Name	Muhammad Asad
Reg. #	2019-EE-383
Marks	

Experiment no. 1

Separately Excited DC Generator

Apparatus:

- Universal Power Supply 60-105.
- dc Compound Wound Machine 63-120
- Torque & Speed Control Panel 68-441
- Dynamometer Machine 67-502
- Switched Three Phase Resistance Load 67-142
- Shaft Coupling and Key 68-703
- System Frame 91-200
- Standard Set of Patch Leads 68-800
- Either:

Virtual Instrumentation (Option 60-070-VIP)	• Multichannel I/O Unit	68-500
	• Software Pack CD	68-912-USB
	or	
Conventional Instrumentation (Option 60-070-CI1)	• Two Voltmeter and Ammeter panels	68-110

Theory:

The dc separately excited generator has its field winding connected to an external supply. This is illustrated in Figure 3-7-1.

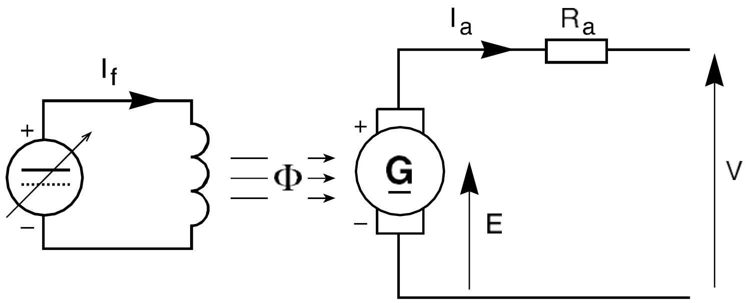


Figure 3-7-1: Equivalent Circuit of a dc Separately Excited Generator

Now consider the effect when a load is connected to the generator output. From Figure 3-7-1:

$$\mathbf{V = E - I_a R_a}$$

If the load resistance is large, Ia is small and the voltage drop across the inherent armature resistance is negligible. As Ia increases V decreases linearly if the generated EMF is kept constant.

Circuit Diagram:

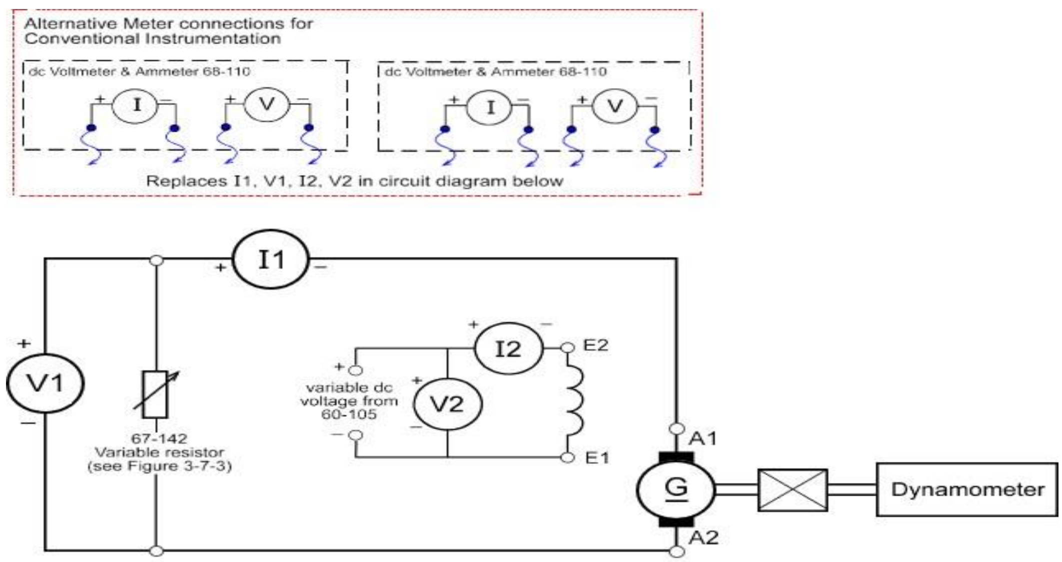


Figure 3-7-2: Circuit Diagram with resistance shorting link fitted

Effect of Field Current on Output Voltage

Ensure that the generator is open circuit by setting all the resistance box (see Figure 3-7-3) switches to off and that the shorting link is removed.

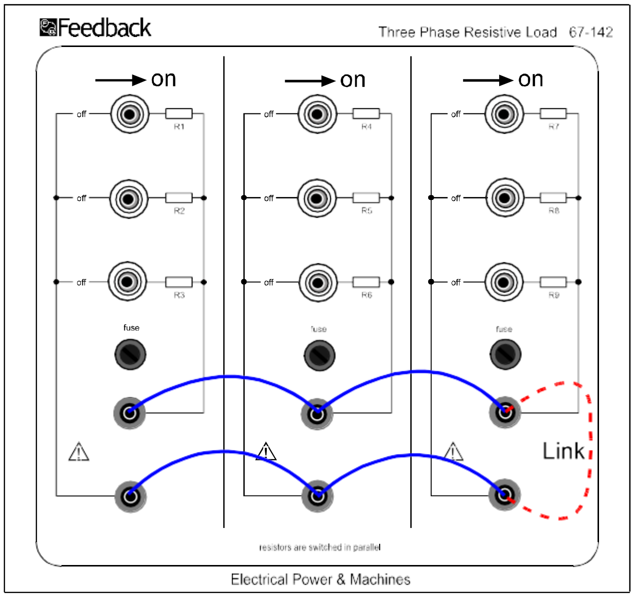


Figure 3-7-3

Procedure:

On the 60-105 unit, set the '3 phase circuit breaker' to the on position. Using either the 68-441 panel or the virtual instrumentation software, set the motor speed to 3000 rpm. Maintain this value throughout the test. Use the variable dc supply on the 60-105 power supply unit to adjust the field current. Turn the 'variable output voltage' control to 0% on the Universal Power Supply 60-105 and then switch off the '3 phase circuit breaker'.

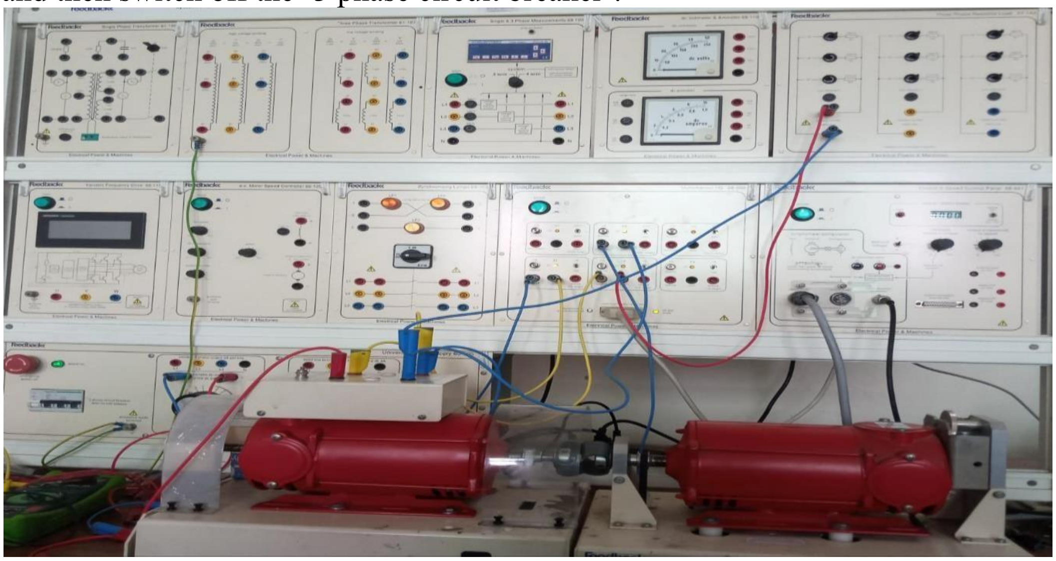
Effect of Load Current on Output Power and Output Voltage

Procedure:

- On the 60-105 unit, set the '3 phase circuit breaker' to the on position.
- Using either the 68-441 panel or the virtual instrumentation software, set the motor speed

to 3000 rpm. Maintain this speed value throughout the test.

- Take measurements of load current and output voltage for the values of the load resistance.
- Turn the 'variable output voltage' control to 0% on the Universal Power Supply 60-105 and then switch off the '3 phase circuit breaker'.



Observation:

No load condition:

Speed = 3000 rpm	
Field Current (A)	**Output Voltage (V)**
0.08	23
0.10	92
0.12	135
0.14	154
0.16	180
0.18	195

Load Condition:

Speed = 3000 rpm			
Load Resistance (Ω)	**Load Current(A)**	**Output Voltage (V)**	**Output Power (W)**

950	0.28	140	39
638	0.25	141	35
546	0.17	142	24

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Experiment no. 2

Single phase induction motor with Capacitor Start

Apparatus:

- Universal Power Supply 60-105.
- Single Phase Capacitor Start Induction Motor 64-110
- Torque & Speed Control Panel 68-441
- Dynamometer Machine 67-502
- Shaft Coupling and Key 68-703
- System Frame 91-200
- Standard Set of Patch Leads 68-800
- Either:

Virtual Instrumentation (Option 60-070-VIP)	• Multichannel I/O Unit	68-500
	• Software Pack CD	68-912-USB
	or	
Conventional Instrumentation (Option 60-070-CI1)	• Three & Single Phase Measurements	68-100

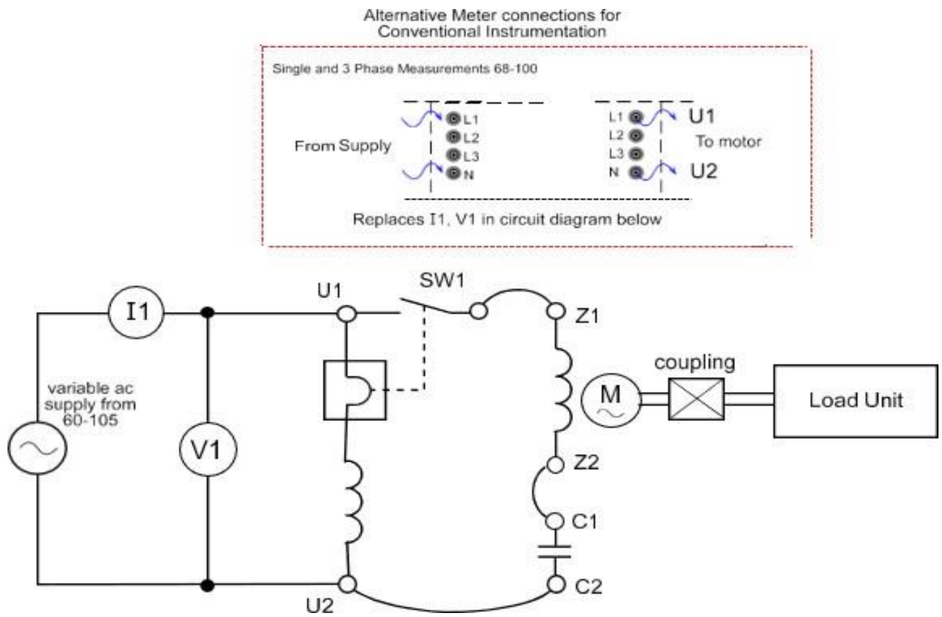
Theory:

The connection of the Single Phase induction motor is relatively straight forward, with the windings consisting of one that is called the Main and a second that is termed Auxiliary; used only when starting the motor from rest.

Two windings are necessary since a single winding simply produces a pulsating flux in the air gap and the motor is effectively a single phase transformer with an air gap in its magnetic circuit and shorted secondary winding. Under these conditions no effective shaft toque is produced due to the lack of a quadrature current necessary to produce a torque between the main winding and the rotor. Hence there is no preferred rotational shaft direction and the motor will produce a loud hum under these conditions and take a high current from the supply.

To produce a starting torque an auxiliary circuit is required that must produce a current that is displaced from the main winding current in time and be of sufficient magnitude to allow enough torque to be produced to start the rotor moving. Once shaft rotation takes place the rotating magnetic field will accelerate the rotor up to near synchronous speed and no further operation of the auxiliary circuit is required and it can be disconnected from the main circuit. If the motor stalls it will come to rest and not start again, until the auxiliary winding is reconnected.To achieve the necessary starting conditions the auxiliary circuit normally consists of a winding and capacitor that is designed to produce a phase shift between the two windings of as close as possible to 90 degrees. The combination of the spatial and time difference between the fields due to the main and auxiliary windings produces a rotating magnetic field, which causes the rotor to move in the direction of the rotating field. The motor then essentially becomes a two phase machine.

Circuit Diagram:



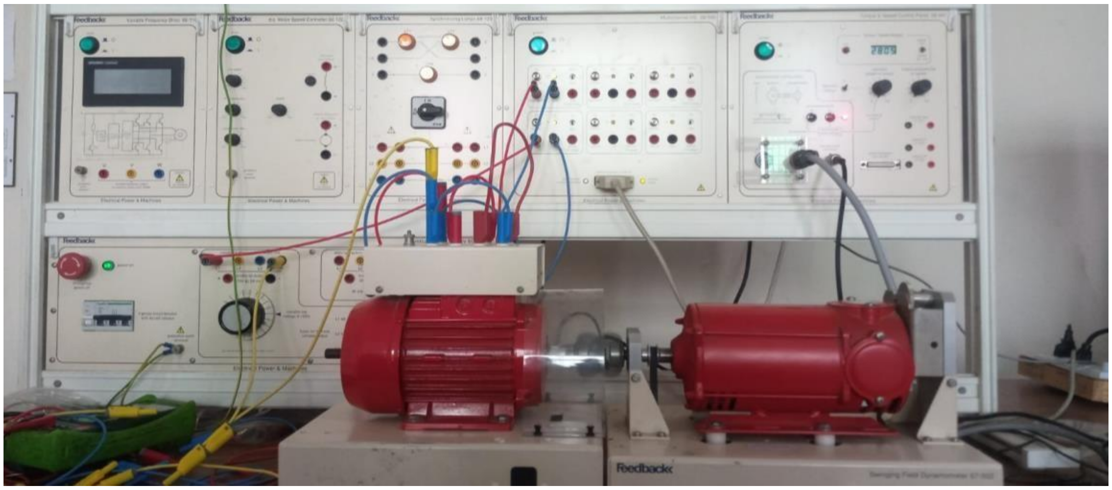
Procedure:

Speed / Torque and Efficiency Measurement:

On the 60-105 unit, set the ‘3 phase circuit breaker’ to the on position. Using either the PC Virtual Instrumentation Software or the 68-100 ac single and three phase measurements conventional instrumentation.

- Supply Voltage
- Supply Current (any one of the three)
- Input Power from single phase ac wattmeter (or calculate from Eq 1)
- Power Factor
- Torque Nm
- Speed rpm

Turn the ‘variable output voltage’ control to 0% on the Universal Power Supply 60-105 and then switch off all power by setting the ‘3 phase circuit breaker’ to the off position.



Observation:

torque = 0.652

speed = 2892 rpm

P_{in} = 144.1 W

P_o = 95.4 W

Efficiency = 66%

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Experiment no. 3

3- Phase Squirrel Cage Induction Motor

Apparatus:

- Universal Power Supply 60-105.
- Three Phase Dual Voltage Squirrel Cage Induction Motor 64-501
- Torque & Speed Control Panel 68-441
- Dynamometer Machine 67-502
- Shaft Coupling and Key 68-703
- System Frame 91-200
- Standard Set of Patch Leads 68-800
- Either:

Virtual Instrumentation (Option 60-070-VIP)	• Multichannel I/O Unit • Software Pack CD	68-500 68-912-USB
	or	
Conventional Instrumentation (Option 60-070-CI1)	• Three & Single Phase Measurements	68-100

Theory:

To understand the principles of operation of a 3-Phase Squirrel Cage Induction Motor, we need to understand two factors:

• The phase relationships between the phases in a three-phase power source, and how these can be used to produce an axially rotating magnetic field in the motor stator.

• The operation of Fleming's Right-Hand Rule.

From these two factors we can work out the basic design of a self-starting motor.

Rotating Magnetic Field

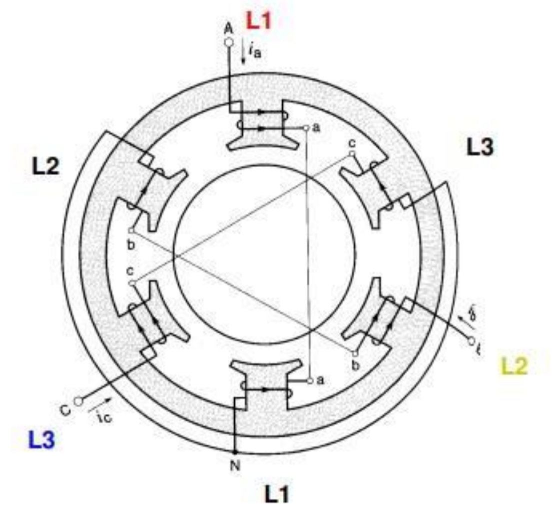
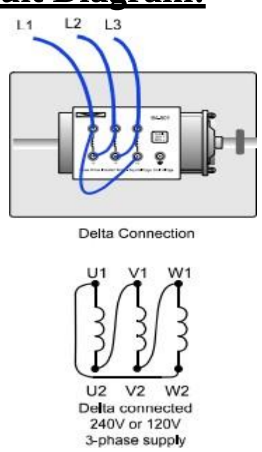
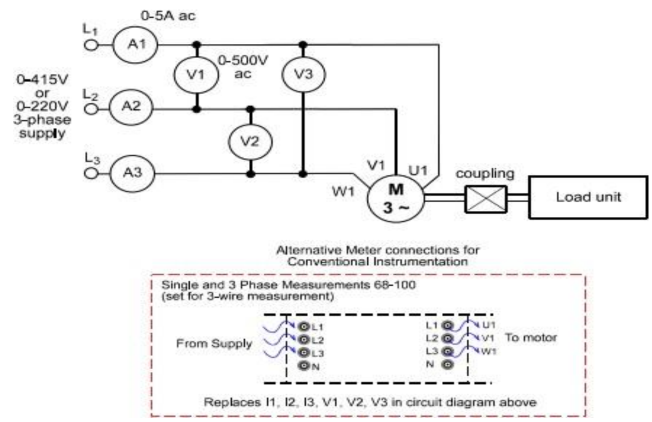


Figure 3-9-1

Circuit Diagram:





Procedure:

Ensure power is switched off at the 60-105 unit (the '3 phase circuit breaker' set to the off position.

Connect the ac motor into the delta configuration as shown in Figure 3-9-9. On the 60-105 unit, turn the 'variable output voltage' control to 0% and then set the '3 phase circuit breaker' to the on position. Power is now available as indicated by the 'power on' green indicator being illuminated.

Using either the PC Virtual Instrumentation Software or the 68-100 ac single and three phase measurements conventional instrumentation, take the following readings for values of the applied torque from the minimum to 0.8 Nm in increments of 0.1 Nm and enter them in to a copy of the appropriate Practical 9.2 Results Table (400 V or 210 V).

Record the values:

• Line Current (any one of the three).

• Input Power (from 3 phase wattmeter).

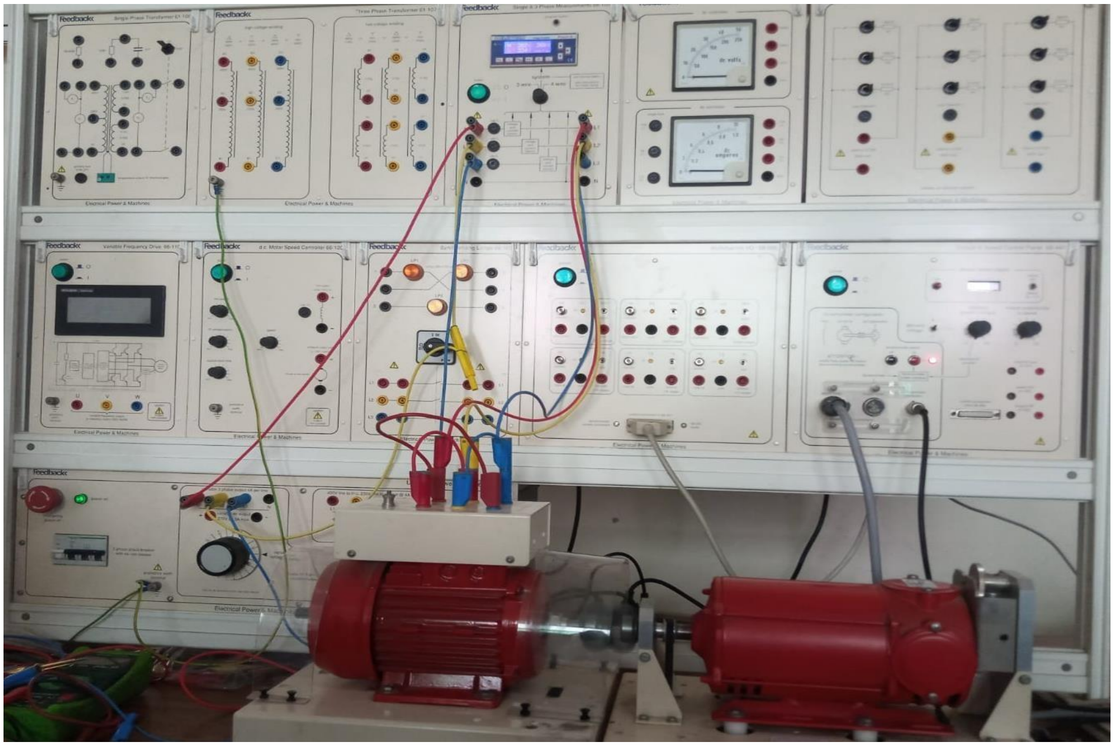
• Power Factor.

• Output Power (calculated).

• Torque Nm.

• Speed rpm.

Turn the ‘variable output voltage’ control to 0%, and switch off the 3-phase supply circuit breaker on the 60-105 unit.



Observation:

Input power = 687 W

Output Power = 163.7 W

Efficiency = 23.8

Name	Muhammad Asad
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Marks	

EXPERIMENT # 5

Load Characteristic Curve of an Alternator.

Objective:

To draw the load characteristic curve of an alternator.

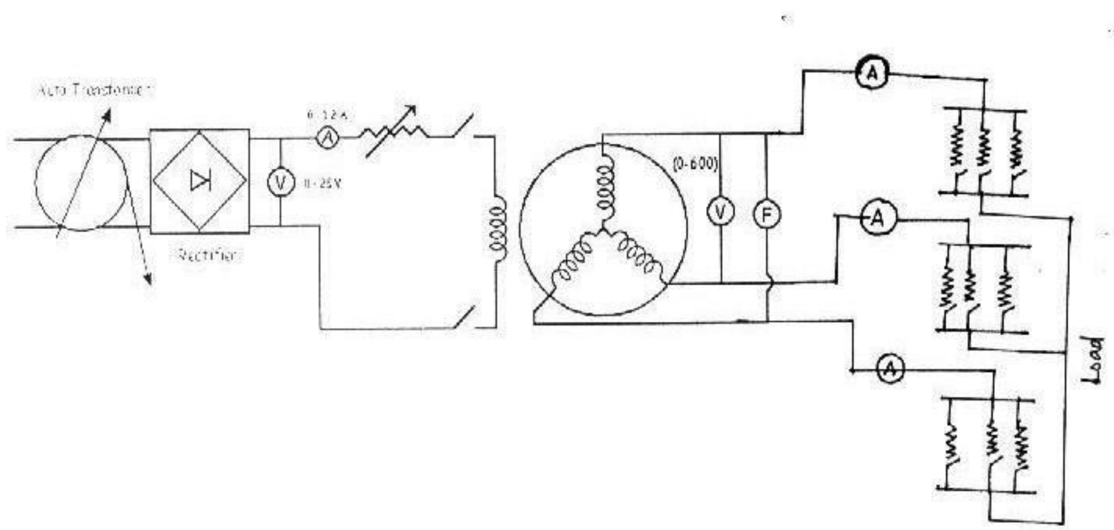
Apparatus:

- 3 AC Ammeters
- AC Voltmeter
- DC Voltmeter
- DC Ammeter

Theory:

The purpose of the experiment is to study the relationship of armature current under loaded condition against the field excitation for exciting the pole. DC is supplied by the DC generator mounted on the same shaft of the alternator as supplied through the rectifier exciter.

Circuit Diagram:

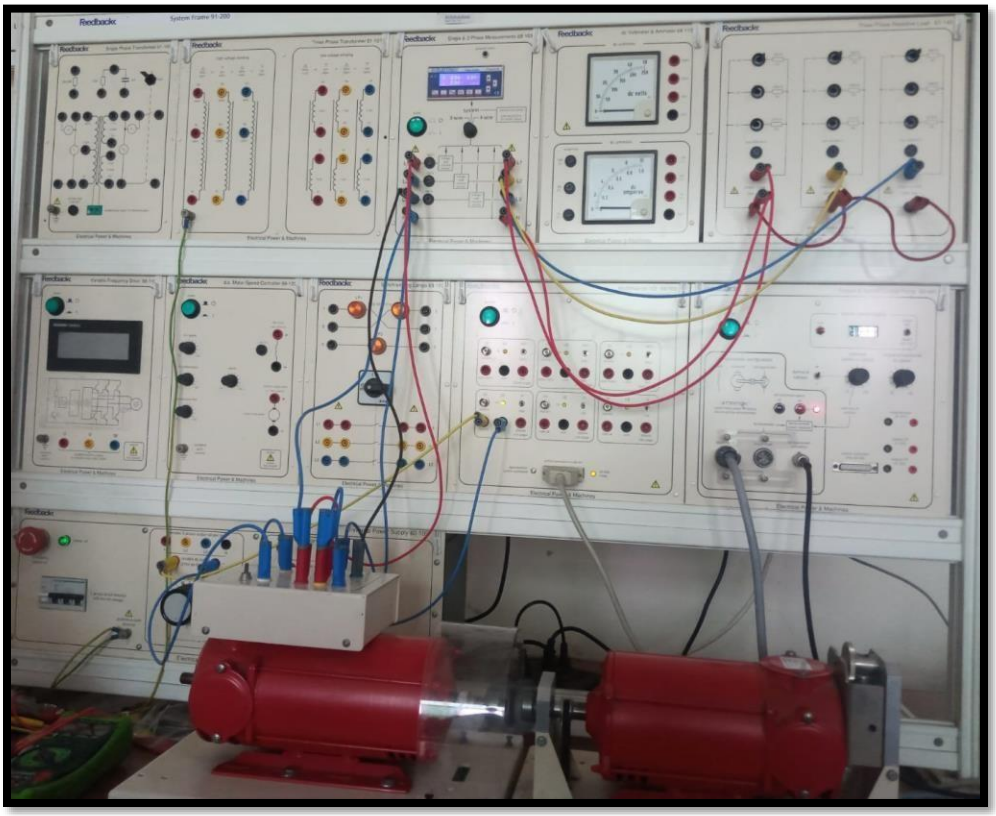


Circuit Diagram of Loaded an Alternator

Procedure:

1. Make all the connections as per diagram
2. Connects the load to all the three phaser.
3. Run the alternator with the help of the prime mover at normal speed.

4. Apply the low DC voltage at the field.
5. Note the exciting current at the different field.
6. Increase the load and take the readings.
7. Plot the load characteristics current of alternator.



Observations:

Sr.No.	I_1(A)	I_2(A)	I_3(A)	V(Volts)	I_f(A)	$I_L=I_1+I_2+I_3$(A)
1	0.03	0.03	0.03	28	0.08	0.09
2	0.04	0.04	0.04	34.7	0.10	0.16
3	0.06	0.06	0.06	49.1	0.13	0.18
4	0.09	0.09	0.09	55.7	0.16	0.27
5	0.11	0.11	0.11	59.3	0.18	0.33