EE1302: INTRODUCTION TO ELECTRICAL ENGINEERING

LABORATORY 04

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SEMESTER: 01

DATE : 15 /11 /2022

TABLE 1 : SUMMATIVE LABORATORY FORM

Semester	01
Module Code	EE1302
Module Name	Introduction to Electrical Engineering
Lab Number	04
Lab Name	Introduction to Electrical Wiring
Lab conduction date	2022.10.05
Report Submission date	2022.11.08

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OBSERVATION

Part A

The table below illustrates the key components and ratings of the Electrical Machine Laboratory's three phase power supply system.

TABLE 2 : THE PRIMARY COMPONENTS OF THE THREE PHASE POWER SUPPLY SYSTEM AND THEIR RATINGS

Components	Ratings	
	Current(A)	Voltage(V)
MCCB(Main Switch, 3 poles)	200	690
MCB(Single pole)	32	400
MCB(Three poles)	32	400
MCCB(Three poles)	100	240/480
Relay	0.03	

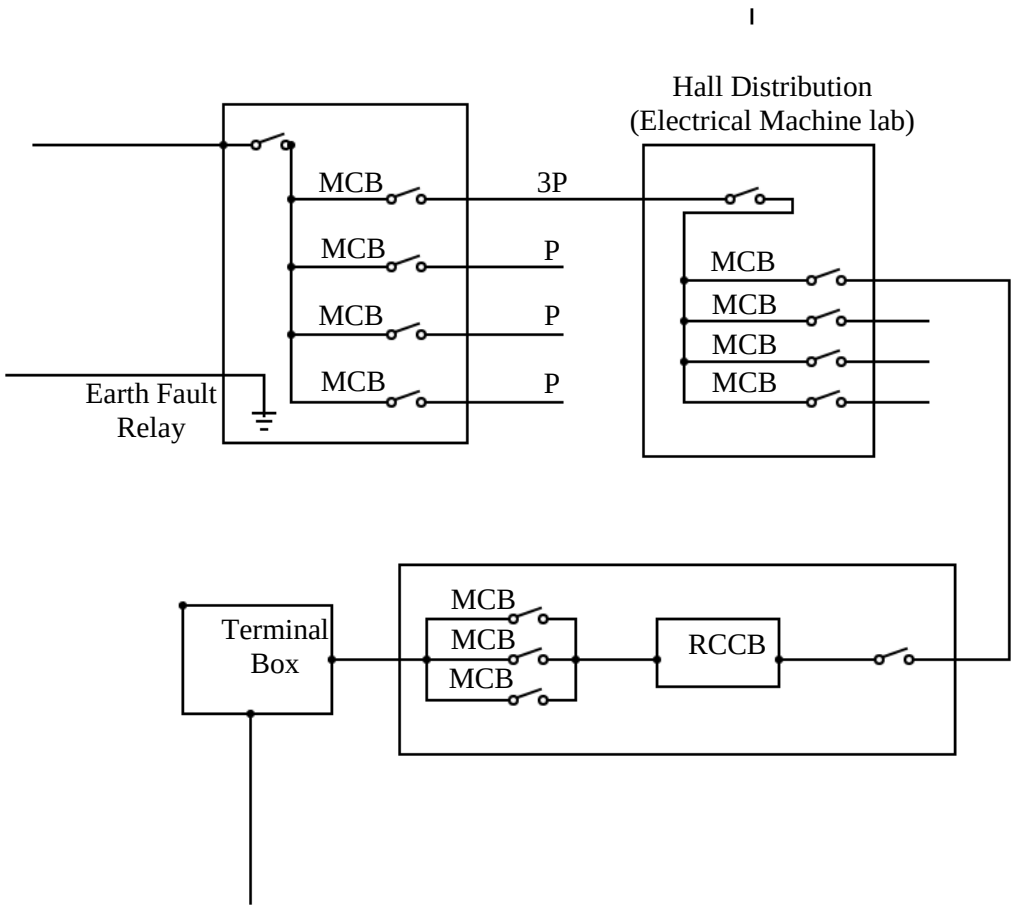

FIGURE 1 : THE WIRING DIAGRAM OF THE ELECTRICAL MACHINE LAB

The table below illustrates the key components and ratings of the main terminal box available in the laboratory.

TABLE 3 : EQUIPMENT AND RATING OF MAIN TERMINAL BOX

Equipment	Ratings	
	Current(A)	Voltage(V)
Three pole MCB	32	400
RCCB	100 A overload current limited and 63 current difference rating	240/480
4 single pole MCB	32	400

Part B

TABLE 4 : MAIN COMPONENTS PROVIDED AND THEIR RATINGS

Components	Voltage (V)
Bulb(60W)	220
Switch	220
Wires	220

The bellow diagrams show single, two and three switch control systems.

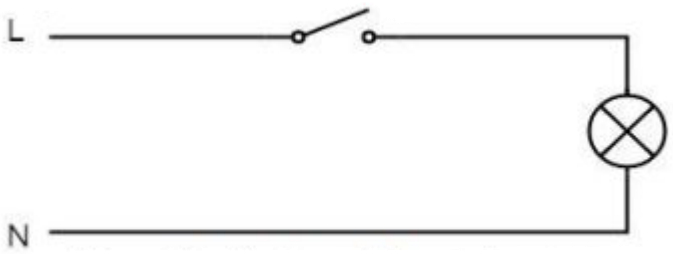

FIGURE 2 : SINGLE SWITCH CONTROL SYSTEM

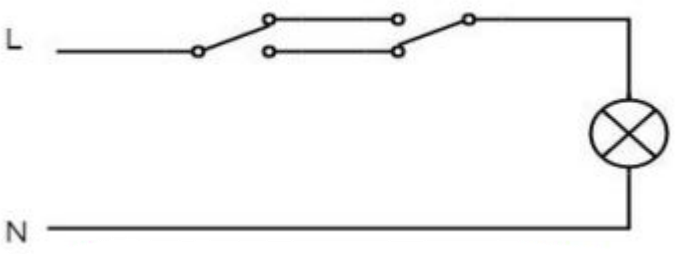

FIGURE 3 : TWO SWITCH CONTROL SYSTEM

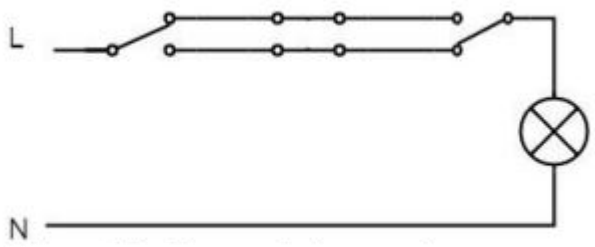

FIGURE 4 : THREE SWITCH CONTROL SYSTEM

Part C

Continuity Test

TABLE 5 : EXPERIMENTAL VALUES OF THE CONTINUITY TEST

The resistance between the live and live conductor	0.40 Ω
The resistance between the neutral and neutral conductor	0.69 Ω
The resistance between the live and neutral conductor	0.30 Ω

Insulation Resistance Test

TABLE 6 : EXPERIMENTAL VALUES FOR THE INSULATION RESISTANCE TEST

The resistance between the live and neutral conductor	>2099 MΩ
The resistance between earth and live conductor	>2099 MΩ
The resistance between earth and neutral conductor	294.5M Ω

Polarity Test

TABLE 7 : EXPERIMENTAL VALUES FOR THE POLARITY TEST

The voltage between live and earth conductor	83V
The voltage between live and neutral conductor	227V
The voltage between earth and neutral conductor	1.0V

CALCULATIONS

The resistance between live and live conductor (R1)	=	0.40 Ω
The resistance between neutral and neutral conductor (Rn)	=	0.69 Ω
The resistance between live and neutral conductor (R^1)	=	0.30 Ω

SPECIMEN CALCULATIONS

$$R = \frac{R1 + Rn}{4}$$

$$R = \frac{0.40 + 0.69}{4}$$

$$R = 0.2725\Omega$$

But the Reading = 0.30 Ω
Because the resistance of the connecting wires affects the resistance between the live and neutral conductors.

DISCUSSION

Part A

The main components of the three phase power supply system of the Electrical Machine laboratory are,

(a) MCCB
(b) MCB
(c) Earth fault relay

- MCCB is an abbreviation for Molded Case Circuit Breaker. This additional type of electrical protection mechanism is used when the maximum permitted load current of a micro circuit breaker is exceeded. The MCCB connects circuits and protects against overload and short circuit failures. It can even be employed in domestic applications for higher current ratings and fault levels. MCCBs are employed in industrial applications due to their high breaking capacity and wide current ratings. MCCBs can be used to protect main electric feeder distribution, generators, and capacitor banks. It provides appropriate protection when an application requires discrimination, customizable overload settings, or earth fault protection.
- Overcurrent protection is provided by an MCB, which is an electromechanical device. When there is an irregularity in the electrical network, such as an overload or short circuit, the circuit is automatically turned off. MCBs are extremely fast to reset and require minimal maintenance.
- An earth fault is an accidental defect between the earth and the live conductor. When a fault current returns through the ground or any electrical device, it causes damage to the equipment. Fault detection and prevention devices are used in the installation to protect the machinery

The major components of the laboratory's main terminal boxes are,

Residual Current Circuit Breaker (RCCB):

RCCB is an abbreviation for Residual Current Circuit Breaker. This residual current device is essentially an electrical wiring device that disconnects the circuit if current leaks through the human body or current is not balanced between the phase conductors. It is the most secure device for detecting and tripping electrical leakage currents, ensuring protection against electric shock generated by direct contacts.

RCCBs are commonly used in series with MCBs to protect them against overcurrent and short circuit current. A RCCB gadget connects both the phase and neutral wires. These are a highly effective type of shock protection that is extensively used to defend against leakage currents of 30, 100, and 300mA. It is life-saving equipment used to protect the human body from electrical currents and is required in many states for household installation.

The diagram below demonstrates the RCCB mechanism.

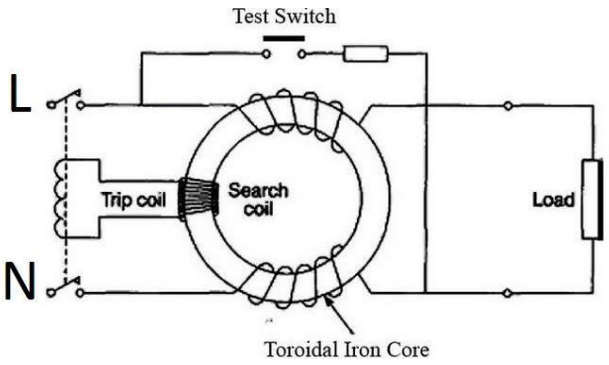

FIGURE 5 : RESIDUAL CURRENT CIRCUIT BREAKER (RCCB)

MCB (Miniature Circuit Breaker)

The MCB operates automatically by magnetic or thermal mechanisms. The two properties are used to ensure good operation during both short circuit and overload scenarios.

(a) THE MAGNETIC MECHANISM

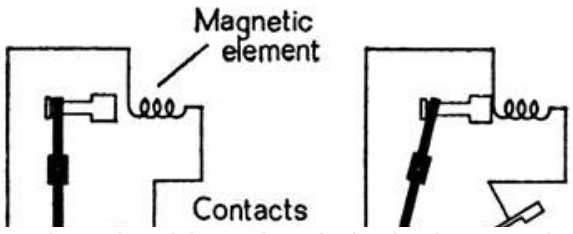

FIGURE 6 : MAGNETIC MECHANISM OF THE MCB

The magnetic mechanism makes use of a solenoid with an iron component. It is used for short circuit protection because to the need to almost immediately isolate high fault currents. When the circuit current reaches a set threshold due to an increase in magnetic field intensity, the iron piece moves in the direction of the solenoid. The connections are opened, and the tripping linkage is turned on. If the MCB is closed again while the fault remains, the contacts will not hold.

b**) THERMAL MECHANISM**

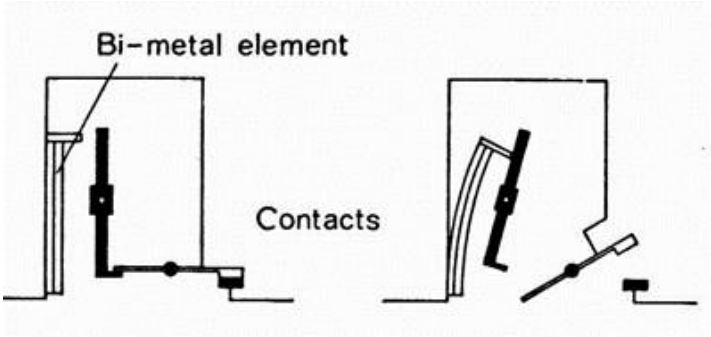

FIGURE 7 : THERMAL MECHANISM OF THE MCB

In the thermal mechanism, a heat-sensitive bimetal element is used. When the element reaches a certain temperature, the consequent deflection trips the circuit breaker. The amount of current required to heat the element to this temperature defines how long it takes and offers the important time delay characteristics.

Part B

Q1)

The quantity of electrical current and the time it takes for it to flow through the body determine the amount of damage produced by an electrical shock. For example, merely 2 seconds of electrical current at 1/10 amp passing through the body is enough to kill. To keep their hand and arm muscles under control, a person may only need to use less than 10 milliamperes of internal current (milliamps or mA). Muscles can become paralyzed or "frozen" at currents greater than 10 mA. When this happens, a person is unable to release a tool, wire, or other object. In fact, increasing your grip on the electrified object may allow you to be exposed to the shocking current for longer.

As a result, portable shock-producing gadgets could be extremely harmful. If you can't get out from under the tool, the current will continue to flow through your body for a longer period of time, potentially causing respiratory paralysis (the muscles that control breathing cannot move). You hold your breath for a few moments. People stopped breathing after being shocked with currents at voltages as low as 49 volts. 30 mA of electricity is usually enough to paralyze the respiratory system.

As a result, it is self-evident that the minimum current that may pass through the human body without causing harm is 10mA or less.

Q2)

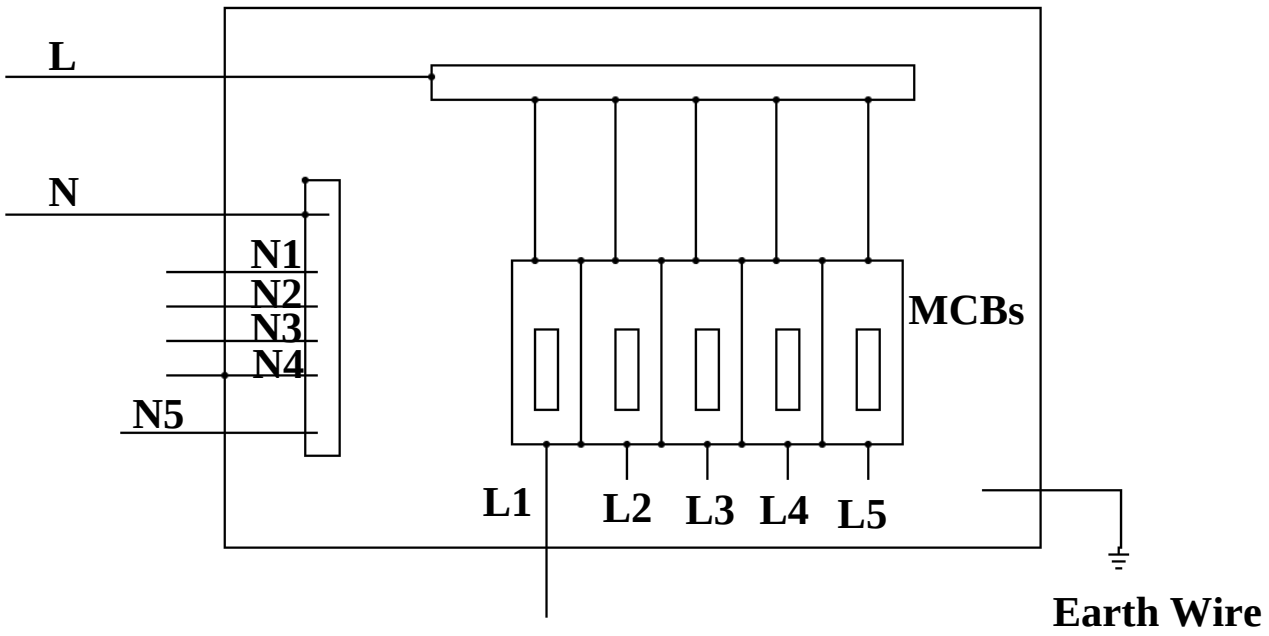

FIGURE 8 : DISTRIBUTION BOX

Part C

Q1)

Continuity of earth conductors

Because of an earth continuity test, these safety features will function as intended in the case of a fault. The resistance between the switchboard and the earth point of an appliance or power point is measured. Low resistance means that, in the event of a defect, the current will go to the earth point (safe) rather than escaping to the outside (safety hazard). Fire, electric shock, and possibly death are risks related with current escape. Earth connections must be tested on a regular basis because they are subject to damage from a variety of reasons, including corrosion, improper connections, insulation crimped beneath screw terminals, and the use of wires that are too small.

Continuity of the ring final circuits

A continuity test is essential for locating broken wires or damaged components in a circuit. It can also help determine whether the soldering is effective, whether the resistance is too high to allow current passage, or whether the electrical wire between two locations is broken. A continuity test can be used to verify or reverse-engineer an electrical circuit or connection.

Continuity testing can be used to identify problems with wire and cable goods, such as cold solder connections. In the field, handheld mustimeters with two probes are used.

Insulation Resistance

Insulation resistance must be maintained at safe levels to protect against production loss and electric shocks to individuals.

Polarity

When working with electrical circuits, we frequently refer to the polarity of various points in the circuit. Understanding polarity is essential for connecting the leads of polarity-dependent devices like meters and motors. Polarity is also significant in determining current flow direction.

Earth electrode resistance

Earth electrodes are necessary because they serve a critical role in protecting people from electrical hazards. They function as insulation due to their design and placement in the ground. Earth electrodes, in addition to the material type, are essential to decrease the chance of electrical surges causing harm.

Q2).

The resistance between live and live conductor (R1) = 0.4 Ω

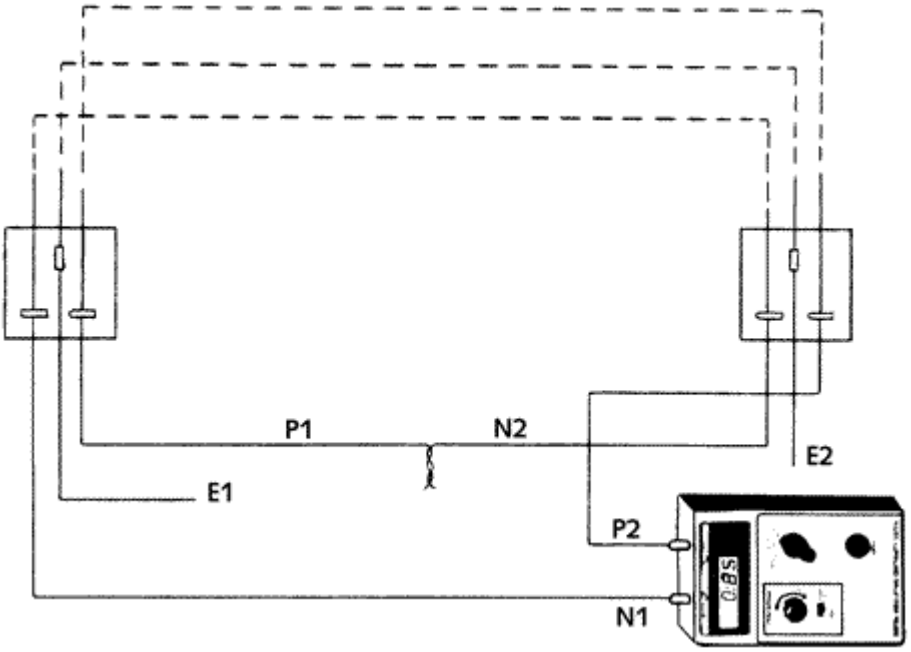

FIGURE 9 : TEST TO CONFIRM THE CONTINUITY OF A RING FINAL CIRCUIT

The resistance between neutral and neutral conductor (Rn) = 0.69 Ω

The resistance between live and neutral conductor (R) = 0.30 Ω

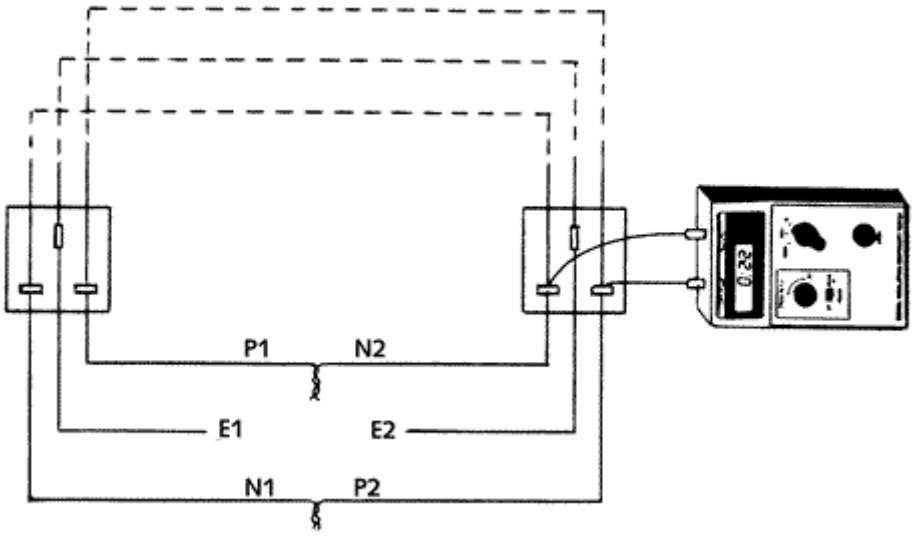

FIGURE 10 : TEST TO CONFIRM THE CONTINUITY OF A RING FINAL CIRCUIT

$$R = \frac{0.40 + 0.69}{4}$$
$$R = 0.2725\ \Omega$$

But, the Reading = 0.3 Ω

Reading must have a value of 0.2725, according to the equation. However, the reading was 0.3. This is due to the resistance of the cables used to connect the live and neutral conductors. Environmental and equipment errors are also factors. To put it another way, the resistance of the connecting wires influences the resistance between the live and neutral conductors.

Q3)

Before conducting the test, the power must be turned off and the installation disconnected to ensure that no equipment electrically connected to the circuit to be tested, particularly devices subject to voltage surges, is exposed to the test voltage.
Any pilot or indication bulbs or capacitors connected to the section to be tested should be verified before testing. To avoid erroneous findings, any that are present should be unplugged. It should also be checked to determine whether any voltage-sensitive electronic devices, such as electronic fluorescent light starters, dimmer switches, touch switches, timers, power controllers, and residual current devices with electronic amplifiers, are attached.

References

[1] "The Importance Of Earth Electrodes," [Online]. Available: https://www.thelocalelectrician.com.au.

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