Install an alternator, identify part and terminals of alternator

Objectives: At the end of this exercise you shall be able to
- **select the location and type of foundation**
- **determine the type of fasteners and prepare the Template**
- **dig pit on the floor and prepare the concrete mixture**
- **place fasteners with a template and grout the fasteners**
- **read and Interpret the name plate details of alternator set**
- **identify their parts and write their names**
- **identify the terminals of alternator.**

Requirements

Tools/Instruments

• Right spanner set 5 mm to 25 mm	- 1 Set
• DE spanner set 5mm to 25mm	- 1 No.
• Dial gauge	- 1 No.
• Feeler gauge	- 1 No.
• Ball pein hammer 1 Kg	- 1 No.
• Cold chisel 19mm dia 200mm long	- 1 No.
• Round file bastard 200mm	- 1 No.
• Flat file bastard 200 mm	- 1 No.
• Steel rule 300 mm	- 1 No.
• Crowbar 1800mm	- 1 No.
• Lead hammer 1 Kg	- 1 No.
• Screwdriver 300mm with 6 mm blade	- 1 No.
• Spirit level 200 mm	- 1 No.
• Alignments pins (Fixture pin)	- 1 Set

Equipments/Machines

• Electric drilling machine	- 1 No.
• 3 Phase Alternator 3KVA 500V 50 Hz coupled to suitable motor	- 1 No.
• Ohm meter	- 1 No.
• Phase sequence meter	- 1 No.

Materials

• PVC insulated copper cable 2.5 sq mm 600V grade	- as reqd
• Test lamp 250V	- 1 No.
• Bolts and nuts	- as reqd
• Cement	- as reqd.
• Sand	- as reqd.
• Earth wire GI 14 SWG	- 3 m

PROCEDURE

TASK 1: **Install an alternator set**

1 Select the Proper place of Installation for the alternator set.

2 Select a suitable type of foundation by referring to the manufacturer's Instructions.

3 Select a suitable fastener by referring to the manufacturers's instructions.

4 Take the measurement of the bed frame as in Fig 1 and enter the data in Table 1.

Fig 1

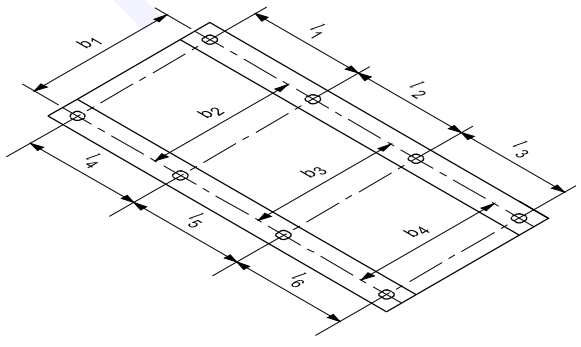


Table 1

Outside dimensions

Length	.....mm
Breadth	.....mm
Height	.....mm

Table 2

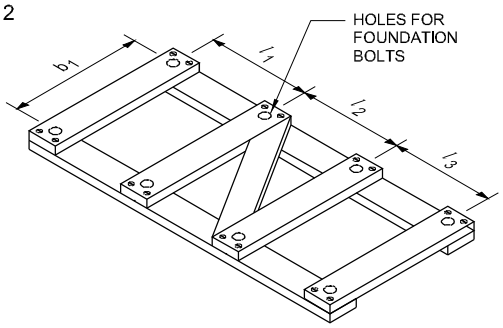
Distance measured from the adjacent holes

$1_{1..}$.....mm	$l_{4..}$.....mm	$b_{1...}$.....mm	b_4.....mm
1_2 .....mm	l_5.....mm	$b_{2.}$... mm	
1_3....mm	l_6 .....mm	$b_{3.}$.....mm	

5 Measure the position and size of foundation bolt holes and enter the data in Table 2.

6 Prepare a template for the bed frame , mark the position of the foundation bolt on the template and drill the frame. (Fig 2)

Fig 2



7 Mark the position of the foundation bolts in the selected space on the floor using the template.

8 Dig the floor at the marked places, such that the depth of holes is 15 cm more than the length of the anchor bolt below the floor surface.

9 Mount the foundation anchor bolts in the template and place the template on the ground surface so that the anchor bolts enter the holes already dig in proper position.

10 Check for level using the spirit level.

11 Fill the space around the bolt with thin coarse cement mortar.

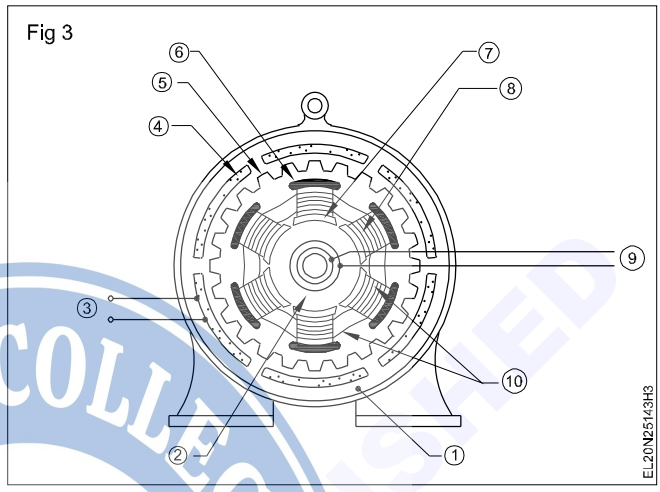
12 Allow it to settle down for 8 to 12 hours, then remove the template.

13 Cure the cement mortar with water for a minimum of two days.

14 Finish the surface by plastering neatly.

15 Install the alternator set and fix with nuts.

Fig 3

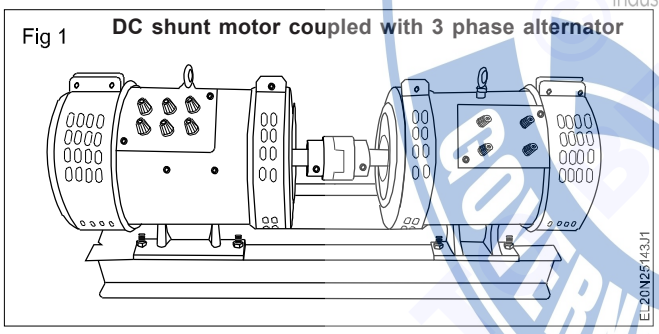


TASK 2 : **Identify the parts of alternator**

1 Read and interpret the name plate details of the given alternator.

2 Identify the parts of the alternator from the real object or form the exploded view chart (Fig 1)

Fig 1 **DC shunt motor coupled with 3 phase alternator**



3 Label the each part with number and write the name of the parts in Table 1.

Table 1

S No.	Label No.	Name of the part
1		
2		
3		
4		
5		
6		
7		

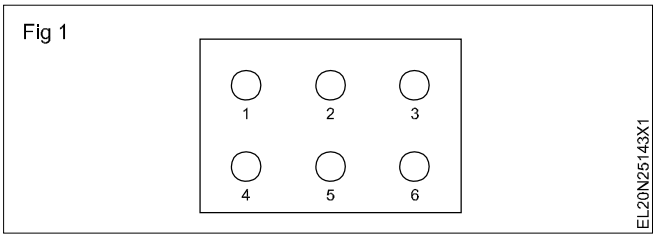
TASK 3 : **Identify the terminals of a 3 phase, star connected alternator**

In a 3-phase, star-connected alternator three windings are internally connected in the star and four terminals are brought out to the terminal block. These four terminals consist of three beginning ends of the 3-phase winding and one neutral.

1 Check there is any marking on the terminals and note it down also. If not, give your own marking as 1,2,3 etc as shown in Fig 1.

2 Identify the terminals which show the internal connection, following the procedure stated in the above working steps and also as shown in Fig 2a. Measure the resistance in between them and record the readings in Table 1.

Fig 1



3 Identify the field winding from the terminal block (Fig 2b)

Fig 2

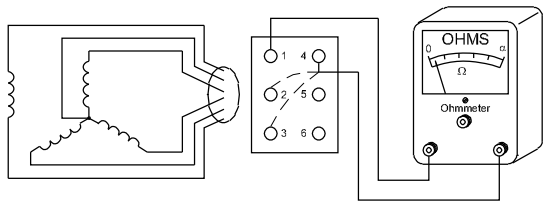


Fig 6(a)

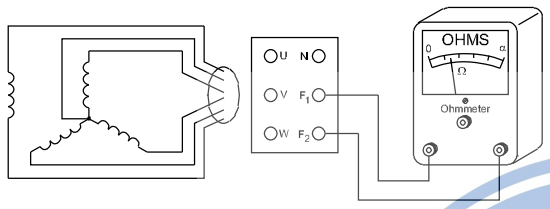


Fig 6(b)

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Only one pair will be independent with marginally high resistance. This pair belongs to the field winding. The other four terminals which show continuity between them belong to the star-connected, main winding terminals.

Out of the four terminals, three terminals will give comparatively high resistances between them. These are the ends of the three coils called UVW terminals. However, the left out terminals out of the four will give half the value of resistance when measured between any one terminal of UVW and that terminal. This terminal is the neutral and has to be marked as 'N'. The marking of the 3-phase terminals as UVW is tentative. The correct phase sequence is to be checked with the help of a phase-sequence meter, then only the terminals could be marked as UVW.

4 Mark the terminals accordingly.

5 Show your making to your instructor and get his approval.

Table 1

Sl No.	Between	Resistance value in ohms	Remarks
1	1 - 2		
2	2 - 3		
3	3 - 4		
4	1 - 3		
5	1 - 4		
6	2 - 4		
7	5 - 6		

Test for continuity and insulation resistance of alternator

Objectives: At the end of this exercise you shall be able to
- **test the alternator windings for continuity**
- **test the insulation resistance between the stator and rotor windings.**

Requirements

Tools/Instruments

- Cutting pliers 200mm - 1 No.
- Spanner set 5mm to 200mm - 1 Set
- Screwdriver 200mm - 1 No.
- Screwdriver 100mm - 1 No.
- Megger 500V - 1 No.

Equipment/Machines

- Alternator, 3-phase, 3 KVA 415V - 1 No.

Materials

- P.V.C. insulated copper wire 23/0.2 mm size - 5 m
- Insulation tape - 1 m.
- Test lamp 60W / 240V - 1 No.

PROCEDURE

TASK 1 : **Read and interpret the name plate details of an alternator**

1 Read and interpret the name-plate details of the 3-phase alternator.

2 Identify the terminals of the alternator as you did in Exercise No.2.5.143. Task : 3.

TASK 2 : **Conduct continuity test by using a lamp**

1 Take the test lamp and identify the cable to which the S.P. switch and the fuse are connected in series with the lamp. Use this as Probe 1.

2 Connect Probe 2 to terminal `N' and touch the terminals R, Y and B alternatively by Probe 1. (Fig 1) Observe the lamp condition and enter the same in Table 1.

The phase wire should be identified in the test lamp as Probe 1, and should be connected through the switch and fuse to the test lamp. Care should be taken to see that the phase wire does not touch the body or frame of the alternator. Do not touch any terminal while testing with AC supply.

3 Check the continuity between F_1 and F_2 and enter the finding in Table 1.

Fig 1

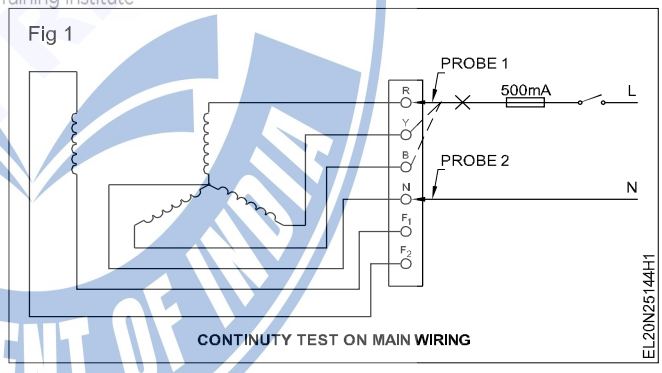


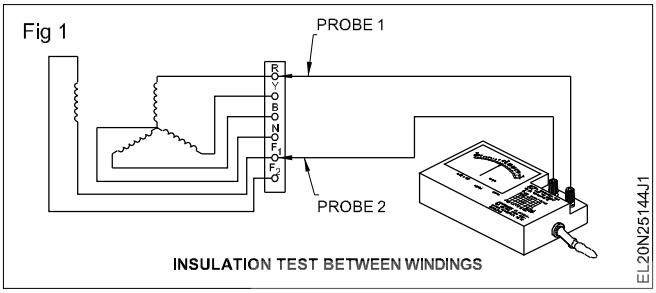
Table 1

Sl.No.	Connection between	Condition of lamp
1	R and N	
2	Y and N	
3	B and N	
4	F_1 and F_2	

TASK 3 : **Measure insulation resistance between windings**

1 Connect one prod of the Megger to any one of the terminals R,Y,B,N and the other prod to the terminal F1 or F2 as shown in Fig 1.

Fig 1



You can connect to any one of the terminals R, Y, B and N as all of them are having continuity as ascertained earlier.

2 Rotate the Megger at its rated speed and measure the insulation value and record it in Table 2.

The measured value should not be less than 1 megohm.

Table 2

Sl. No.	Insulation resistance between windings	Value in megohms
1	Between RYBN and field winding F_1 & F_2	

TASK 4: **Measure the insulation resistance between the windings and the body**

1 Connect one of the prods of the Megger to any one terminal, RYBN and the other prod to the body/frame of the alternator.

2 Rotate the Megger at its rated speed and measure the insulation resistance. Record it in Table 1.

Table 1

Sl. No.	Insulation resistance between winding and the body	Value in MΩ
1	Between armature winding R/Y/B/N and the body	
2	Between field winding F_1 & F_2 and body	

3 Connect the Megger probe to terminal F_1 or F_2 and the other probe to the body.

Rotate the Megger at its rated speed and measure the insulation resistance value, and record it in Table 1.

The measured insulation value should not be less than 1 megohm.

4 Compare these values of insulation resistance with those entered in the alternator maintenance card available in the section, and discuss the variations in the reading with your instructor.

Connect, start and run an alternator and build up the voltage

Objectives: At the end of this exercise you shall be able to
- **read and interpret the name-plate details of an alternator**
- **test and identify the terminals of an alternator**
- **connect, start, run, adjust the speed and frequency of the alternator**
- **adjust and set the rated voltage of an alternator.**

Requirements

Tools/Instruments

- Insulated cutting pliers 200mm - 1 No.
- Screwdriver 150mm - 1 No.
- Screwdriver 100mm - 1 No.
- Voltmeter AC 0 to 500 volts - 1 No.
- Ammeter DC 0 to 5 amps - 1 No.
- Tachometer 0 to 3000 r.p.m. - 1 No.
- Single phase frequency meter 250V - 45 to 55 Hz. - 1 No.

Equipment/Machines

- 3-phase alternator 3KVA 415V 50 Hz. coupled to a suitable DC motor. - 1 Set
- Rheostat 480 ohms 2 amps - 2 Nos.
- 4-point starter 30 amps 250V - 1 No.

Materials

- PVC insulated copper cable 2.5 sq mm 600 V grade - 10 m.
- Insulation tape - 30 cm.
- Fuse wire 5A, 15A - as reqd.
- T.P.I.C. switch 16 amps 500V - 1 No.
- D.P.I.C. switch 32 amps 250V - 2 Nos.

PROCEDURE

TASK 1: **Connect, start, run, adjust the speed and frequency of an alternator**

1 Read and interpret the name-plate details.

2 Test and identify the terminals of the alternator.

3 Test the alternator for insulation resistance between the windings, the winding and the ground, and record the values separately.

The insulation resistance value should not be less than one megaohm

4 Select a suitable range of rheostats, ammeters, voltmeters, switches and cables according to the specification of the available alternator.

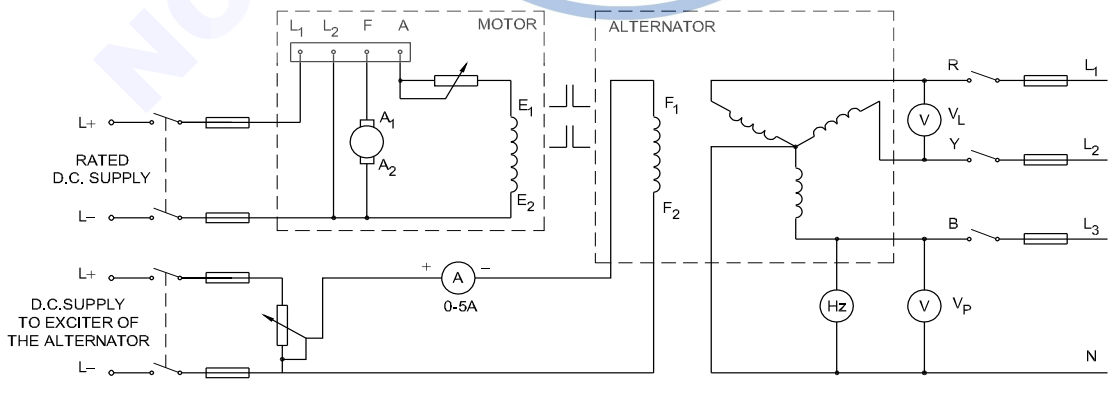
You may have to change the ranges of the meters and rheostat according to the rating of the available alternator with respect to Fig 1.

5 Make the connections as per the circuit diagram.

6 Adjust the field rheostat of the prime mover to cut out position, and the field rheostat of the exciter in the minimum voltage position.

7 Check the couplings.

Fig 1



CONNECTIONS FOR MAGNETISATION CHARACTERISTIC OF THE ALTERNATOR

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8 Switch `ON' the DC supply to the prime mover (DC motor) and start the prime mover through the 4-point starter.

9 Adjust the speed of the prime mover through its field rheostat to the rated speed of the alternator.

10 Switch `on' the DC supply to the exciting winding of the alternator. Note down the field current, line voltage and phase voltage of the alternator in Table.

11 Note down the frequency (if possible, for the frequency meter may not read at a low voltage) in Table.

12 Increase the field current in 10 to 12 equal steps. For each step measure the phase voltage, line voltage, frequency and field current and enter the values in Table until the alternator output voltage reaches its rated value.

The field current should be varied gradually in equal steps in the ascending order. Otherwise it will disturb the shape of the plotted curve.

13 Increase the excitation current such that the alternator line voltage is about 10% above the rated value.

14 Draw the curve I_F versus V_P taking I_F on the `X' axis and $V_P$ on the `Y'axis. The curve shows the O.C.C. or the magnetisation characteristic of the alternator.

15 Write your conclusion regarding the relation between the field current and phase voltage as well as the line voltage and phase voltage.

Conclusion

Table

Sl.No.	Field current I_F	Line voltage V_L	Phase voltage V_P	Frequency V_F	Remarks

Determine the load performance and voltage regulation of a 3-phase alternator

Objectives: At the end of this exercise you shall be able to
- **connect, start, run, and build up the voltage of an alternator**
- **determine the voltage regulation of an alternator.**

Requirements

Tools/Instruments

- Combination pliers 200mm - 1 No.
- Round nose pliers 150mm - 1 No.
- Electrician's knife - 1 No.
- M.I. ammeter 0 to 20 amps - 3 Nos.
- M.I. voltmeter 0 to 500 volts - 1 No.
- M.C. voltmeter 0-300V - 1 No.
- M.C. ammeter 0-5A - 1 No.
- Frequency meter 500V, 45 to 50 Hz. - 1 No.
- Power-factor meter 500V, +0.5 to -0.5 P.F. - 1 No.
- Tachometer 300 to 3000 r.p.m. - 1 No.

Equipment/Machines

- 3-phase alternator 500V 5/10 kW coupled with DC shunt motor having facility for speed control - 1 Set
- 3-phase lamp load 415/400V 5 KW - 1 No.
- 3-phase squirrel cage motor 500V 50HZ, 3 HP with DOL starter and switch - 1 No.

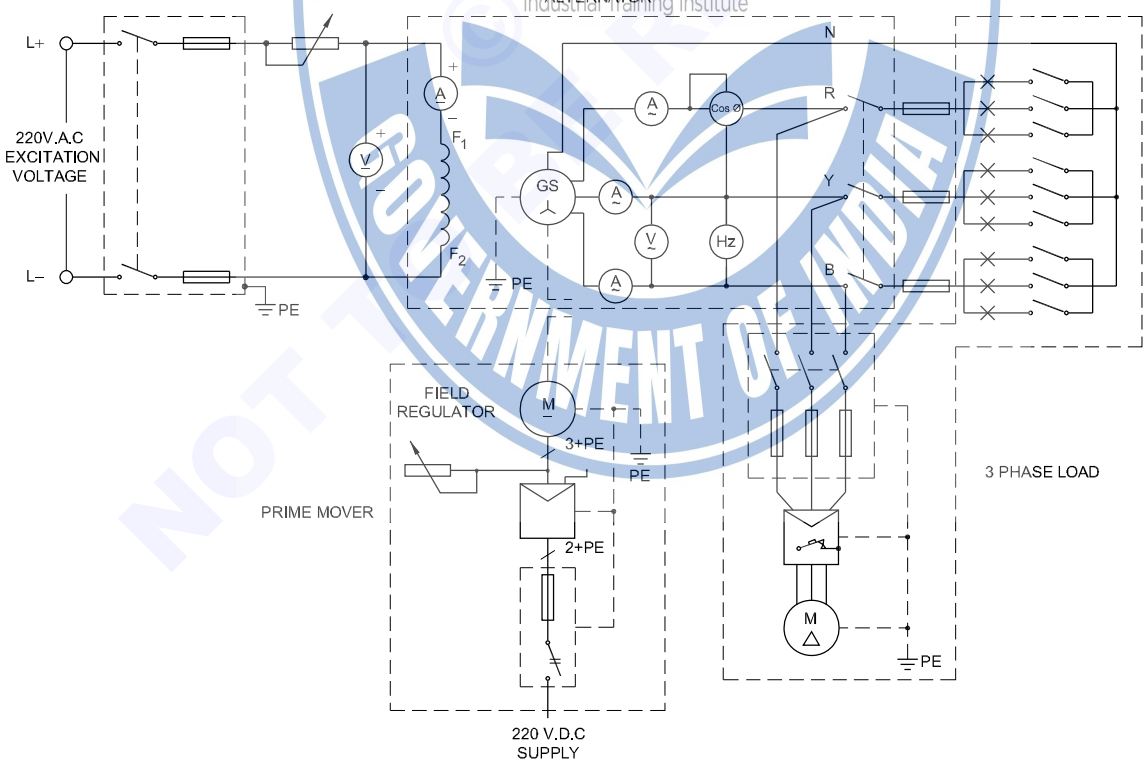
Materials

- P.V.C. insulated stranded aluminium cable -10 m
- T.P.I.C. switch 32 amps 500v - 2 Nos.

PROCEDURE

TASK 1 : **Connect, start, run, and build up the voltage of an alternator**

Fig 1



CONNECTIONS OF 3 - PHASE ALTERNATOR WITH LOAD

1 Note down the name-plate details of the given alternator in Table 1. (As per exercise 2.5.144 Task : 1)

2 Select proper sizes of cables, fuse wires, switches etc., as per the name-plate ratings (rated capacity) of the given 3-phase alternator.

3 Connect the exciter output terminals to the field of the alternator with the rheostat, ammeter and voltmeter. (Fig 1)

The exciter output voltage is shown in Fig 1 as 220V DC. Different manufacturers choose different exciter voltages suitable for their alternators. You may have to select the voltmeter and ammeter ratings according to the voltage rating of the field of the available alternator.

4 Connect the alternator terminals RYB and N to the load as per the circuit diagram (Fig 1). Keep the load switches and also all the lamp switches of the lamp load in the `off' position.

Check the voltage rating of the power factor and frequency meters whether they are for phase voltage or line voltage. Connect accordingly. Do not forget to connect the star point of the lamp load to the neutral point of the alternator. The bulb wattage rating should be equal in all lamps.

5 Show the connection to your instructor and obtain his permission to start the prime mover.

6 Run the alternator at its rated speed. Measure and record the speed. Speed..... r.p.m.

7 Build up its voltage by adjusting the field rheostat to the rated voltage of the alternator. Read and record it. Voltage .....volts.

— — — — — — — — —

TASK 2 : **Determine the voltage regulation of an alternator**

1 Close the T.P.I.C. switch of the motor load and start the motor by the D.O.L starter.

2 Close also the T.P.I.C. switch of the lamp load and increase I_L up to the alternator's rated value in steps of one ampere. Read and record the values of I_L, V_L & P.F. frequency in Table 1.

3 Reduce the load and switch off the alternator.

4 Draw the three curves for the 3 sets of reading showing the terminal voltage versus load current. Keep the terminal voltage in the Y axis and load current in the X-axis.

5 Calculate the voltage regulation for the above different loads at 5 and 10 amperes by using the formula:

Percentage voltage regulation ($\%V_R$)

$$\%V_R = \frac{\text{No.load voltage - Full load voltage}}{\text{Full load voltage}} \times 100$$

6 Based on steps 5 and 6 write your conclusion in the space given below.

Conclusion 1

Conclusion 2

Table 1

Sl. No.	Load current equal in all the three phases I_L	Terminal Voltage V_L	Frequency kept constant	Power Factor cos Ø	Power = $\sqrt{3}\ E_L I_L \cos Ø$	Remarks

— — — — — — — —

Parallel operation and synchronization of three phase alternators

Objectives: At the end of this exercise you shall be able to
- **read and interpret the name plate details of the two 3 phase alternators**
- **synchronise the two 3 phase alternators by dark lamp method and test it**
- **synchronise the two 3 phase alternators by dark and bright lamp method and test it**
- **synchronise the two 3 phase alternators by synchroscope method and test it.**

Requirements

Tools/Instruments

- Trainees tool kit - 1 No.
- MI Voltmeter 0-500V - 2 Nos.
- Frequency meter (45 - 50 - 55 Hz) - 1 No.
- Phase sequence indicator - 1 No.
- Synchroscope - 1 No.

Equipments/Machinery

- 3 Phase alternators 5 kVA/500V 50 Hz coupled with prime mover (/adjustable speed control) - 2 Nos.
- Rheostat 150 ohms/1A - 1 No.

Materials

- TPIC switch 16A, 500V - as reqd.
- ICDP / Knife switch 16A, 250V - 1 No.
- ICTP / Knife switches 16A, 500V - 2 Nos.
- 100W/250 V lamps - 6 Nos.
- Connecting wires - as reqd.

PROCEDURE

TASK 1 : **Read and interpret the name plate details of the alternators**

1 Read and interpret the name plate details of the 3 phase alternators.

The voltage rating of two alternators must be same. Rating of alternators (kVA), not necessary must be same. The load can be shared according to the rating of alternators.

TASK 2 : **Synchronise the two 3 phase alternator by dark lamp method and test it**

For connecting two alternators in parallel they must fulfil the following conditions.

1. **Terminal voltage of both the alternators must be same**
2. **Supply frequency of both alternators must be equal**
3. **Phase sequence of both the alternators must be ideal**

1 Check the phase sequence of the main bus bar line by using phase sequence indicator/meter

2 Connect and set the arrangement of incoming alternator and outgoing alternator with prime mover coupled, TPIC main switch, voltmeters and frequency meters and lamp connection in series. (Fig 1).

While connecting the alternators, care should be taken, that corresponding phase lines must be connected of both alternators. (i.e.) 1st alternator is connected to L1, L2 and L3 then the 2nd alternator must also be connected to same L1, L2 and L3.

3 Keep the main switch of incoming alternator -1 in closed position after ensuring the phase sequence are correct.

4 Keep the main switch of alternator - 2 in opened position.

5 Start and run the first alternator and build up the rated voltage

6 Measure the line voltage between phases, then measure the frequency of an alternator-1 and note down the readings of voltmeter and frequency meters in Table 1.

Fig 1

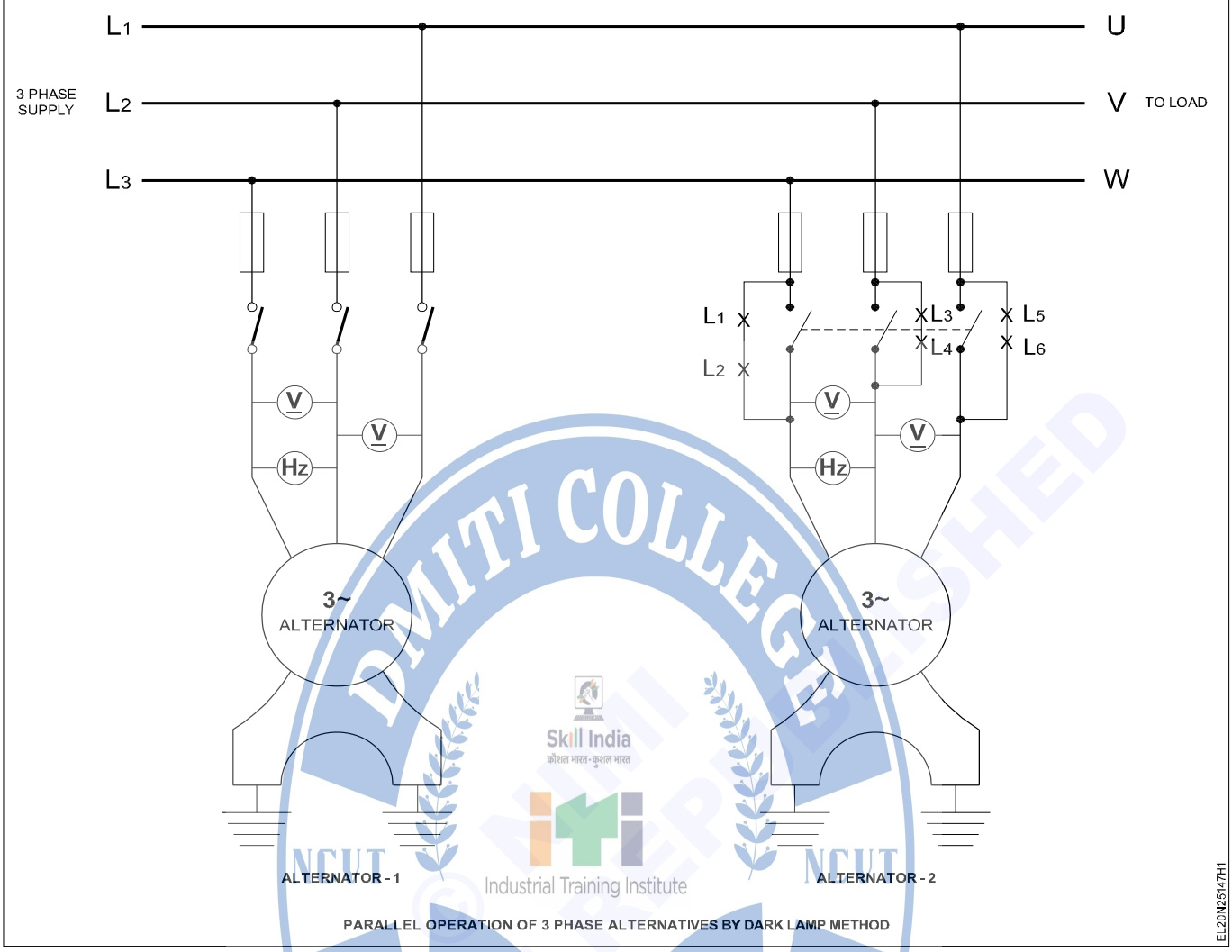


Table 1

Alternator 1

S No.	Voltage reading in Volt	Frequency in Hz
1	L1 - L2	L1 - L2
2	L2 - L3	L2 - L3
3	L3 - L1	L3 - L1

7 Start , run and build up the rated voltage

8 Measure the line voltages and frequency in alternator 2 and note down the readings in Table 2.

Table 2

Alternator 2

S No.	Voltage reading in Volt	Frequency in Hz
1	L1 - L2	L1 - L2
2	L2 - L3	L2 - L3
3	L3 - L1	L3 - L1

9 Check the condition of the two lamp.

If the voltage and frequency are equal the lamps will becomes dark and then becomes bright. If the voltage and frequency of the both alternators are not same, the lamps will flicker.

10 Adjust the field excitation current in the alternator 2 and bring the voltage to the same value of the alternator 2.

11 Check the condition of lamps brightness.

If the lamps are flickering still now, then the frequency may not be equal, it must be brought to same equal frequency value of alternator 1

12 Adjust the speed of the prime mover of alternator 2 and bring the frequency as same as in alternator 1

Now, all the lamps are bright and then become dark at a time, it indicates all the conditions are fulfilled for synchronising.

13 Close the main switch of alternator - 2 when all the lamps are in dark condition.

Now the alternators are synchronised (parallel) and ready for sharing the load.

14 Switch 'ON' common load for both the alternators.

15 Check the loads are shared equally by the two alternators.

16 Get it checked with your instructor.

— — — — — — — —

TASK 3 : **Synchronise the two 3 phase alternators by dark and bright lamp method**

1 Check the phase sequence of the main bus bar lines by using phase sequence indicator

2 Connect and set up the arrangement of the alternator - 1 and alternator - 2 with prime mover, TPIC switch, lamp connection. (2 pairs of lamp are connected across two phases, In one phase, the pair of the lamps are in series with voltmeters and frequency meters. (Fig 2)

3 Repeat the working steps from 3 to 8, in Task - 2

4 Note down the readings in table - 3 & Table - 4

Table 3

Alternator - 1

S. No.	Voltage reading in Volt	Frequency in Hz
1	L1 - L2	L1 - L2
2	L2 - L3	L2 - L3
3	L3 - L1	L3 - L1

Table 4

Alternator - 2

S. No.	Voltage reading in Volt	Frequency in Hz
1	L1 - L2	L1 - L2
2	L2 - L3	L2 - L3
3	L3 - L1	L3 - L1

5 Look at the condition of the lamps

If the voltage and frequency are equal then one pair of the lamp will be dark and other two pair will be bright

If the voltage and frequency of the both the alternators are not same, then the lamp will flicker not giving standstill lighting

6 Check the voltage and frequency are not equal repeat the steps from 10 to 12 of task 2and bring the same value of voltage and frequency as in alternator - 1

If all the condition are fulfilled, then all the lamps will not flicker and one pair of the lamp will be dark and other two pair lamps will be bright at a time.

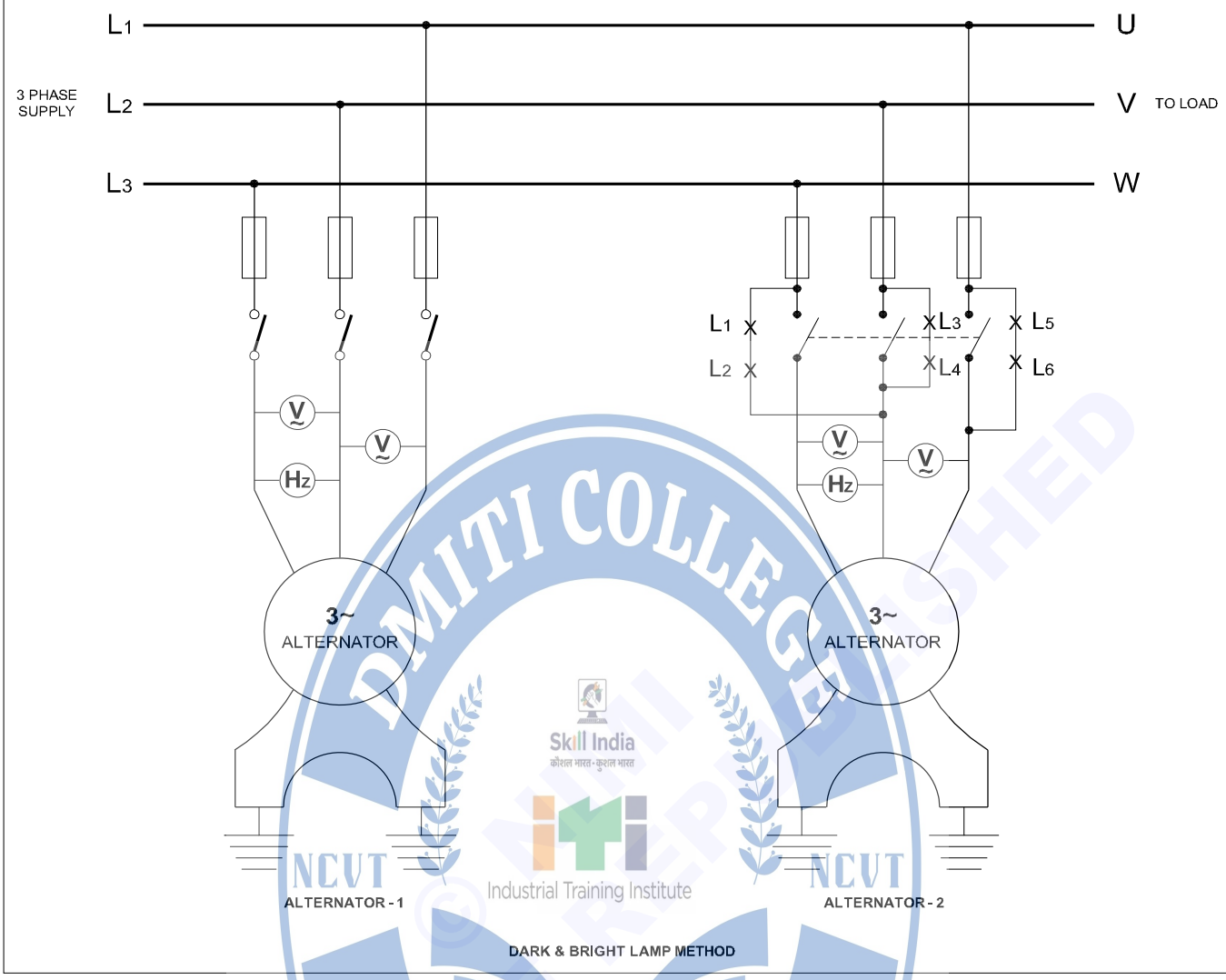
7 Close the main switch of alternator - 2 when the lamps are bright condition

Now the 2 alternators are synchronised (parallel) and ready for sharing the load

8 Switch 'ON' the common load for both alternators

9 Check the loads are shared equally by the two alternators

Fig 1



TASK 4 : **Connect two alternators in parallel by using synchroscope**

1 Collect the instruments as shown. (Fig 3)

2 Connect the equipment and instruments. (Fig 3)

Keep `open' the bus-bar switch S_1 and synchronising switch S_2.

3 Start the incoming alternator (Alternator-2) with low excitation.

4 Close the bus-bar switch S_1.

One alternator (Alternator-1) is connected to the bus-bar that produces the rated V.

5 Observe the bus-bar voltage V_1 and incoming voltage V_2.

6 Adjust the excitation of the incoming alternator till $V_1 = V_2$. The voltage of incoming and exciting machine should be equal.

7 Check the pointer in the synchroscope.

8 Adjust the speed of the alternator. If it is indicating fast, reduce the speed of the incoming machine gradually observing the synchroscope pointer.

If it indicates slow, increase the speed of incoming machine slowly. The result should be slow movement of the pointer to 0.

When the pointer comes to zero position very slowly, the bulb behind the dial will glow bright.

9 Adjust the speed of the incoming alternator for minimum oscillation of the synchroscope pointer.

10 Close the synchronising switch `S_2' at zero, and the steady position of the synchronising pointer.

When the two voltages of the incoming and existing machines are the same in magnitude and phase, synchroscope pointer will be at zero.

Fig 1