%Efficiency

Cos Ø= 1

Load(X)	Iron loss(W_i)	Cu lossX^2(W_{cu})	Total losses(W)	Output=X*S* Cos Ø	Input= output losses	%Efficiency

Where X is the fraction of load & S is the full load KVA of the transformer

PRECAUTIONS:

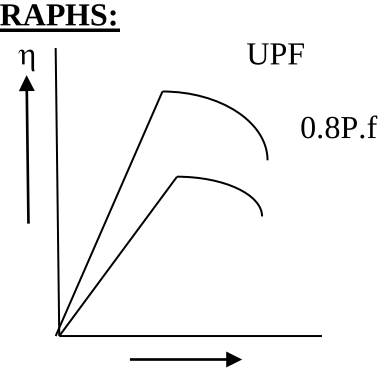
1.All connections should be tight and neat.
2.Voltmeter,ammeter,wattmeter must be carefully choosen.
3.Variac on secondary must be in zero position before switching on supply.
4.while switching off supply bring variac of secondary to zero position.

CALCULATIONS:

GRAPHS:

Efficiency VS Output at UPF and 0.8 PF

EXPECTED GRAPHS:



RESULTS:

DISCUSSIONS OF RESULTS :

VIVA:

1. While conducting the Sumpner's test on a pair of transformers ,what would be the reading of voltmeter on the secondary side if the secondaries are in phase opposition ,when rated voltage is applied across the primary windings ?
2. What are the conditions for conducting back to back test on a pair of transformers?
3. If No Load current of a transformer is 0.6A what would be the reading of the ammeter connected on primary side in a set up for conducting back to back test ?
4. What does the reading of wattmeter on the primary & secondary indicate?
5. If the full load current of each transformer is 10A .What would be the reading of the ammeter on the secondary sides of the transformers in an arrangement for conducting back to back test ?

EXP 12. HOPKINSON'S TEST

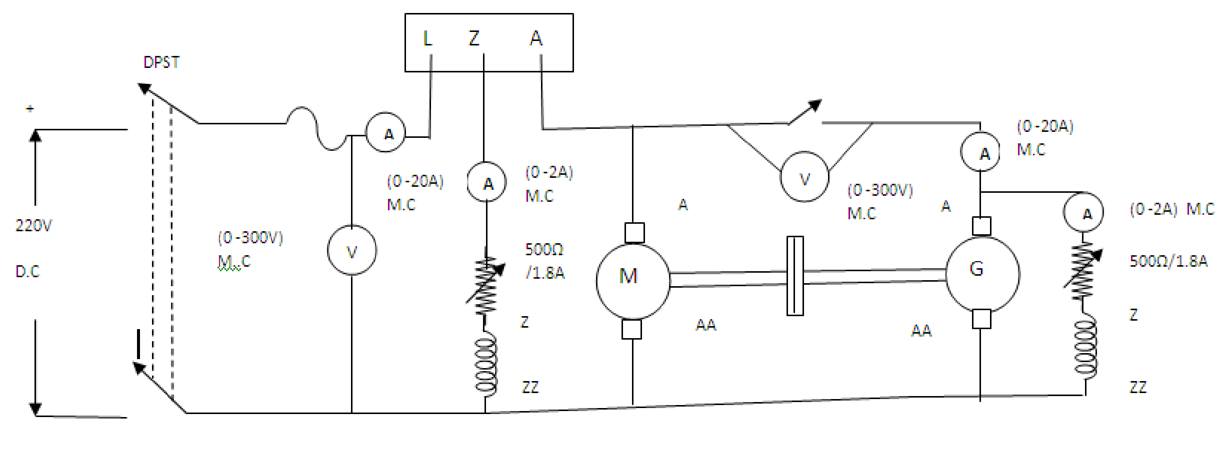
AIM : To test two identical D.C shunt machines & determine their efficiencies at various percentage of full load a) when running as motor b) when running as generator

NAME PLATE DETAILS :

APPARATUS REQUIRED:

SL.NO	NAME OF EQUIPMENT	RANGE	QUANTITY
1	Voltmeter(MC)	0-300V	2
2	Ammeter(MC)	0-2A	2
		0-20A	2
3	Rheostat	500Ω/1.8A	2

CIRCUIT DIAGRAM:



PROCEDURE:

1. Connect the circuit as shown in figure
2. Initially the switch interconnecting the two machines should be open
3. Start the machine –I with the help of starter & adjust its field rheostat so that it runs at rated speed (The machine –I drives the machine –II)
4. The Switch is necessary to safeguard the machines if their polarities are not correct .This will be indicated by the voltmeter V_1 .It will indicate either a small voltage or approximately twice the voltage of the supply mains (In the latter case interchange the armature terminals)
5. The excitation of machine-II is gradually increased (by adjusting its field rheostat) till the voltmeter V_1 reads Zero

6. In case the generator voltage & supply voltage are of opposite polarities the voltmeter will read double the supply voltage .In such case the supply voltage is switched off & armature terminals of the generator should be reversed . Close the switch S (Machine –II is now floating neither taking current from supply nor delivering any current)
7. Now adjust the field rheostats & take readings at different currents (The machine with lower excitation will act as motor & the other machine act as generator)
8. Speed should be kept constant throughout the experiment
9. Reduce the load on the supply to minimum by adjusting the field rheostats o both the machines .Then switch off the supply .
10. Measure the armature resistances of both the machines .

OBSERVATIONS:

SNo	V	I_1	I_2	I_3	I_4	Wc	ηm	ηg

PRECAUTIONS:

1.All the connections should be clear and tight.

2.The voltmeter and ammeter should be carefully chosen so that their ranges are more than max. Values to be measured.

3. The voltmeter connected across the switch S should be of double the range equal to double the value of supply voltage .

CALCULATIONS:

Assuming as Machine-I is running as motor ,Machine –II as a generator
Armature copper loss in generator $=(I_3-I_4)^2$ Ra =Pagcu
Armature copper loss in Motor = $(I_1 -I_2 +I_3)^2$ Ra =Pamcu
Shunt copper loss in Generator = V I_4
Shunt copper loss in Motor =VI_2
Power taken from the supply =V I_1
Stray losses for the set = VI_1 –[Pagcu+Pamcu-V(I_2 +I_4)]=Ps
Stray losses for each machine = Ps/2
<u>For generator :</u>

Total Losses = Pacu+ VI_4 + Ps/2
Output = VI_3
η = Output /(Output + Losses) =VI_3 /(VI_3 + Total Losses)

For Motor :

Total Losses = Pam+ VI_2 + Ps/2

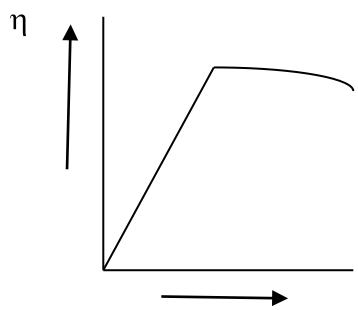
Input =$V(I_1 + I_3)$

η =(Input –Losses)/(Input) = $(V(I_1 + I_3)$-Pam)/ $V(I_1 + I_3)$

GRAPHS:

Efficiency Vs Output

EXPECTED GRAPHS:



DISCUSSIONS OF RESULTS :

VIVA:

1. Why Hopkinson's test is also known as regenerative test?
2. Compare the power drawn from the supply in swinburne's & Hopkinson's test
3. How is Hopkinson's test better than Swinburne's test