REGULATION OF ALTERNATOR USING SYNCHRONOUS IMPEDANCE METHOD

AIM:

To find the regulation of a 3 - ϕ alternator by using synchronous impedance method.

APPARATUS REQUIRED:

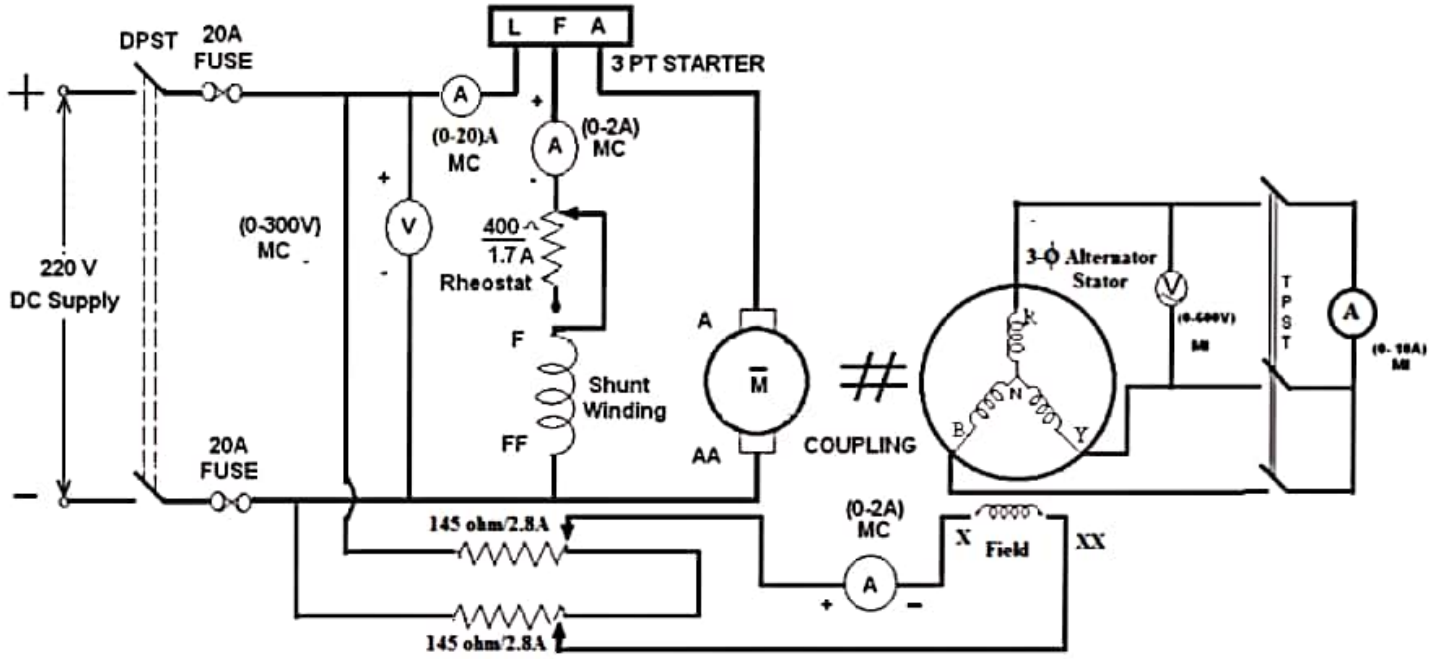
Sl. No.	Equipment	Type	Range	Quantity
1	Voltmeter	MI	(0-300/600)V	1 no
2	Ammeter	MI	(0-5/10)A	1 no
3	Ammeter	MI	(0-2.5/5)A	1 no
3	Rheostat	Wire-wound	400 Ω /1.7A 145Ω /2A	1 no 2 no
4	Tachometer	Digital	*****	1 no
5	Connecting Wires	*****	*****	Required

NAME PLATE DETAILS:

DC Motor(prime mover)	3- ϕ Alternator
KW :	Power Rating:
Voltage :	PF :
Current :	Line voltage:
Speed :	Speed
Exctn : Shunt	Exctn Voltage:
Voltage :	Rated Current :

Field current::	

CIRCUIT DIAGRAM:



PROCEDURE:

Open Circuit Test:

1. Make the connections as per the circuit diagram.
2. Before starting the experiment, the potential divider network in the alternator field circuit and field regulator rheostat of motor circuit is set minimum resistance position.
3. Switch ON the supply and close the DPST switch. The DC motor is started by moving starter handle.
4. Adjust the field rheostat of DC motor to attain rated speed (equal to synchronous speed of alternator)
5. By decreasing the field resistance of Alternator, the excitation current of alternator is increased gradually in steps.

6. Note the readings of field current, and its corresponding armature voltage in a tabular column.
7. The voltage readings are taken upto and 10% beyond the rated voltage of the machine.

Short Circuit Test:

1. For Short circuit test, before starting the experiment the potential divider is brought back to zero output position, i.e., resistance should be zero in value.
2. Now close the TPST switch.
3. The excitation of alternator is gradually increased in steps until rated current flows in the machine and note down the readings of excitation current and load current (short circuit current)
4. Switch OFF the supply.

OBSERVATIONS:

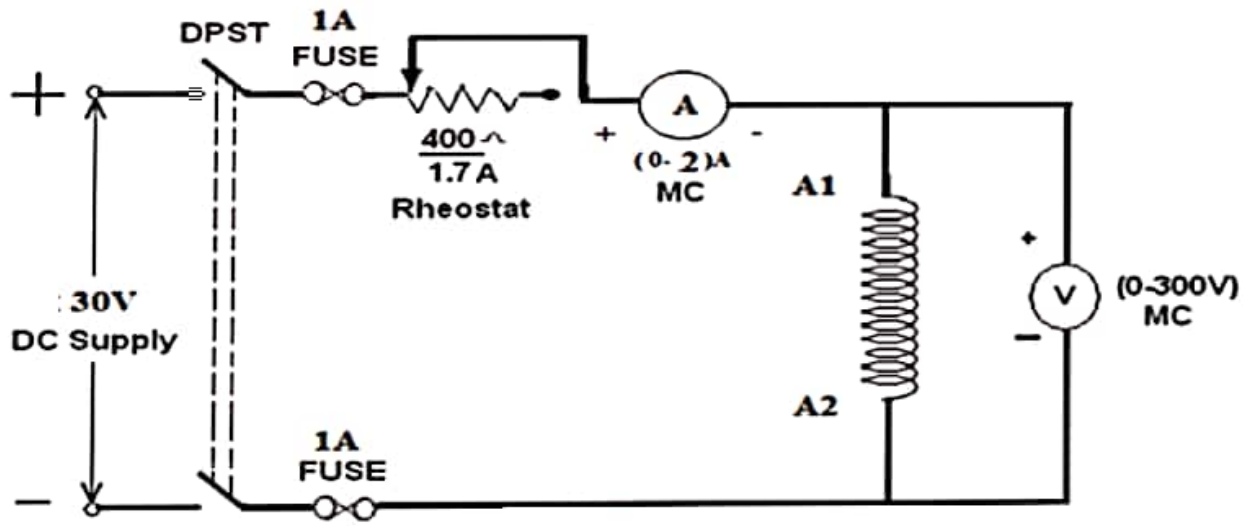
Sl no.	OC test		Sl no.	S.C. test	
	Field current in Amp.(I f)	OC voltage per phase (Vo)		Field current I_f(Amp.)	SC current I_{sc} Amp.

Procedure to find Armature resistance of alternator:

1. Connections are made as per the circuit diagram.
2. Switch ON the supply. By varying the rheostat, take different readings of ammeter and voltmeter in a tabular column.

3. From the above readings, average resistance Ra of a armature is found out.

Connection diagram to find Ra



OBSERVATIONS:

Sl no.	Armature current I(amp)	Armature voltage Va (volts)	R_{dc}=V / I

Procedure to find synchronous impedance from OC and SC tests:

1. Plot open circuit voltage, short circuit current verses field current on a graph sheet.
2. From the graph, the synchronous impedance for the rated value of excitation is calculated.
3. The excitation emf is calculated at full load current which is equal to the terminal voltage at No load.

4. The voltage regulation is calculated at rated terminal voltage.

MODEL CALCULATIONS:

$Z_S = \frac{V_{OC}}{I_{SC}}$ for the same I_f and speed: $X_S = \sqrt{Z_S^2 - R_a^2}$ [$\because R_a R_{dC}$]

Generated emf of alternator on no load is

$$E_0 = \sqrt{(v\cos\phi + I_a R_a)^2 + (v\sin\phi \pm I_a X_S)^2}$$

+ for lagging p.f.

- for leading p.f.

The percentage regulation of alternator for a given p.f. is

$$\% \text{ Re}g = \frac{E_0 - V}{V} x\ 100$$

Where

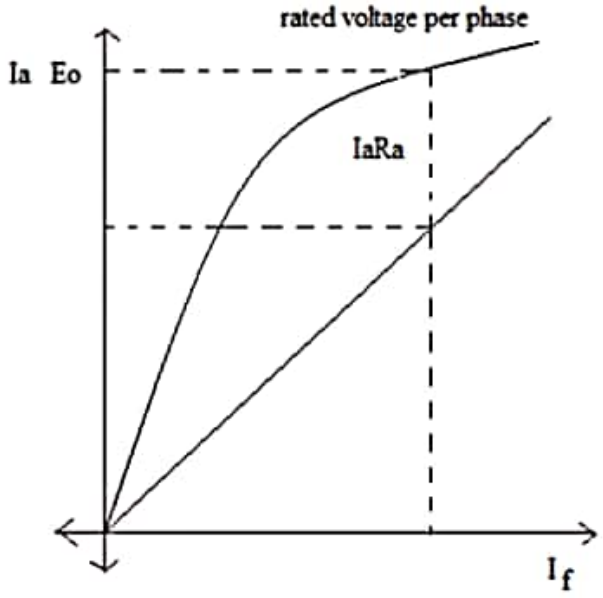
E_0 – generated emf of alternator (or excitation voltage per phase)

V – full load, rated terminal voltage per phase.

MODEL GRAPHS:

Draw the graph between I_f V_S E_0 per phase

and I_f Vs I_{SC}



PRECAUTIONS:

(iii) Connections must be made tight

(iv) Before making or breaking the circuit, supply must be switched off

RESULT: