ELECTROMECHANICAL EQUIPMENT OPERATION AND MAINTENANCE

NTQF Level III

Learning Guide -16

Unit of Competence: - Maintain Induction Motor Functions

Module Title: - Maintaining Induction Motor Functions

LG Code:- EIS EME3 M05 0917 LO-02-16

TTLM Code: - EIS EME3 M05 0219TTLM –v1

LO-02: - Prepare circuit diagrams

Instruction Sheet	Learning Guide #02

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

- Preparing power circuit and control circuit diagram
- Identifying type of control components & wiring devices and other materials
- Connecting the circuit and wiring diagram

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to

- Construct power circuit and control circuit of different type of motor starting
- Connect the components according to the wiring diagram

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 18.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1” in page 10
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.
8. Read the information written in the “Information Sheet 2”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
9. Accomplish the “Self-check 2” in page 13.
10. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).
11. Read the information written in the “Information Sheets 3 . Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.

12. Accomplish the “Self-check 3” in page 11.
13. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3).
14. If you earned a satisfactory evaluation proceed to “Operation Sheet 1” in page 17, However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
15. Read the “Operation Sheet 1” and try to understand the procedures discussed.
16. If you earned a satisfactory evaluation proceed to “Operation Sheet 2” in page 18. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
17. Read the “Operation Sheet 2” and try to understand the procedures discussed.
18. Do the “LAP test” in page 19(if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work.

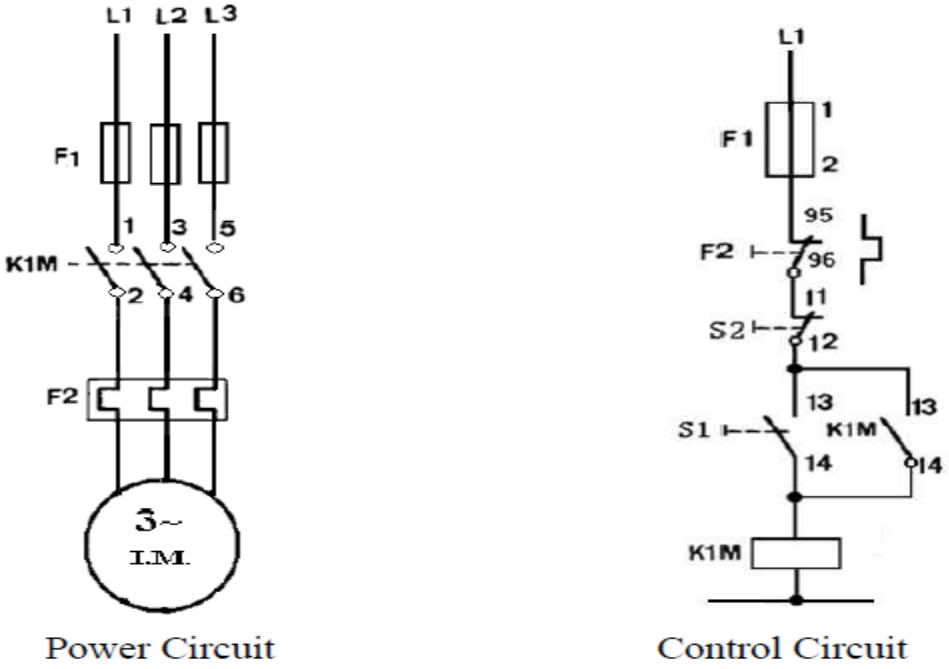
Information Sheet-1	Preparing power circuit and control circuit diagram

1.1 Introduction to Power circuit and control circuit

A control circuit :-is a special type of circuit used to control the operation of a completely separate power circuit . Control wiring is wire that carries a low voltage signal to a relay, contact or terminal point. Usually and 24 or 12 volts but is considered low having anything under 48 volts .

A power circuit is defined as any circuit used to carry electricity that operates a load. and the circuit control is part of the power circuit when the device is operate.

1.2. power circuit and control circuit diagram of direct on line (DOL)



Power Circuit Control Circuit

Figure 1. 1. schematic diagram of power and control circuit of DOL

Where L1, L2, L3 shows line voltage

Voltage between L1-L2=380V/400V, L1-L3=380V/400V, L2-L3= 380V/400V

Voltage between phase –neural 220v/250v

F1- fuse/circuit breaker, F2= thermal over load relay, S1= start push button

S2= stop pushbutton, K1M= main magnetic contactor (power contactor)

Working principle

The DOL starter consists of a coil operated contactor K1M controlled by start and stop push buttons.

When you press the start push button S1, the contactor coil K1M is energized from line L1.

The three mains contacts (1-2), (3-4), and (5-6) in fig. (1) are closed energized. Then motor is connected to the supply. When the stop push button S2 is pressed, the supply through the contactor K1M is disconnected/de energized. Since the K1M is de-energized, the main contacts (1-2), (3-4), and (5-6) are opened. The supply to motor is disconnected and the motor stops.

Refer……

https://www.youtube.com/watch?v=_uCan4ehHSs

https://www.youtube.com/watch?v=bBxZnW6szgU

1.3. power circuit and control circuit diagram of star -delta

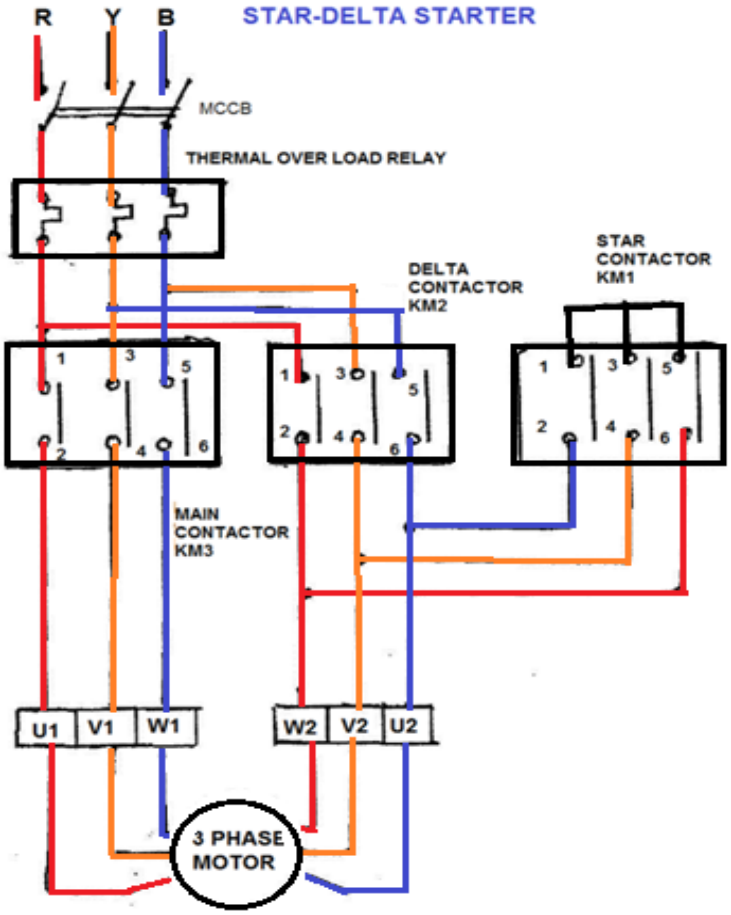


Figure 1. 2. power circuit of star-delta wiring diagram

Where R, Y, B power line source voltage

V1, U1, W1, = the primary terminal of the motor

V2, U2 , W2, = the secondary terminal of the motor

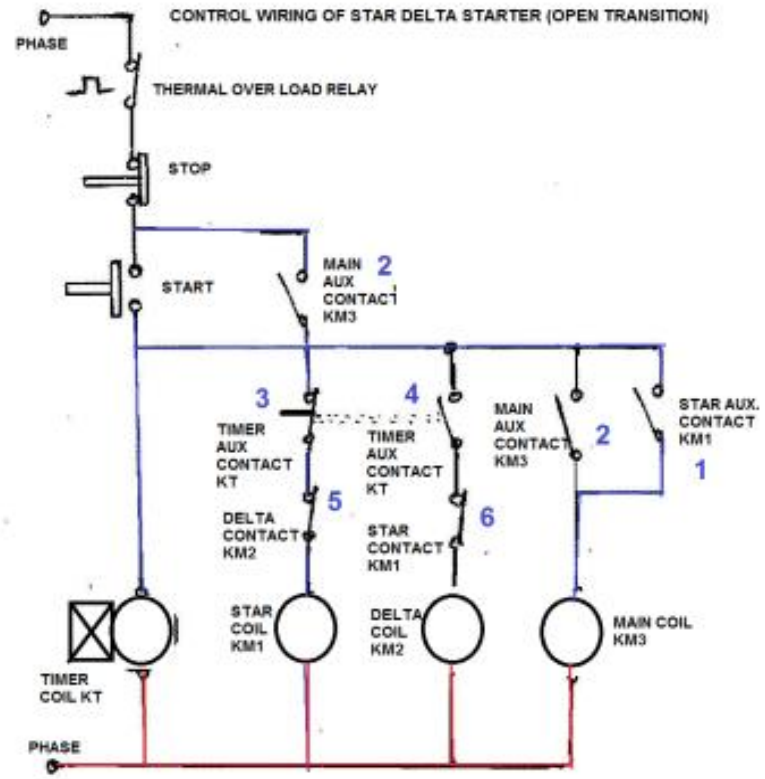


Figure 1. 3. control circuit - wiring diagram of star- delta

Working principle

- The main circuit breaker serves as the main power supply switch that supplies electricity to the power circuit.
- The main contactor connects the reference source voltage R, Y, B to the primary terminal of the motor U1, V1, and W1.
- When you press the start push button in the control circuit the Main Contactor (KM3) and the Star Contactor (KM1) are closed /energized initially, and then after a period of time, the star contactor(KM1) is opened or de energized, and then the delta contactor (KM2) is closed/energized . The control of the contactors is by the timer (K1T) built into the starter. When Star Auxiliary Contactor (1)(which is placed on Main Contactor coil circuit)became NO to NC it's complete The Circuit of Main contactor Coil (KM3) so Main Contactor Coil energized and Main Contactor's Main and Auxiliary Contactor Change its Position from NO To NC. This sequence happens in a friction of time.
- After pushing the ON push button switch, the auxiliary contact of the main contactor coil (2) which is connected in parallel across the ON push button will become NO to NC, thereby providing a latch to hold the main contactor coil activated which eventually maintains the control circuit active even after releasing the ON push button switch.

- When Star Main Contactor (KM1) close its connect Motor connects on STAR and it's connected in STAR until Time Delay Auxiliary contact KT (3) become NC to NO.
- Once the time delay is reached its specified Time, the timer's auxiliary contacts (KT)(3) in Star Coil circuit will change its position from NC to NO and at the Same Time Auxiliary contactor (KT) in Delta Coil Circuit(4) change its Position from NO To NC so Delta coil energized and Delta Main Contactor becomes NO To NC. Now Motor terminal connection change from star to delta connection and the motor runs at full speed.

Refer ……..

https://www.youtube.com/watch?v=OtydNtCxYQI

https://www.youtube.com/watch?v=JTr8TSiHhEM

https://www.youtube.com/watch?v=HTKfFzp8Sm0

3.4. power circuit and control circuit diagram of Auto- transformer starting

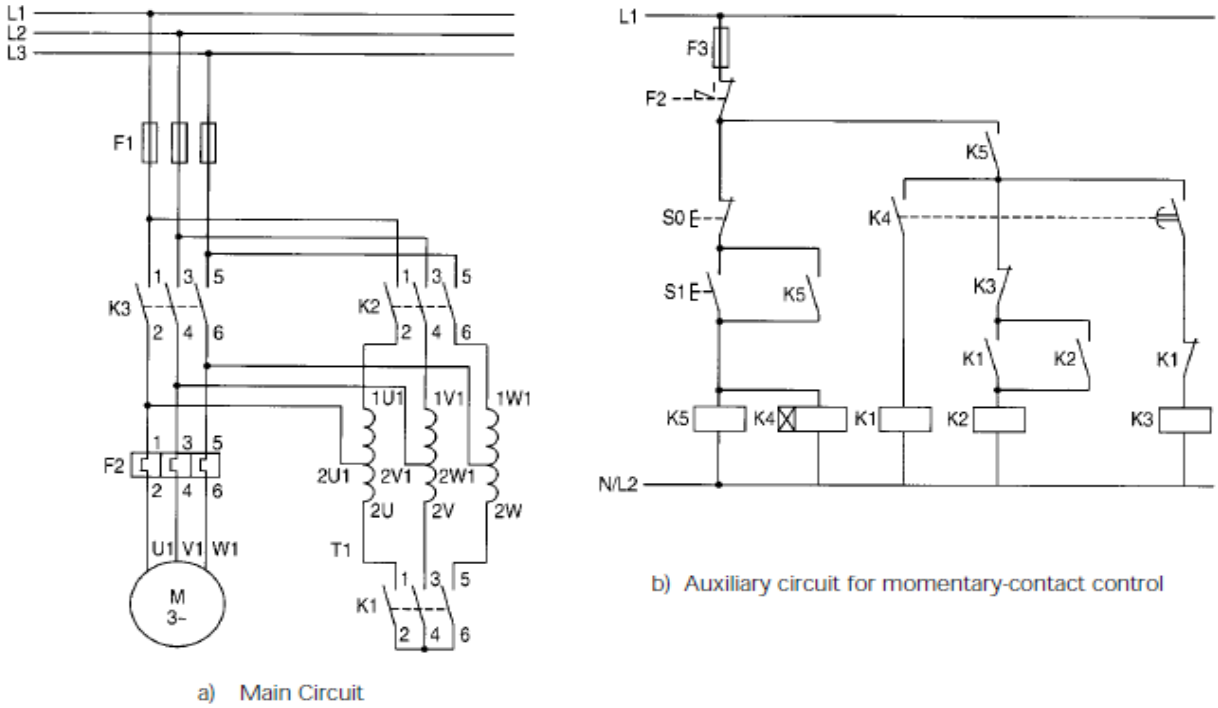


Figure1. 4. (a) show power circuit of auto-transformer

(b) shows control circuit of auto-transformer

Where

S0 = 'OFF' Push button S1 = 'ON' Push button K1 = Star contactor

K2 = Transformer contactor, K3 = Main contactor K5 = Contactor relay (2NO + 2NC) K4 = Time relay, F1 = Main circuit fuses, F2 = Overload relay, F3 = Control circuit fuse

Working principle

The operation principle of auto transformer method is similar to the star delta starter method. The starting current is limited by (using a three phase auto transformer) reduce the initial stator applied voltage.

The auto transformer starter is more expensive, more complicated in operation and bulkier in construction when compared with the star – delta starter method. But an auto transformer starter is suitable for both star and delta connected motors, and the starting current and torque can

be adjusted to a desired value by taking the correct tapping from the auto transformer.

3.5. power circuit and control circuit diagram of forward and reverse starting

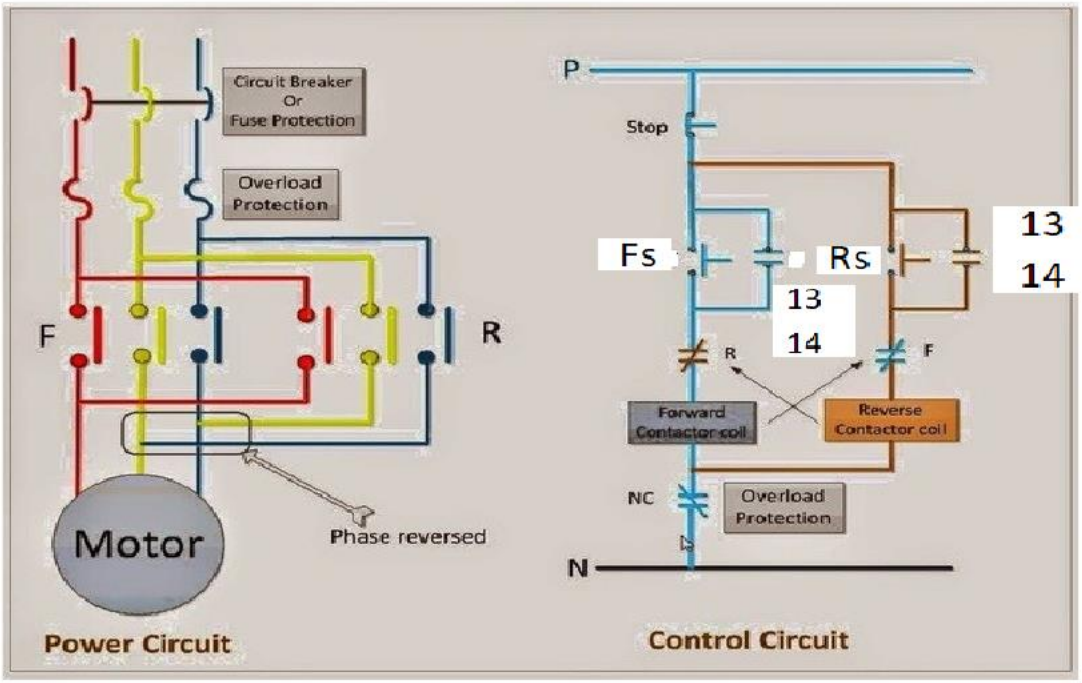


Figure 1. 5. power circuit and control circuit diagram of forward and revers starting

Where

F= forward main magnetic contactor R= reverse main magnetic contactor

Fs =forward start push button Rs= reverse start push button

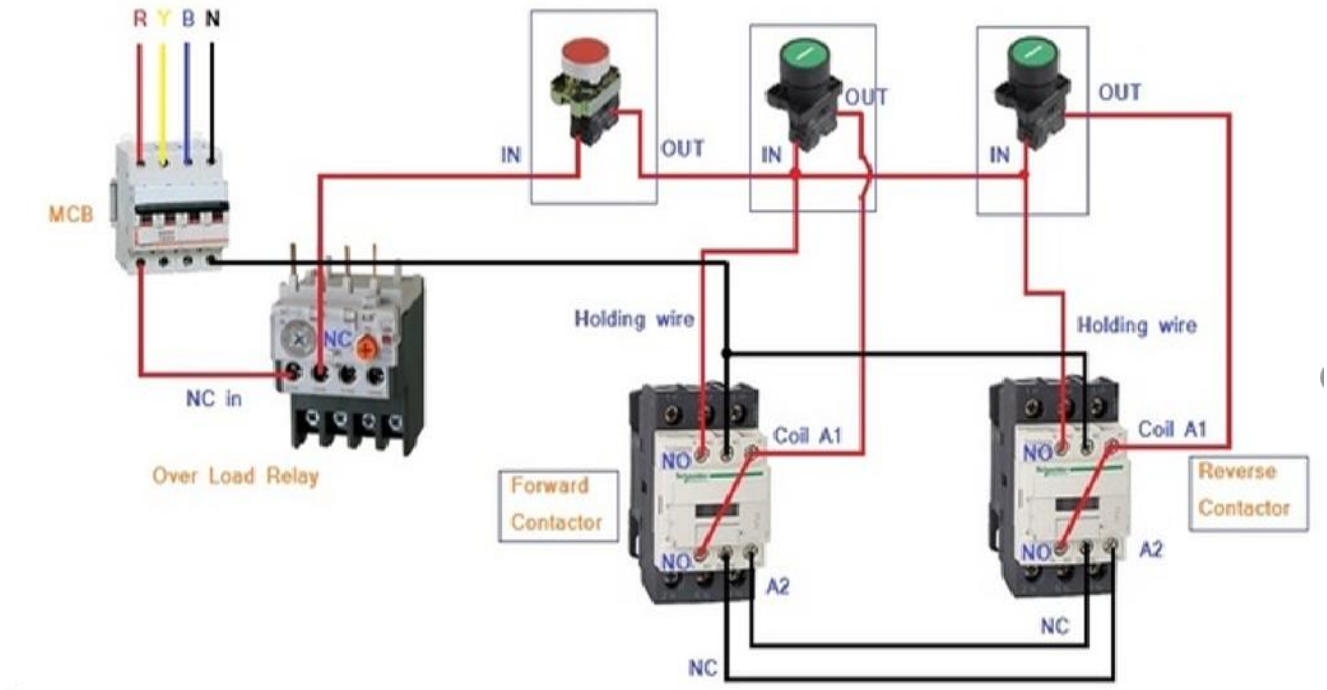


Figure1. 6. forward and reverse control wiring diagram

Working principle

When you press Fs figure 5. Of control circuit forward contactor be become energized and then the motor runs forward direction until you press stop push button when you press stop push button the motor become de energized when you press Rs the reverse contactor become energized .and then the runs in the reverse direction of the forward start until you press stop push button .

Self-Check -1	Written And Tracing Wiring Diagram Test

Directions: Answer all the questions listed below. Use the proper materials for the drawing of wring diagram.

1. Write elements of power circuit and control circuit components in Dol wiring diagram (5pts)
2. Trace the power and control circuit of
   a. Dol (5pts)
   b. Star-delta (5pts)

Note: **Satisfactory rating - 10points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____
   __
2. _____
   _____
   _____

Information Sheet-2	Identifying type of control components & wiring devices and other materials

2.1. Introduction

There are different types of control components In different types of motor starting method and also the wiring device and the materials used may not be the same.

2.2. direct on line power and control component and wiring device

power components of DOL are:- , main circuit breaker(3phase MCB), main magnetic contactor and thermal overload relay

control components of DOL are:- single phase circuit breaker (1MCB), start stop push button , normally open auxiliary contactor of 3 phase MCB

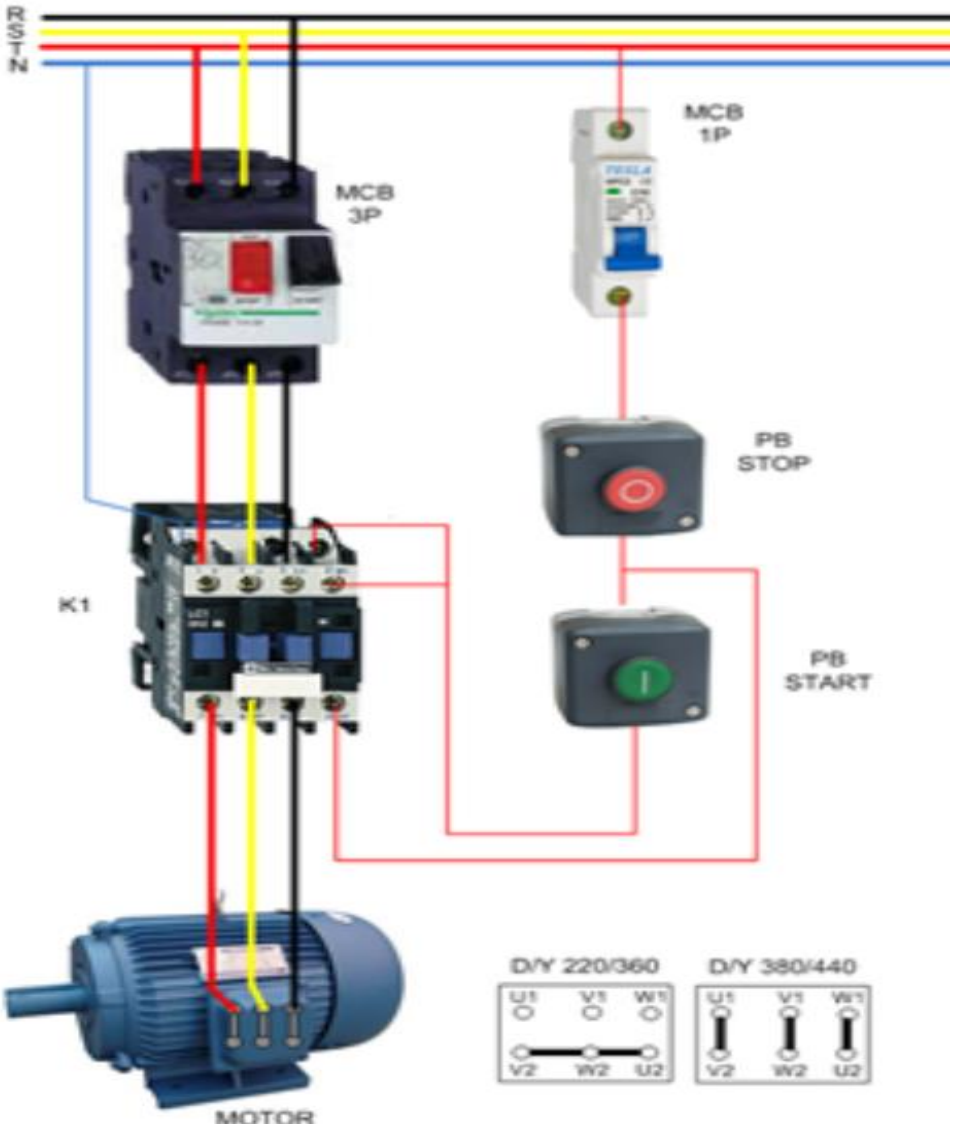


Figure 2.1.DOL power circuit and control circuit components of wiring device

2.3. Star delta control component and wiring device

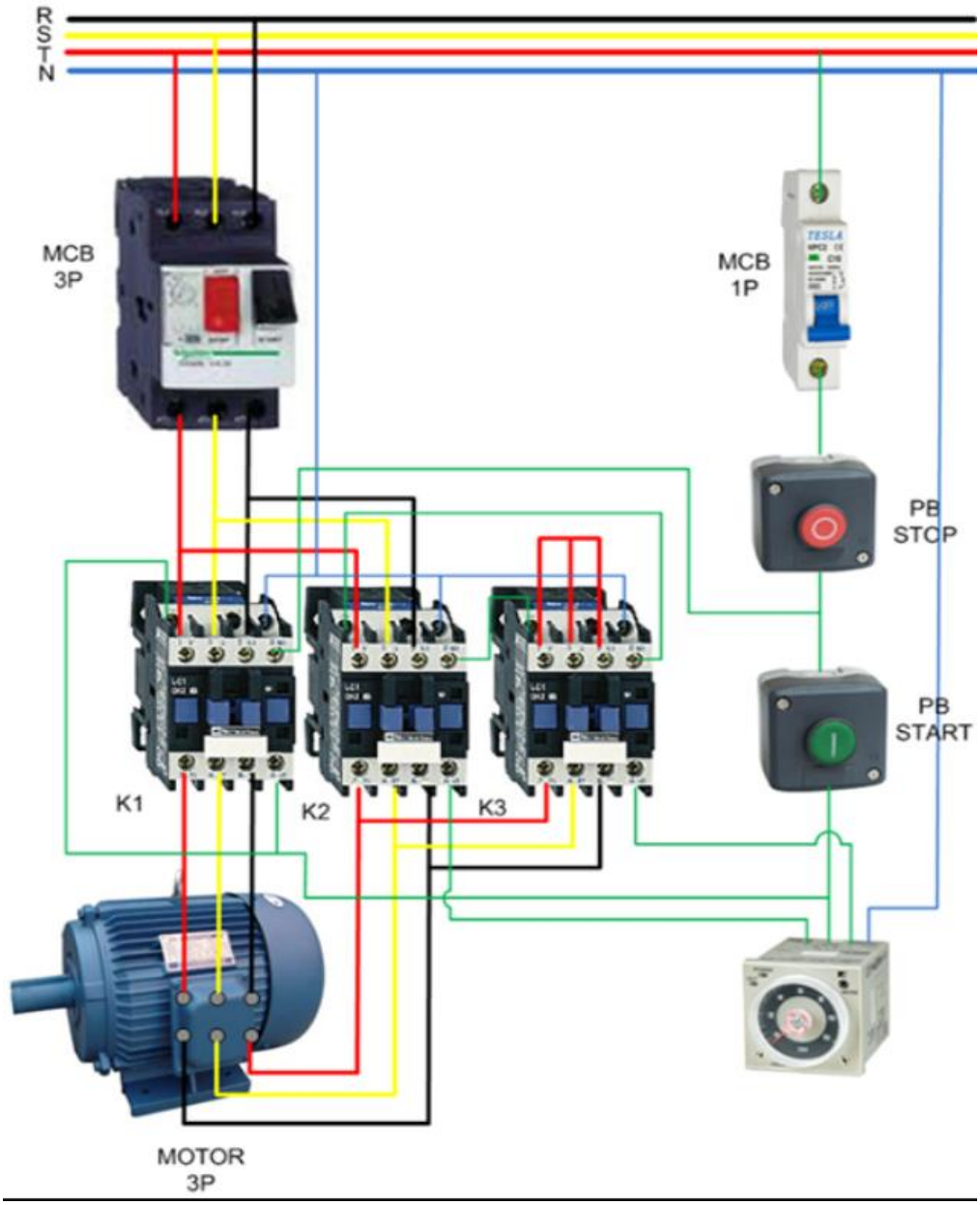


figure 2.2. star-delta power circuit and control circuit components of wiring device

power components of star-delta 3phase-MCB, line magnetic contactor(K1), delta magnetic contactor(k2), star-magnetic contactor (k3)

star-delta control components are single phase breaker(1pMCB), stop and start pushbutton and time delay relay and for more information, refer information sheet 1 of LG-29 LO-1

Self-Check -2	Multiple choice test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. ---------- One of the following is not the components of Dol control device
   A. Single phase circuit breaker
   B. Fuse
   C. Timer
   D. contactor
2. ----------The device used to convert star-connection to delta connection in automatic star-delta starting with in specified period is
   A. transformer
   B. Auto-transformer
   C. Time delay relay
   D. All
3. ----------The push button required in forward and reverse starting
   A. One
   B. Three
   C. Four
   D. Two

Note: **Satisfactory rating – 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1._____

2._____

Information Sheet-3	Connecting the circuit and wiring diagram

3.1 Introduction

Different type of motor starting mechanism has different circuit and wiring diagram configuration.

Circuit: - is the complete path of electric current through the wiring diagram. whereas wiring is the inter connection of device with conductor in power and control circuit to make the system energize or de energize. Or A circuit diagram is a graphical representation of an electrical circuit

Wiring diagram: is the diagram that indicates the actual material and the circuit connection used in sequential order to execute our work activates. A wiring diagram usually gives information about the relative position and arrangement of devices and terminals on the devices, to help in building or servicing the device

Power circuit diagram of start –delta

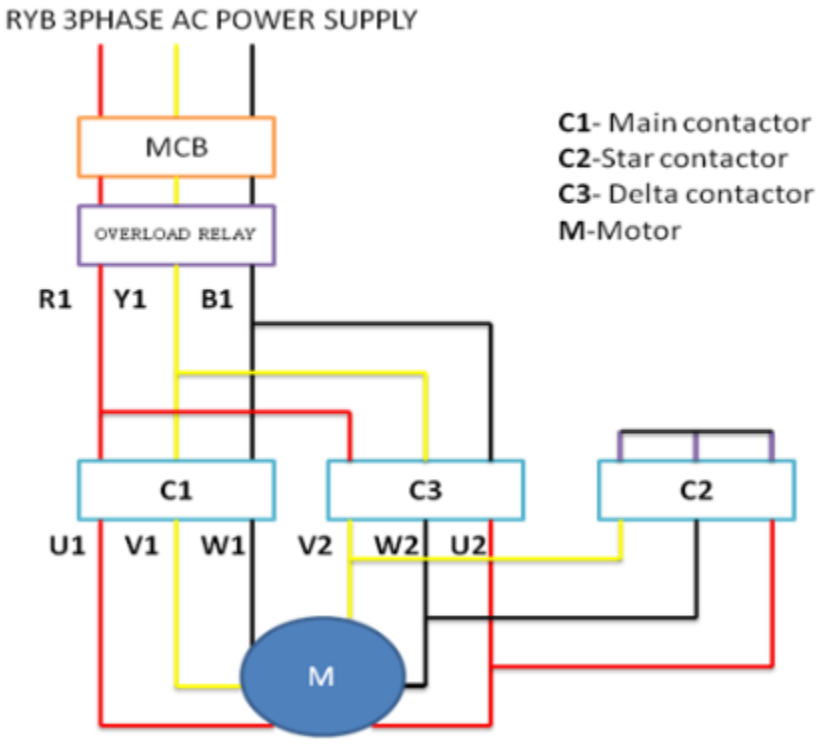


Figure 3.1 power circuit diagram of star- Delta .

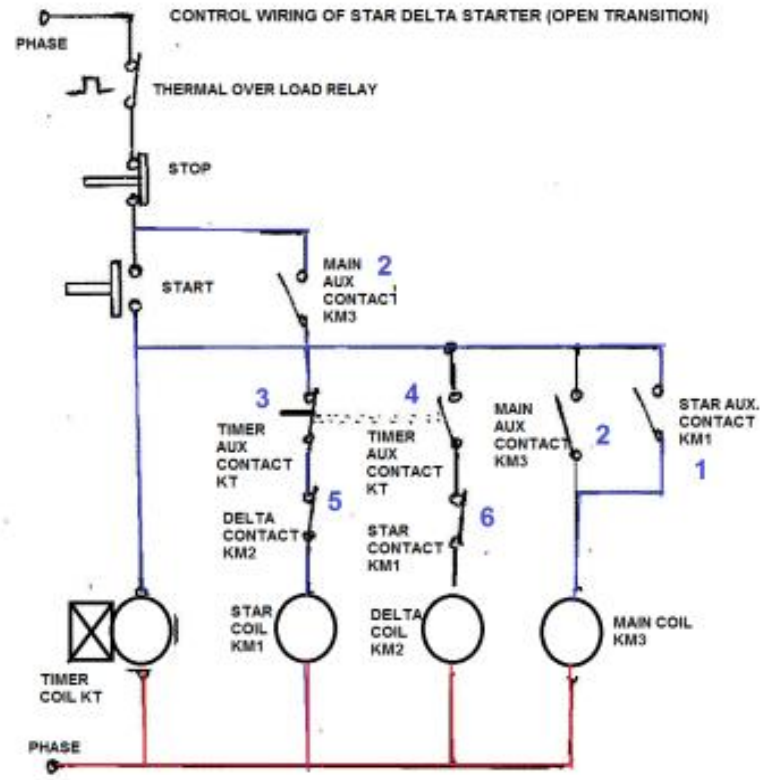


Figure 3.2. power and control wiring diagram of star-delta

Common Procedure for connecting the circuit and wiring diagram

Refer….

https://www.youtube.com/watch?v=OtydNtCxYQI&t=524s

https://www.youtube.com/watch?v=LtHOybhXpiU

https://www.youtube.com/watch?v=_uCan4ehHSs&t=12s

https://www.youtube.com/watch?v=o6mkSOBzhgU

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the difference between circuit diagram and wiring diagram
2. What makes difference the control circuit diagram of DoI and star-delta
3. Sketch the power and control circuit wiring diagram of star-delta

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1._____

2._____

Operation Sheet 1	preparing power and control circuit of DOL

Techniques for preparing power and control circuit of DOL

Step 1- wear PPE.

Step 2- Draw the wiring diagram of power and control circuit of Dol

Step 3- select the necessary tools and materials required for construction of Dol.

Steps 4- check the functionality of each device before mounting it

Step-5 Construct the circuits

Step 6-connect the motor to circuit

Step 7- test the motor /the circuits

Operation Sheet 2	Connecting control component and wiring device of motor start

Techniques for preparing power and control circuit of star-delta or any

Step 1- Wear PPE.

Step 2- Draw the wiring diagram of power and control circuit of (star-delta) or any

Step 3- Select the necessary tools and materials required for construction of star-delta any

Steps 4- Check the functionality of each device before mounting it

Step-5 Construct the circuits

Step 6-Connect the motor to circuit

Step 7- Test the motor /the circuits

.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hours.

Task 1. Construct direct on line wiring power and control device

- Draw power and control circuit
- Prepare proper device and materials
- Select proper tools
- Construct the device

.

List of Reference Materials

1. https://www.youtube.com/watch?v=_uCan4ehHSs
2. https://www.youtube.com/watch?v=bBxZnW6szgU
3. https://www.youtube.com/watch?v=OtydNtCxYQI
4. https://www.youtube.com/watch?v=JTr8TSiHhEM
5. https://www.youtube.com/watch?v=HTKfFzp8Sm0
6. https://www.youtube.com/watch?v=OtydNtCxYQI&t=524s
7. https://www.youtube.com/watch?v=LtHOybhXpiU
8. https://www.youtube.com/watch?v=_uCan4ehHSs&t=12s
9. https://www.youtube.com/watch?v=o6mkSOBzhgU