

## **CHAPTER ONE**

### **1.0 INTRODUCTION**

The Students Industrial Work Experience Scheme (SIWES) is a Skills Training Programmed designed to expose and prepare students of Universities, Polytechnics/Colleges of Technology/Colleges of Agriculture and Colleges of Education for the Industrial Work situation they are likely to meet after graduation.

The scheme also gives students the opportunity of familiarizing and exposing themselves to the needed experience in handling equipment and machinery that are usually not available in their Institutions. Before the establishment of the scheme, there was a growing concern among our Industrialists that graduates of our Institutions of higher learning lacked adequate practical background studies preparatory for employment in Industries. Thus, the employers were of the opinion that the theoretical education going on in higher institutions was not responsive to the needs of the employers of labour. It is against this background that the rationale for initiating and designing the scheme by the Fund during its formative years 1973/74 was introduced to acquaint students with the skills of handling employer's equipment and machinery. The ITF solely funded the scheme during its formative years. But as the financial involvement became unbearable to the Fund, it withdrew from the Scheme in 1978. The Federal Government handed over the scheme in 1979 to both the National Universities Commission (NUC) and the National Board for Technical Education (NBTE). Later the Federal Government in November 1984 reverted the management and implementation of the SIWES Programme to ITF and it was effectively taken over by the Industrial Training Fund in July 1985 with the funding being solely borne by the Federal Government.

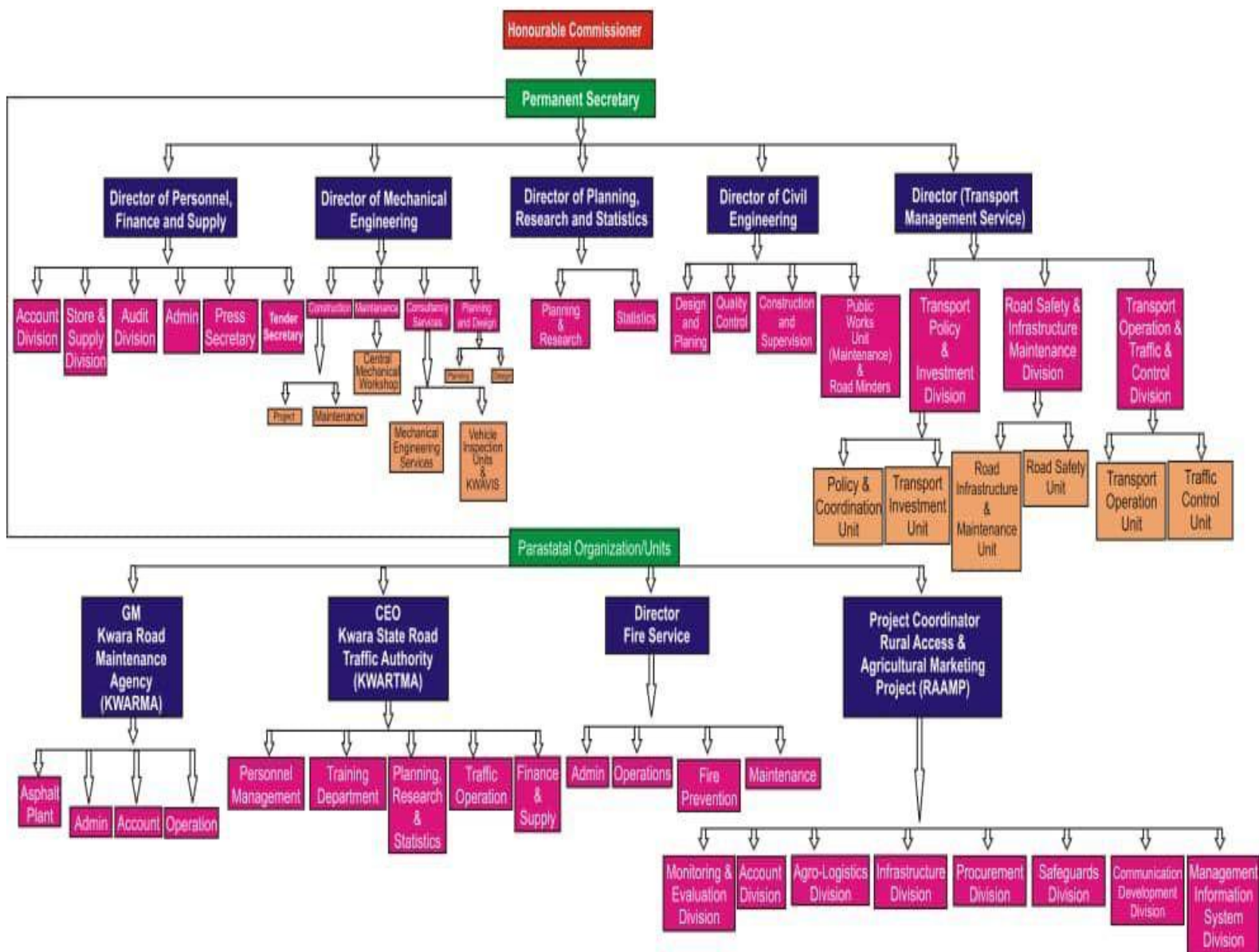
#### **1.1 GOALS AND OBJECTIVES OF SIWES**

1. To enhance the knowledge of students (theory) of what they have been taught in school by backing it with enough practical
2. To provide students the opportunity to apply their theoretical knowledge to practical work situation whereby it bridge the gap between the theory works in the class and the practical works in the site.

3. To provide an avenue for students to acquire industrial skill and experience in their course of study.
4. To enable students to develop more affection for their chosen profession.
5. To expose students to working method and technique in handling equipment and machineries that may not be available to them in school.

## 1.2 ORGANIZATION CHART

### MINISTRY OF ENERGY, ILORIN ORGANOGRAM



## **CHAPTER TWO**

### **2.0 THEORETICAL WORK DONE**

#### **2.1 SAFETY PRECAUTIONS IN ELECTRICAL WORK**

Electrical work involves handling high-voltage equipment, cables, and machinery, which can pose serious risks if proper safety precautions are not followed. Ensuring a safe working environment is essential to prevent electric shocks, burns, equipment damage, and even fatalities.

##### **2.1.1 PERSONAL PROTECTIVE EQUIPMENT (PPE) FOR ELECTRICAL WORK**

Personal Protective Equipment (PPE) refers to specialized clothing and gear designed to protect electrical workers from hazards such as electric shocks, burns, falling objects, and excessive noise. PPE is essential for minimizing risks and ensuring a safe working environment when handling electrical installations and repairs.

#### **Types of PPE Used in Electrical Work**

##### **1. Safety Boots**

Safety boots are insulated, non-conductive footwear designed to prevent electric shocks when working in high-risk environments. They provide grip on slippery surfaces and protect against heavy falling objects.



## **2. Electrical Insulated Gloves**

Insulated gloves protect workers from direct contact with live electrical circuits by preventing the flow of electric current through the body. They are made from high-dielectric rubber materials and are often worn with leather outer gloves to prevent punctures and mechanical damage.



## **3. Helmets**

Helmets protect the head from falling objects, accidental contact with live electrical wires, and arc flashes. Electrical hard hats are made from non-conductive materials like fiberglass or thermoplastic to prevent electrical conductivity.



## **4. Lockout/Tagout**

Lockout/Tagout devices are safety locks and warning tags used to isolate electrical circuits during maintenance. These devices prevent accidental re-energization of electrical equipment, ensuring that maintenance work can be carried out safely without the risk of electric shock.

## 5. Safety Glasses or Face Shields

Safety glasses and face shields protect the eyes and face from flying debris, sparks, and arc flashes during electrical work. They are made of impact-resistant.



## 6. Fire-Resistant Clothing

Fire-resistant (FR) clothing is designed to resist ignition and prevent burns caused by electrical arc flashes and sparks. These clothes are made from self-extinguishing materials that do not melt onto the skin.



## 7. Hearing Protection

Earplugs and earmuffs protect workers from high noise levels produced by generators, transformers, and heavy electrical tools. Prolonged exposure to loud sounds can cause hearing loss.

### **2.1.1 IMPORTANCE OF SAFETY IN ELECTRICAL WORK**

The importance of safety in electrical work includes:

- ❖ Preventing electric shocks that could lead to serious injury or death.
- ❖ Avoiding short circuits and fire hazards due to faulty wiring or equipment.
- ❖ Ensuring compliance with safety regulations such as those by the Nigerian Electricity Regulatory Commission (NERC) and International Electrotechnical Commission (IEC).
- ❖ Protecting equipment and electrical systems from damage caused by improper handling.

## **2.2 ELECTRICAL POWER SYSTEMS**

Electrical power systems are networks responsible for generating, transmitting, and distributing electricity to homes, industries, and commercial areas. These systems ensure the efficient and reliable flow of electricity from power plants to end-users. The three main stages of an electrical power system are Generation, Transmission, and Distribution.

### **2.2.1 GENERATION OF ELECTRICAL POWER**

- ❖ Electric power generation is the first stage of the electrical supply process. It involves converting different energy sources into electrical energy. The major sources of electricity generation include:
  - ❖ Thermal Power Plants generate electricity by burning coal, natural gas, or oil to produce steam that drives turbines. Example: Gas-fired power plants in Nigeria.
  - ❖ Hydroelectric Power Plants use flowing water to spin turbines and generate electricity. Example: Kainji Dam, Shiroro Dam, and Jebba Dam in Nigeria.
  - ❖ Nuclear Power Plants produce electricity through nuclear fission, where atomic nuclei split to release heat that generates steam for turbines. Nigeria currently has no operational nuclear power plants.

- ❖ Renewable Energy Sources include solar, wind, and biomass, providing clean and sustainable electricity. Example: Solar farms in Katsina and wind farms in Kano.

### **2.2.2 TRANSMISSION OF ELECTRICAL POWER**

Electricity is transmitted from power plants to substations at high voltage to reduce energy loss. Step-up transformers increase voltage for efficient long-distance transmission through high-tension lines. At substations, step-down transformers lower the voltage for safe distribution to consumers.

#### **Key Components of Transmission Systems**

1. Step-up Transformers increase voltage levels to minimize energy loss during transmission. Example: A power plant generates electricity at 11kV, and a transformer steps it up to 330kV for long-distance transmission.
2. High-Tension (HT) Transmission Lines carry high-voltage electricity over long distances through overhead cables and pylons. Transmission lines operate at different voltage levels, with 330kV for long-distance transmission and 132kV for regional transmission.
3. Substations regulate voltage levels before power is distributed to local areas. They use step-down transformers to reduce voltage, making it suitable for consumer use.

### **2.2.3 DISTRIBUTION OF ELECTRICAL POWER**

Distribution of electrical power involves delivering electricity from substations to consumers at a usable voltage. Step-down transformers reduce high voltage to 415V for three-phase and 240V for single-phase supply. Electricity is then distributed through low-tension (LT) lines to homes, businesses, and industries, where distribution boards regulate power flow.

## Key Components of Distribution Systems

- ❖ Step-down Transformers reduce voltage from 33kV or 11kV to 415V (three-phase) or 240V (single-phase) for safe consumer use. These transformers are commonly found in residential and industrial areas.
- ❖ Low-Tension (LT) Distribution Lines deliver electricity from substations to homes and businesses through overhead or underground cables, ensuring reliable power supply.
- ❖ Distribution Boards (DBs) regulate and control power flow to different circuits within buildings. They are essential in factories, offices, and commercial complexes for proper load management.
- ❖ Consumers (End Users) include industries, hospitals, schools, homes, and businesses, where electricity is used for lighting, machinery, and daily operations.

### 2.3 TRANSFORMERS

Transformers are electrical devices used to increase (step-up) or decrease (step-down) voltage levels in power systems. They play a crucial role in ensuring efficient electricity transmission and distribution by minimizing energy losses over long distances.





## **Types of Transformers**

1. Step-up Transformers increase voltage levels, making electricity suitable for long-distance transmission. They are used in power stations to raise the generated voltage from around 11kV to 330kV or 132kV before transmission.
2. Step-down Transformers reduce high transmission voltages to safer levels for distribution. They lower voltages from 33kV or 11kV to 415V (three-phase) or 240V (single-phase) for industrial and residential use.
3. Distribution Transformers are step-down transformers used at the final stage of the power supply system, located on electric poles or ground-mounted near consumers.
4. Isolation Transformers provide electrical separation between circuits to prevent voltage surges and protect sensitive equipment.

## **2.4 EARTHING SYSTEMS**

Earthing (grounding) is the process of connecting electrical installations to the earth to prevent electric shocks and protect equipment from faults. It provides a low-resistance path for fault currents, ensuring safety in electrical systems.

### **Types of Earthing Systems**

- ❖ Pipe Earthing uses a galvanized iron (GI) pipe buried vertically in the ground to dissipate fault currents. This method is commonly used in substations and industrial areas due to its efficiency in handling high fault currents.
- ❖ Plate Earthing involves burying a copper or galvanized iron plate deep in the soil to provide a grounding point. This type of earthing is widely used in commercial and residential buildings for effective electrical safety.

- ❖ Rod Earthing uses a copper or steel rod driven into the ground to provide an earth connection. This method is simple and cost-effective, commonly used for lightning protection and electrical installations in homes and offices.

## **2.5 DISTRIBUTION BOARDS**

A distribution board (DB) is an essential component of an electrical system that regulates, distributes, and protects electrical circuits in residential, commercial, and industrial buildings. It houses protective devices like circuit breakers and fuses to prevent electrical overloads and faults.



### **2.5.1 COMPONENTS OF A DISTRIBUTION BOARD**

1. Main Switch controls the entire electrical supply to the building, allowing power to be turned off in case of maintenance or emergencies.
2. Miniature Circuit Breakers (MCBs) protect individual circuits from overloads and short circuits by automatically disconnecting power when faults occur.
3. Residual Current Circuit Breaker (RCCB) detects leakage currents and disconnects power to prevent electric shocks and fire hazards.

4. Busbars distribute electrical power to different circuits, ensuring efficient and organized power flow.
5. Neutral and Earth Bars provide safe grounding for electrical systems, preventing shocks and stabilizing voltage levels.

## **2.6 HIGH TENSION NETWORKS**

High-tension (HT) networks are used for transmitting and distributing high-voltage electricity over long distances. These networks operate at voltage levels such as 11kV, 33kV, 132kV, and 330kV, ensuring efficient power delivery with minimal losses.

## **2.7 WIRING AND CABLING SYSTEMS**

Wiring and cabling systems ensure efficient power distribution in buildings, providing safe and reliable connections for electrical devices. Proper wiring configurations help prevent overloading, short circuits, and electrical hazards.

## **2.8 HAND TOOLS USED IN ELECTRICAL INSTALLATION**

Hand tools are essential for safe and efficient electrical installations, helping electricians perform tasks include the following tools:

1. Pliers: Used for gripping, twisting, bending, and cutting electrical wires. They come in different types such as long-nose pliers for handling small wires.



2. Screwdrivers: Used for tightening and loosening screws in electrical connections. Electricians commonly use flat-head.



3. : Used to remove insulation from electrical wires for proper connections. They have adjustable notches to accommodate different wire sizes.



4. Multimeter: resistance to be analog or (DMM).



Measures voltage, current, and diagnose electrical faults. It can digital, with digital multimeters

5. Cable Cutters: Cuts thick electrical cables for proper sizing and connections. Heavy-duty cable cutters are used for large-diameter wires.

## **2.9 FAULT TRACING AND ELECTRICAL REPAIRS**

Fault tracing is the process of identifying and diagnosing electrical faults in a system to ensure safe and efficient operation. Electrical faults can occur due to short circuits, open circuits, loose connections, overloads, or insulation failures. Proper fault tracing helps prevent electrical hazards, equipment damage, and power failures.

### **Steps in Fault Tracing**

1. Visual Inspection check for burnt wires, loose terminals, tripped breakers, or physical damage.
2. Use of testing tools applies a multimeter, clamp meter, or continuity tester to detect voltage, current, or resistance abnormalities.
3. Identifying the fault type determine if the issue is a short circuit, open circuit, overload, or insulation failure.
4. Isolating the Faulty Section Disconnect affected components or circuits to pinpoint the exact fault location.
5. Repairing the Fault Replace or fix damaged wires, faulty breakers, blown fuses, or weak connections.
6. Testing After Repairs Recheck voltage, current, and continuity to ensure the system is functioning correctly.
7. Restoring Power Switch the system back on and monitor for stability.

## CHAPTER THREE

### 3.0 PRACTICAL WORK DONE

#### 3.1 INSTALLATION OF DISTRIBUTION BOARDS

A distribution board (DB) is an essential component of an electrical system that distributes power to different circuits. It helps protect electrical installations from overloads and short circuits using circuit breakers or fuses.



##### Process of Installation

The DB is first mounted on a secure wall in an accessible location. The main breaker is connected to the incoming power supply, followed by individual miniature circuit breakers (MCBs), which control different electrical loads such as lighting, sockets, and heavy appliances. The neutral and earth bars are also connected to ensure safety.

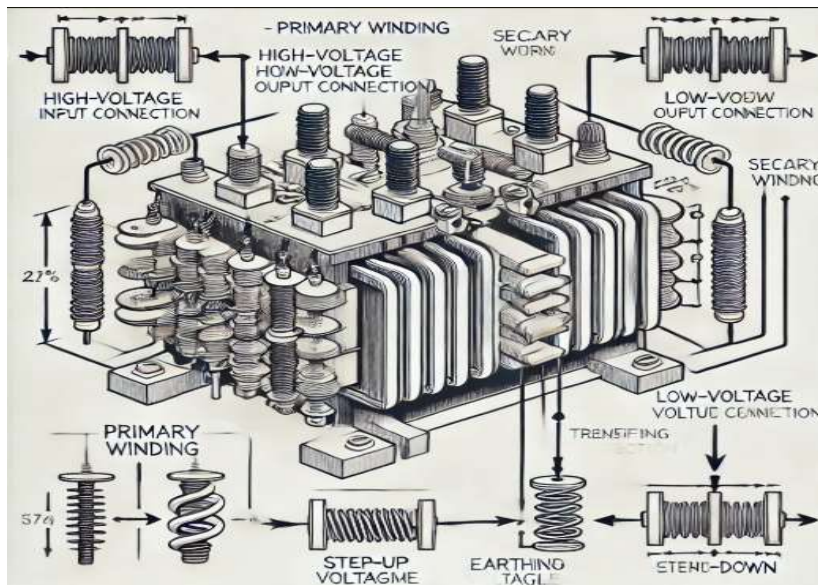
##### Safety Measures

Before installation, the power supply must be switched off to prevent electric shocks. Protective equipment such as gloves and insulated tools should be used. Proper earthing is also necessary to avoid electrical hazards.

A properly installed DB ensures safe and efficient power distribution, reducing the risk of electrical faults.

### 3.2 TRANSFORMER INSTALLATION AND CONNECTION

A transformer is an electrical device used to step up or step down voltage levels in a power system. Proper installation and connection ensure efficient power transmission and distribution while preventing electrical hazards.



**Detailed Transformer  
Wiring and Components**

#### Process of Transformer Installation

The installation begins with selecting a stable and well-ventilated location for the transformer, ensuring it is away from moisture and flammable materials. The transformer is mounted on a concrete platform or pole, depending on its type and capacity.

#### Connection of the Transformer

Once installed, high-voltage (HV) input cables from the power source are connected to the primary winding, while low-voltage (LV) output cables are connected to the secondary winding for distribution. Proper earthing is done to protect against faults and ensure safety. Circuit breakers and surge protectors are installed to prevent electrical damage.

## **Safety Precautions**

During installation, power must be disconnected, and protective equipment such as gloves and insulated tools should be used. Regular inspections and maintenance help prevent overheating and failures.

A properly installed and connected transformer ensures efficient power distribution, reduced energy loss, and system stability.

### **3.3 EARTHING SYSTEM IMPLEMENTATION**

Earthing (grounding) is a critical process in electrical installations that ensures safety by directing fault currents into the ground, preventing electric shocks, equipment damage, and fire hazards.

#### **Process of Earthing Implementation**

The earthing process starts with selecting a suitable location with good soil conductivity. Depending on the type of earthing used, a copper/galvanized rod, plate, or pipe is buried at an appropriate depth. A conductor (earth wire) is then connected from the grounding system to electrical installations, ensuring a low-resistance path for fault currents.

#### **Types of Earthing Used in Installation**

- **Rod Earthing:** A copper or steel rod is driven into the ground for simple and cost-effective grounding.
- **Plate Earthing:** A copper or GI plate is buried in the soil for better conductivity, commonly used in buildings.
- **Pipe Earthing:** A galvanized iron (GI) pipe is placed vertically in moist soil, suitable for substations and industrial setups.



## Safety Measures in Earthing Implementation

Proper earthing depth and moisture retention improve conductivity. The resistance should be kept low to allow smooth dissipation of excess current. Regular testing and maintenance ensure the earthing system remains effective.

A properly implemented earthing system protects lives, prevents equipment failure, and stabilizes voltage levels in electrical installations.

### 3.4 FAULT TRACING AND ELECTRICAL REPAIRS

Fault tracing is the process of identifying and diagnosing electrical faults to restore proper system functionality. Electrical faults can occur due to short circuits, open circuits, loose connections, overloads, or insulation failures, which may lead to power failures, equipment damage, or electrical hazards.

#### Process of Fault Tracing and Repairs

The process begins with a visual inspection, checking for burnt wires, loose terminals, tripped breakers, or damaged components. If no visible faults are found, electrical testing tools such as a multimeter, clamp meter, or continuity tester are used to measure voltage, current, and resistance.

Once the fault is located, necessary repairs are carried out, including replacing damaged wires, fixing loose connections, resetting breakers, or rewiring faulty circuits. After repairs, the system is **tested again** to ensure it functions correctly before restoring power.

#### Safety Measures

During fault tracing and repairs, power must be switched off to prevent electric shocks. Electricians should use insulated tools, wear protective equipment, and follow standard electrical safety procedures.

## **CHAPTER FOUR**

### **4.0 CHALLENGES ENCOUNTERED AND LESSONS LEARNED**

#### **4.1 CHALLENGES ENCOUNTERED**

During the training, several challenges were faced in the course of executing various electrical tasks. One major challenge was dealing with faulty electrical components, which made troubleshooting difficult and time-consuming. Additionally, there were instances of inadequate tools and testing equipment, which sometimes slowed down the efficiency of work.

Another challenge was diagnosing complex electrical faults, especially in distribution boards and transformer connections. These required extensive testing and analysis to determine the root cause of the problem. Environmental factors such as unfavorable weather conditions, limited access to certain installations, and working in confined spaces also posed difficulties during some tasks.

#### **4.2 LESSONS LEARNED**

The industrial training provided valuable practical exposure that helped bridge the gap between theoretical knowledge and hands-on application. One key lesson learned was the importance of safety precautions, such as using proper personal protective equipment (PPE) and following safety procedures to prevent electrical hazards.

Additionally, the training enhanced problem-solving skills, particularly in fault tracing and electrical repairs. It also improved understanding of power distribution systems, transformer connections, and earthing techniques. The use of different electrical tools and testing equipment was another crucial skill gained, helping in the efficient installation and maintenance of electrical systems.

## **CHAPTER FIVE**

### **5.0 RECOMMENDATIONS AND CONCLUSION**

#### **5.1 RECOMMENDATIONS**

Based on the experiences gained during the industrial training, several recommendations can be made to improve future training exercises. Industries and training centers should provide more advanced tools and testing equipment to facilitate accurate fault detection and repairs. Regular safety drills and workshops should be conducted to reinforce electrical safety awareness and ensure compliance with standard procedures.

Additionally, trainees should be given more opportunities to work on complex electrical installations to enhance their problem-solving skills. Industries should also ensure proper maintenance of electrical systems to prevent faults and hazards. Finally, educational institutions should incorporate more practical sessions in electrical courses to better prepare students for real-world applications.

#### **5.2.1 CONCLUSION**

The industrial training was a highly beneficial experience, bridging the gap between theoretical knowledge and practical application. It provided hands-on exposure to electrical installations, fault tracing, maintenance, and safety procedures. The challenges encountered during the training helped in developing technical skills, teamwork, and problem-solving abilities.

Overall, the training has contributed significantly to professional growth in the electrical field, preparing the trainee for future work in power systems, distribution, and electrical maintenance.